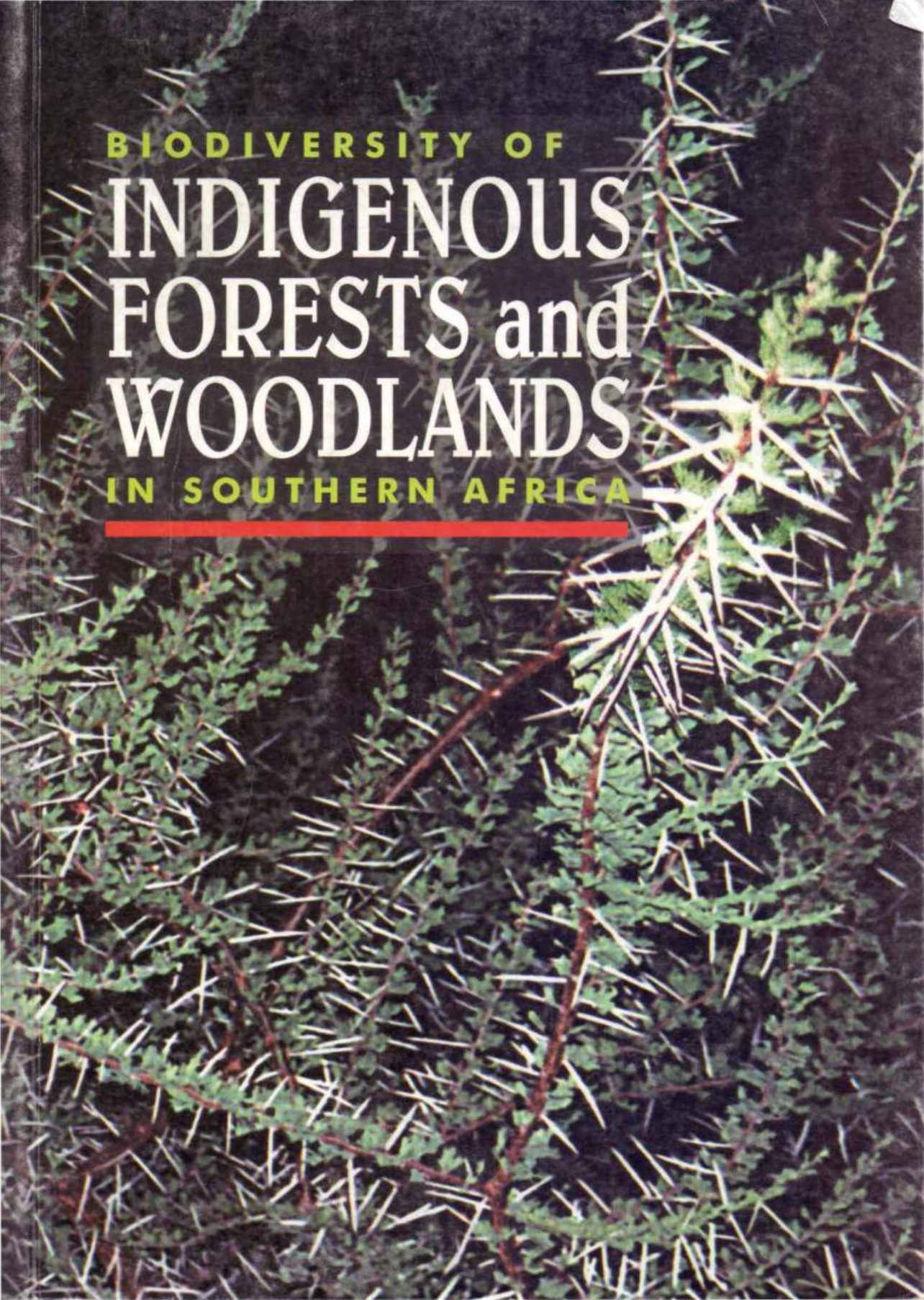
BIODIVERSITY OF
INDIGENOUS
FORESTS and
WOODLANDS
IN SOUTHERN AFRICA

BIODIVERSITY OF INDIGENOUS FORESTS and WOODLANDS IN SOUTHERN AFRICA

IUCN
The World Conservation Union

SARDC
Southern African Research and Documentation Centre

NETCAB
NETWORKING AND CAPACITY BUILDING

SADC - Southern African Development Community
Environment and Land Management Sector Coordination Unit
Private Bag A284, Maseru 100, Lesotho
Tel: 266 312158 Fax 266 310190/310465

IUCN - The World Conservation Union
Regional Office for Southern Africa
Box 745, Harare, Zimbabwe
Tel 263-4 728266/7 Fax 263-4 720738

SARDC - Southern African Research and Documentation Centre
IMERCSA - Musokotwane Environment Resource Centre for Southern Africa
Box 5690, Harare, Zimbabwe
E-mail cep@imercsa.sardc.net
Tel 263-4 720814 Fax 263-4 737301

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BIODIVERSITY OF INDIGENOUS FORESTS and WOODLANDS IN SOUTHERN AFRICA

A report by the Southern African Development Community (SADC),
IUCN - The World Conservation Union
and the
Southern African Research and Documentation Centre -
Musokotwane Environment Resource Centre for Southern Africa (SARDC-IMERCSA)

Writers

Alexandra S. King
Clever Mafuta
Elton Laisi
Joana Makuvise
Maxwell Chivasa
Tendayi Kureya

Editor

Hugh McCullum

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CONTRIBUTORS and Writers by Chapter

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Otlogetswe Totolo, Lecturer, Department of Environmental and Natural Sciences, University of Botswana
David May, Lesotho Agricultural College
Yemi Katerere, Regional Director, IUCN-ROSA

2. FORESTS AND WOODLANDS of Southern Africa (**by Clever Mafuta**)
Todd Ngara, Climatologist, UNDP, Zimbabwe
Coert Geldenhuys, Director, Forestwood, South Africa

3. BIODIVERSITY of Indigenous Forests and Woodlands (**by Alexandra S. King**)
Coert Geldenhuys, Director, Forestwood, South Africa

4. ECOLOGICAL Processes (**by Joana Makuvise**)
Todd Ngara, Climatologist, UNDP, Zimbabwe

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Sosten Chiotha, Director, LEAD Southern Africa, Zimbabwe

6. Forest and Woodlands Products USES AND VALUES (**by Alexandra S. King**)
Bruce Campbell, University of Zimbabwe
Alan Marsh, Tikologo Trading Trust, Queenstown, South Africa

7. ECONOMIC VALUATION and Accounting (**by Clever Mafuta**)
Clever Mafuta, CEP Programme Coordinator, SARDC IMERCSA
Maxwell Mukwekwerere, Forestry Commission, Zimbabwe

8. POLICY ANALYSIS (**by Elton Laisi**)
Elton Laisi, Regional Consultant, SARDC IMERCSA
Doris Mwinga, Chief Parliamentary Draughtsman, Ministry of Legal Affairs, Zambia

9. SUSTAINABLE MANAGEMENT of Indigenous Forests and Woodlands (**by Clever Mafuta and Elton Laisi**)
Keitirele Patricia Walker, Forestry Association of Botswana
Ingrid Lorbach, Hinter den Hoffen, Rosdorf, Germany
Jeanette Clark, Council for Scientific and Industrial Research, South Africa
Yemi Katerere, Regional Director, IUCN-ROSA
Mark Mulenga, Lecturer, Department of Geography, University of Zambia
Abdalla Shah, Research and Forest Officer, Zanzibar, Tanzania
Henry Sichingabula, Lecturer, Department of Geography, University of Zambia
Tanny Cohen, Consultant, Zimbabwe
Francis Musonda, Lusaka National Museum, Zambia

10. TRENDS AND SCENARIOS The Way Forward (**by Elton Laisi, Munyaradzi Chenje and Tendayi Kureya**)
Tendayi Kureya, Senior Programme Researcher, SARDC IMERCSA
Harrison Kojwang, Directorate of Forestry, Namibia

REVIEWERS by Chapter

1. Regional Overview FOREST AND REGIONAL WOODLAND BIODIVERSITY
Paul Maro, SADC ELMS, Lesotho
Scientific Advisory Committee members

2. FORESTS AND WOODLANDS of Southern Africa
Jonathan Timberlake, Biodiversity Foundation of Southern Africa, Zimbabwe
David Everard, Environmentek, CSIR, South Africa

3. BIODIVERSITY of Indigenous Forests and Woodlands
Isaac Mapaure, University of Zimbabwe
Osmund Mwandemele, Namibia

4. ECOLOGICAL Processes
Bob Scholes, South Africa
Isla Grundy, Southern Alliance for Indigenous Resources, Zimbabwe

5. Status of Forests and Woodlands, and PATTERNS OF CONVERSION
Graham von Maltitz, South Africa
Osmund Mwandemele, Namibia
Rob Blackie, Namibia

6. Forest and Woodland Products USES AND VALUES
Isla Grundy, Southern Alliance for Indigenous Resources, Zimbabwe
Christopher Shikaputo, Namibia
Sosten Chiotha, Director, LEAD Southern Africa, Zimbabwe

7. ECONOMIC VALUATION and Accounting
Graham von Maltitz, South Africa
Rob Blackie, Namibia

8. POLICY ANALYSIS
Kay Muir-Leresche, Zimbabwe
Rob Blackie, Namibia

9. SUSTAINABLE MANAGEMENT of Indigenous Forests and Woodlands
Monica Francis, Institute of Development Studies, Zimbabwe
Jeanette Clarke, Council for Scientific and Industrial Research, South Africa

10. TRENDS AND SCENARIOS
Scientific Advisory Committee members
Kay Muir-Leresche, Zimbabwe

All Chapters
Coert Geldenhuys, Director, Forestwood, South Africa
Yemi Katerere, Regional Director for Southern Africa, IUCN
Michel Laverdieere, FAO Regional Office, Harare, Zimbabwe
Jacquie Chenje, IUCN-ROSA
All Senior Staff, SARDC IMERCSA

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Upon publishing *Water in Southern Africa* in 1996, the partners of the Communicating the Environment Programme (CEP) — SADC ELMS, IUCN-ROSA and SARDC IMERCSA — resolved that an account of the biodiversity of the indigenous forests and woodlands in southern Africa needed to be documented and publicised in order to assist countries of the region to take appropriate steps in how the biodiversity is used and managed.

The importance of biodiversity goes beyond the ordinary because it is an important source of food, timber, medicines and other requirements necessary for supporting life for the peoples of southern Africa. It is also an essential element in economic terms supporting, as it does various industries, including tourism and manufacturing.

Biodiversity of Indigenous Forests and Woodlands is a product of many thoughts and ideas from a wide variety of experts in different fields from the southern African region and beyond for which CEP and its partners are most grateful.

We wish to acknowledge the important advice and support given by the Scientific Advisory Committee (listed separately) who scrutinised the entire book. They also advised on its structure and the desired content under the able guidance of the late Moremi Sekwale, former coordinator of the North-South Water Carrier Project in Botswana and Dr Harry Chabwela from Zambia.

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bold and decisive management style you possess. A very special thanks also to the other two members of the CEP Steering Committee: Dr Yemi Katerere, the IUCN Regional Director for Southern Africa, who wrote the Foreword to this book, and Phyllis Johnson, the SARDC Executive Director, for your constant support and encouragement. Thanks to Nils Christoffersen, then acting director of IUCN-ROSA, for participating so fully in the demands of this exercise as a member of the SAC, a reviewer of all the chapters and for ringing the alarm bell as we proceeded. Your role as facilitator at the Trends and Scenarios workshop is also acknowledged. Also at IUCN-ROSA we thank Tabeth Matiza-Chiuta, for your knowledge and guidance during preparation of the background papers and Jacquie Chenje, for your inspiration.

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Paul Wade and Wayne Miller of Inkspots Design Studios brought the text design, maps and cover into one format, both attractive and readable.

While a wide process of consultation was undertaken in researching and writing this book and every effort has been made to balance its presentation, we accept full responsibility for any errors or omissions.

Munyaradzi Chenje
Director,
SARDC IMERCSA

August 2000

FOREWORD

The publication of *Biodiversity of Indigenous Forests and Woodlands in Southern Africa* as part of the thematic update of the *State of the Environment in Southern Africa* is timely given the renewed interest and focus on the importance of the African dry forest and woodland ecosystem.

This follows 10 years of neglect and under-investment in the region's forests and woodlands despite spiraling poverty, severe land and resource degradation and some of the most political and violent conflicts around access to land. Consequently, the 1990s have been described as the lost decade as far as investments in dry forest ecosystems are concerned and the subsequent delay in defining new patterns of land and resource ownership and management. So, in many respects this book's publication presents valuable information in redefining a new regional forestry agenda. It is also the first attempt to produce a regional publication designed to empower people at different levels of decision-making and policy development and implementation through information on the state of the region's indigenous forests and woodlands.

Southern Africa's forests and woodlands are prominent and extend from the desert margin scrub forests to open woodlands bordering more humid ecosystems. When compared to the region's other ecosystems, they support the largest number of people and livestock, making them central to food security and offering the greatest potential for expansion of the rain-fed agricultural frontier. Consequently they face high human and development pressure. The forests, directly and indirectly, support much of the region's predominantly rural population. In times of drought, crop failure or degradation of grazing areas, they provide a safety net in the form of food and browse and grass for livestock. The ecosystem also performs valuable functions in watershed management, habitat, nutrient cycling and carbon sequestration. The forests and woodlands represent a resource that is truly cross-sectoral.

They play a critical role in the regulation of water production in the region's watersheds. To many farmers, this biodiversity is valuable as land for agricultural expansion and a source of alternative grazing. Forests provide habitat for the region's abundant wild fauna and flora that is the cornerstone of a burgeoning tourism industry. Forests contain food, energy, building materials and medicine. They are indispensable in their multiple environmental functions. For these reasons the biodiversity of forests and woodlands are everyone's business and not simply a resource to be exploited by every sector without due regard to the long-term impacts of unsustainable use and mismanagement.

The pressure to supply a range of forest products and services resulted in a heightened concern in the late 1970s. The response of regional governments, with international donor support, was to initiate tree-planting programmes in rural and peri-urban areas to address fuelwood shortages and to ease the pressure on the region's remaining indigenous forests and woodlands. At the same time there were emerging issues in the

management of the dry forests and woodlands that called for a different approach to confronting the complex relationship between agriculture, livestock and forest systems. There was a realisation that past investments in forestry projects had failed to address the region's worsening poverty. It also became clear that the dry forests offered the greatest potential to contribute to poverty eradication given that they already support the bulk of the region's population directly or indirectly.

A primary cause of deforestation in the region has been clearing land for agriculture. In Zimbabwe, much of this expansion has been for cash crops such as tobacco, cotton and sugar cane, accompanied by an increasing demand for wood as energy, construction and other uses such as medicinal. In Malawi, the demand for wood to dry tobacco combined with high population densities in the rural areas have contributed to shrinking indigenous woodlands to the point where government required tobacco farmers to plant woodlots to ease the pressure and invasion of protected areas.

Clearing land for cultivation is not recent in the region and is inevitable given the dependence of the primarily rural population on mixed farming, especially maize production, under rain-fed conditions. As the demand for more food from a growing population increases, the pressure on the remaining forests and woodlands is likely to escalate. Additional pressure will likely occur as countries try to resolve the land question. Land reform in countries such as Zimbabwe, Namibia, Mozambique and South Africa will result in a further loss if resettlement programmes continue to be pre-occupied with allocating land for subsistence farming without considering other non-agricultural based economic activities.

This publication acknowledges that challenges to forests and woodlands biodiversity management are not just technical and that they can contribute significantly to poverty eradication. It is now clear that forest management includes governance issues such as devolution, participation and transparency in allocation of licenses; equitable distribution and access to forest resources; enabling policies; and the struggle between traditional institutions and formal state laws and rules. *Biodiversity of Indigenous Forests and Woodlands of Southern Africa* acknowledges that participation in their management is grossly undermined by the fuzziness around resource rights over land and land-based resources.

This book has been written in accessible language so that people at different levels of decision-making can access the information and apply it in making sound decisions that contribute to rural economic growth and facilitate a linkage between the rural and formal economic sectors. It demonstrates the centrality of the biodiversity of forests and woodlands in our lives, the need to change attitudes and approaches to their management and that it should not be seen as the domain of foresters alone.

All sectors need to consider forests and woodlands as the foundation and cornerstone of all their plans and initiatives.

Dr. Yemi Katerere,
Regional Director for Southern Africa,
The World Conservation Union,
(IUCN-ROSA)

EXECUTIVE SUMMARY

It is beyond doubt that forests and woodlands play an important role in supporting various forms of life at local, regional and global levels. Some of the major contributions of forests and woodlands, especially to human, animal and aquatic life, include the generation of oxygen, which is used to sustain life, the provision of various foods for growth and reproduction purposes and the sustainable use of soil and water resources.

Biodiversity as defined by the Convention on Biological Diversity (CBD) is "the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". People are part and parcel of forest and woodland biodiversity.

The southern African region is covered by a variety of vegetation formations, ranging from rainforests, woodlands, thickets, shrublands and grasslands to semi-desert and desert. Woodlands are the most extensive vegetation formation, occupying 75 percent of the region's total land area. Deciduous forest (1.1 percent) is mostly found in Zambia and Mozambique, while evergreen forest (0.7 percent) is principally in Angola and Tanzania. Arid shrublands (including Karoo types) constitute 6.9 percent, primarily in South Africa. A small-scale mosaic of forest, savannah and grassland covers 2.4 percent, mainly in Angola. The other formations cover relatively small areas, and they include deserts mainly in Namibia and Botswana, wetlands, mangroves and swamps, and *sclerophyllous* shrublands or fynbos found only in South Africa.

The benefits and products derived from forests and woodlands are numerous, to the extent that the first inhabitants of the region — hunter-gatherers — depended solely on the forests and woodlands for everyday survival. These can be classified into several main categories:

- foods such as fruit from indigenous woodland trees;
- soil nutrient inputs such as leaf litter;
- fodder, timber and browse for livestock;
- raw materials for processing into goods for household consumption or sale;
- indigenous hardwoods for processing by the saw-milling industry; and
- other industries such as tourism.

It is difficult, however, to value forests in monetary terms since not all the goods and services they provide are traded in competitive markets. Indeed, in some cases markets do not exist for some of the goods and services obtained from forests, resulting in under-estimation of forest values, and therefore less attention is paid to their conservation. There exist poor reporting mechanisms for forest produce especially that which is harvested in rural communities. Economic valuation of all forest goods and services and their inclusion in national accounts would provide a more acceptable way for assessing the performance of a country's forestry sector.

The availability of water is probably the single major factor that influences the development of forest and woodland biodiversity in southern Africa. Water availability determines the direction and rate of ecological processes i.e. soil development, biomass accumulation, decomposition and nutrient cycling. Southern Africa has, however, been prone to recurrent and severe shortages of water.

Land use and tenure have an impact on forestry and woodland resources. Land use changes, particularly over the past two to three decades, have been largely responsible for the extent and condition of the forests and woodlands in southern Africa today. Because of the ever-dwindling diversity, the nations of the region established protected and semi-protected areas to conserve and sustainably use forest, woodland and biodiversity resources.

Some of the world's largest nature areas are found in the region:

- Central Kgalagadi Game Reserve in Botswana (52,800 sq km);
- Selous Game Reserve in Tanzania (52,200 sq km);
- Namib-Naukluft National Park in Namibia (49,768 sq km); and
- Kafue National Park in Zambia (22,400 sq km).

Protected areas are home to more than 40 different species of large mammals and are just one tool for implementing sustainable development in the wake of diminishing natural resources.

Based on Agenda 21, which emerged from the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992, the Commission on Sustainable Development (CSD) was given responsibility to monitor the implementation of the UNCED commitments. The CSD had to look for ways of putting in place a "non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests."

Current issues and debates are focused on the obstacles to sustaining forest and woodland biodiversity resources, especially the need to arrest deforestation and desertification. Other debates include those addressing tenurial rights, devolution from central government to communities and maintaining ecological processes as a function of forests. Sustainable forest and woodland management sounds easy enough to achieve, but this is not so. Poverty is one of the driving forces behind biodiversity degradation in southern Africa as both a consequence and a cause. As such, any improvements in environmental quality should help reduce poverty.

The forest and woodland biodiversity knowledge base in southern Africa needs to be improved. This must include correcting past failures in policy and ensuring that conservation and sustainable use of the biodiversity and equitable sharing of benefits are made an integral part of all socio-economic development. As the region grows into a cohesive economic bloc, it is important that policies implemented at the national level feed directly into regional needs.

Current trends seem to suggest a dubious future especially when the trends are projected onto the horizon. Population growth, land use patterns, industrialisation and general poverty will certainly impact negatively

on biodiversity, while other factors such as governance, research and education will impact according to how they are implemented. Scenario-building requires some assumptions such as changes in technology, evolution of policy and other unpredictable events.

Coming up with a vision of a southern African future in which biodiversity and forest exploitation is sustainable, is like art — it requires imagination. Unlike prediction, which is a futile exercise, a future scenario can become a reality.

Southern Africa Map 0.1

SOURCE: SADC/IUCN/SARDC, State of the Environment in Southern Africa, Maseru/Harare, 1994

INTRODUCTION

The first human inhabitants of southern Africa were hunter-gatherers who relied wholly on the produce from the indigenous forests and woodlands. People hunted animals and gathered wild fruits as part of their everyday life, and as they had comparably smaller populations, they had little negative impact on the environment.

Today, most of the vast forests and woodlands have disappeared. Biodiversity has been eroded by such factors as the loss of habitat through human-induced activities such as the expansion of agriculture, industrialisation and over-harvesting of natural resources. The presence of natural resources such as forests continues to contribute to the existence and survival of people, especially the majority of the rural dwellers who, in most parts of the region, are subsistence farmers.

This book reports the status, trends and derivatives from the indigenous forests and woodlands. Special effort has been made to focus on the factors affecting the status of these resources, and the trends in their use and conservation.

This book is, the second thematic update of the book, *State of the Environment in Southern Africa* published in 1994, and follows the first update, *Water in Southern Africa*. It considers 12 of the 14 SADC countries on mainland Africa, from the equatorial rainforests of the Democratic Republic of Congo (DRC) to the *fynbos* of the Cape in South Africa, from the mangroves on the Mozambican coastline to the desert biodiversity of Angola and Namibia.

Biodiversity of Indigenous Forests and Woodlands in Southern Africa has been carefully presented to meet the varying needs of the different levels and sectors of the peoples of the region. The language used is accessible and additional material has been placed in boxes for the interested reader.

The purpose of this book is to give an accessible overview of forest and woodlands issues in southern Africa. The contents are intended to inform, motivate and empower people in the region at different levels of decision-making to build upon the good, traditional, management activities passed down through generations, and to be aware of the need to conserve these resources

The format

Just as with *State of the Environment in Southern Africa* and *Water in Southern Africa*, there has been a deliberate attempt to avoid technical language and explanations, and definitions are provided where technical language is used. Maps, tables, photographs and other illustrations have been used to highlight the information contained in the text.

The book has been structured into 10 chapters, each tackling an important aspect of the status of forests and woodlands. The first chapter gives a regional overview while chapter two looks at forests and woodlands of southern Africa in perspective. Chapter three on the biodiversity of indigenous forests and woodlands is an attempt to narrate the quality and quantity of the biodiversity we have in the region. Because of the nature of the size and governance of the region, it has not been possible to cover all the areas in the same level of detail, but every effort has been made to include output from as many projects and publications as possible.

Ecological processes and their link to biodiversity are discussed in the fourth chapter, while patterns of conversion of forests and woodlands and the factors behind these patterns are highlighted in chapter five. The most agreed upon factors have been discussed in some detail. One cannot talk of the importance of these resources without listing the benefits we derive. This is done in chapter six, and an effort to quantify these benefits in monetary and economic terms is done in the following chapter. The last three chapters look at forestry policy, management and trends and scenarios.

The book gives the environment a human face, highlighting people's opportunities and problems through well-researched articles written by journalists in the region. The articles cover a wide spectrum, documenting triumphs over natural phenomena such as fires and droughts whose occurrence may not be controlled, to problems originating from human activities such as the expansion of agriculture, which can be controlled.

The process

This book is as much a process as a product. As part of the ongoing Communicating the Environment Programme (CEP), the process involves the Southern African Development Community's Environment and Land Management Sector (SADC ELMS), the World Conservation Union Regional Office for Southern Africa (IUCN-ROSA), and the Southern African Research and Documentation Centre's Musokotwane Environment Resource Centre for Southern Africa (SARDC IMERCSA). The latter is named after India Musokotwane the late IUCN-ROSA regional director, a Zambian environmentalist, who initiated the process leading to the book, *State of the Environment in Southern Africa*.

The overall objective of CEP is to inform, motivate and empower people at all levels of environmental decision-making in southern Africa, from the individual and NGOs to the private sector and governments, to take positive actions to counter environmental degradation and move towards sustainable development paths by providing them with clear, objective and meaningful information on the environment.

The partnership is also to facilitate understanding and communication between environmental groups and decision-makers. The success of this product was a group effort involving a Scientific Advisory Committee (SAC) drawn from experts on the subject, working in different institutions in the region. Each chapter was written by a well-qualified researcher-writer with contributions from experts in the region, and was reviewed by a wider selection of experts as well as members of the SAC. Chapter 10 on trends and scenarios was based on deliberations from a regional workshop tasked with providing the basis of the chapter.

1 REGIONAL OVERVIEW

The subject of forest and woodland biodiversity is relatively new in southern Africa.[1] However, there can be no doubt that forests and woodlands play an important role in supporting various forms of life at local, regional and global levels. Some of the major contributions to human, animal and aquatic life are:

- generation of oxygen, which is used to sustain life;
- provision of various foods for growth and reproduction; and
- sustainable use of soil and water resources.

Forest and woodland biodiversity in relation to factors determining its development which are addressed in this overview include:

- biodiversity definition;
- biophysical and socio-economic aspects;
- distribution of forests and woodlands and related policies;
- issues pertaining to sustainable development; and
- current debates and future scenarios.

WHAT IS BIODIVERSITY?

Biodiversity has been defined by the Convention on Biological Diversity (CBD) as "the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems".[2]

In other words, biodiversity describes the various forms of plant and animal life on earth such as people, animals, birds, trees, crops, grasses, fish, insects, and reptiles, all of which are supported by the complex interaction of prevailing reproduction elements, including the availability of water, soil, temperature, topography and geology.

It encompasses genetic, species and ecological diversity in a given environment. This diversity of species and genes affects the ability of ecological communities to resist or recover from disturbances and environmental change, including long-term climatic change.[3]

Both the biophysical and socio-economic aspects of southern Africa affect forest and woodland biodiversity. These elements are considered in detail below.

Population

People are part and parcel of biodiversity. In addition, people particularly in the rural areas, use firewood as their main source of energy. Therefore, the distribution of forests and woodlands is expected to vary according to the population distribution and densities. Heavily populated areas are likely to have few forests and woodlands remaining, examples being urban areas and other settlement zones and their immediate environments. Rapid population increases are also expected to have similar negative impacts on forest and woodland resources.

Forest and woodland biodiversity components Box 1.1

1. Genetic diversity
Genetic diversity (the variation of genes) within a forest or woodland species, is the ultimate source of the particular biodiversity at all levels. It is the material upon which the agents of evolution act. This permits the development of new breeds of plants and animals. Loss of variability may lead to adverse effects for fitness and adaptive change in populations.

2. Species diversity
The greatest and most readily noticeable form of forest and woodland biodiversity depletion is species extinction. A species is a group of plants, animals, micro-organisms, or other living organisms that are morphologically similar; that share inheritance from common ancestry; or whose genes are so similar that they can breed together and produce fertile offspring. Slowing down the rate of disappearing species is a key objective of forest and woodland biodiversity conservation. To manage diversity, one should know the number of species classified as extinct, threatened, endangered, rare or vulnerable relative to the total number of known forest or woodland-dependent species.

3. Ecosystem diversity
This is the variety and pattern of forest and woodland ecosystems and communities consisting of plants, animals and micro-organisms, the soil, water, and air on which they depend. The elements interact in a complex manner. Maintenance of the variety and quality of the ecosystems is necessary for the preservation of species. Without sufficient quantities of their natural habitats, forest and woodland species become vulnerable. One should look at the percentage and extent in area of forest and woodland types relative to historical condition and to total forest and woodland area. Other aspects should look at the percentage and extent of area by forest and woodland type and age; area, percentage and representativeness of forest and woodland types in protected areas; and level of fragmentation and connectedness of forest and woodland ecosystems.

SOURCE: Modified from the Department of Environmental Affairs and Tourism, 1997-9; and the Canadian Council of Forest Ministries, 1996 pp6-7

As of 1998, the population of southern Africa was more than 194.8 million people, constituting 25 percent of the continent's total.[4] The mean annual population growth rate between 1990 -1995 ranged between 1.1 percent in Mauritius and the Seychelles to 3.7 percent in Angola, with the region's average at about 2.7 percent. Population densities ranged from about 1.9 people per sq km in Namibia to an estimated 550.2 per sq km in Mauritius. Excluding Mauritius and the Seychelles, the region's average density was approximately 33.2 people per sq km. Assuming that an average annual population growth rate of about 2.7 percent is maintained, southern Africa's population is likely to double in 26 years.[5] The percentage of rural population varied between about 45 percent in the Seychelles to about 86.5 percent in Malawi with the region's average about 66.2 percent.

Population data for southern Africa 1995 Table 1.1

Country	Total 1995 (millions)	Population Density 1995 (people/km²)	Mean annual % increase (1990-1995)	Rural % (1995)
Angola	11.0	8.8	3.7	68.1
Botswana	1.5	2.6	3.1	71.9
DRC	43.9	19.4	3.2	70.9
Lesotho	2.1	67.5	2.7	76.9
Malawi	11.1	118.3	3.5	86.5
Mauritius	1.1	550.2	1.1	59.4
Mozambique	16.0	20.4	2.4	65.8
Namibia	1.5	1.9	2.7	62.5
Seychelles	0.1	164.4	1.1	45.9
South Africa	41.5	34.0	2.2	49.2
Swaziland	0.9	49.7	2.8	68.8
Tanzania	29.7	33.6	3.0	75.6
Zambia	9.5	12.7	3.0	56.9
Zimbabwe	11.3	29.1	2.6	67.9
Total/mean	181.2	33.2 *	2.7	66.2

* Excluding Mauritius and the Seychelles.
SOURCE: Compiled from FAO, 1997 p178

Considering the population densities presented in Table 1.1, forest and woodland resources would be highly degraded in countries such as Lesotho, Malawi, Mauritius and Seychelles while least degraded in Angola, Botswana, Namibia and Zambia. The remaining countries, the Democratic Republic of Congo (DRC), Mozambique, South Africa, Swaziland, Tanzania and Zimbabwe would be categorised as moderately degraded.

Forests and woodlands

Excluding the DRC and the Seychelles, indigenous forests and woodlands cover about 56.6 percent of the total land area and plantation forests 0.2 percent.[6] Excluding woodlands, indigenous forests within the 14 southern African countries cover approximately 28.4 percent of the total land area.[7] Altogether, the forest area of southern Africa amounts to 28.6 percent of the total land area.

BIOPHYSICAL FACTORS

Rainfall and water availability

The availability of water is probably the single major factor that influences the development of any particular forest and woodland biodiversity in southern Africa. Water availability determines the direction and rate of ecological processes such as soil development, biomass accumulation and decomposition and nutrient cycling.

Rainfall in southern Africa is largely dependent upon evaporation over the Indian Ocean. In addition, several other weather networks including the Inter-Tropical Convergence Zone (ITCZ) combine to produce the rainfall pattern. High inputs of the sun's heat, and a large, irregular and discontinu-

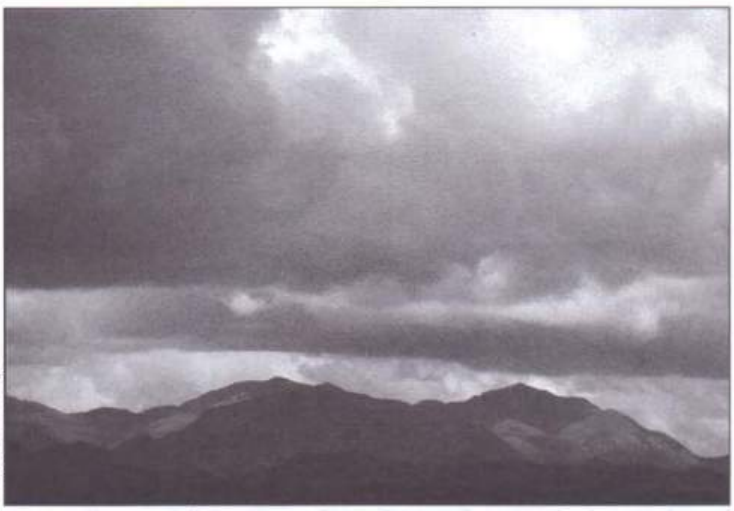


Photo: M Chenje

Generally, rainfall increases from the south towards the north and northeast.

ous belt of low-pressure and unstable moist air, which provides erratic patterns, and high, erosive intensities of rainfall distinguish the tropical zones. The ITCZ is a zone of intense rain-cloud development created when the southeast trade winds from the southern part of the region collide with the winds from the north.[8] During a normal rainy season the ITCZ fluctuates between mid-Tanzania and southern Zimbabwe and bring good rains to most parts of the region between late October and late March.

Generally, rainfall increases as one moves from the south towards the north and northeast. Forest and woodland biodiversity can be expected to increase in richness in a similar trend. The driest areas are found in the west and southwest (parts of Botswana, Namibia and South Africa), whereas the eastern and northeastern areas (Lesotho, parts of Mozambique and Zambia) have annual average rainfall above 1,000 mm (Map 1.1). Excluding the DRC, Mauritius and the Seychelles, the average annual rainfall within southern African is less than 800 mm. If semi-arid zones are loosely defined to cover those with average annual rainfall between 100 and 600 mm, then approximately half of southern Africa falls into this category.[9]

Rainfall is seasonal, low and erratic. Regular rainfall throughout the year favours forest development while long dry seasons lead to woodland development (including mixtures of grasses and trees).

Based on precipitation zones, the southern African climate can be sub-divided into humid, semi-arid and arid zones.[10] The humid zone covers about 57 percent of the region, and receives sufficient soil moisture to support plant growth for at least 180 days annually. About 15 percent of the region is semi-arid, where the growing season varies between 76 and 120 days. About 28 percent falls within the arid climate, where the growing season averages less than 76 days annually. Angola, Malawi, Mozambique, Tanzania and Zambia are mainly humid, while Lesotho, Swaziland and Zimbabwe have arid to semi-arid climates. Botswana and Namibia are largely within the arid zone, whereas South Africa shares large portions of its climate between humid and arid.

Plants adapt to shortages of water and extreme heat mainly through evapotranspiration, a process by which water vapour moves through the leaves to the atmosphere. Basically, higher temperatures result in higher evapotranspiration rates. To save water in hot, dry areas or periods, some plants go dormant, appearing to die, while others shed their leaves until just before the start of the wet season. Still others develop short stems and thick, fleshy leaves which hold water and minimise evapotranspiration. Others develop leathery or needle-like

Annual rainfall in southern Africa Map 1.1

SOURCE: Adapted from Frühling, P., *A Liquid More Valuable than Gold*, p.13

leaves to protect them from the hot sun and strong drying winds. Similarly, animals also adapt to such conditions as well as the various vegetation zones associated with specific animals.

Temperatures and winds

The water cycle, a process by which the sun's heat results in evapotranspiration leading to condensation, rainfall, runoff, infiltration and groundwater storage would not take place without the sun. In fact, without the sun all forms of life on earth would not exist. Vegetation growth and other forms of life depend on it. Photosynthesis, a process by which plants use carbon dioxide and water to prepare their food, requires enough light and right temperatures to take place.

Daytime temperatures exceed 40°C in the low altitude areas in summer while, in contrast, frosts are common in the south during winter.[11] Temperatures below 0°C are experienced in areas of over 1,600m above sea level especially in Angola, Lesotho, South Africa and Zimbabwe. The two lowest temperatures ever recorded in southern Africa were -18°C at the top of the Drakensberg Escarpment in Lesotho, and -19°C on the Old Planalto in Angola. Seasonal variations of the mean monthly temperatures in the region are small, with the general pattern of daytime temperatures between 25-30°C. The coolest months are generally June and July while October and November are the warmest.

Atmospheric temperatures are important. Extremely high temperatures cause excess evapotranspiration, thereby resulting in plants wilting and eventually dying due to moisture starvation while low temperatures retard plant growth. The reverse has similar negative impacts. Temperatures also have a significant influence on the adaptation and morphology (structure and shape) of vegetation and animals.

Surface winds also affect the development of vegetation root systems and regulate temperatures. Although there is very little seasonal variation, southern African winds often reach speeds of one to four m-a-second. Strong winds are usually experienced during winter and blow from east to southeast over the region, although at times they are often part of well-developed thunderstorms or outbreaks of shower rain.

Tropical cyclones, winds with speeds of more than 120 km am hour, usually destroy forests and woodland biodiversity. These are common in southern African coastal areas and often sweep across Mauritius and the southeastern shores of the continent. In 1995, cyclone Bonita formed over the Indian Ocean and swept across coastal areas of Mozambique before moving inland[12] causing damage to vegetation. It was associated with the wettest season in decades. Another cyclone, Eline, had devastating impacts on the Mozambican and South African coasts as well as in Zimbabwe and Botswana in 2000.

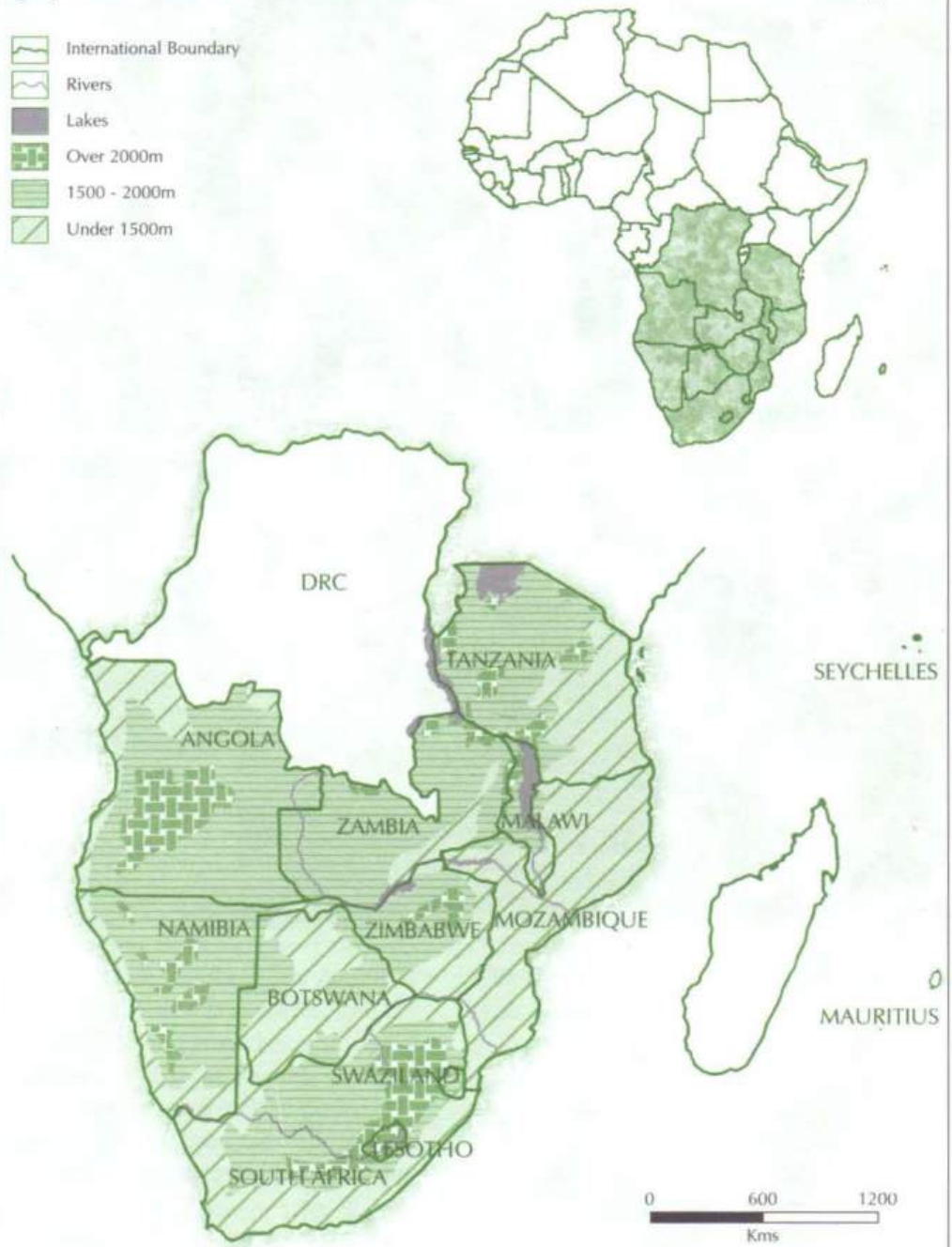
Topography

Major topographical features of interest include height above sea level and water features. Topography cannot be isolated from soil, water catchment areas, geomorphology and vegetation development. The development of various microsoil and vegetation types along a mountain slope speaks volumes on the importance of topography on forest and woodland development. (Map 1.2.)

The southern African region consists mostly of an extensive inland plateau, the Great African Plateau. This stands about 900 m above sea level and is surrounded by narrow coastal lowlands in the west and south, and a broad lowland area in the east.[13] The Kgalagadi basin covers much of the western part of the plateau, extending from the Orange River in South Africa to the southern DRC water-

Topographical features of southern Africa

Map 1.2



SOURCE: Adapted from Chabwela, H., *Wetlands: A Conservation Programme for Southern Africa*, IUCN and SADC, Harare, Nov 1991, in Chenje, M., and Johnson, P., et al, *State of the Environment in Southern Africa*, Harare/Maseru, 1994, p.67

Photo: IUCN/ROSA

Photo: M Chenje

shed. The basin forms the major geological influence on the region and comprises beds of deep-red, sandy soils.[14]

Other outstanding features of the region are the eastern and western Rift Valley networks. The eastern rift bisects Tanzania and continues to the north-east through Kenya, while the western rift runs from Lake Edward in Uganda through Lake Tanganyika and Lake Malawi-Nyasa to the eastern coast near Beira in Mozambique. Less distinctive branches of the western rift also extend along Luangwa and the middle Zambezi valleys to the southern margins of the Okavango Delta in Botswana.[15]

Semi-permanent surface water availability has a strong bearing on the development of riverine and other wetland plant and animal habitats as well as human settlements. Southern Africa has a number of perennial rivers such as the Cunene, Kafue, Limpopo, Orange, Shire, and Zambezi; lakes such as Malawi-Nyasa, Tanganyika and Victoria; dams such as Cahora Bassa and Kariba; the Okavango Delta; floodplains such as Barotse and Kafue Flats in Zambia, Marromeu in Mozambique and Wembere in Tanzania; and various *dambos* scattered over the region.

Soils and geology

Soil texture and structure — aspects of particle size and their arrangement – determine, among other things, the availability of plant and micro-organism food; the amount of surface evaporation and runoff; water infiltration and moisture content; and the rate of erosion, all of which determine forest and woodland biodiversity production.

The original geology controls the chemical composition of the resultant soil. Plant production tends to be higher in soils with high clay content and

Photo: IUCN/ROSA

Photo: H McCullum

The endless shoreline of Mozambique, the highlands of Zimbabwe, the Barotse floodplains of Zambia and the dry Namib desert of Namibia.

Soil in southern Africa is diverse, closely reflecting the underlying geology. As such, there is also great plant and animal diversity in the region. The broad soil classes range from extensive sand areas and loamy sands in Botswana, Mozambique, Namibia and Zimbabwe, to heavy clays widely scattered in the sub-region; and from highly-leached and arid acrisols, ferralsols and nitisols mainly in Tanzania to neutral, alkaline and saline soils in Botswana.[16] (Map 1.3.)

Drought

In simple terms, drought refers to a shortage of water.[17] It denotes dryness and should not be confused with aridity, which is a permanent condition. Drought is temporary in nature and a dry spell must last long enough to cause drought-related damage, otherwise it is not drought. Drought, therefore is relative, rather than absolute in weather conditions.[18]

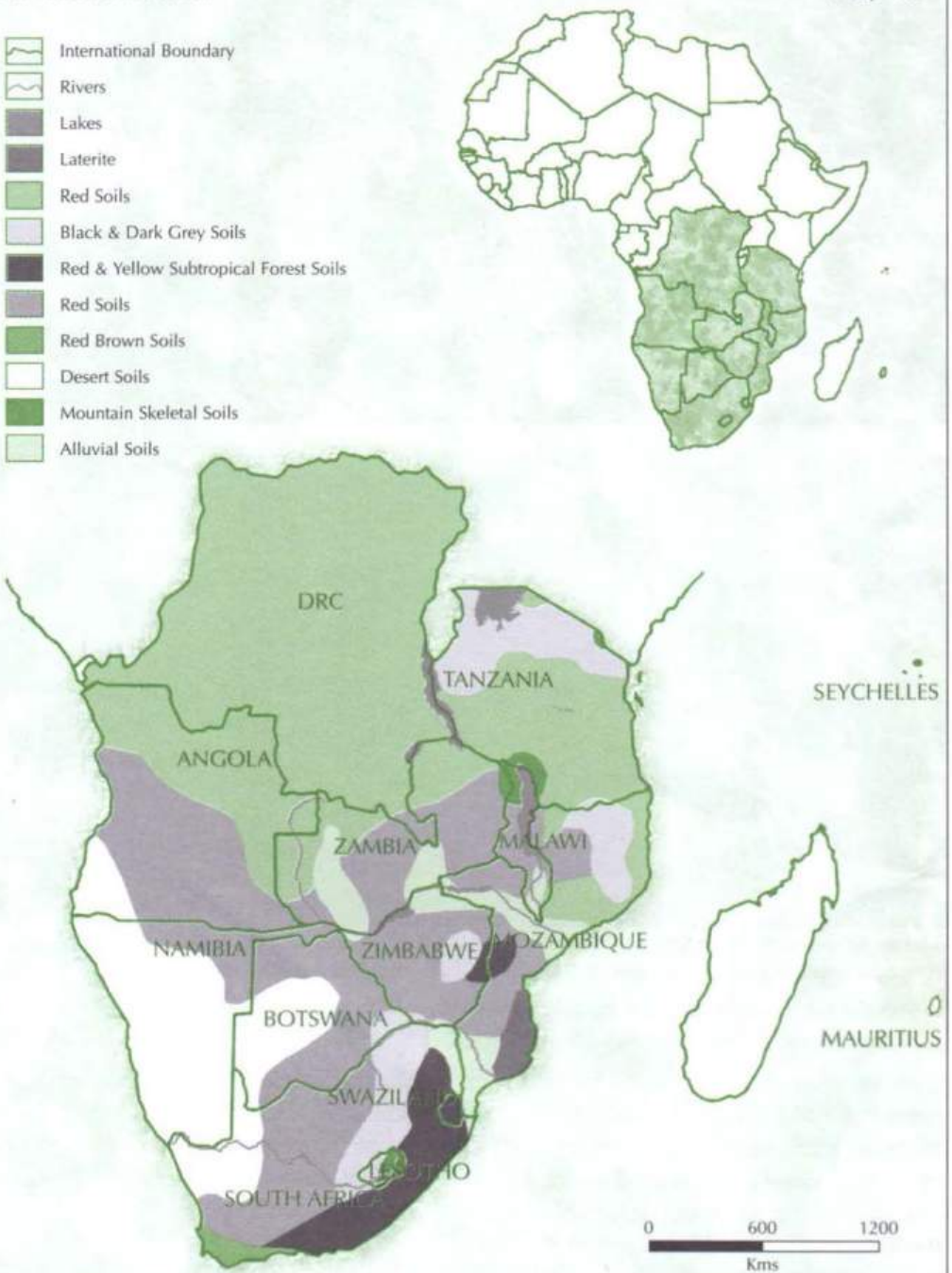
lower on sandy soils, because the former have a better water and nutrient retention capacity. On the other hand, a heavy presence of clay particles may lead to waterlogging, which drowns tree roots resulting in less plant development. While shallow soils have poor water-holding capacities, deep soils such as the Kgalagadi sands let water percolate to depths beyond the reach of tree roots.

Shortage of water directly or indirectly leads to the deaths of plants and animals and, in some cases, people. Depending on frequency, droughts may result in temporary or permanent changes in vegetation structure and form.

Drought in southern Africa has been linked to El Niño, in particular the El Niño-Southern Oscillation

Soils of southern Africa

Map 1.3



SOURCE: Adapted form Chinene, R.N., Shaxson, T. F., Molumeli, P., and Segerros, M., *Guidelines to Better Land Husbandry in the SADC Region*, Maseru, 1996, p.15

(ENSO). El Niño was discovered and named by 16th-century Peruvian fishermen. It means "the boy-child" in Spanish, because the event usually occurs around late December, the time when Christians celebrate the birth of Jesus Christ. It is a weather phenomenon that starts with the warming of waters in the western Pacific Ocean, eventually affecting about a quarter of the world's weather pattern. This causes droughts during the normal planting season in southern Africa or contributes to their severity.[19] An overview of the region's weather and climatic patterns since 1800 records the following as drought periods:[20] 1820-1830; 1844-1849; 1910; 1921-1930; 1946-1947; 1967-1973; 1981-1982; 1986-1987; and 1991-1992.

Photo: M Chenje

Shortage of water directly or indirectly leads to the deaths of plants and animals and, in some cases, people.

The reverse of the El Niño, La Niña (Spanish for little girl) takes place when a cold phase occurs in the western Pacific resulting in unusually heavy rains in southern Africa. During this period, the western Pacific is cooler than the Indian Ocean and the wind systems bring the cold air from the Pacific to the Indian Ocean.[21]

SOCIO-ECONOMIC FACTORS

People and the environment

The interaction of the peoples of southern Africa with their environment has been considered in much detail in other publications.[22] The indigenous people of the region have always interacted with their environment, and have a rich heritage of managing and living with forest and woodland resources. Historical forest and woodland biodiversity management cuts across many cultures, and often defies current political boundaries.

Traditional names of animals, birds and plants have profound meanings and an understanding of the living environment among various cultures in southern Africa. Cultural taboos were used to sustain threatened animal and plant species. Seasonal hunting and trapping of animals and birds for consumption was a way of conservation especially in those areas where hunting or gathering were not allowed during the reproductive seasons.

Before the farming era in southern Africa, hunter-gatherers, who moved around hunting and collecting forest products for subsistence, occupied the region. Of particular importance are the Basarwa (also known as the San), from parts of Botswana, Namibia, South Africa and Zimbabwe. The Basarwa lived in harmony with their forest and woodland resources and also initiated pastoralism by moving their animals about the countryside and living in temporary shelter. Pastoralism assumed greater significance, particularly in parts of Botswana, Namibia and Tanzania,

where the land was not suitable for rain-fed agriculture. At about the same period sedentary farming communities emerged over the entire southern African region, practising shifting cultivation.[23] Farming communities had significant impacts on the forest and woodland biodiversity as more and more land was required to look after the steadily increasing populations. Pastoralists also began losing their grazing land to the farmers.

The era of colonisation in southern Africa brought with it a range of socio-political and economic changes. All the productive land (which supported balanced ecosystems) was captured and indigenous communities were driven onto marginally productive areas. This had the most significant impact on the already biologically poor ecological zones of forests and woodlands. The rapidly increasing rural population escalated loss of the limited biodiversity resources within such ecological zones. Such unsustainable developments led to the systematic removal of forest and woodland resources for timber, cropland, fuelwood, pasture, urbanisation, mining and other commercial activities.

Land use and tenure systems

Land use and tenure have a major impact on management strategies for forestry and woodland resources. Land use refers to the way in which a particular piece of land is utilised. Examples include agriculture, rural or urban settlements, forest reserves, game parks, national parks, roads and areas that are set aside as wetlands and rangelands. Land use changes, particularly over the past two to three decades, have been largely responsi-

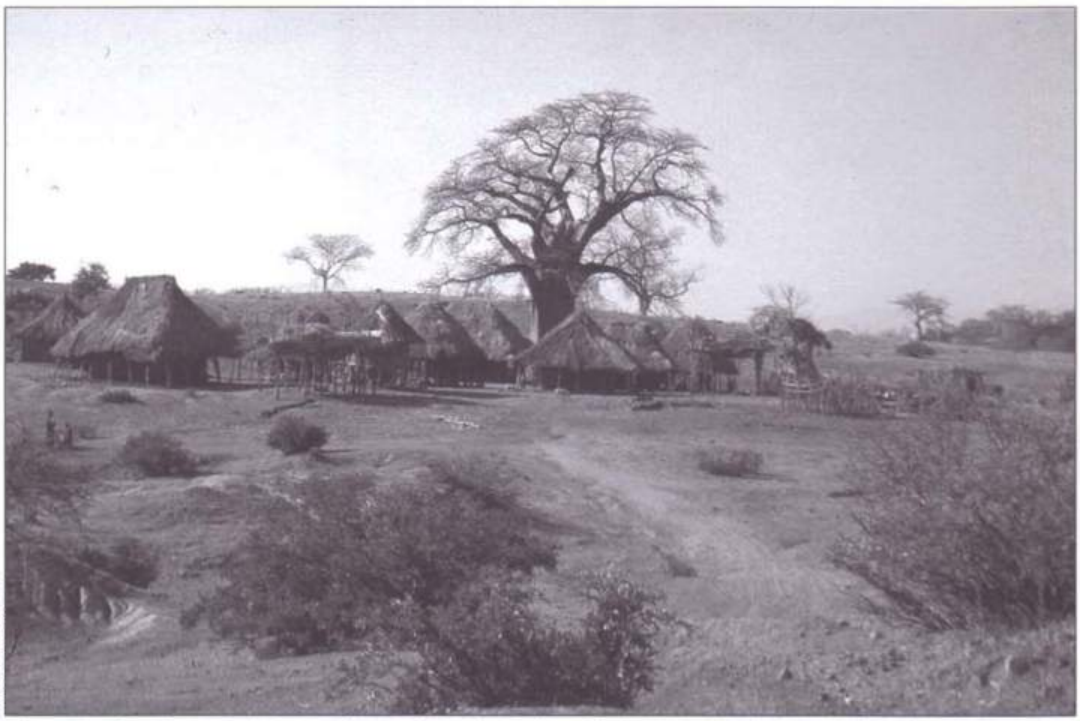


Photo: IMERCSA

The era of colonisation in southern Africa brought with it a range of socio-political and economic changes. All the productive land (which supported balanced ecosystems) was captured and indigenous communities were driven onto marginally productive areas.

ble for the extent and condition of the forests and woodlands in southern Africa today. The dry tropical and non-tropical forests, including woodlands and savannah are located in areas dominated by subsistence agriculture and rangelands, which support large numbers of livestock. The forests of the huge Congo River basin are relatively intact. Excluding the DRC, Mauritius and the Seychelles, the main land use categories within southern Africa are:[24]

- agriculture (six percent);
- permanent pasture (22 percent);
- forest and woodland (56 percent); and
- other (16 percent).

Land tenure refers to the rights to manage, use and lease. Major tenural rights in southern Africa include freehold, state and customary rights: freehold land is privately owned and regarded as private property; state ownership is government-owned land; and customary land provides security of tenure through community land ownership and allocation of use to its members.[25] Traditionally the chief, who had power over all productive resources including forest and woodland biodiversity, granted cultivation and other rights. This system is still operative, particularly in large parts of rural Botswana, South Africa, Zambia and Zimbabwe.

The state, through agencies and institutions such as forestry commissions and departments of natural resources and national parks and wildlife has, since colonial times, always owned and controlled large portions of forest and woodland resources in southern Africa. The problems are rooted in the historical process through which state forestry and woodland institutions evolved over the last century. They show concepts of bureaucratic centralisation in forestry and woodland resource governance, authoritative legislative strategies and management attitudes and practices that are borrowed from industrialised countries and therefore foreign to southern Africa.[26]

Today much common-property land that covers forest and woodland resources has become open-access land and has been converted to farming, often with significant negative impacts on biodiversity. In addition, most protected forest and woodland areas in the region fall under state or private ownership.

Clear property rights provide powerful incentives for owners and tenants to use their land sustainably. Land tenure systems need reform especially in countries such as Namibia, South Africa and Zimbabwe where land distribution is biased towards the minority white-settler communities. Reforms are also inevitable where laws are inadequate to control land use, protect forests and woodlands and safeguard, particularly, rangelands.

Politics and policies

Southern Africa is a relatively stable region, except for on-going disturbances in Angola and DRC. War situations destroy forest and woodland biodiversity, directly and indirectly through fires, bombings, chemical warfare pollution, tree-cutting to remove cover, wildlife theft and killing for food or economic gain, temporary suspension of law and order in protected areas and land pressure from high concentrations of refugees and displaced persons.[27] Considerable forest biodiversity has also been lost through:

- selective colonial land distribution policy and subsequent liberation wars in Angola, Mozambique, Namibia, South Africa and Zimbabwe;
- civil conflicts in Angola and Mozambique;
- apartheid South African aggression and destabilisation strategy against independent countries in the region;
- structural adjustment programmes (SAPs) in the DRC, Malawi, Tanzania Zambia and

Zimbabwe have relegated most indigenous people to absolute poverty; and forced them to turn to forest and woodland resources for survival;

- long years of command economies in the context of colonialism, the Cold War and liberation struggles, which led to the economic weakness of potentially rich countries such as Tanzania and Zambia (1961-1991); and
- corrupt regimes such as the DRC under the late President Mobutu, which brought economic development to a standstill for decades (1965-1997).

SADC countries have drawn up a Policy and Strategy for Environment and Sustainable Development (1994), which calls for equity-led growth and the need to integrate environmental impact assessments (EIAs) in decision-making. The policy is based on UNEP's Agenda 21, a blueprint on how to make development socially, economically and environmentally sustainable.[28] Forests and woodlands are an integral element of Agenda 21 and the southern African countries have taken it further in SADC's proposed programme for the region. The Southern African Environment and Sustainable Development (SAESD) programme emphasises the shared responsibility and commitment of SADC countries to managing environmental resources. This requires the region's members to share information and expertise on common environmental problems and natural resources for achieving sustainable development and securing their shared future.[29]

The Convention on Biodiversity (CBD), the most recognised international agreement on the conservation of biodiversity, was signed by 167 countries at UNCED in June 1992. It entered into force on 29 December 1993, having been ratified by 41 countries. By the end of December 1996, the number of ratifications had reached 141.[30] All SADC states have either signed or ratified the CBD. Three objectives of the Convention are:[31]

- conservation of biological diversity at the genetic, species, and ecosystem levels;
- sustainable use of biological resources; and
- fair and equitable sharing of the benefits derived from the use of genetic resources.

ECOLOGICAL ZONES OF SOUTHERN AFRICA

The nature, biological composition, distribution and production potential of forests and woodlands in southern Africa is but an indication of the existing ecological zones. These are ultimately determined by the varying biophysical and socio-economic conditions that have been discussed earlier.

Various authors have identified a number of southern African ecological zones (Map 1.4).[32] These include:

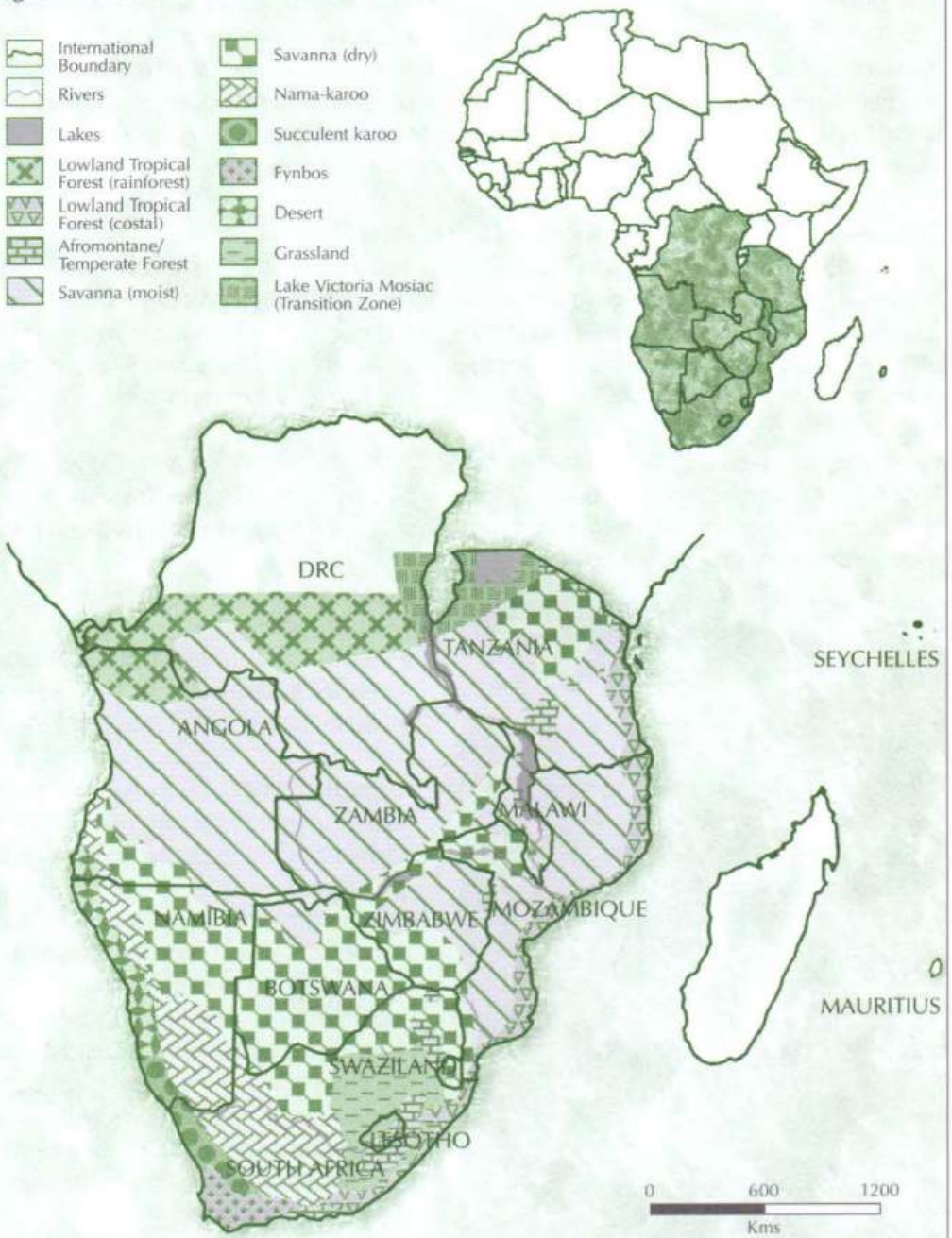
- Lowland Tropical Forest (rainforest);
- Lowland Tropical Forest (coastal);
- Afromontane-Temperate Forest;
- Savanna (moist);
- Savanna (dry);
- Nama-Karoo;
- Succulent Karoo;
- Fynbos;
- Desert; and
- Transition zone (Lake Victoria mosaic).

From such specific ecological zones, about seven broad forest and woodland zones can also be identified. (Their detailed description and distribution is treated in more detail in chapters 2 and 4).[33] These include:

- Lowland Tropical Forest;
- Afromontane and Temperate Forest;
- Grassland;
- Savanna Woodland;
- Moist Savanna woodland;

Ecological zones of southern Africa

Map 1.4



SOURCE: IUCN, *Biodiversity in Sub-Sahara Africa and its islands: Conservation management and sustainable use*, IUCN, Gland, 1990; IUCN, *Directory of Afrotropical Protected Areas*, IUCN, Gland, 1987; and IUCN, *Protected Areas of the World*, IUCN, Gland /Cambridge, 1992, in Chenje, M., and Johnson, P., et al, *State of the Environment in Southern Africa*, Harare/Maseru, 1994, p.161

- Dry Savanna Woodland; and
- Fynbos.

Plantations are becoming a more significant component of forest resources in southern Africa, particularly in Lesotho, South Africa and Swaziland where they account for almost all the entire industrial forest estate. In Tanzania, Zambia and Zimbabwe plantations are a major source of timber.[34] South Africa alone has over 1.2 million hectares of plantations. As most governments lack financial resources to manage forests and woodlands, there has been a tendency to encourage the private sector to take over this role.

Exotic tree species such as Eucalyptus, Pine and Cypress are commonly grown in southern African plantations. However, with the emergence of rural community forestry programmes, more attention has been paid to indigenous tree species which can serve multiple purposes. The private sector operates on logging leases for indigenous forests. The Forest Stewardship Council of Zimbabwe, for example, is working towards developing forest management standards for companies exploiting indigenous resources.[35]

Photo: R Mweninguwe

Chigumula Bluegum Plantation, Malawi.

PROTECTED AREAS

Southern Africa covers approximately 31 percent (907 million ha) of Africa's total land area. The region is rich in biodiversity and its potential is exploited through a network of protected areas that include parks and reserves.

Some of the world's largest protected areas are found in the SADC region. These are:

- Central Kgalagadi Game Reserve in Botswana (52,800 sq km);
- Selous Game Reserve in Tanzania (52,200 sq km);
- Namib-Naukluft National Park in Namibia (49,768 sq km); and
- Kafue National Park in Zambia (22,400 sq km).

Protected areas (Map 1.5) are home to more than 40 different species of large mammals. Of these, five are carnivores and the remainder feed on plants.

Protected areas permit the survival of plants and animals, safeguarding rare and endangered species. They also serve as natural laboratories for scientists studying forest and woodland biodiversity and others interested in biodiversity in general. A range of wild plants are utilised in research that leads to the improvement in crop productivity through cross-breeding while others are used to develop disease-resistant crops and still others, for the development of pharmaceutical drugs.

Protected areas generate income from both consumptive and non-consumptive tourism. Visitors to

Protected areas of southern Africa Map 1.5

SOURCE: Frost, P.G.H., *"Determinants of Structure and Function of Southern Africa Biomes"*, for SADC, 1993; and Rutherford, M.C., and Westfall, R.H., *"Biomes of Southern Africa: An Objective Categorization"*, *Memoirs of the Botanical Survey of South Africa*, Department. of Agriculture and Water Supply, Pretoria, 1986, No. 54, in Chenje, M., and Johnson, P., et al, *State of the Environment in Southern Africa*, Harare/Maseru, 1994, p.83

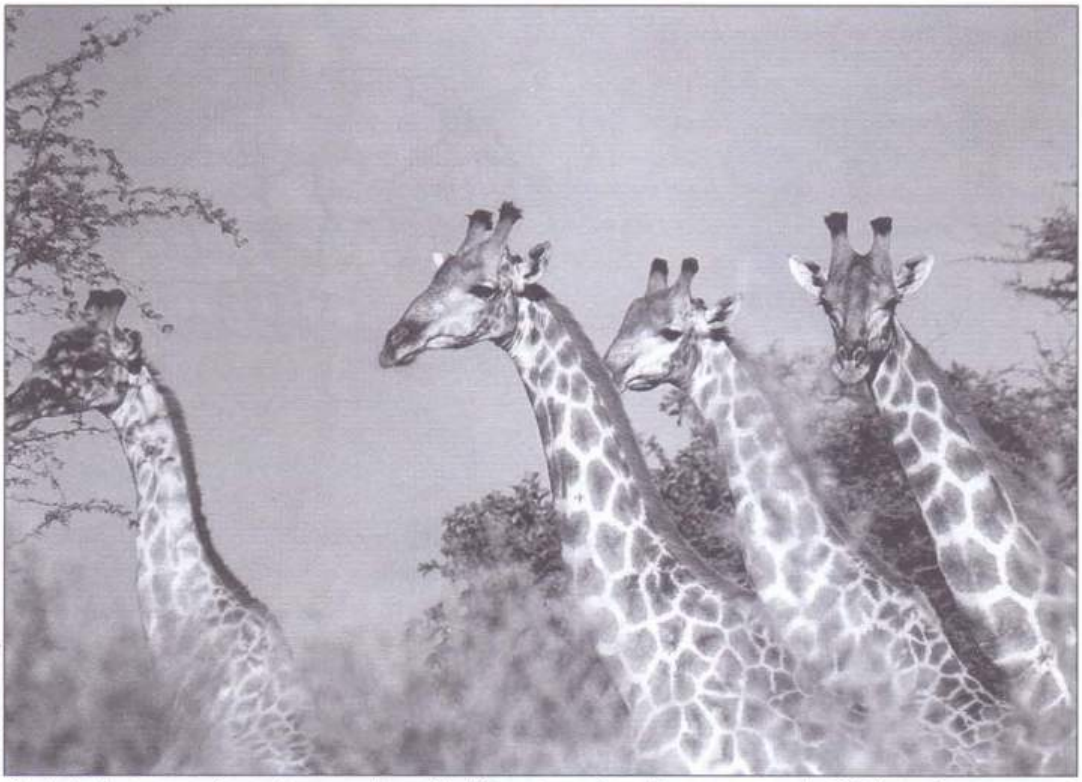


Photo: M Chenje

Protected areas are home to more than 40 different species of large mammals. Of these, five are carnivores and the remainder feed on plants.

such areas of southern Africa are particularly interested in wildlife within the protected areas. In addition, tourism is associated with many employment opportunities.

Threats to forest and woodland biodiversity

From the regional perspective, the key forest and woodland biodiversity issues that dominate policy debate are:

- the impact of deforestation in the semi-arid and arid zones and in the highlands, the disruption of stream flows and increased soil erosion, caused by expansion of agricultural land, excessive fuelwood harvesting and overgrazing, especially in communal areas;
- the impact of rapid population growth and cultivation on state-owned forests and woodlands;
- large-scale timber production; and
- forest and woodland burning.

Probably the single greatest threat is human-settlement encroachment into protected and other open areas of southern Africa. This causes over-exploitation and, at times, total removal of forests and woodland resources. Half of Tanzania's protected areas have been encroached upon. Maswa Game Reserve, was reduced three times in size in about 25 years while Mkomazi Game Reserve was reduced by twice its original size.[36] Habitat change, likewise, is a threat: activities such as grazing, agriculture, urbanisation and mining change ecosystems in such a variety of ways that wildlife populations may fail to adapt.

Livestock grazing disturbs plant species composition as they selectively feed on sweet, nutritious grasses causing sharp increases in non-nutritious and sour grasses. The result is the displacement of some wildlife species. Dam construction has similar impact since plants and some animal species are drowned during filling. Indirect negative impacts on plant and wildlife were experienced during the construction of the Kariba dam on the Zambezi River between Zambia and Zimbabwe when buffalo herds that used to feed on the Marromeu floodplain lost their habitat because of the change in flood regimes.

Wildlife in southern Africa is also threatened by commercial poaching networks, disease, armed conflict, and lack of financial resources to effect control mechanisms. Botswana, Namibia and Zimbabwe successfully lobbied for the downlisting of the Elephant by the Convention on International Trade in Endangered Species (CITES) from Appendix 1, which banned trade in ivory and other elephant products, to Appendix 2 which permits sustainable trading and use. The decision reached by CITES at its conference Harare between 9 and 20 June 1997, narrowly voted against a South African lobby to downlist its white rhino. In 2000 at the Nairobi CITES meeting the 1997 decision was upheld with a two-year moratorium and South African elephants were also downlisted..

Forest and woodland products

Forest and woodland resources sustain a number of important ecological and human functions that are demanded and supplied at various levels. These range from needs at the local, through national and regional, to the global level. The outputs and benefits from these resources can be put into four classes. These include wood products, non-wood products, recreation and ecotourism, and environmental services.

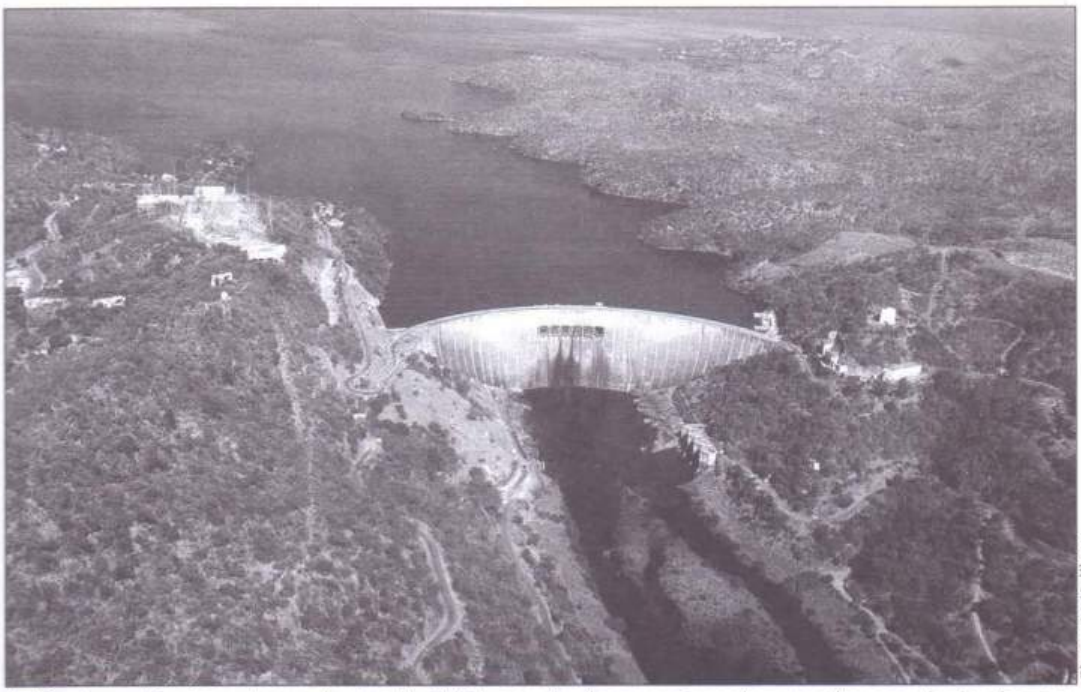


Photo: M Kullberg

Indirect negative impacts on plant and wildlife can also be experienced as was the case during the construction of the Kariba dam on the Zambezi river between Zambia and Zimbabwe.

Officers shoot suspected poacher Box 1.2

Photo: M Chenje

Officials from the Department of National Parks and Wildlife Management in Chirundu on Tuesday killed a suspected poacher and recovered 17 elephant tusks.

According to police Assistant Inspector Joseph Manyakaidze, parks officials based at Nyakasinga Gate in Nyakasikana area were attracted to the poachers some four km away by gunshots.

A team of three officers was deployed, and came into contact with seven poachers near Chewore River. One of the poachers was shot and six of his colleagues escaped towards the Zambezi River. The body of the poacher was taken to Karoi Hospital mortuary.

The team also recovered the tusks, three homemade pots, a mosquito net and 15kg of maize-meal.

Manyakaidze said it was believed the poachers were foreign nationals. Joint investigations are being conducted by police and the Department of National Parks and Wildlife.

In an attempt to protect the country from possible illegal ivory trading, the government has put in place a statutory instrument tightening control over ivory trade within the domestic market.

Under the new arrangements, ivory dealer licences would be issued to those who prove they fully and faithfully account for all the raw ivory bought. In the past ivory could be purchased from licensed dealers but this was abolished. Only the Department of National Parks and Wildlife Management would be authorised to sell raw ivory.

SOURCE: *The Herald*, Harare, Zimbabwe, December 11 1997, p.1

Wood products include items such as firewood, timber and paper. Africa's fuelwood consumption requires special mention as it represents more than a quarter of the world's demand. This leaves fuelwood as the single major product of Africa's (including southern Africa) forest and woodland resources. Southern Africa produces a small proportion of the world's total round-wood for timber, and most exports are in the form of logs. Except for South Africa, Swaziland, Tanzania and Zimbabwe, other countries import all of their paper requirements. South Africa alone produces 73 percent of Africa's wood pulp.

Non-wood products are often utilised by rural people to supplement subsistence agricultural production, thereby contributing to the achievement of food security and decent health status. Although numerous and varied, non-wood products fall into three broad classes[37] — plant products, animal products and services. Large amounts of non-wood products and services are consumed at local and national levels. Commercialisation of such products may, however, increase their future consumption at the local, national, regional and international levels.

Photo: CURE Resource Centre

Africa's fuelwood consumption represents more than a quarter of the world's demand.

The biomass within the semi-arid and arid rangelands of the region provides sustenance for livestock, particularly in the dry season. Herders derive milk, one of their staple foods, from the livestock.

Genes from wild forest species have also been used to improve wheat, sugar, coffee and the genetic properties of other crops.

Another important forest and woodland product is the mushroom. Some 700,000 people of the Upper Shaba area of DRC consume an average of about 20 tonnes of mushrooms annually.[38] In Zimbabwe, during the rainy season alone, an estimated 1.8 kg of mushrooms per person are consumed.

The promotion of tourism depends on sustainable management of forest and woodland resources for biodiversity conservation. Ecological tourism — ecotourism — is one of the fastest growing areas of the tourism industry in southern Africa. Ecotourism is an economic activity that can be carried out in harmony with forest and woodland resources. It reduces negative impacts on the land and local cultures, while helping to generate income and jobs. It offers an opportunity for the region to earn millions of dollars of foreign currency annually.

Forests and woodlands of southern Africa also contribute to global ecological cycles, which are complex self-regulating processes responsible for recycling the planet's limited supplies of water, carbon, nitrogen and other life-giving components. Africa's forests help "sink" carbon dioxide, the greenhouse gas largely

responsible for global warming. Because of the large natural forests in the region, and the lower levels of industrialisation, almost all countries in the region are net "sinks" of carbon dioxide, meaning they consume more carbon dioxide than they emit. This contrasts favourably with industrialised countries, which have net positive emissions.

The larger proportion of the farming population in southern Africa lives in rural communal areas. Forests and woodlands fertilise and nurture their soil. Canopies prevent splash erosion, thereby keeping the soil intact. The root and tree trunk networks soak up rainfall and subsequently release it slowly into the air and surface or sub-surface waters.[39]

Threatened species

The following categories are commonly used regarding threatened plant and animal species:

- extinct – species wiped out of existence;
- endangered – species facing extinction;
- vulnerable – species which could become endangered if current threats are not checked;
- rare – species restricted in distribution or thinly spread over an extensive area and at risk of declining;
- out of danger – species that were once endangered or vulnerable but have since recovered; and
- indeterminate – species about which too little is known.

Two mammal species, the Quagga and Blue antelope, were both hunted to extinction during the 19th century. Similarly, a number of plants are threatened in the region. Although not much work has been done, figures from Lesotho, South Africa and Swaziland show that in the Fynbos ecological zone, 1,326 plant species are threatened; in Succulent Karoo, 558; and 67 in the Nama-Karoo.[40]

Among bird species, conservationists consider the Egyptian Vulture and the African Skimmer to be endangered. However, many birds fall within the rare category including the Cape Vulture, Jackass Penguin, Damara Tern, Wattled Crane, Black-Cheeked Lovebird, Swynnerton's Forest Robin, East Coast Alakat, Spotted Ground Thrush, Papyrus Yellow Warbler and Shoe-billed Stork. Endangered reptiles and amphibians include the Green, Hawksbill, Olive and Leatherback turtles, while the Geometric tortoise and the Nile crocodile are vulnerable.

Photo: APC/D Martin

Among bird species, conservationists consider the Egyptian Vulture and the African Skimmer to be endangered. However, many birds fall within the "rare" category including the Swynnerton's Forest Robin, above.

Of the known invertebrates (animals with no spine, such as insects, spiders and snails), two types of butterflies, the Bashee River Buff and Morant's Blue, are presumed extinct; the Cottrell's Blur and Dickson's Monkey Blue of the Cape Province in South Africa are endangered, and six more species vulnerable.[41]

MANAGEMENT POLICIES

Southern African countries have played pioneering roles in rural forestry and participatory management of natural forests, woodlots and wildlife management. Community-based wildlife management programmes in the region include:

- Chobe Enclave (Botswana);
- Tchuma-Tchato (Mozambique);
- Community-Based Natural Resources Management Programme (Malawi);
- Peoples and Parks (South Africa);
- Living in Finite Environment – LIFE (Namibia);
- Selous Conservation Programme (Tanzania);
- Administrative Management Design for Game Management Areas – ADMADE (Zambia); and
- Communal Areas Management Programme for Indigenous Resources – CAMPFIRE (Zimbabwe).

Regional organisations have also been formed to enhance sustainable management. These include the African Timber Organisation (ATO), which has its headquarters in Libreville, Gabon and incorporates the southern African countries of Angola, DRC and Tanzania; and the SADC Forestry Sector Technical Coordination Unit (SADC-FSTCU) with its headquarters in Lilongwe, Malawi. In 1990, the SADC-FSTCU developed its Forestry Programme of Action (FPA). The programme focuses on six general areas:

- forestry training and education;
- improved knowledge of the forest resource base;
- focused forest research;
- improved forest resource management;
- forest products utilisation and marketing; and
- integration of environmental protection with forestry development.

SUSTAINABLE DEVELOPMENT

Forest and woodland biodiversity are part of the biophysical environmental resources, and thereby need to be sustainably exploited. Based on Agenda 21, the Commission on Sustainable Development (CSD) was given the responsibility to monitor the implementation of the UNCED commitments. The CSD had to look for ways of putting in place a "non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests".[42] Human beings are at the centre of concerns for sustainable development and they are entitled to a healthy and productive life in harmony with nature.[43]

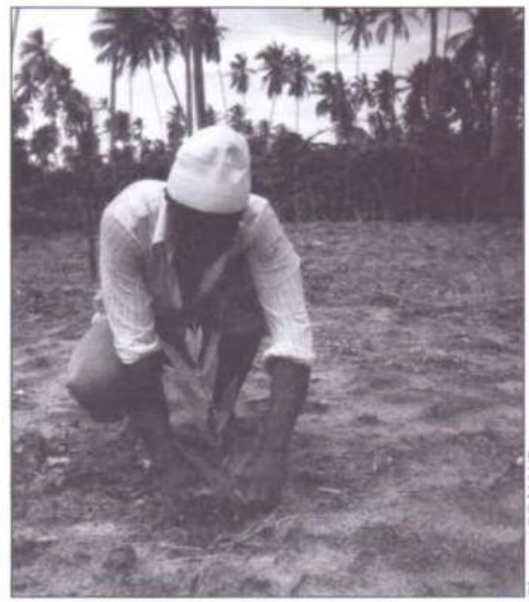


Photo: APC/WWF

Human beings are at the centre of concerns for sustainable development.

Sustainable development, needs to balance resource use and resource availability. To a larger extent people have been preoccupied with conserving (protection from harm or unnecessary loss) non-renewable resources. However, both renewable and non-renewable resources should be equally conserved for the prolonged enjoyment of the benefits derived from them. The forestry and woodland resources equilibrium has been con-

stantly disturbed by the introduction of humankind into the cycle which has become detrimental. The population of southern Africa and the world over is steadily increasing on a finite land surface and amid diminishing forest and woodland resource bases. In addition, the selfishness of people and their struggle for supremacy means that resources are over-exploited to satisfy the needs of today. Genuine cross-border resource-sharing has also proved extremely difficult.

Given this scenario, a balance between resource use and resource availability may be achieved by the sustainable use of what little is available. This calls for a comprehensive plan on how best the available scarce forest and woodland resources within southern Africa could be used. This not only calls for effective and efficient population control policies, but also the best ways of conserving forest and woodland resources, including capital generated from any commercial activities. The success of the management plan requires a united regional political, social and economic front such as SADC. The SHARED Programme could therefore be the cornerstone of a success story. The balance, however, is dependent on the ability to share cross-border forest and woodland resources within SADC.

Meeting the basic needs of growing populations is dependent on a healthy environment. Southern African governments should reduce poverty levels, giving particular attention to income-generation and employment strategies directed at the rural poor, who are living within or on the edge of fragile forest and woodland ecosystems. Demographic data should be accurate and constantly updated to promote its use in sustainable forest and woodland biodiversity planning and management.

Poverty is one of the main causes of forest and woodland degradation in southern Africa and is both a consequence and a cause of this degradation. Clearly any improvements in environmental quality should help reduce poverty. When people lack adequate financial and other resources, they are left with no choice but to turn to unsustainable use of natural forests and woodlands to meet their basic needs. It becomes a vicious circle.

Linked to poverty and the degradation, is the debt crisis afflicting many southern African countries. Debt servicing leads to the reduction in public ser-

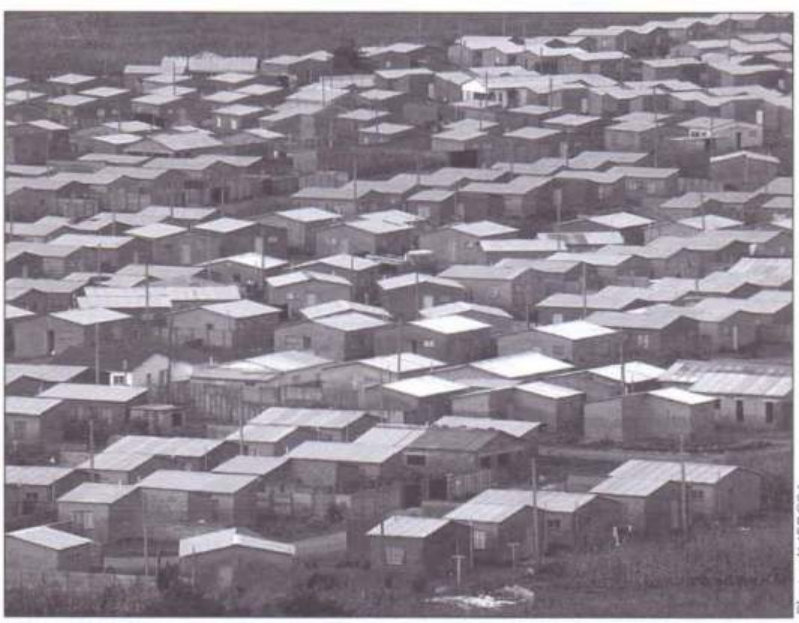


Photo: IMERCSA

The population of southern Africa and the world over is steadily increasing on a finite land surface and amid diminishing forest and woodland resource bases.

vice resources and forces governments to accept unfavourable conditions attached to aid packages. Forced retrenchments in the workforce are often one condition of the International Monetary Fund and World Bank financial support in SAPs. Most of those retrenched relocate to their rural homes where they can turn to forest and woodland resources for their survival. Some of the poorest nations in the world are in southern Africa.[45]

If sustainability is to be achieved there should be continuous conservation of genetic resources. Wild animal and plant species must be conserved, along with soil and water. Local people should be involved in policy formulation about forests and woodlands. They should also have a significant share of whatever benefits are reaped from sustaining animal and plant resources, especially from community-based conservation practices.

CURRENT ISSUES AND DEBATES

Current issues and debates are focused on the obstacles to sustaining forest and woodland biodiversity resources, especially the need to arrest deforestation and ultimately desertification. Other debates include those addressing tenural rights, devolution from central government to communities and maintaining ecological processes as a function of forests.

Sustainable forest and woodland management may sound easy to achieve, but the reality is not. Different interests have interpretations and practices which do not mesh:

- to the forest and woodland industry, it means a continuous and secure supply of timber to processing plants;
- to forest managers, it means long-term maintenance of the forest and woodland;.
- to financial managers, it means constant profits;
- to ecologists, it means the preservation of forest and woodland biodiversity; and
- to local people, it is the maintenance of forest and woodland production potential and locally held values.

Photo: P Wade

Poverty is one of the main causes of forest and woodland degradation and is both a consequence and a cause.

Sustainability in forest and woodland management in southern Africa must, however, take a holistic approach, encompassing all these viewpoints.

The forces driving deforestation are complex. As such, there is need to consider and understand the linkages between resource degradation and social unrest that threaten both the environment and socio-economic stability. Unless actions are taken now to protect forest and woodland biodiversity, we risk losing forever the opportunity of reaping its full potential for humankind. The mean annual deforestation rate in southern Africa was about -0.5 percent for the period 1990-1995.[46] Efforts aimed at replacing the lost indigenous forests and woodlands through afforestation programmes and related activities have achieved little progress and that trend is likely to continue in the near future.

The forest and woodland areas of southern Africa represent the most accessible source of much needed capital stock, both for the state and the

individual. This "business opportunity" requires investments in transport and processing machinery. Once the forests and woodlands have been cleared, the land is well-suited to other forms of production. Such a change in land use is reasonable since the need for food will continue rising with population growth.[47] Poor forest and woodland biodiversity management is attributed to the fact that both colonial and post-colonial governments managed, and are still managing, extremely large areas against their limited income base and institutional capacities. By strengthening the private sector's role, a dynamic involvement of local communities, and reform of ownership rights are considered essential for improved management.

The biodiversity knowledge base in southern Africa should be improved. This must include correcting past policy failures and ensuring that conservation and sustainable use of the biodiversity and equitable sharing of benefits are made an integral part of all socio-economic development.

The following actions may be undertaken to sustain forest and woodland biodiversity:[48]

- good management practices;
- good conservation practices;
- sustainable use of products;
- equitable sharing of benefits;
- accommodating and appreciating the role of research, monitoring and inventory;
- building national capacity and expertise;
- involvement of community or local people; and
- agroforestry practice.

Photo: APC/WWF

By strengthening the private sector's role, a dynamic involvement of local communities, and reform of ownership rights are considered essential for improved management.

LINKAGES TO OTHER CHAPTERS Box 1.3

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
The extent and distribution of the major vegetation types in the region are introduced in chapter one and detailed in chapter two.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
There are three aspects of biodiversity: genetic, ecosystem, and species that are important when considering human interaction with the environment. It is important to outline the fundamental reasons for conserving biodiversity and equally important to outline the trends in forest and woodland biodiversity for the region.

4 ECOLOGICAL PROCESSES
Forests and woodlands play pivotal roles in regulating natural cycles such as the water, carbon and nitrogen cycles.

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Human activities and natural processes affect forests and woodlands in various negative ways. The extent of biodiversity loss in the region has been most severe in the last century, mainly from human-induced causes.

6 FOREST AND WOODLAND PRODUCTS: USES AND VALUES
The resources of woodlands and forests are central to the livelihood systems of millions of rural and urban dwellers. The demand for forest produce such as firewood is on the increase, while the forests themselves are dwindling.

7 ECONOMIC VALUATION AND ACCOUNTING
The economic significance of indigenous forests and woodlands is usually under-reported. Forests and their associated benefits have been traditionally taken for granted, and it is only now that these resources have been drastically reduced that efforts to establish their appropriate value have been established.

8 POLICY ANALYSIS
Effective local, national and regional policy instruments are necessary to implement sustainable forest and woodland biodiversity management strategies.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Forestry management practices have to evolve to ensure that the future is sustainable. The region has varied management practices in place and these could be transformed to practices that are sustainable. Some new conservation management ideas have been implemented, and are yielding interesting results.

10 TRENDS AND SCENARIOS
Scenario building includes among other things, an assessment of the prevailing trends and some assumptions about the future. Factors such as population, economic performance and areas under agriculture may be assumed to increase while other factors such as rainfall, temperatures and soil texture may be assumed to remain constant.

ENDNOTES

1. Southern Africa hereby refers to the Southern African Development Community (SADC) countries. As of December 1997, SADC membership constituted 14 countries: Angola, Botswana, Democratic Republic of Congo (DRC), Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. However, this publication does not often include the DRC and Seychelles

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Photo: H McCullum

Khaya anthotheca (Red Mahogany), *this particular tree is reputed to be the tallest tree in Zimbabwe, found in the Chirinda forest in the Eastern Highlands.*

2 FORESTS AND WOODLANDS OF SOUTHERN AFRICA

The region is covered by a variety of vegetation, ranging from rainforests, woodlands, thickets, shrublands and grasslands to semi-desert and desert.

Woodlands are the most extensive vegetation formation, occupying 75 percent of the region's total land area. Deciduous forest (1.1 percent) is mostly found in Zambia and Mozambique, while evergreen forest (0.7 percent) is principally in Angola and Tanzania.[1]

Arid shrublands (including Karoo types) constitute 6.9 percent, primarily in South Africa. A small-scale mosaic of forest, savannah and grassland covers 2.4 percent, mainly in Angola.[2] The other formations cover relatively small areas, and include deserts, mainly in Namibia and Botswana, wetlands, mangroves and swamps, and shrublands or fynbos found only in South Africa.

The nature, biological composition, distribution and production potential of the region's ecosystems are mainly determined by the physical environment, with climate and soil as major factors. Other influences include the frequency and intensity of fire, the influence of animals through grazing and browsing and the impact of people.

FOREST AND WOODLAND TYPES

Definitions and classification

Southern African forests and woodlands are mainly composed of deciduous trees which lose their leaves for at least part of the dry season. The duration of the leafless conditions depends partly on temperature, but principally on the availability of soil moisture.

There are a variety of approaches that can be used to classify and describe vegetation. One such approach describes vegetation according to its structural or physiognomic make-up such as tree height and density.

An alternative classification, known as the phytochorological method, classifies vegetation purely on its species composition. Using this approach, geographical areas with distinct flora are classified into phytochoria, which are broad areas with similar groupings of plant species.

A third approach is known as the biome method, which classifies vegetation on the basis of the structure of the dominant vegetation formation and the physical environment.

For the purpose of this review, the phytochorological approach is most appropriate, taking into account as it does the species composition of various formations since the phytochoria are mutually distinct from each other.

Southern Africa has six main phytochoria[3] containing substantial forest or woodland areas:

- Guineo-Congolian regional centre of endemism;
- Guinea-Congolia-Zambezia regional transitional zone;

Extent and distribution of major structural vegetation formations in southern Africa Table 2.1

Country	Area 100,000 ha										
	Forest		FSM	Woodland		Shrublands		Grassland		Wetlands	
	E	D		Moist	Arid	Arid	Scle	Moist	Arid	SWA	DES
Angola	23.9	1.9	149.9	849.9	148.5	-	-	63.3	-	1.1	3.7
Botswana	-	-	-	186.6	341.6	-	-	-	24.7	8.7	-
Lesotho	-	-	-	-	-	-	-	23.2	7.3	-	-
Malawi	-	0.3	-	81.9	15.8	-	-	3.0	-	5.0	-
Mozambique	4.5	26.3	16.6	494.8	225.1	-	-	5.3	-	9.0	-
Namibia	-	-	-	161.1	507.0	41.8	-	-	0.02	-	131.1
S. Africa	4.1	2.0	-	55.4	366.4	428.4	46.4	187.4	129.5	-	113.1
Swaziland	-	-	-	5.5	8.6	-	-	3.3	-	-	-
Tanzania	15.6	-	-	645.1	72.8	-	-	-	104.9	63.4	-
Zambia	-	37.1	-	583.7	43.9	-	-	66.5	-	17.5	-
Zimbabwe	1.4	4.9	-	255.0	114.1	-	-	8.0	-	2.1	-
Total	49.4	72.6	166.5	3,319	1,843.7	470.3	46.4	359.9	266.3	106.7	118.0

Legend: E-Evergreen forest; D-Deciduous forest; FSM-Forest Savanna Mosaic; Scle-Scerophyll Shrubland; Swa-Wetlands Swamps; Des-Desert.

SOURCE: Kruger, F.J., Scholes, R.J. and Geldenhuys, C.J.; 'Strategic Assessment of Land Resources in Southern Africa as a Framework for Sustainable Development', Proceedings of National Veld Trust Jubilee Conference, 1994

- Zambezian regional centre of endemism;
- Afromontane archipelago-like centre of endemism;
- Zanzibar-Inhambane regional mosaic; and
- Tongaland-Pondoland regional mosaic.

MAIN VEGETATION TYPES

Guineo-Congolian regional centre of endemism

Forests of the Guineo-Congolian regional centre are present in northern Angola in the form of evergreen and semi-deciduous forests and forest-woodland mosaics. Some are also found as isolated forest patches extending southwards along the Angola escarpment.[6]

Guineo-Congolian rainforests are found in the Cabinda enclave of Angola where trees reach heights of 30-50 m. Common species include *Gilletiodendron ogoouense*, *Tetraberlinia bifoliolata*, and *Librevillea klainei*.[7] The forests are surrounded by more extensive areas of partially deciduous forest, with species such as *Gossweileriodendron balsamiferum* (agba, tola wood), *Oxystigma oxyphyllum* (lolagbola, tchitola), *Pentaclethra macrophylla* (owala oil), *Terminalia superba* (Afara), *Celtis philippensis*, *C. mildbraedii*, *Morus mesozygia* (African Mulberry) and *Warburgia salutaris* (pepper-bark tree).[8] These forests benefit from an almost continuous cloud cover resulting from the cold influence of the Benguela Current.

Compared with rainforest areas in other continents, most of the Guineo-Congolian region is relatively dry. Many tree species have slender trunks covered with thin smooth bark, and their leaves are large, dark green, and have drip tips. Although

Definitions of the main vegetation units of southern Africa Table 2.2

Vegetation unit	Definition
FORMATIONS OF REGIONAL EXTENT	
Forest	A continuous stand of trees at least 10 metres tall, with their crowns interlocking.
Woodland	An open stand of trees at least eight m tall with a canopy cover of more than 40 percent. Grasses usually dominate the field layer.
Bushland	An open stand of bushes usually between three and seven m tall with a canopy of more than 40 percent. A bush is a woody plant, usually multi-stemmed, intermediate in habit between a shrub and a tree.
Thicket	A closed stand of bushes and climbers, densely interlocked to form an impenetrable community, usually between three and seven m tall.
Shrubland	An open or closed stand of shrubs up to two m tall.
Grassland	Land covered with grasses and other herbs, either without woody plants or the latter not covering more than 10 percent of the ground.
Wooded	Land covered with grasses and other herbs, with woody plants covering between 10 and 40 percent of the ground.
TRANSITIONAL FORMATIONS OF LOCAL EXTENT	
Shrub forest	Intermediate between forest and bushland
Transition	Intermediate between forest and woodland
Shrub/woodland	Stunted woodland less than eight m tall, or vegetation intermediate between woodland and bushland
EDAPHIC FORMATIONS	
Mangrove	Open or closed stands of trees or bushes occurring on shores between high and low water marks.

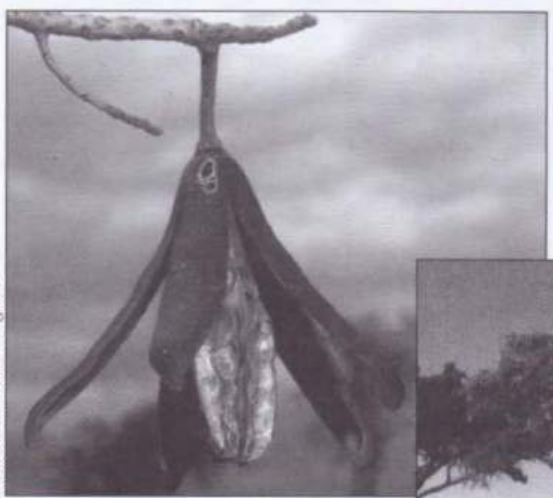
SOURCE: White, F, *The Vegetation of Africa*, UNESCO, 1983

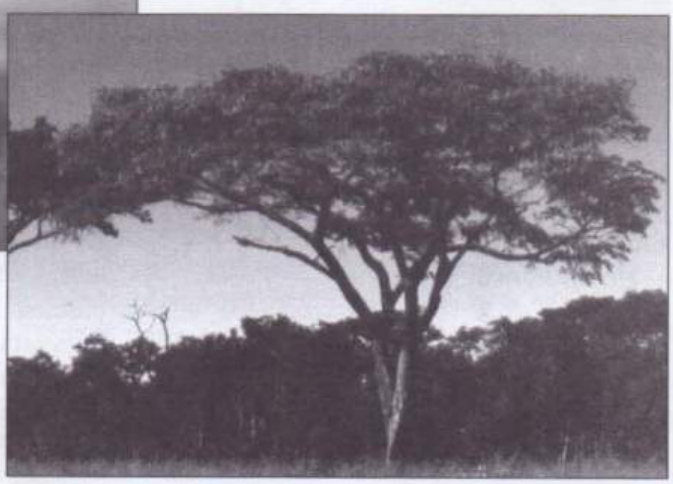
some species are deciduous, the forests themselves are evergreen. Climbing herbs are usually present, but are abundant only in the wetter upland areas.

Guinea-Congolia/Zambezia regional transitional zone

This zone is set between the predominantly west African flora of the Guineo-Congolian region and the predominantly southern African flora of the Zambezian region. It extends from the Atlantic coast across northern Angola and includes a thick mantle of Kgalagadi sands on the plateau of eastern Angola.

Extensive rainforests penetrate towards the south in the wide valleys of the major tributaries of the Congo River, and are surrounded by vast areas of tall grassland interspersed by gallery forests in the valleys, with isolated forest patches on ridges and plateaus.[9] The trees are 20-40 m tall, and include many of the species found in the Guineo-Congolian centre. In the grasslands trees and shrubs are sparsely scattered, because their survival requires considerable tolerance to intense annual fires.





Photos: M Coates Palgrave

From top left, clockwise, Large False-mopane, Kiaat (bloodwood or mukwa) in pod, White-stinkwood, Kiaat in leaf and a Wooden-banana pod.

At the western end of the transition zone climate changes rapidly from the arid coastal plain, where the vegetation is predominantly Zambezian, to the humid, and essentially Guineo-Congolian cloud-forests on the escarpment of the interior plateau.

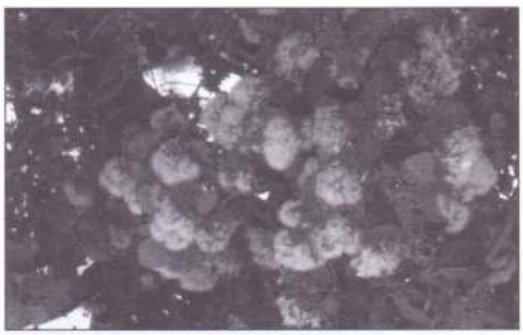
Zambezian regional centre of endemism

The Zambezian region is the second largest botanically defined geographical area in Africa after the Sahara and the largest in southern Africa.[10] It covers the whole of Malawi, Zambia and Zimbabwe, more than 80 percent of Angola, large parts of Tanzania and Mozambique, and smaller areas of the DRC, Namibia, Botswana and South Africa. The Zambezian regional centre occupies most of the Great African Plateau, and principally falls within the tropical summer-rainfall zone with a single rainy season of between 500-1,400 mm per year. Annual rainfall decreases from north to south. In some southern parts of the region, the dry season is severe and lasts for more than six months. Frost is widespread and frequent. The flora is rich and diverse, and shows a wide range of vegetation types, including:

- Zambezian dry evergreen forest;
- Zambezian dry deciduous forest;
- Zambezian woodland; and
- Itigi deciduous thicket.[11]

Zambezian dry evergreen forest

This dry evergreen forest, where trees rarely exceed 25 m, has similarities to the Guineo-Congolian rainforest. Confined to the wetter northern parts of the Zambezian region where annual rainfall is more than 1,200 mm, it is simpler in structure than rainforests, and the leaves of trees are harder. Cultivation and fire have destroyed most dry evergreen forests, and only disturbed fragments remain, usually with secondary and wooded grasslands. The main species are readily killed by fire, and they include *Entandrophragma delevoyi* (sapele, wooden-banana), *Syzygium cordatum*, *S. guineense* and *S. owariense* (waterberries), *Julbernardia seretii*, *Marquesia acuminata*, *M. macroura*, and *Parinari curatellifolia* (mobura, mobola-plum). *Cryptosepalum pseudotaxus*, and *Daniellia alsteeniana*.[12]

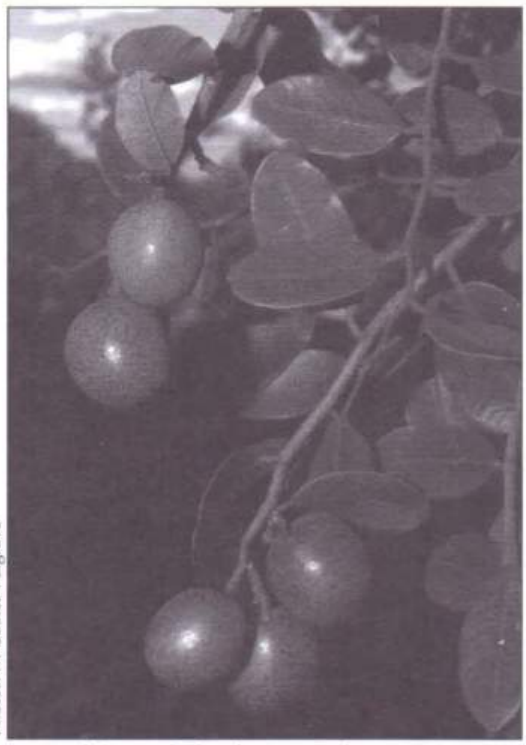


Waterberry flowers and leaves.

Waterberry fruit and leaves.

Mobura or mobola-plum with characteristic rounded crown.

Photos: M Coates Palgrave



Photos: M Coates Palgrave

Fruit of the Mobola-plum or mobura.

Zambezi-teak in flower.

Zambezi dry deciduous forest

This occurs in a mosaic with secondary grassland in areas with rainfall between 600-900 mm per year, usually in deep sandy soils. The canopy varies from 12-25 m, usually in deep sandy soils, and is often dense and thicket-like, consisting almost entirely of deciduous species. The most extensive deciduous forests are the teak forests on the Kgalagadi sands in the southern part of the upper Zambezi basin (northern Namibia, southeastern Angola, northern Botswana, western Zimbabwe and southwestern Zambia).[13] *Baikiaea plurijuga* (Zambezi-teak) sometimes forms almost pure stands,[14] but also grows in various mixtures. In the extreme south-east of Angola and northern Namibia pure teak stands are rare. The species is most typically associated with *Pterocarpus angolensis* (kiaat), *Julbernardia paniculata* (mutondo), *Dialium englerianum* (Kgalagadi pod-berry), with local communities of Manketti-nut, *Schinziophyton rautaneni*.

Zambezian woodland

Woodlands are the most widespread and characteristic vegetation of the Zambezian regional centre of endemism, and are of three types:

- Miombo woodland;
- Mopane woodland; and
- Undifferentiated Zambezian woodland.

The main vegetation over the greater part of the Zambezian region is mopane, especially on the main Zambezi plateau and its flanking escarpment where the soils are freely drained and leached.

In terms of structure and species composition, miombo woodland is very different from other types. It is nearly always dominated by species of

Brachystegia spiciformis (muputu, musasa), *B. boehmii* (musamba, mufuti, muombo), *B. utilis*, *B. longifolia*, *B. microphylla*, either alone or with *Julbernardia* species, *J. seretii*, *J. paniculata*, (mutondo), and *J. globiflora*. (munondo, kamponi).[13] The woodlands are distinctive because of the shape of the dominant trees – their boles are mostly short but relatively slender, with branches that markedly ascend before spreading out to support the light, shallow, flat-topped crown. The trees are mostly 10-20 m tall and deciduous, although some are almost evergreen. Many of the woody species demand light and show some degree of fire resistance. Woody climbers and ferns are normally absent, except on fire-protected sites. The herbaceous layer is usually sparse, with grasses growing a metre in height. There is little foliage between the ground layer and the lower canopy.

A distinction is usually made between wetter and drier miombo, based partly on the dominant species and also on the associated vegetation types.

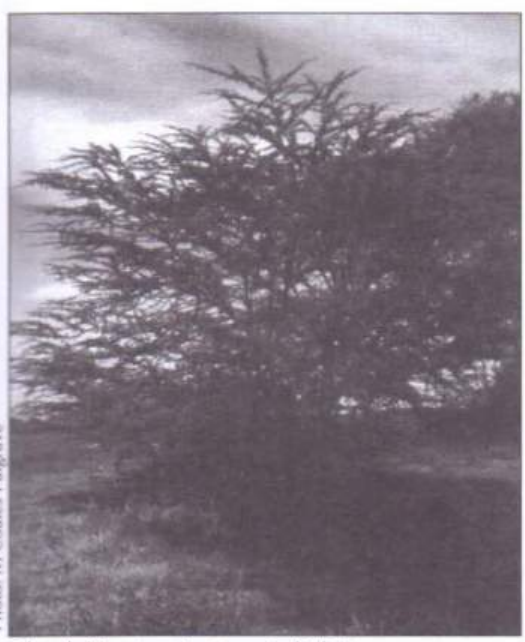


Photo: M Coates Palgrave

Floodplain Acacia (Acacia kirkii).

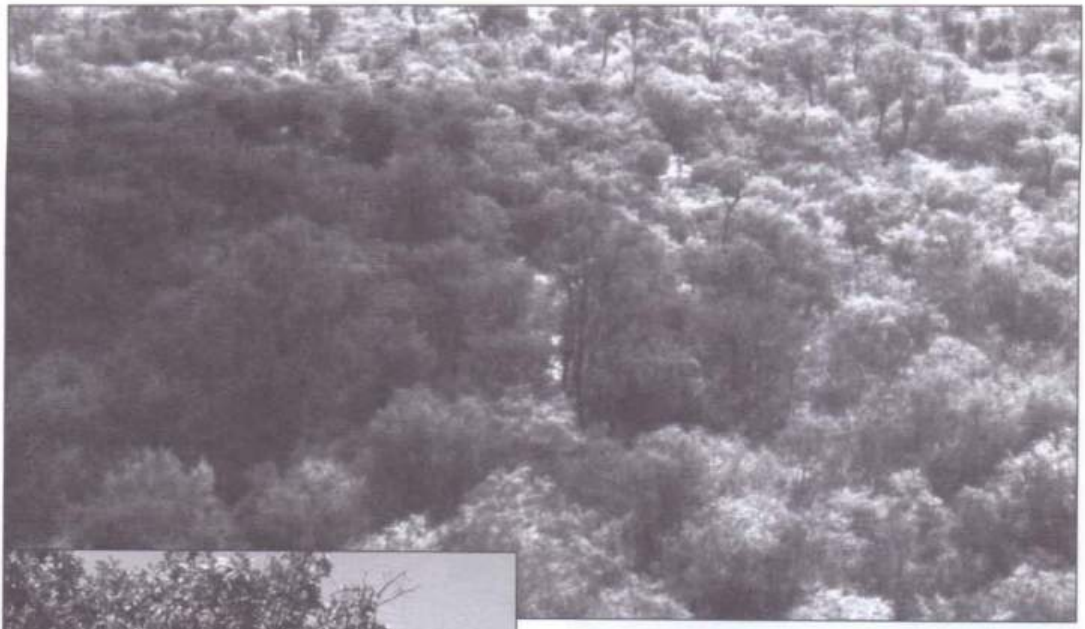
Wetter miombo is generally found in areas with an annual rainfall of over 1,000 mm and has a canopy of at least 15 m. It is rich in flora and includes such species as *Brachystegia floribunda*, *B. glaberrima*, *B. taxifolia*, *B. wangermeeana* and *Marquesia macroura*. Much of northern Angola, north and central Zambia, Malawi, north-central Mozambique and the western fringe of Tanzania is covered in wetter miombo.[14]

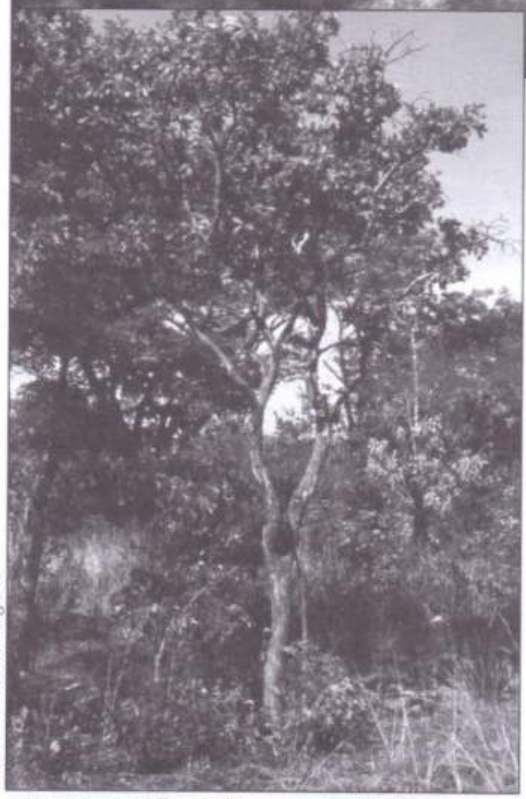
Photo: M Coates Palgrave

Mountain-acacia Brachystegia.

Drier miombo is found where there is less than 1,000 mm annual rainfall, and has a canopy height less than 15 m. The main species *Brachystegia spiciformis* (muputu, musasa), *B. boehmii* (musamba, mufuti, muombo), and *Julbernardia globiflora* (munondo, kamponi). This woodland fringes the Luangwa and mid-Zambezi valleys and is transitional between the mopane woodland of the valley bottoms and the wetter miombo of the northern plateau. It is widespread over much of the central watershed of Zimbabwe, northern Mozambique and southern Tanzania.[15]

Mopane woodland, dominated by *Colophospermum mopane* (mopane), is widespread in the drier half of the Zambezian region.[16] It is the most extensive vegetation in parts of the Zambezi, Luangwa, Limpopo, Shashi and Save valleys,[17] as





Photos: M Coates Palgrave

Mopane woodlands have a remarkable structural uniformity, owing to the almost complete dominance of the mopane itself and its characteristic appearance.

well as in the Makgadikgadi and Okavango depressions of Botswana, but is otherwise almost absent from the Kgalagadi sands. Extensive areas in northwestern Namibia and southwestern Angola are covered in mopane woodland or shrubland. The woodland is 10-20 m tall, with a strong correlation between rainfall and height. Mopane woodlands have a remarkable structural uniformity, owing to the almost complete dominance of the *Colophospermum mopane* (mopane) itself and its characteristic appearance.

Shrub mopane forms a bushland rather than woodland, and is characterised by expanses of mopane shrubs with a height of 1-2 m.[18] This may be due to root restrictions, but can also be caused by damage from repeated browsing by large mammals such as Elephants. Mopane and miombo rarely occur together, and their associated flora is totally dissimilar.

Undifferentiated Zambezian woodlands occur north of the Limpopo valley on a wide range of

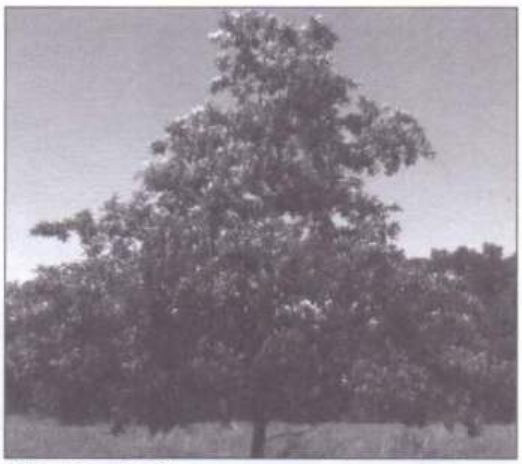
soils. They are richly floral and more easily defined by the absence of the miombo dominants and mopane than by its own floral composition. Although miombo species are normally absent, some of their associates are present, such as *Afzelia quanzensis* (chamfuta, pod-mahogany), Burkea, *B. africana* (wild-syringa), *Dombeya rotundifolia* (wild-pear), *Pericopsis angolensis* (afrormosia), *Pseudolachnostylis maprouneifolia* (duikerberry, kuduberry), *Pterocarpus angolensis* (kiaat), and *Terminalia sericea* (silver terminalia).[19]

Pod-mahogany, chamfuta.

Duikerberry or Kuduberry.

Photos: M Coates Palgrave

A group of Burkea.



Silver Terminalia.

South Undifferentiated Zambezian woodland is found between the Limpopo valley and the northern limits of the South African highveld, and extends southwards as a narrow tongue between the northern extension of the Drakensberg Escarpment and the coastal plain. In structure and floristic composition it is intermediate between North Zambezian Undifferentiated woodland and Tongaland-Pondoland semi-evergreen bushland and thicket. The woodlands are mostly short, less than nine m high, but locally well-developed taller woodlands can also be found.

Kgalagadi woodland found on the sands of the upper Zambezi, is a type of forest modified by fire and cultivation. Evergreen *Cryptosepalum pseudotaxus* forest occurs in the north, while deciduous gusi, *Baikiaea plurijuga* (Zambezi-teak) forest is found in the south. Other widespread species include *Afzelia quanzensis* (chamfuta, pod-mahogany), *Pterocarpus angolensis* (kiaat), species of *Combretum, C. psidioides, C. molle, C. zeyheri, Dialium englerianum* (Kgalagadi pod-berry), *Diplorhynchus condylocarpon* (wild-rubber, mutowa), *Erythrophleum africanum* (ordeal-tree), *Hymenocardia acida* (miombo heart-fruit, ka/mu/pempe), *Lannea discolor* (live-long, ka/mu/bumbu), *Parinari curatellifolia* (mobura, mobola), species of monkey-orange or mutamba, *Strychnos pungens, S. henningsii, S. cocculoides*) and *Swartzia madagascariensis* (snakebean).[20]

Photo: M Coates Palgrave

Snake-bean.

Chipya woodland grows on soils on the Central Africa Plateau in parts of Zambia, DRC (Shaba) and Malawi where rainfall exceeds 1,000 mm per year, and also on alluvial soils of lake basins and their associated river systems. Chipya refers to vegetation in which various trees other than the miombo dominants grow mixed in tall grass. Such vegetation burns fiercely and the trees are remarkably fire-resistant. The woodland occurs on sites formerly occupied by forest or transition woodland, and owes its existence to cultivation and fire.

Photo: M Coates Palgrave

New young shoots of the Ordeal-tree.

Itigi deciduous thicket

Itigi deciduous thicket is a localised type, one of several varieties of thicket that occur throughout the Zambezian region. The thicket is found where soils are deep, sandy and soft in the rainy season but harden considerably on drying. It covers a large area in central Tanzania, and also occurs in Zambia in the depressions between Lake Mweru-Wanthipa and the southern end of Lake Tanganyika.[21] The thickets are composed of multi-branched shrubs that form a 3-5 m canopy. The shrubs are interlaced to form a thick continuous cover which is dense when in leaf. Light is excluded and the ground layer is sparse.

Afromontane archipelago-like regional centre of endemism

The Afromontane region extends from north and west Africa through Tanzania, Malawi, Mozambique, Zimbabwe, Swaziland and finally along the Drakensberg Escarpment and other mountains to the Cape Peninsula in South Africa.[22] In the tropics, most Afromontane communities are only found above 2,000 m except where the climate is more oceanic, such as the West Usambara Mountains in Tanzania, where they can occur at 1,200 m. Further south, they descend progressively, and along the southeastern coastline of South Africa, occur almost at sea-level.[23]

On many mountains there are up to three altitudinal vegetation belts within the afromontane zone:

- Forest;
- Ericaceous; and
- Afroalpine.

The lowermost vegetation type is forest, below which is generally a transition zone to lowland types. Nearly everywhere, however, fire and cultivation have destroyed the vegetation of this transition zone.

Most afromontane tree species are widely distributed and ecologically abundant, while exhibiting a wide range of growth forms. Three forest types are found in the afromontane regional centre:

- Afromontane rainforest;
- Undifferentiated afromontane forest; and
- Single-dominant afromontane forest.

Afromontane rainforest

Afromontane rainforest occurs mostly on wet slopes of high mountains from southern Ethiopia to Malawi at altitudes of between 1,200-2,500 m and with annual rainfall of 1,250-2,500 mm. It is similar in structure to certain types of Guineo-Congolian lowland rainforest, with 25-45 m trees at the upper levels. Species, however, are vastly different. One of these differences is the occurrence of tree ferns and conifers. Another is the high degree of bud protection, while the tips of leaves are less well developed. The shrub layer is three to six m tall, and is poorly differentiated from the lower tree layer. The herb layer is usually sparse and consists of forest grasses and ferns. Woody and strangling climbers are abundant. Some tree species are briefly deciduous, but the forests are generally evergreen.

Photo: APC/D Martin

Afromontane rainforest, Tanzania.

Undifferentiated Afromontane forest

Undifferentiated afromontane forest is usually lower in height than its rainforest counterpart, which it replaces at higher altitudes on the wetter slopes and at comparable altitudes on drier slopes.

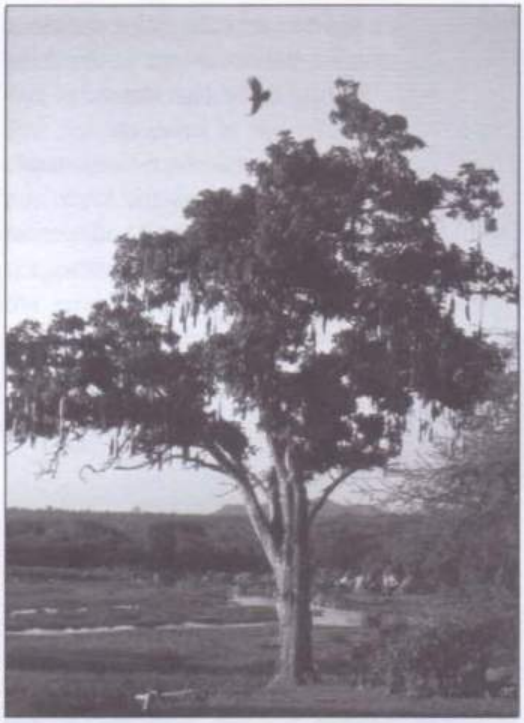


Photo: APC/D Martin

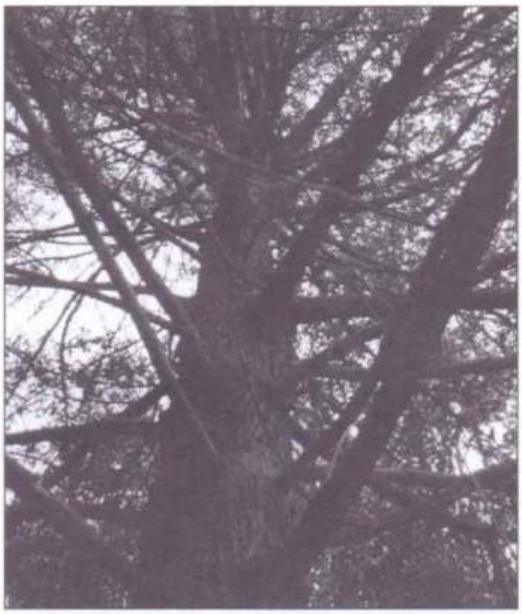
Photos: M Coates Palgrave

Photo: P Wade

Clockwise from top left, Sausage-tree, the flower and leaves of the African Holly, the fruit of the African Holly and a close up of a sausage pod.

It usually, but not always, receives lower rainfall. Most stands are floristically mixed, but sometimes after fire they are replaced by almost pure stands of *Widdringtonia* (cedar) species, juniper, *Juniperus procera*, *Hagenia abyssinica* (koso or kousso). The following assemblage of species could almost be used to define the afromontane region as a whole: *Apodytes dimidiata* (white-pear), *Halleria lucida* (tree-fuchsia), *Ilex mitis* (African holly), *Nuxia floribunda* (kite-tree), *N. congesta*, *Ocotea bullata* (black stinkwood), the yellowwoods including *Podocarpus falcatus*, *Prunus africana* (African almond), *Rapanea melanophoeos* (Cape-beech) and *Xymalos monospora* (lemonwood).[24]

Photos: P Wade



Above, trunk, branches and leaves of a Yellowwood.

Left and above, Cape-beech and leaves.

Single dominant Afromontane forest

There are three types of single-dominant afromontane forest: *Juniperus procera* (juniper) forest, *Widdringtonia* (cedar) forest and *Hagenia abyssinica* forest.[25] Juniper forest has a scattered distribution from the Red Sea Hills in Sudan south to the Nyika Plateau in northern Malawi. It is found on drier slopes of mountains between altitudes of 1,800 and 2,900 m, and occasionally down to 1,000 m. Frequently it forms forest in which it is the most abundant species, and is a strong light-demander that does not regenerate in its own shade. Its presence as a forest tree is largely dependent on fire to facilitate regeneration without competition. Cedar forests extend from southern South Africa (Cedarberg Mountains) to Mount Mulanje in Malawi, and are very susceptible to fire. The main canopy of mature forest on Mount Mulanje is about 27 m in height.

Hagenia abyssinica (koso or kousso) forest is found on most of the higher mountains between Ethiopia and the Nyika Plateau in Malawi. Its altitudinal range lies between 1,800-3,400 m but is normally absent from afromontane rainforest and the taller types of undifferentiated afromontane forest.

Characteristically *Hagenia* species form almost pure stands that are 9-15 m tall, in a narrow zone between taller types of montane forest and the thickets and shrublands of the Ericaceous belt. The biggest trees have trunks up to two m tall and 1.6 m in diameter which support massive spreading branches. The best-developed stands are clearly forest, though of a simpler structure. The species thrives in bright sunshine, and can withstand at least some burning, though repeated fires will kill it.

Zanzibar-Inhambane regional mosaic

The region occupies a 50-200 km wide coastal belt from southern Somalia to the mouth of the Limpopo River in southern Mozambique.[26] Most of the land lies below 200 m, with annual rainfall of 800-1,200 mm, and a well-defined dry season. In many areas, rainfall is comparable to that of the Zambezian Region, but the dry season is less severe. Forest is the most widespread vegetation, but has been largely replaced by secondary wooded grassland and cultivation. The forests are rich in species, but owing to the different climatic factors over its range, the Zanzibar-Inhambane regional mosaic changes rapidly in floristic composition and structure.

Zanzibar-Inhambane lowland rainforest was formerly extensively developed in Tanzania along the lower parts of the eastern highland arc, but only small fragments remain today due to extensive logging. The forest is almost evergreen and trees grow up to 20 m high. It differs from Guineo-Congolian rainforest in the greater degree of bud protection, less well-developed drip-tips on the leaves, and the paucity of climbers.

The best example of transitional rainforest is the East Usambara mountains in northeastern Tanzania. These mountains are not high enough for the occurrence of afromontane rainforest, but harbour many species which are separated from their closest relatives by wide intervals. This suggests that they have served as refuge for a formerly more widespread flora which has disappeared over much of its former area. Transitional rainforest also occurs as small enclaves in the Zambezian Region, such as the Misuku Hills and Nchisi Mountain in Malawi, and Chirinda forest in Zimbabwe.[27]

Zanzibar-Inhambane undifferentiated forest shows progressive floristic impoverishment towards the south. Some species are confined to the wetter types and some to the drier, but many occur throughout. In the moister variants the main canopy occurs at 15-20 m, and from it emergents

rise to a height of 30-35 m. Many of the canopy species are briefly deciduous and woody climbers are plentiful, although epiphytes are scarce. The drier forests cover a larger area than the moister forests and extend further to the north and south. They are more diverse floristically than the wetter forests and many of the larger tree species can be locally dominant or co-dominant.

Tongaland-Pondoland regional mosaic

This region extends along the coast, south of the Zanzibar-Inhambane region from the Limpopo River to Port Elizabeth in South Africa.[28] In the north it is fairly wide, but narrows to the south where mountains come close to the coast. Elsewhere in the south the region penetrates inland along river valleys. It lies below the Afromontane region or the Afromontane/ Tongaland-Pondoland transition zone. Where the vegetation has not been completely destroyed, it consists of a complex mosaic of forest, shrub-forest, and evergreen and semi-evergreen bushland and thicket in a matrix of secondary grassland and wooded grassland.

Tongaland-Pondoland undifferentiated forest formerly extended as a narrow continuous band along the coast. Further inland it was confined to moderate slopes and, in regions of low relief, to soils with a high water table throughout the year. Variation in floristic composition is kaleidoscopic. Canopy height varies from 10-30 m. In the tallest stands the trees are straight with long boles, but in the stunted types they are often crooked and branch low down. The canopy is evergreen to semi-evergreen. Woody climbers are generally much scarcer than in the afromontane forest of the mistbelt.

The region's evergreen and semi-evergreen bushland and thicket occur where rainfall is too low to support forest. In the north this thicket is most extensively developed in low-lying areas between the forests of the coastal plain and those of the inland mountains, but further south it occupies deep valleys.[29]

Photo: P Wade

Riverine vegetation along the Zambezi River.

Photo: APC/D Martin

An escarpment forest in Tanzania, showing the tall and slender Sterculia appendiculata *(baboon puzzle).*

LINKAGES TO OTHER CHAPTERS Box 2.1

1 REGIONAL OVERVIEW
Southern African forests and woodlands are made up mainly of deciduous trees. About half of the region is humid while the rest is semi-arid to arid. The main forest and woodland and forest vegetation types are Guineo-Congolian centre of endemism, the Guineo-Congolia-Zambezia regional transitional zone, the Zambezian regional centre of endemism, the Afromontane archipelago-like centre of endemism, the Zanzibar-Inhambane regional mosaic and the Tongaland-Pondoland regional mosaic.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
The different forest and woodland types of the region are associated with different types of biodiversity. Some species are, however, common to different centres of endemism, while fauna biodiversity is mainly influenced by the existing plant biodiversity.

4 ECOLOGICAL PROCESSES
Forests and woodlands play pivotal roles in regulating ecological cycles such as the water, oxygen, carbon and nitrogen cycles. Forests, for example, are better than cropped land at regulating oxygen (which they release during photosynthesis) and carbon dioxide (which they take up during photosynthesis).

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Forest and woodland areas have undergone great reduction in recent times as more land has been converted to agricultural use. The future structures depend on management practices implemented today to curb the current patterns of conversion. Indigenous forests are being converted to agricultural land and sometimes to plantations that are not rich in biodiversity.

6 FOREST AND WOODLAND PRODUCTS: USES AND VALUES
The resources of woodlands and forests are central to the livelihood systems of millions of rural and urban dwellers. Forest and woodland products are closely associated with the prevailing type of forests, but some products such as firewood are common to all areas of the region irrespective of the associated forest type.

7 ECONOMIC VALUATION AND ACCOUNTING
The economic significance of indigenous forests and woodlands is usually under-reported. Forests and their associated benefits have traditionally been taken for granted, and it is only now that these resources have been drastically reduced that efforts to establish their appropriate value have been established.

8 POLICY ANALYSIS
All the countries of the region maintain a forestry policy to manage, develop and use these resources. The main objective of such policies is to exploit forests and woodlands in a sustainable manner for national posterity and development.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Sustainable management is the main tool left to ensure future existence of natural forests and woodlands in southern Africa.

10 TRENDS AND SCENARIOS
Forest and woodland resources of the region will continue to be depleted, as human needs continue to rise. Future scenarios, however, will depend on policies and practices.

ENDNOTES

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3 BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS

Traditional societies in Africa lived in harmony with nature, deriving all their requirements from the environment without endangering the resources. These societies developed strategies to preserve the living resources for the benefit of present and future generations and they were deeply enshrined in their traditional values.[1]

However, with European contact, colonialism, industrial development, increasing human populations and greater demand for goods and services pressures began to mount on the environment. As the environment came under greater and greater stress, an awareness of imminent danger began to grow and campaigns advocating the conservation of biological diversity to save the earth's resources from the brink of extinction became one of the world's most important concerns.

The need to arrest the loss of biological diversity is especially important in sub-Saharan Africa where people depend on these resources to a far greater extent than many other parts of the world. Since the United Nations Conference on Environment and Development (UNCED) most governments have instituted concerted efforts to conserve biological diversity and sustainable development.

BIOLOGICAL DIVERSITY

CBD defines biodiversity as "the variability among living organisms from all sources, including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and of ecosystems".[2]

This does not mean that biodiversity is the sum of all ecosystems, species and genetic material but rather it is the variability between and among them. Biological diversity can be viewed at three levels:

- genetic diversity represents the heritable variation within and between populations of organisms;
- species diversity is a measure of the total number of species in a given area; and
- ecosystem diversity is often evaluated through measures of the diversity of the component species and relates to the variety of habitats (forests, woodlands, wetlands, etc.) within which species occur.[3]

Much of southern Africa is covered by woodlands with a smaller fraction covered by grasslands and closed forests. The woodlands, which form unique savanna habitats, can be subdivided into two categories based on their average annual rainfall regimes, the wet and dry savannas with annual rainfall ranges of 1,000 mm to 1,200 mm and less than 1,000 mm, respectively. Closed evergreen forests, on the other hand, occur where annual rainfall is much higher than the wet savannas and are mostly found on mountains and moister lowlands on the windward slopes of mountains. These broad divisions can be further subdivided into smaller units, depending on their particular characteristics and species composition.

Biodiversity conservation approaches: species or ecosystem-based? Box 3.1

Much of the early conservation emphasis in Africa focused mainly on large mammals. Evidence can be observed by the distribution of many existing protected areas that reflect this bias. An increasing interest today, however, has been directed towards identifying sites of importance for plants, birds, reptiles, butterflies and other groups. The idea of protecting representative samples of all ecosystems has led to the establishment of a more balanced system of protected areas. This is what is termed as the ecosystem approach to conservation and it has many pragmatic advantages. Ecosystems can be mapped, measured and quantified more easily than species numbers and densities. By conserving ecosystems, thousands of inter-related species are saved.

But ecosystems are made up of individual species and ultimately it is only through monitoring species that the status of ecosystems can be assessed. Species distributions do not fall into neat pockets but instead form a continuum of overlapping forms. Therefore, more refined species-based systems for classifying and monitoring ecosystems and more detailed measures of species' occurrences and abundance are essential. Only by taking conservation at species level can the azonal and non-habitat related threats of hunting, poaching, levels of utilisation, competition with domestic animals, indirect impacts from other human-related developments, pollution and other factors affecting the status of wildlife species in the region be addressed. Depending on the circumstances, both the species-based and ecosystem-based approaches can be adopted.

SOURCE: UNEP/IUCN, *Review of the Protected Areas System in the Afrotropical Realm*. John and Kathy MacKinnon Consultants, IUCN Publication Series, 1986

Southern African ecosystems can be divided into six regional centres of endemism:

- Zambezian;
- Karoo-Namib;
- Cape floristic;
- Afromontane;
- Indian Ocean Coastal belt and;
- Kalahari-Highveld transitional zone

These broad divisions contain a wide variety of animal and plant life and, within them several "hot spots" can be identified where there is high species richness or high levels of endemism, hence high biodiversity.

The Zambezian regional centre is the largest in extent and contains the highest number of plant species, about 8,500, but the endemism level is relatively low. The afromontane region has the highest level of plant species endemism at 75 percent. Fauna richness and diversity is also high in the region, with Tanzania having the largest number of higher vertebrates and high levels of endemism. Eight "hot-spots" have also been identified in the region and the conservation status of some of them needs to be improved if the unique endemic species are to be saved.

GENETIC DIVERSITY

In the past, little attention has been given to the genetic diversity of indigenous plants and animals. Focus has usually been on the genetic diversity of crop plants and domesticated animals to improve desired characteristics such as disease and drought

resistance. However, with improved methods in genetics, such as protein electrophoresis, it is now possible to quantify the amount of variation between individuals and obtain a picture of the geographic structure of the species in genetic terms. The inherent genetic diversity in most species provides the raw material to respond rapidly to changed circumstances.

Of all the centres of endemism occurring in the region, moist tropical forests are by far the richest biological units in terms of genetic diversity. Unfortunately these are the very units that are most threatened through human activities. Much of the current work on the genetic diversity in the region is being done on woodland species.

The establishment of the SADC Regional Gene Bank, based in Zambia and the subsequent formation of national plant genetic resources' committees in the various countries in the region has resulted in great strides in the study of genetic plant diversity. The objective of this gene bank is to preserve the indigenous plant genetic resource material of the region.[4]

In Zimbabwe, the Forestry Commission and the gene bank housed at the department of research and specialist services are actively involved in studies of genetic plant diversity. This involves the adoption of conservation approaches to arrest genetic erosion. To date, 11 strict nature reserves have been established by the division, with Teak (*Baikiaea plurijuga*), Kiaat (*Pterocarpus angolensis*), Mopane (*Colophospermum mopane*), and Large false-mopane (*Guibourtia coleosperma*) as the target species.[5] On Wild-loquat (*Uapaca kirkiana*), there is a SADC project to collect seed from different provinces and experiment to determine the genetic diversity. Studies done so far indicate variations among the provenances from Mozambique, Zimbabwe, Malawi, Zambia and

Photo: P Wade

Mahobohobo or Wild-loquat (Uapaca kirkiana) *around Domboshava area in Zimbabwe.*

Tanzania. Substantial work has also been done on provenances of Apple-ring thorn *(Faidherbia albida)*[6] and African acacias such as Camel-thorn *(A. erioloba)*, Sweet-thorn *(A. karroo)*, Scented-thorn *(A. nilotica)*, Three-hook thorn *(A. senegal)* and Umbrella-thorn *(A. tortilis)* to establish their genetic diversity.[7] For Apple-ring thorn *(Faidherbia albida)*, it was established that there was great variation in the provinces, those from southeast Africa showing high growth rates and those from the northwest showing qualities of adaptive significance.[8] The variations were strongly related to the temperature of the area of seed origin and the type of ecosystem in which the species naturally occurs.

Results of experiments on the genetic diversity of a number of indigenous vegetables and crop relatives are also indicating great variation in populations. Scientists have reported a wide range of variability in 30 different indigenous vegetable species.[9]

Paperbark Acacia in flower and a close-up of the flowers.

Photos: M Coates Palgrave

Nyanga flat top Acacia or the Umbrella tree.

Photos: M Coates Palgrave

Scented-pod Acacia showing pods and a close-up of the flowers.

Biodiversity conservation: good politics but poor science? Box 3.2

Biodiversity has become a "buzzword" which trips easily off the lips of many politicians but one wonders how many really know what it means. Even many scientists find it difficult to define it in a way that would make sense to a layperson. Perhaps biodiversity is not such a good scientific concept. To understand it in scientific terms, it is better to consider the underlying terms of species diversity, genetic diversity and ecosystem diversity, each of which is quite clear. One can argue that no species should be lost due to human action, and there are laws based on that principle. We can also ensure that the valuable inherited characteristics of every species of economic value are conserved, which is the fundamental principle guiding the genetic resources movement. One can also insist that adequate representative samples of all the different ecosystems be protected which has been the mainspring of the national parks movement for years.

Biodiversity may be a weak scientific concept but it is an immensely powerful political one, strengthened by its political incarnation in the CBD. This convention advocates the conservation of the diversity of life, ensuring that where nature and natural resources are used, they are used sustainably, and ensuring that the uses of biodiversity are equitable. The provisions of the CBD do reflect particularly well the difficult balance between conservation and development that every developing country has to tread. Testimony to this is the holistic interpretation of the convention by many countries, gradually shifting emphasis to social and economic rather than the scientific aspects.

The bottom line is that the CBD formalised a new international regime designed to conserve biodiversity, ensure its sustainable use and equitable sharing of the benefits from its use. By linking objectives of conservation, benefit-sharing and technology transfer, the convention also established a framework to strengthen economic incentives for conservation by seeking complementarities between commercial, conservation and development goals (Reid et al., 1995).

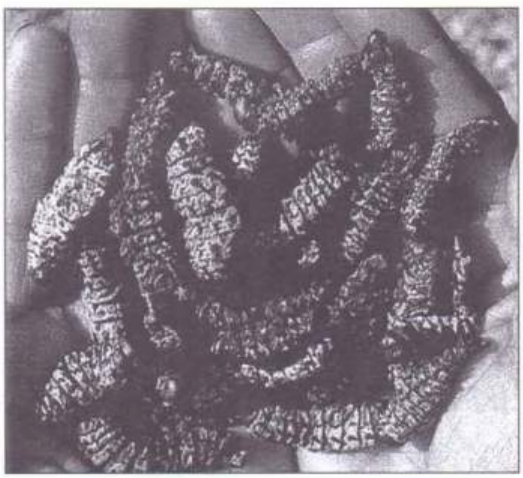
SOURCE: Botanical Information Company, Plant Talk: Editorial, What Really is Biodiversity? *Plant Talk* Issue No.4, January 1996, p2

FUNDAMENTAL REASONS TO CONSERVE BIOLOGICAL DIVERSITY

Forest and woodland resources play various ecological, cultural, environmental and socio-economical functions. Their conservation will be of much benefit to these functions and can be rated as either "goods" or "services" offered by the environment. These functions can either be direct or indirect.[10]

Some of the important roles played by tree ecosystems are vital to the functioning of the earth's life-support systems. The fundamental reasons why biodiversity should be conserved with respect to the various scenarios in which forests and woodlands are valued are:[11]

- climate regulation — large blocks of forests and woodlands have great influence on the climate. They act as buffers and regulate the climate over a large part of the land surface;
- gas regulation — ecosystems also play a crucial role as "sinks" for carbon dioxide and the production of oxygen. Tropical forests contain up to 100 times more carbon in their vegetation and soils than croplands and pastures; [12]
- watershed protection — forests and woodlands help stabilise the land by reducing soil erosion. This allows for more water to be captured and kept within the system, which would otherwise be lost where there are no forests. Areas protected by forests also act as a source of water for local communities;
- refugia — forests and woodlands form important habitats for a wide variety of both resident and transient populations of animals that can be used for the benefit of humans in various ways for economic or subsistence benefits;
- economic benefits — woodlands, forests and animals can be used commercially (food production, raw materials, genetic resources) to improve the livelihoods of humans in different ways.[13] Game animals can be killed and sold or consumed. Woodlands and forests provide timber, fruits, and other products. Many insects and mushrooms are obtained from the woodlands and forests and benefit communities by supplementing their food requirements;
- recreation — tourism earns many southern African countries millions of dollars annually. Many people from different areas across the globe visit national parks, safari areas and botanic reserves to see interesting plants and animals;
- culture — ecosystems provide opportunities for non-commercial uses, mainly to do with culture. Traditional rain-making and other ceremonies also take place under specific tree species and habitats;



Photos: M Mulenga

Many insects and mushrooms benefit communities by supplementing their food requirements.

- erosion control — protection of soil against erosion, runoff and compaction is considered one of the principle roles of trees. Both canopy and litter can protect the surface from the impact of erosive rains and dampen extreme moisture and temperature fluctuations. Trees can also protect soil against wind erosion by retarding the movement of soil particles;[14]
- nutrient cycling — ecosystems are important in the storage, internal cycling, processing and acquisition of nutrients. Tree-based natural systems are characterised by efficient nutrient cycling and more efficient utilisation of nutrients already in the soil or those added from outside. Most nutrients are stored in the biomass or topsoil and a constant cycle of nutrient transfer operates through physical and biological processes of rainwash, root decomposition and plant uptake. The mechanism by which tree-based systems can maintain efficient nutrient cycling is believed to be through the capture of nutrients in soil solution by tree roots that would otherwise be lost by leaching. Tree roots exploit greater depth and volume of soil, followed by translocation of these nutrients through the plant system and the return, via litter, to the soil surface where they become available to coincident or subsequent surface rooting plants;[15] and
- waste treatment — ecosystems help in the recovery of mobile nutrients and removal or breakdown of excess nutrients and compounds.

CAUSES OF BIOLOGICAL DIVERSITY LOSS

The loss of biodiversity is caused by a number of factors, acting either individually or interactively:

- loss of habitat — one of the most serious threats to biodiversity is the loss of habitats, mostly due to land-clearing for agricultural purposes necessitated by population pressure. Habitat loss has also been associated with habitat fragmentation particularly to do with pastoral development, cultivation, forestry operations (including deforestation), settlement, plantation development, fire and pollution. Animals

Photo: APG/D Martin

One of the most serious threats to biodiversity is the loss of habitats, mostly due to land-clearing for agricultural purposes necessitated by population pressure.

like the African Elephant also contribute to woodland destruction due to their ever-increasing numbers in some of the range states in the region, worsened by the compression of their habitat.[16] The Riverine Rabbit, Lechwe, Cape Mountain Zebra, Geometric Tortoise, some birds and plants are examples of species presently threatened by habitat loss;

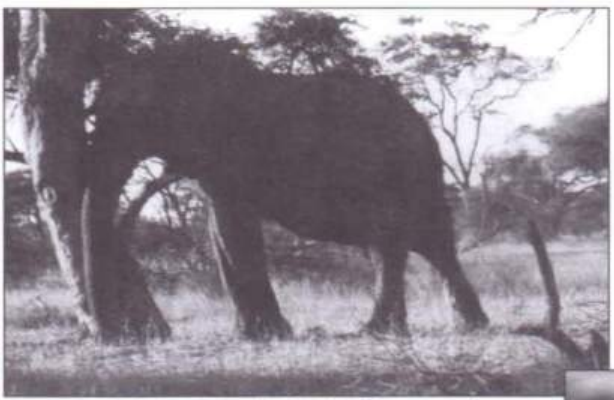


Photo: APG/D Martin

Animals such as the African Elephant contribute to woodland destruction due to ever-increasing numbers in some of the range states, worsened by the compression of their habitat.

- over-exploitation — when natural forests are being logged for timber, there is a tendency to over-exploit. In some cases the logged species will be reduced to populations below the viable level leading to loss of biodiversity. Poaching and overhunting have also led to low populations of animals like the Black Rhino, Giant Sable, Black-faced Impala, Lechwe and the Cape Mountain Zebra. A number of reptile species have also been affected by over-exploitation of eggs and adults for meat;
- introduction of alien species — the introduction of alien plants, especially invasive plants, whether deliberately or by accident, has also led to the loss of biodiversity. Most of the introduced species invade natural ecosystems and out-compete the native vegetation. For example, the invasion of parts of the fynbos vegetation in South Africa[17] and eastern highlands grasslands in Zimbabwe by exotic species such as Australian *Acacia* and Pine *(Pinus)* species threaten the survival of *Restio*, Heather *(Erica)* and *Protea* species. Over time the native species are lost. Introduced animals may also prey on or hybridise with the native species leading to some loss; and
- disturbance and persecution — disturbance, persecution and uprooting of species, including deliberate eradication leads to loss of biodiversity. Humans normally eradicate species causing pest problems where farmers have eliminated Wild Dog, Cheetah, Leopard and Hyena. The Cape Vulture has also fallen victim.[18] Disturbance in the form of habitat change and contamination by toxic chemicals also threaten some animal species.

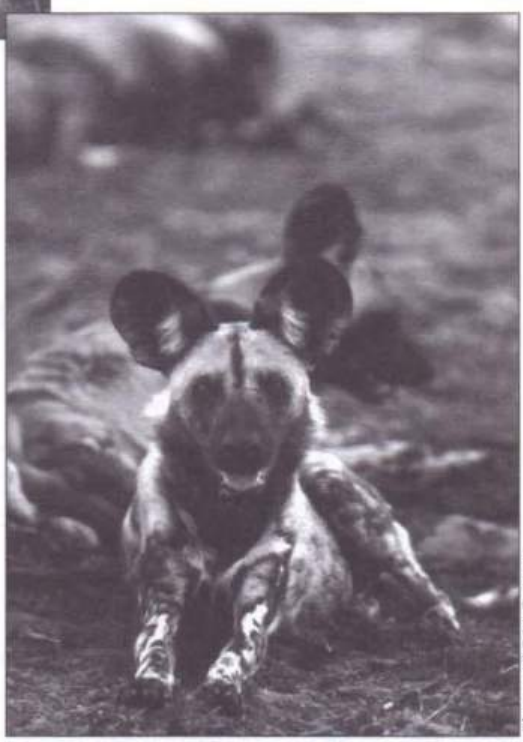


Photo: APG/N Greaves

Humans can eradicate species, causing pest problems where farmers have eliminated Wild Dog (above) Cheetah, Leopard and Hyena.

Forest and woodland resources play important functions in the livelihood of humankind. These resources serve various economic, ecological, social and cultural functions, making the conservation of biological diversity important. Greater realisation of the need to conserve biological diversity reached a high note with the signing and ratification of the CBD by many countries, including member states of SADC.

TRENDS IN BIOLOGICAL DIVERSITY

The loss of biological diversity is part of a worldwide trend which has accelerated in recent decades as awareness has grown about the potentially disastrous consequences of its loss, particularly on the earth's ecological functions and the fulfilment of basic human needs. Due to the important functions served by ecosystems, any environmental degradation that leads to their destruction must be viewed as a serious threat to the future.

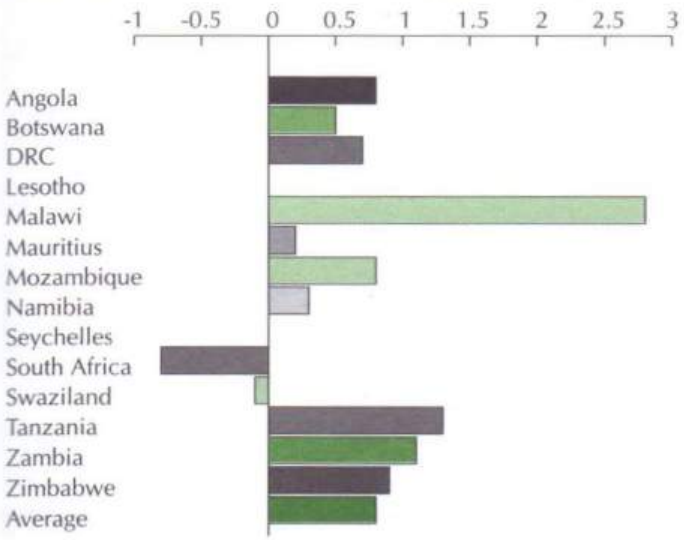
Forests and woodlands are being lost annually at rates that are not properly quantified for each country or region. About 0.8 percent of the earth's tropical forests are lost each year.[19] Deforestation also has serious economic, social and ecological implications related to the respective functions of the forests. It is difficult to quantify, but they include the loss of biological diversity, which takes many forms and, at its most fundamental and irreversible stage, involves the extinction of species.

A number of species have become either locally or totally extinct in the region in the last few centuries. Examples are four antelope species in Lesotho and Swaziland, Blue Wildebeest in Malawi, Tssessebe in Mozambique, the endemic Bluebuck from the southwestern Cape in South Africa and the Kob in Tanzania.[20] It has been estimated that at least 27,000 species become extinct every year as habitats are destroyed in tropical forests:[21]

- large-scale extinction of plants, birds and reptiles in Mauritius;
- many more species in the region are threatened at a faster rate than first believed; and
- climate change has also led to some extinction.[22]

One problem being faced by the region is that there is a serious lack of natural resource inventories and other baseline data that are of fundamental importance for monitoring biodiversity trends.

Deforestation trends in the SADC region (%) Figure 3.1



The people of southern Africa have historically lived and depended on the biodiversity of their forests and woodlands. The region exhibits varied biodiversity patterns, and societies have shaped their lives around these patterns. While biodiversity continues to be eroded in various ways, the region has finally faced the call to conserve it, and has started to institute policies and activities targeted at sustainable use of resources. However, much remains to be done.

LINKAGES TO OTHER CHAPTERS Box 3.3

1 A REGIONAL OVERVIEW
The people of southern Africa have historically lived and depended on the biodiversity of their forests and woodlands. The region exhibits varied biodiversity patterns, and societies have shaped their lives around these patterns.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
The different regional forest and woodland types of the region are associated with different types of biodiversity. Some species are, however, common to different centres of endemism, while fauna biodiversity is mainly influenced by the existing plant biodiversity.

4 ECOLOGICAL PROCESSES
The three aspects of biodiversity – genetic, ecosystem and biological – contribute to ecological processes. Cycles such as the water, carbon, nitrogen and other nutrients depend on plant and animal activities at some stages.

5 STATUS OF FORESTS AND WOODLANDS AND PATTERNS OF CONVERSION
Although loss of biodiversity is of global concern, it is most severely felt in Africa, because of the direct dependence of the inhabitants on biological resources for food, fuel and construction materials. Patterns of conversion of forests and woodlands have a direct bearing on the associated biodiversity. Land clearing for agriculture usually involves clearing existing species and introducing a monoculture exotic species.

6 FOREST AND WOODLAND PRODUCTS: USES AND VALUES
Biodiversity products from indigenous forests and woodlands can be classified as wood and non-wood products. Wood products include fuelwood, timber and construction material, while non-wood products include forest extracts such as honey, medicines, mushrooms, wild game and services such as spiritual shrines and tourism.

7 ECONOMIC VALUATION AND ACCOUNTING
Some aspects of biodiversity are difficult to quantify economically. One of the reasons for the gradual decline in the region's natural forests and woodlands quality can be attributed to the fact that the value of its resources is not always reflected fully in economic transactions. For example, it would be difficult to quantify the economic value of woodfuel collected (at random) by rural families, or the cost of using alternative sources.

8 POLICY ANALYSIS
Some policy instruments aimed at safeguarding the biodiversity of forests and woodlands include direct policies such as forestry, land tenure and the introduction of reserves and protected areas. Indirect policies include sustainable agricultural, encouragement of trade and introduction of alternative means of production such as new fuels, and the establishment of regional and national gene banks.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Sustainable management of forests and woodlands in southern Africa is the sole hope for future quality and quantity of biodiversity resources.

10 TRENDS AND SCENARIOS
The factors affecting the trends in biodiversity include economic growth, trade, increase in population, governance and legislation, and awareness. The future, based on current trends, looks bleak, but efforts are being made from all sectors to reach a sustainable path.

ENDNOTES

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4 ECOLOGICAL PROCESSES

Forests and woodlands are home to many highly localised endemic populations of animals, vertebrates and invertebrates as well as a variety of plants.

These plants have an important function over climate, and are central to regulating wind, temperature, humidity and rainfall. Green plants remove carbon dioxide from the atmosphere through photosynthesis. The carbon is stored in the foliage, stems, root system and, most importantly, the woody tissue in the main trunks of trees. Because of their long lifespan of and relatively large sizes, trees are the storehouses of carbon. Overall, forests store 20 to 100 times more carbon than croplands and play a critical role in the regulation of atmospheric carbon concentrations.[1]

When trees die or are harvested, the stored carbon is released. Some of it becomes part of the organic matter of forest soils. The remainder is released into the atmosphere, largely as carbon dioxide, but also as methane and other greenhouse gasses (GHG). The rate of release may be slow due to the rate of decay caused by fungi, bacteria, insects and other organisms. Sudden disturbances such as wildfires and clearing and burning of forests for agriculture and human settlement can cause rapid release of large volumes of GHG.[2] Within this process, they release oxygen into the atmosphere and assist in the global recycling of water, oxygen, carbon dioxide and nitrogen.

Forested areas are also important in helping to preserve water catchment.[3] Their capacity to act as sponge areas assists in enabling rainwater to efficiently infiltrate and percolate into the soil and slowly release it through rivers, streams and springs. Some is also retained as groundwater in aquifers.

Forest and woodland canopies, ground litter and the influence of forests to regulate winds, plays an important role in controlling soil erosion. This process further helps to control the amount of sediment washed into rivers and reservoirs, as well as reducing the severity of flooding.

Growing pressure on land resources in many parts of southern Africa has extended crop farming into areas which, because of limited rainfall and defined climate, topography or soil quality, are inappropriate for agriculture. Ploughing pasturelands and farming hillsides are two examples of pressures, which lead to erosion.[4] Among the major problems associated with the extension of farming into marginal areas are the depletion of soil fertility plant cover, wind and water erosion and deforestation. This results in changes in the hydrological cycle by increasing runoff, reducing the ability of the soil to absorb and retain water and increasing evaporation from bare lands.

The destruction of natural forests and woodlands, replacing them with exotic plantations which have a higher water demand than indigenous vegetation,

Photo: M Chenje

The rapidly increasing population contributes to soil erosion and loss of limited biodiversity resources within certain ecological zones.

disturbs the ecological balance between rainfall utilisation and conservation.[5] Burning fossil fuels and converting forestlands into farming areas cause significant increases in the levels of carbon dioxide and other GHGs in the atmosphere.

If the destruction of natural forests and woodlands occurs on a large scale, moisture levels are drastically curtailed, further reducing the amount of evaporation into the atmosphere and the amount of rainfall. For example, in South Africa, while the need for timber, pulp and paper is increasing, it is now accepted that clearing indigenous forests has been detrimental to local water resources.[6] Replacing forests and woodlands by shrubland and grassland drastically influences the reduction of water resources.

In the tropical regions of the world, deforestation rates have been 10 to 20 times greater than reafforestation in recent years. Average annual deforestation is greatest in Latin America, but it is also high in Africa's open forests. In Central America, the area of forests and woodlands declined 38 percent, from 115 to 71 million ha between 1950 and 1983.[7]

In the commercially unproductive closed forests of Africa and Asia, deforestation rates were relatively low. In the early 1980s, annual losses were less than 0.6 percent of all remaining forests in all tropical regions, although the exact amounts and rates varied by more than a hundred-fold among countries.[8] Deforestation rates in the southern African region annually average 0.8 percent. (see chapter 3).

The most dominant feature in the southern African vegetation is grasses and scattered trees. Most of the land is covered with forests and Savannah woodlands interspaced with grasslands. Angola, has

the largest percentage of forests and woodlands in southern Africa, taking up about 25 percent of its total geographical area of 1,246,700 sq km.[9]

Tropical forests cover some 53 percent of the total global forest area.[10] The major concern in the tropics is the accelerating rate of deforestation and forest degradation. The destruction of the southern African forest resources is one of the major challenges facing the region. Their value is incalculable since they contain 60 percent of the region's biomass.

FORESTS AND THE GREENHOUSE EFFECT

The earth receives its energy from the sun as solar radiation. Short-wave solar radiation passes through the atmosphere with little or no interference and warms the earth's surface. Long-wave thermal radiation emitted by the warmed surface of the earth is partially absorbed by a number of trace or GHGs,[11] known as the greenhouse effect. The continued increase of heat-trapping gases in the atmosphere, especially carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (CFCs) results in the retention of heat in the lower atmosphere.[12]

The impact of industrial gases is also a concern for ecological processes. Industry in the region is one of the many culprits responsible for environmental degradation particularly as it affects atmospheric conditions. South Africa produces the worst air pollution in the region, particularly in the eastern Transvaal due to the high concentration of industries, which emit GHGs. Although the severity of acid rain has not been adequately researched, there is the likelihood that several ecosystems are vulnerable.

Similarly, pesticides and herbicides used in the agriculture industry have a bearing on ecological processes and conditions. A well-known example was spraying DDT near streams and rivers in Zimbabwe in the 1970s, aimed at controlling the breeding and spread of Tsetse Fly. The result was a serious reproductive condition among birds when their eggshells were found to be so thin that they broke before hatching took place. The effects of other chemicals such as fertilisers include eutrophication of water bodies.

Photo: APG/D Martin

Industry in the region is one of the many culprits responsible for environmental degradation particularly as it affects atmospheric conditions.

THE CARBON CYCLE

The carbon cycle is the movement of carbon, in its various forms, over the earth's surface, interior and atmosphere. The major pathways of carbon transfer are photosynthesis, respiration and oxidation. The carbon cycle consists of four interconnected reservoirs or pools:

National forest and woodland changes in southern Africa 1981-83 and 1991-93 and carbon dioxide emissions in 1991 from land use change Table 4.1

COUNTRY	Forest and woodlands (ha x 10^3) 1991-1993	% Change since 1981-83	Carbon Dioxide Emissions (tonnes x 10^3) in 1991 from Land Use Change
Angola	51,917	-3.1	16,000
Botswana	26,500	0.0	3,200
Lesotho	80	-4.8	NA
Malawi	3,700	-1.1	11,000
Mauritius	44	-24.1	9
Mozambique	14,053	-7.7	15,000
Namibia	18,030	-1.8	1,800
South Africa	8,200	0.0	14,000
Swaziland	118	15.7	370
Tanzania	33,500	-14.4	22,000
Zambia	28,727	-2.3	34,000
Zimbabwe	8,800	-7.4	5,300

SOURCE: WRI/UNEP/WB, *World Resources: A Guide to the Global Environment 1996-97*, Oxford University Press, Oxford, 1996.

- atmosphere;
- terrestrial biosphere;
- oceans; and
- sediments.

These reservoirs either absorb carbon from another source or release it to another reservoir. For example, green plants are carbon "sinks" because they absorb carbon from the atmosphere while an industrial plant, which releases carbon into the atmosphere is a carbon source.[15]

In recent years, increased human needs caused by the rising population in southern Africa, have necessitated extensive land-clearing for agriculture and fuelwood. In Zimbabwe, woodland cover is being denuded at an average rate of 1.5 percent per annum with highest rates experienced in communal areas. This loss of forest releases some of the carbon sequestered in trees and other forest organic matter especially when they are burned. The resulting build up of carbon dioxide in the atmosphere triggers the greenhouse effect, contributing to climate change.

Linkages between forest cover and precipitation

Higher temperatures increase the amount of evaporation from the surface and this increases the levels of moisture in the atmosphere. Evaporation will normally occur from plants, land, lakes, rivers, streams and other sources holding water. More energy absorbed by trees and the land surface results in increased evapotranspiration, which later condenses to form clouds and, under certain conditions, precipitation may occur.

However, climate models suggest that the effect will be uneven. Plants may have reduced rates of transpiration in an atmosphere with elevated levels of carbon dioxide, or under conditions of increased humidity. Where global atmospheric

Photo: IMERCSA

Evaporation occurs from plants, land, lakes, rivers, streams and other sources holding water.

concentrations of carbon are high, there could be a world reduction in cloud formation and less precipitation.[14] Rising temperatures due to global warming are likely to increase evapotranspiration and, in the absence of any changes in rainfall, potential water availability would be reduced. This warming and the associated changes in relative humidity, wind speed and radiation would also lead to increases in potential evapotranspiration of between five to 20 percent across the southern African region. How important these increases would be for the region also depends on the changes in rainfall patterns.[15]

Forests and woodlands also play an essential role in maintaining other natural systems and processes including nutrient cycling, watershed management through reduction of soil loss and erosion, soil moisture retention, and air quality control.

Nutrient cycling

Litter (leaves, twigs, branches, bark and roots) is an essential link in organic production-decomposition cycles. Litter represents the major pathway of nutrient movement, and is an easily observable component of nutrient cycling.

Some of the nutrient content in falling and standing litter, as well as that in the upper 100 mm of the soil is lost through leaching and the feeding roots. Maintenance of the forest cover would maintain the nutrient cycle and biomass productivity in the system. On the other hand, loss of vegetation cover leads to continuous loss of nutrients through non-production of litter and leaching.

Carbon sequestration

Woodlands, as the major biome in southern Africa, have a substantial potential for storing a large part of the carbon dioxide emitted annually. Therefore, if managed properly, they could positively affect the balance between carbon assimilation and respiration. Savannah soils are typically low in carbon mainly due to being sandy and dominated by low-activity clays,

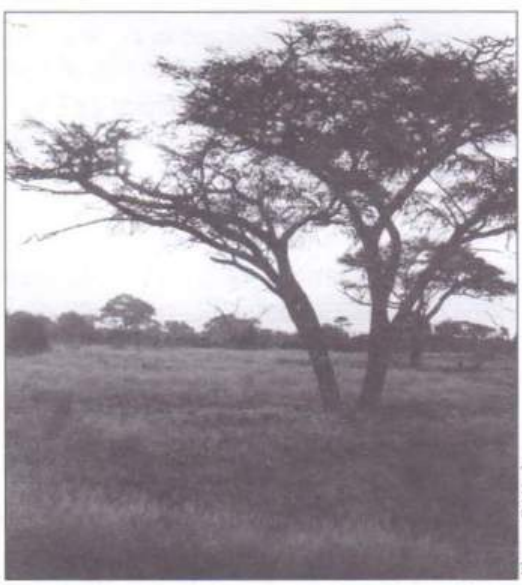


Photo: P Wade

Savannah soils are low in carbon due to being sandy and dominated by low-activity clays, resulting in a low potential for stabilising carbon.

resulting in a low potential for stabilising carbon. Soil temperatures are high, which promotes respiration. A significant fraction of the assimilated carbon is also lost to fire.

Despite the constraints posed by aridity, Fine-leafed Savannas can achieve similar carbon storage rates as they are found in areas with high-activity clays. However, they are currently subject to greater human pressures. Sustainable timber harvesting practices in the broad-leafed savannas, with conversion of wood-stored carbon to articles such as hardwood furniture contribute to maximising carbon storage.

Watershed management

Forests play a protective role to watersheds by ensuring a sustained flow of water from catchments throughout the year and preventing soil erosion and drift-sand formation in coastal and inland areas. Springs and rivers originate from mountainous areas covered by forest vegetation. The presence of vegetation enables the falling precipitation to be absorbed, infiltrated and stored in the soil. The water is subsequently released slowly. Loss of vegetation cover, on the other hand, exposes the soil to raindrop impact and excessive runoff, causing erosion and flooding and, consequently, loss of land and water resources.

By preventing floods and soil erosion and the associated destructive sediment transport by floodwaters, forests in watersheds also give valuable protection to water resource investments in irrigation, hydropower and urban water supply.

Linkages between deforestation and dryland climates

Forests and woodlands show a remarkable degree of resilience to climate variability and anthropogenic interference or environmental disturbance. In large areas in Angola, Malawi, Mozambique and Zambia, forest and woodland biomass, together with complex ecosystems, are a function of rainfall, temperature, evapotranspiration, sunshine hours and solar radiation.[16]

Dry savannas are primarily limited in water. Water supply of grasses growing in semi-arid regions is evidenced by their regime where the beginning and the end are both abrupt. Water limitation to vegetation and the soil is apparent at the end of the season. During the rest of the wet period, the growth rate of vegetation is mainly influenced by the nutrient content of the soil and the growth rate of the species on that soil. In dry savannas, there is alternating water supply and nutrient limitation. This condition can be considered as water supply controlling the duration of the grass production.

It has also been predicted that there could be a range of temperature increases of between 1.5°C to 4.5°C with a doubling of carbon dioxide equivalence from levels recorded during the middle of the 20th century. This is expected to occur at an average rate of 0.3°C per decade during this century and could result in a temperature increase of 1°C above the present levels by the year 2025 and of 2°C before the end of this century.[17]

Increased warming of the earth's surface could lead to increased evaporation and greater average precipitation in some areas, while other regions could experience reduced rainfall. High latitude regions are expected to have an increased movement of warm moist air masses towards the earth's Poles, leading to increased annual precipitation and the resulting runoff. Tropical storms such as typhoons and hurricanes on the other hand, develop when the ocean surface temperatures are in excess of 26°C. Higher ocean surface temperatures could result in an increase in tropical storms and potentially great damage to forest resources.

If the current increase in GHG emissions continue as predicted, ocean levels could rise by 60 cm by the year 2100, resulting in severe impacts on small island nations, countries with large areas of low-lying coastal plains where large population concentrations exist including southern Africa's 10,041 km coastline.

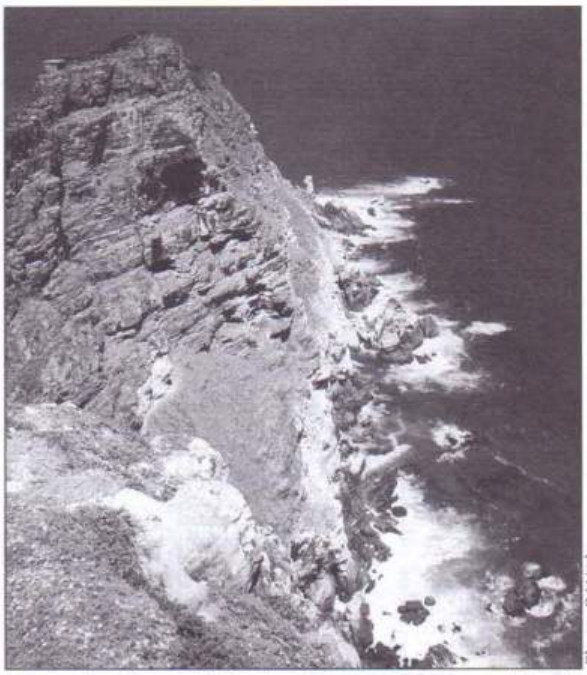


Photo: P Wade

Ocean levels could rise by 60 cm by 2100, resulting in severe impacts on small island nations and countries with large areas of low-lying coastal plains where large population concentrations exist along southern Africa's 10,041 km coastline.

Recent studies have dealt extensively with dryland plant ecology and ecosystems at regional and global levels.[18] The advent of Geographical Information System (GIS) technology has ushered in a period of improved appreciation of seasonal changes in dryland plant cover as a response to rainfall amounts and distribution, as well as biomass burning. Forest and woodland distribution is influenced by:

- edaphic (salt content, fertility, drainage and moisture retention);
- hydrological (perennial or ephemeral water resources);
- topographic, anthropogenic (fire, land clearing, grazing and trampling by animals); and
- climatic (rainfall, wind and temperature) factors.

Dry forests occur in arid and semi-arid regions of southern Africa. A dry forest is characterised by its seasonality and by the existence of two vegetation layers where there is a layer of trees and an underlying layer of grasses.[19] Dry-forested regions are often found to be in critical water balance. Forests and woodlands also play the function of habitating micro-organisms in the soil where there is adequate and suitable soil moisture. These organisms play a crucial role in soil formation and enrichment through production of humus.

As a home to micro-organisms, under suitable conditions, forests and woodlands provide ideal conditions for the growth of fungi on which some animals feed. Larger animals feed on the smaller ones, which depend on fungi, and they too, are prey to others, thereby maintaining the food chain.

Savannah vegetation in the SADC region grows in areas with annual rainfall of between 400 mm and 1,400 mm per year. Limiting factors for the growth rate of forests and woodlands are mainly nutrients and soil moisture. The soils of the savannah forests and woodlands have, in general, low nutrient status. Two major determinants of forests are herbivorous animals (plant-eaters) and fire.

When a forest is disturbed, the area is invaded by a community of alien pioneering plants, initiating a succession of changes. Succession after fire, is influenced by the fact that only rarely are trees killed by

fire. When ground-matter is destroyed or severely reduced, root suckering leads to rapid re-development. There are six main phases in the process of succession:[20]

- nudation, which is the production of an open area;
- migration of available species to the new habitat;
- emesis, which is the adjustment of the plant to its new environment, involves the processes of germination, growth and reproduction;
- competition (both intra- and inter-specific) between the organisms present in the habitat;
- reaction phase of the plants and animals on this new habitat takes place. (competition and reaction do not necessarily follow each other but may occur simultaneously); and
- stabilisation of the community reaches a climax at which it is held to be in equilibrium with its environment. The climax stage relates to the most complete adaptation of vegetation to the conditions of the existing environment.

Forest systems are only sustainable when exploitation of their resources does not upset the ecological balance. If the system results in loss of soil through wind or water, siltation of drainage channels and reservoirs may occur and the system cannot be said to be sustainable. Where harvesting removes more nutrients from the soil than are added, the ecological balance is in disequilibrium which could affect the performance of natural tree-growth to climax. When forests, or the process of their exploitation, leads to a net loss of organic material or breakdown of soil structure, the system of management has to be reversed.

In Tanzania and Zimbabwe, the regeneration process of forests and woodlands has been achieved through fencing. This approach is more beneficial than tree planting because indigenous trees are naturally adapted to local conditions, pests and diseases as well as weather conditions. Recent studies have shown that earlier research on the use of natural forests and woodlands underestimated the development of techniques to improve indigenous woodland production.

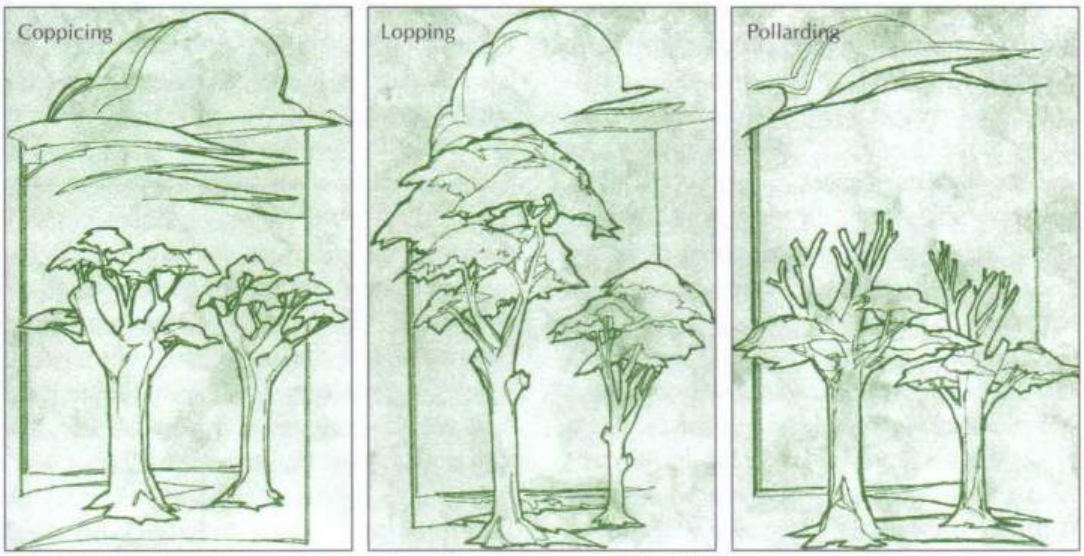
Some of these techniques include (Figure 4.1) coppicing (cutting trees off near their base to allow shoots to grow which are then harvested) and pollarding (where cutting is done at head height which prevent the new shoots being eaten by animals). Village practices encouraging forest and woodland regeneration included extension and fences in commercial areas of Zimbabwe. Tradition in Zimbabwe and other countries forbids cutting trees which provide local people with wild fruit, fodder and encourage soil fertility or provide shelter and shade.[21]

The solutions need to be seen from a broader point of view. It is clear that one of the main underlying factors is population growth and density which

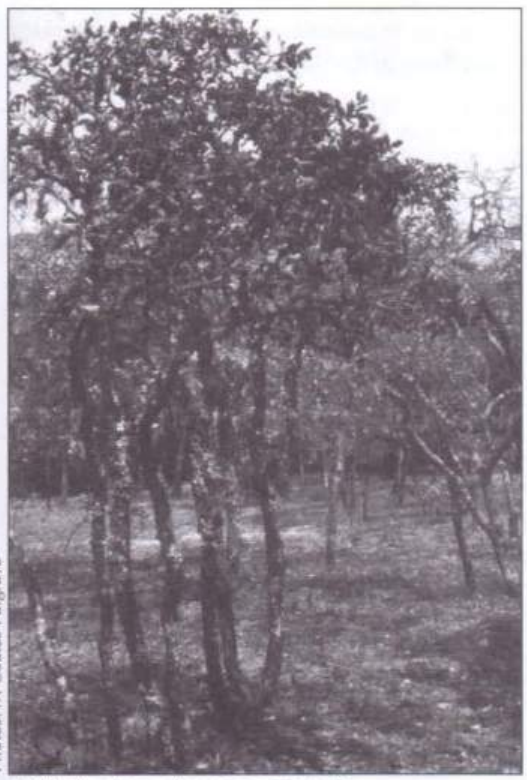
Photo: M Coates Palgrave

Burkea showing a young coppice shoot.

Coppicing, Lopping and Pollarding Figure 4.1



SOURCE: A D K Nyoroh, The KAWI popular science series, *Renewable Energy – Conservation*, UNESCO/APNET 1999



Photos: M Coates Palgrave

Mobola-plum showing regrowth.

Tradition in Zimbabwe and other countries forbids cutting trees which provide local people with wild fruit, like the Mahobohobo above.

results in ever-increasing demands for new agricultural lands and forestry to compete with agriculture.

The other role played by forests is their ability to stabilise climate by absorbing solar radiation. Forests

have a relatively low surface albedo, (a measurement of the ability of a surface to reflect light). Clearing forests increases the surface albedo of the earth, causing it to radiate more heat back to the atmosphere. An increase in albedo has been known to contribute to the expansion of deserts. There could be linkages between changes in vegetation and its reflectivity and rainfall.[22] In southern and western Zimbabwe, rainfall amounts have been decreasing since the 1980s, culminating in the severe droughts of the 1980-83 and 1991-92 seasons.

It is also believed, that due to deforestation, desert conditions are encroaching on western and southern Zimbabwe. However, despite the development of models to simulate climate change scenarios under deforestation, the relationship of albedo and evapotranspiration to climate change is still poorly understood. It is not easy to predict climate change caused by forest clearing.

Hydrological cycle

Water, in its various forms, is continuously transferred from the oceans to the atmosphere and back to earth again. Part of this water is also transferred from land surfaces to the atmosphere and returns through precipitation ending up as runoff or storage. This transfer, primarily driven by solar energy, is the hydrological cycle. (Figure 4.2)

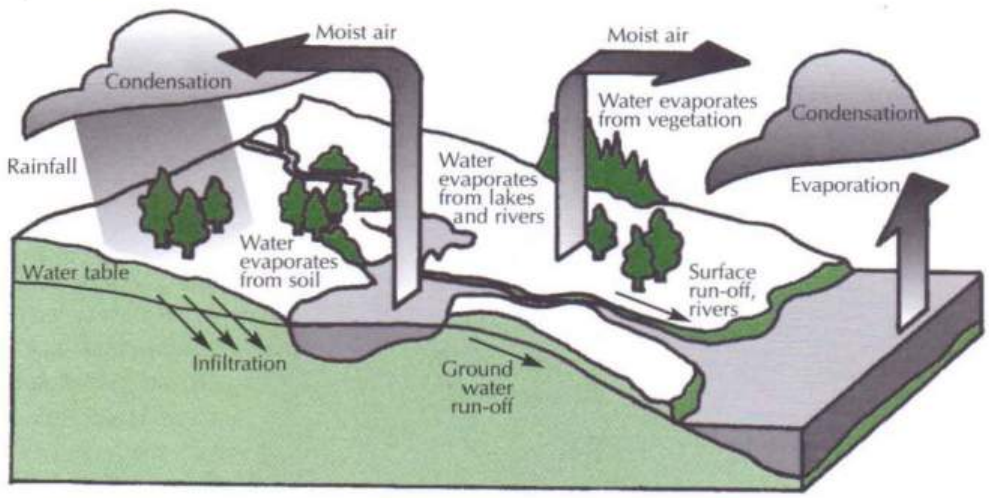
Southern Africa is generally classified as a dry subregion, characterised by seasonal rainfall with a decisive effect on forests and woodlands.[23] Soil moisture storage, as expressed in the hydrological cycle, exerts influence on vegetation while various factors combine to affect soil degradation. Vegetation cover conserves the soil where roots bind and aerate it, protecting the soil from the ferocious effects of wind and heavy rain.

Precipitation

Rainfall is a major source of water for southern Africa, although an average is, at best, an estimate because of its variability in space and time, making it is difficult to develop a quantitative model.

Of particular significance and concern over climate have been the periodic droughts which have a

The hydrological cycle Figure 4.2



SOURCE: Supplement, "Conserving water", *The Star*, Johannesburg, March 1996

marked impact on the economies of the region. While historical records are available on droughts in southern Africa, it is difficult to explain what mechanisms are behind these phenomena. However, in recent times, the influence of the El Niño phenomenon has been acknowledged.[24]

Evapotranspiration

Evapotranspiration combines water losses due to evaporation and transpiration. Not all the rain that falls reaches the soil surface to be taken up by plants. This water either evaporates from the vegetation or flows down the stem. Evaporation includes water that immediately vaporises from water, vegetation and soil surfaces. The amount of evaporation that takes place from a surface depends on several factors including relative humidity, wind speed, sunshine intensity and cloud cover.

Groundwater

Because of the steady influence of vegetation on percolation of precipitation into the soil, groundwater recharge is made possible and in instances where favourable conditions occur, groundwater flow takes place, thereby feeding rivers and streams. Lateral groundwater flow can occur where water, which has percolated into the ground, reaches an obstruction such as a rock. In southern Africa, rivers and streams show a much greater range of mean maximum discharge and variability than their temperate counterparts. Surface slope, vegetation cover, rainfall intensity and land use control infiltration and runoff in dryland climates. In general, vegetation increases infiltration and reduces runoff and the greater the level of infiltration, the greater the proportion of base flow to total flow.

Reproductive performance of indigenous forests

The fruiting patterns of indigenous trees in forest conditions is usually erratic, with alternating good and bad seed years. Making yield predictions unreliable. The method of seed dispersal is crucial in determining the area covered by indigenous

Photo: H McCallum

A dried-up river bed in Namibia.

forests. For instance, trees with dehiscent pods, which burst open to allow the seeds to scatter, dominate southern Africa's dry woodland vegetation types.

The problems of seed availability, storage and pretreatment limit the growth of many indigenous trees from seed. Seeds may have to be exposed to fire or go through the digestive systems of birds and animals to facilitate germination. In the case of *Guibourtia coleosperma* (umtshibi, large false-mopane), for example, birds assist with the dispersal of its seed. Natural decay of fruits over several seasons facilitates the germination of hard-coated seeds of *Acacia* species and *Schinziophyton rautanenii*. For *Pericopsis angolensis* (afrormosia), fire and rainfall regime play a vital role in natural seed germination. Other species rely on vegetative regrowth after primary establishment from seed. Such species rely on seedling coppice, roots and stumps. Examples of such trees are *Baikiaea plurijuga* (Zambezi-teak), *Pterocarpus angolensis* (kiaat) and *Afzelia quanzensis* (chamfuta).

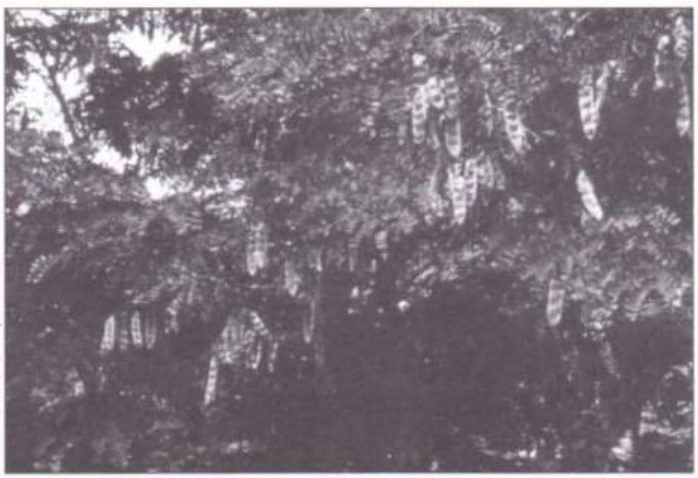


Photo: APG/PJ Stephenson

Photo: IUCN/ROSA

The method of seed dispersal is crucial in determining the area covered by indigenous forests.

Regeneration from seed is a rare event for miombo species. For example, the regeneration of the *Parinari curatellifolia* (mobura or mobola-plum), is almost invariably found regrowing from coppice and root suckers. Natural forests and woodlands contain a range of different species of flora and fauna. As a result, unsustainable forest exploitation can lead to a considerable loss of biodiversity. Recent estimates suggest that more than half the world's species are in tropical forests.[25]

The natural forests and woodlands of southern Africa are already reduced in size and are fragmented. Limiting factors for growth are mainly nutrients and moisture. The soils of the savannah woodlands have, low nutrient status. Over-exploitation of these woodlands by humans and fluctuations in climatic conditions, can lead to the promotion of dryland conditions, which could eventually promote desertification.

LINKAGES TO OTHER CHAPTERS Box 4.1

1 A REGIONAL OVERVIEW
The region experiences varied climatic zones, and the rate of ecological processes differs in these zones. For example, the wetter northern regions (DRC) absorb more carbon dioxide than the arid and desert areas of the Namib and Kalahari.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
Forests and woodlands regulate ecological processes much better than converted land. For example, based on equal areas, natural forests sink up to 10 times more carbon dioxide than cropland.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
Each aspect of biodiversity in a natural forest or woodland plays a part in the functioning of ecological cycles. Worms and burrowing animals aerate the soil,

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Although loss of biodiversity is of global concern, it is most felt in Africa, because of the direct dependence of the inhabitants on biological resources for food, fuel and construtions materials. Patterns of conversion of forests and woodlands have a direct bearing on the associated biodiversity. Some species are harvested because of their desired propeties, while harvesting certain species affects others that depend on them for survival.

6 FOREST AND WOODLAND PRODUCTS: USES AND VALUES
Biodiversity products from indigenous forests and woodlands can be classified as wood and non-wood products. Wood products include fuel wood, timber and construction material, while non-wood products include forest extracts such as honey, medicines, mushrooms, wild game and services such as shrines and tourism.

7 ECONOMIC VALUATION AND ACCOUNTING
Some aspects of biodiversity are difficult to quantify economically. One of the reasons for the gradual decline in the quality of natural forests and woodlands can be attributed to the fact that the value of resources is not always reflected fully in economic transactions. It would be difficult to quantify the economic value of woodfuel collected at random by rural families, or the opportunity cost of using alternative sources.

8 POLICY ANALYSIS
Some policy instruments aimed at safeguarding the biodiversity of forests and woodlands include direct policies such as forestry, land tenure, and the introduction of reserves and protected areas. Indirect policies include sustainable agricultural, encouragement of trade and introduction of alternative means of production such as new fuels, and the establishment of regional and national gene banks.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Sustainable management of forests and woodlands in southern Africa is the only hope for future quality and quantity of biodiversity resources.

10 TRENDS AND SCENARIOS
The factors affecting the trends in biodiversity include economic growth, trade, increase in population, governance and legislation and awareness. The future, based on current trends, looks bleak, but efforts are being made from all sectors to reach a sustainable path.

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5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION

Interest in forest management has increased worldwide in the last decade because of a decline in forest cover and loss of forest biodiversity. The Convention on Biological Diversity (CBD) is a major reflection of growing international concern about its loss.[1]

About 56 percent of southern Africa's land area is classified as unconverted forest and woodland, with permanent pasture occupying another 22.5 percent.[2] Some of this vegetation has been degraded through shifting cultivation, overstocking and overharvesting. Only 5.6 percent of the land area has been converted to crop agriculture.[3] Forest and woodland areas have undergone massive reduction in recent years, surpassing the world average of -0.2 percent.[4]

PATTERNS OF CONVERSION

During the 19th century most of the region was covered by natural vegetation consisting of extensive forests and woodlands. Today, this vegetation is confined to a few areas, mainly protected forest reserves, hills and inselbergs and rough terrain. Much of this change — ranging from simple modification and alteration through severe degradation to complete replacement of the original vegetation by introduced species — has been due to human interference. There are three types of change:

- physiognomic;
- areal; and
- floristic.

The most common pattern is physiognomic, in which some vegetation species have been replaced by others. Not only has the structure of vegetation communities changed due to this type of conversion, but also their overall appearance and floristic composition. Forests and woodlands have given way to cultivated fields, grassland, shrub grassland, wooded grassland and bushland. Although secondary forests have managed to re-establish in some areas, they are patchy.

Another major pattern of conversion involves quantitative and qualitative changes in floristic composition. Through this type of forest conversion, certain species such as *Hyparrhenbia* (Thatch grass), *Pericopsis angolensis* (afrormosia) and *Acacia* have increased in relative abundance. Also important is the increase in small trees and shrubs, and the relative thickening of woodlands.

Forests and woodlands are also being converted through the natural processes of plant succession. Competition between species is the main driving force behind this succession, causing changes in the relative abundance of the different species. In semi-arid regions, the unstable climate normally produces fluctuating resource levels that in turn cause plant populations to decrease below a level where competition might have a considerable effect. Nonetheless, competition is important in determining the spacing of trees.

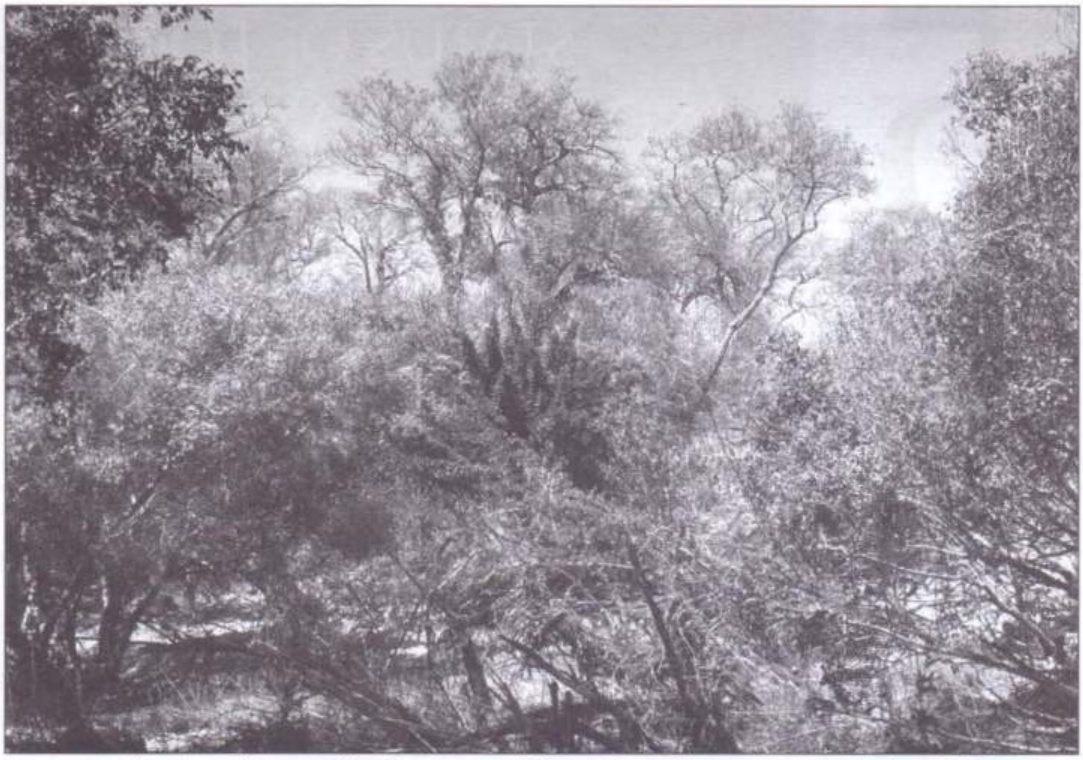

Photo: IMERCSA

In semi-arid regions, the unstable climate normally produces fluctuating resource levels that in turn cause plant populations to decrease below a level where competition might have a considerable effect.

CAUSES OF CONVERSION

Historically forests and woodlands were an open access and common property resource. Unrestricted use was allowed to forest dwellers as well as outsiders. This mode of exploitation was sustainable as long as demand for the various products were limited and the pace of natural regeneration was adequate to cope with human-induced disruptions.

Despite the fact that only 5.6 percent of southern Africa's vegetation has been converted by cultivation and grazing,[5] agriculture remains the single most important factor in forest conversion. It is, however, difficult to determine the exact causes of vegetation change because several environmental processes may have been involved simultaneously, and their impact may be confused.

Habitat loss and fragmentation

Relatively undisturbed ecosystems have shrunk dramatically in area over the past decades as the human population and resource consumption have grown. On average southern Africa loses 204,000 ha of forest area each year through deforestation.[6] In freshwater ecosystems, dams are destroying large sections of river and stream habitat. Other causes of biological diversity loss through habitat loss and fragmentation include fire, expansion of marginal agriculture, logging, mining and armed conflict.

Fire

Fire plays an important role in determining the distribution and patterns of some vegetation communities. It is responsible for the widespread occurrence and maintenance of grasslands, although some owe their existence to natural factors such as

Fundamental causes of biodiversity loss Box 5.1

High rate of population growth
Southern Africa has a youthful population and the resulting demographic momentum means that the sub-region will double its population of 150 million people in the next two decades. As the numbers increase, the region's population is expected to appropriate an ever-increasing share of the region's forest resources.

Emissions of pollutants, including GHGs, are already overtaxing the tolerance of ecosystems and the dispersal capacity of the atmosphere. Ozone-layer depletion, acid rain and air pollution are all taking a toll on biodiversity today and may threaten it even more severely in the future, particularly if climate change accelerates.

The narrowing spectrum of products from agriculture, forestry and fisheries
The emergence of the global exchange over the past century, based on principles of comparative advantage has increased interdependence. In agriculture, crop species have declined as producers now specialize in relatively few crops that provide an edge in the economy. Due to this reduction in crop numbers, local nitrogen-fixing bacteria, mycorhizae, predators, pollinators, seed dispersal and other species that co-evolved over centuries with traditional agriculture die out. In forest areas, the rapid total conversion of forests (often to monocultural cash crops) is widespread.

Economic systems and policies fail to value the environment
Many conversions of natural systems such as wetlands or forests to farmlands and rangelands are economically and biologically inefficient. This happens partly due to the urgent need for land to cultivate, regardless of how sustainable cultivation is, and partly because naturally habitats are commonly under-valued economically.

Mis-evaluation of biological resources
Biological resources are consumed directly and never enter markets;
Biodiversity goods are public goods that no single owner can claim; and
Property rights are more likely to be granted to those who clear and settle on forests and other lands covered with natural vegetation than to forest dwellers living by the sustainable harvest of natural products.

Correctly valued, biologically diverse natural systems are major economic assets. But because such systems are commonly undervalued, biological diversity is seen as a cost rather than an investment.

Inequity in the ownership, management and flow of benefits from both the use and conservation of biological resources
Rapid depletion of biological resources and destruction of habitats are common where a minority of the population owns or controls most of the land. Similar problems are also

encountered when resource control and responsibility for environmental policies and practices lie in the hands of urban people.

Deficiencies in knowledge and its application
Scientists still do not have adequate knowledge of natural ecosystems and their innumerable components. This ignorance is compounded by the destruction of indigenous knowledge systems. Even, where knowledge exists, it does not flow efficiently to decision-makers, who have in consequence often failed to develop policies that reflect the scientific, economic, social and ethical values of biodiversity.

Legal and institutional systems that promote unsustainable exploitation
Ecological and economic realities clearly call for a cross-sectoral approach to biodiversity conservation and management. However, many national institutions in the region operate along rigid sectoral lines, and many environmental institutions are short of resources. A second problem is the over-centralization of government and corporate planning, which hinders local implementation, discourages local participation, and closes the process to citizens groups and non-governmental organizations. Added to these difficulties, many countries in the region lack an adequate system of environmental laws and other instruments to ensure the protection of the environment and the sustainable use of resources. The use of economic instruments to promote environmental protection is insufficient, and basic scientific knowledge is inadequate.

SOURCE: Adapted from: WRI, UNEP & IUCN, *Global Biodiversity Strategy: Guidelines for Action to Save, Study, and Use Earth's Biotic Wealth Sustainably*, 1992.

topography and drainage conditions.[7] Observations from Mbeya, Tanzania,[8] indicate that burning favours vigorous grass growth and prevents regeneration of woody plants, particularly in forests under late-burning regimes. Thus the replacement of forest and woodlands by grassland, wooded grassland and shrub grassland may be attributed to burning, probably in conjunction with cultivation.

Forest ecosystems have evolved with periodic fire caused by lightning over millions of years. However recently people also cause more fires. It has long been recognised that fire can adversely affect many components of an ecosystem if not properly managed. However, there are some plant species that possess features that make them fire-resistant, and others that actually require some fire to stimulate seed germination. These adaptations suggest that fire has been an important evolutionary selective force long before people started exploiting it. The difference however, is that in the past fires may not have been as regular as they are today, and hence the impact of natural fires on forest ecosystems did not seriously threaten their biodiversity.

Reports from Malawi, and the Kavango region of Namibia, indicate that Burkea *(B. africana)* shows resistance to short-term fires under experimental conditions. Other species described as fire tolerant include *Dombeya rotundifolia* (wild-pear), Sweet-thorn Acacia, *A. karroo*, *Brachystegia spiciformis* (muputu, musasa), and *Julbernadia globiflora* (munondo, kamponi).[9]

Despite some degree of fire-tolerance by some species, wild fires remain one of the most significant threats to forests and biodiversity. Trees that lack thick bark or have exposed dormant buds are more readily destroyed. Loss of dormant buds removes the ability of trees to resprout after damage by fire, while for a tree with thin bark the cambium is more exposed. Even when trees are not completely killed by fire, fungi and other diseases and pests may attack through the scars.

The degree of damage to trees and shrubs depends on fire frequency, season or time of burn, species involved and the type of burn. A fire in the early part of the dry season when air temperatures are low and plants still have some residual moisture is generally cooler ('cool burn') than a fire in the late hot season ('hot burn'). A hot burn inflicts more damage to plants as the temperatures to which plant tissues are subjected are substantially higher and plants are also starting to mobilise their food reserves for the forthcoming growing season. Much more plant material is therefore destroyed, and plants are weakened. A report from Namibia shows that after a hot-November burn, the above ground mortality of plants up to two m tall can be more than 75 percent for each of the four most common woody species, Burkea *(B. africana)*, Silver Terminalia *(T. serica)*, Peeling-twig Combretum *(C. psidioides)* and Peeling-bark Ochna *(O. pulchra)*.

Above-ground mortality may be due to combustion of plant material or killing of buds and tissues by high temperatures. Fires that do not kill the canopy can still cause mortality through scorch and bole damage. A crown fire is a rare occurrence where the fire reaches the upper canopy and passes from tree to tree which can be very destructive.

A fire also influences patterns of seed production, seed germination and seedling establishment. If

Photos: M Coates Palgrave

Peeling-bark Ochna and close-up of the trunk.

Photos: M Coates Palgrave

The degree of damage to trees and shrubs depends on fire frequency, season, species involved and the type of burn.

fire occurs when trees are in flower, then seeds may not develop, diminishing propagation potential of the affected tree species. However, for some tree species, seed redistribution in the soil by ants creates underground seed-banks that are little affected by fire. Some tree species may regenerate from the root collar through coppice growth. However, with repeated fires even such plants may lose their ability to regenerate.

Frequent litter fires can reduce biodiversity of herbaceous plant species. Many grass species are less affected as they sprout from buds half-buried in the soil. It is broad-leaved herbaceous species that are most affected. Larger trees are usually all right, and close their canopies to fill out open spaces. Canopy closure reduces the number of plants that can regenerate after fire due to poor light penetration. Repeated surface fires can transform woodland into an area with taller, less dense tree vegetation.

A major concern is not just the actual physical destruction of trees by fire, but the inhibiting effect frequent fires can have on regeneration of woody plants. Seedlings and saplings are far more susceptible than larger trees and if they are repeatedly killed or burned back to the rootstock they coppice so that long-term regeneration of the forest or woodland is severely compromised. The species remains but the vegetation type fossilises until it rapidly disappears when the remaining trees die of old age.

Fire may also affect biodiversity in drier areas by promoting the proliferation of grasses while inhibiting the development of shrub and tree species. In such cases, a reduction in fire disturbance can encourage the development of woody vegetation.

On the other hand, total fire exclusion can impoverish biological diversity because there may be no

external forces to check species that have a tendency to grow vigorously and multiply, choking out others. On Mount Mulanje in Malawi, *Widdringtonia nodiflora* (Mulanje cedar) succumbs to intense fire, and yet, without infrequent cool fires, it is not able to establish itself and compete with other vegetation. Similarly, ephemeral fires may increase diversity through redistribution of resources (e.g. nutrients) and formation of gaps that may greatly influence patterns of seed germination and seedling success. Thus fire may create a "regeneration niche" and increase species diversity.

A mosaic of fire patches across a landscape creates small habitats and regeneration niches. Hence judicious management of fire can greatly increase biodiversity by creating a biologically heterogeneous landscape. Widespread major fires, on the other hand, can create biological homogeneity in a landscape with consequent reduction in biodiversity.

Fire is also damaging to wild fauna, especially the less mobile ones that are killed, while those that are mobile are forced to find new habitats.

It is clear that wild fire is damaging to forests and species diversity, but total exclusion of fire may also produce undesired vegetation with reduced diversity. A carefully managed fire regime may produce the desired effects. The other problem of attempting total fire exclusion is that the potential flammability of the forest is increased with large accumulations of standing dead matter, so that when a fire eventually occurs it will be of high intensity and cause more damage than would have occurred had the plant material not been allowed to accumulate.

Fire exerts a selective effect on species composition, encouraging fire-tolerant species such as *Lannea schimperi* (Rusty-leaved lannea) and *Dalbergia nitidula* (Purple-wood dalbergia). Fire-tender species such as *Ochna afzelii* become less important in burnt areas. *Brachystegia*, regarded as a semi-tolerant species, regenerates quickly in burnt areas.

Besides disrupting the floristic composition of forests and woodlands, fire also affects fauna through loss of habitat. Forest fires in the Bulilimamangwe area of Zimbabwe have been linked with the reduction in yields of the edible mopane worm, but nocturnal mammals are the most affected.

Fire has been used in southern Africa for the past million-and-a-half years[10] starting with Early Stone Age communities, but not widely used until the succeeding Middle Stone Age.[11] Some form of fire management of the vegetation for honey collection, improvement of pastures for game hunting and farming bulbs and rhizomes has been practised for the last 125,000 years.[12]

Afromontane forests in Malawi have suffered the least from direct destruction as the cold climate and associated frost does not encourage agricultural settlement. However, dry season bush-fires lit by hunters, honey-gatherers and iron-smelters, or spreading from the lowlands, have affected the forests over many centuries. Forests affected by these fires include those found on the Nyika and South Vhipya plateau.[13]

Agriculture

The main habitat-displacing activity in the developing world is agricultural expansion.[14] Both cultivation and grazing play a major role in converting and depleting forests.

There is historical evidence that large expanses of woodlands have been converted as a result of shifting cultivation. The widespread occurrence of bushland, consisting mainly of regenerating coppice, in the woodland zones is evidence of such

Photo: IMERCSA

The main habitat-displacing activity in the developing world is agricultural expansion. Both cultivation and grazing play a major role in converting and depleting forests.

effects. In some places, bushlands have grown into secondary woodlands with dense small trees, shrubs and numerous bushes. In the Kavango district of Namibia, much of the savannah woodland was cleared for millet farming, leaving a barren area of sparse grass stretching 300 km along the Kavango River.[15]

The earliest known human lifestyle fit into the environment in much the same way as other plant- and animal-eating species. The impact on biodiversity by hunter-gatherer communities is not well known, nevertheless, owing to the low population and minimum resource needs, the general impact must have been small.

It was when humans started practising settled agriculture about 10,000 years ago that the impact on forests and biodiversity became significant. The fact that substantial quantities of biomass are removed from areas under cultivation means that minerals lost from the soil have to be replaced. This is what led to shifting cultivation where fields are rotated to allow land not being used to build up nutrients and the practice of slash-and-burn or *chitemene*.

Under *chitemene*, the cultivated area is slashed, trees are cut down and the vegetation burned to release nutrients. When crop productivity goes down, the land is abandoned and new areas are opened up. This system of cultivation creates a mosaic of vegetation in different stages of succession. Due to demographic and economic pressures, fallow periods are now gradually being reduced, preventing forest recovery which occurred under extended fallow periods. In some areas, the shifting cultivators have been restricted to less productive land to make room for commercial farming. The result of this has been biological impoverishment of large areas.

The problem with *chitemene* is that trees are felled over a large area to fertilise only 10-15 percent of the deforested land which is then cropped for up to only five years. In Zambia, *chitemene* is responsible for at least 880,000 ha of deforestation each year.[16]

Indigenous forests have been equally affected by cultivation. Large tracts have been converted into monoculture growth of maize, tobacco and other cash crops with forests remaining on marginal areas. Secondary forests have re-established on the valley slopes of the Mbeya Range, Tembera and in parts of Umalila Plateau in Tanzania.[17] These forests are dominated by *Hagenia abyssinica* and *Macaranga kilimandscharia* that are believed to be pioneer forest species.

The most severe impacts on biodiversity are the big agro-industries such as sugar cane and timber plan-

tations, which result in "green deserts", unfavourable to most local species of fauna and annihilating indigenous flora. In addition, some exotic species such as Eucalyptus and Pine, which are commonly grown in timber plantations, exude allelopathic substances or provide shade to discourage undergrowth. There are, however, two qualifications to be made: they destroy grass biodiversity and they behave like pioneers, in that they facilitate or "'nurse"' the development of shade-tolerant forest species.

Photo: P Wade

The most severe impacts on biodiversity are the big agro-industries such as timber plantations, which result in "green deserts", unfavourable to most local species of fauna and annihilating indigenous flora.

Cultivation has also contributed to replacement of the original vegetation in many arable parts of southern Africa, by induced vegetation as indicated by the predominance of cultivated fields and fallows. Scattered trees of *Brachystegia* species, *Uapaca kirkiana* (wild-loquat), *Pterocarpus angolensis* (kiaat), and parklands of *Parinari curatellifolia* (mobola-plum, mobura) trees in cultivated fields in Mlowo district of Tanzania, reflect the selective effect of cultivation.[18] These species are preserved because of their edible fruits or high value timber.

In Malawi, the process of forest conversion is increasing as quickly as the population is growing.[19] With a population of more than 10 million, growing at an annual rate of 3.6 percent,[20] Malawi has one of the highest demands for agricultural land in southern Africa. The population stress is putting the government under increasing pressure to allocate more land. To date, large areas of Malawi's lowland forests around Thyolo, Mulanje and the northern Malawi-Nyasa lakeshore have been cleared for tea and rubber plantations.[21]

Trees are, of course, increasingly important as agroforestry grows. This system of mixing arable farming with forestry provides a wealth of products, which help reduce the risks of market and ecological failure. The trees, many of which are leguminous, improve soil fertility, provide fuelwood and control soil erosion by acting as windbreaks and ameliorating the impact of raindrops. Efforts to encourage agroforestry, while not very successful in Malawi, are slowly bringing in new species such as *Tephronia* and *Sesbania*.[22]

In Chipata, Zambia, short rotation fallows of one to three years using *Sesbania sesban*, have been shown to significantly improve maize yields without inorganic fertilizers.[23] Perhaps the most important service of all is food security, which agroforestry can help to ensure in many ways. In times of drought, trees can provide fruits and other foods that prevent widespread malnutrition and famine.

And even in good years, tree products are essential supplements to the staple cereal crops, ensuring a balanced and nutritious diet.

Grazing by domestic animals, mainly goats and cattle, leads to changes in species composition. Overgrazing is responsible for the increase of such species as Rough love grass *(Eragrotis aspera)*, *Aristida*, Rhodes grass *(Chloris gayana)*, *Sporobolus* and Sickle grass *(Microchloa kunthii)* in many rangelands throughout the region.[24] Where grazing has been intensified to the extent of preventing grass fires, the coarse, unpalatable species such as *Pennisetum schimperi* and rapoko grass *(Eleusine indica)* tend to dominate.[25]

Photo: IMERCSA

Grazing by domestic animals, mainly goats and cattle, leads to changes in species composition.

Other negative impacts that farming can have on biodiversity are due to greatly increased soil erosion and salinisation, which prevent regeneration of native plants in the area. Salinisation occurs when there is an accumulation of chemical compounds found in inorganic fertilizers, which interfere with plant growth.

One major factor in the erosion of biodiversity through farming is the redistribution of plant and animal species and varieties at the expense of local ones. Because local species have been neglected, their existence is greatly threatened. For example, indigenous fruit species are being ignored primarily because they are less productive or more difficult to cultivate.

The replacement of genetically diverse traditionally cultivated varieties by hybrid seeds, which respond better to modern farming techniques and inputs, are slowly eroding the biodiversity of cultivated crops. There is concern that genetically-homogeneous crops are much more open to rapid spread of diseases and their role in large-scale agriculture can greatly reduce landscape diversity. The maintenance of a diversity of landraces, — a subset of biodiversity at the interface between wild and domesticated species that are manipulated by people, — and wild crop relatives is usually justified by their potential or actual use in breeding desirable traits into new crop cultivars.

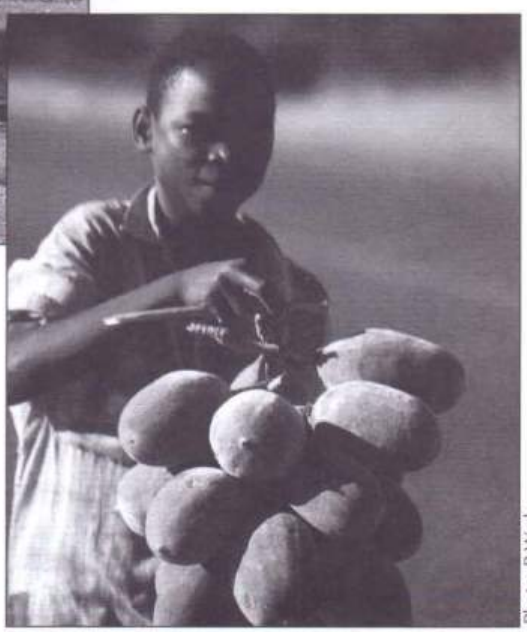

Photo: P Wade

Indigenous fruit species are being ignored primarily because they are less productive or more difficult to cultivate.

Another biodiversity is lost through curing tobacco. The Octopus Cabbage-tree (*Cussonia arborea*) in Malawi is threatened due to excessive use because it is soft, easily cut, light and produces a lot of smoke.

Grazing by cattle, if fairly intensive, can affect biodiversity:

- some grass species are encouraged at the expense of others that are palatable;
- less-palatable broad-leaved herbs can become dominant owing to reduced competitiveness of grasses and other palatable species;
- regeneration of some woody species is reduced as seedlings and young plants are selectively browsed; and
- invasion of an area by woody species can occur if the grass is heavily grazed or if there are many regeneration niches created by overgrazing or trampling.

On the fauna side, some animal species cannot tolerate the disturbance that cattle or other livestock bring, and ranchers often kill or actively discourage predators or large mammalian competitors such as Buffalo. In addition, the plant species and vegetation types comprising the habitat for some invertebrate species may be destroyed. The compartmentalisation of free-ranching large mammal populations by fencing for disease control purposes, along with the localised destruction of species such as Buffalo, in parts of southern Africa has had major effects on the population of wild fauna and consequently their biodiversity.

Large generalist herbivores such as the Elephant are local threats to biodiversity. In areas of high concentration such as Sengwa, Hwange National Park, Mana Pools, Luangwa Valley and Chobe National Park in Zimbabwe and Botswana, they cause major destruction by knocking down trees (especially in Miombo and Mopane woodlands), thus "simplifying" the habitat and ecological processes in a similar way to cattle in ranching areas.

Photo: APG/D Martin

Elephants cause major destruction by knocking down trees, thus "simplifying" the habitat and ecological processes.

A survey carried out in Namibia in 1996 showed that Elephants have a preference for *Pterocarpus angolensis* (kiaat), which they selectively debark. Younger trees are broken or pushed over. In most cases the damage renders the trees more susceptible to fire damage and diseases.

In Botswana, extension of cattle ranching, particularly in the Okavango, following the eradication of the Tsetse Fly, is a potential threat to wildlife resources.

Logging

Forest resources are harvested throughout the world for food, shelter, traditional medicines, dyes, oils, intoxicants, fuels, beverages, fibre, tools, as well as for religious purposes. Such uses threaten the existence of forests and biodiversity in several ways.

Nearly 100 million people in developing countries cannot get sufficient fuelwood for their energy needs and almost 1.3 billion people are consuming

fuelwood faster than it is being replenished. This may explain why in Malawi, indigenous trees were removed in the Machinga and Nalikule forests to be replaced with gum trees that grew faster to meet rising demand.

Rural fuel demand is, however, not the major cause of deforestation. Urban and industrial demand for fuelwood and charcoal are major factors in forest degradation and deforestation. In Malawi and Zambia, most of the charcoal is used in urban centres. Meaning loss of forests is critical near urban centres. For example, to meet the demands of Lusaka alone 2,000 ha of forest is felled annually. At the current rate, deforestation around Lusaka will be about 12,000 ha by the end of 2000.[26]

Photo: IMERCSA

Rural fuel demand is not the major cause of deforestation. Urban and industrial demand for fuelwood and charcoal contribute to forest degradation and deforestation.

Similarly, in Zimbabwe, fuelwood consumption is in excess of 5 million cu m per year and indigenous woodland cover can no longer sustain the demand. In Tanzania, fuelwood depletion has become so serious that many rural women spend the greater part of their working days searching for firewood.[27]

Loggers are usually selective in their choice of species. Their process creates gaps in forest canopy and is associated with road systems, all of which help in opening up forests to further encroachment by agriculture.

As gaps in forests grow, radiation and temperatures also increase while relative humidity decreases. Species, which respond well to low levels of radiation, may be overwhelmed by faster-growing species, which can tolerate the new conditions. Similarly, species with higher water-use efficiency may survive better in larger gaps.

Large gaps can also create favourable conditions for pioneer species, the seeds of which require full exposure to the sun before germination. Seeds of pioneer species can remain viable in the soil for many years and, once given an opportunity to germinate and establish, could change the composition of forest regeneration.

In terms of the commercial value of forests, the most valuable plants sometimes come from climax or mature vegetation. Careless or excessive logging can threaten the commercial and conservation value of forests by causing substantial changes to their composition. For example, vines are prominent pioneer components that germinate from seed. They are also known to re-grow more vigorously than damaged trees and could easily dominate a forest as long as they can find support structures.

Excessive logging can also damage some forests by altering their canopy, changing the forest micro-climate and disrupting the periodicity of leafing, flowering and fruiting of individual trees. Inadvertent destruction during felling and handling may also threaten non-target species.

Photo: IUCN/ROSA

Excessive logging can damage some forests by altering their canopy, changing the forest climate and disrupting the periodicity of leafing, flowering and fruiting of individual trees.

Many forest climax species are poorly dispersed and thus major disturbances may allow other more easily dispersed species to take over disturbed areas.

Forest trees depend on a variety of pollinators, dispersers and pest predators. In turn these animal functionaries depend on other species to complete their life cycles. A break at one point can induce disastrous ripple effects in the ecosystem.

Although extinction of exploited timber species has not been documented, some timber species are pushed to the brink of extinction because of selective exploitation. More common is "commercial extinction", where the species is rarely found in a commercially exploitable form.

Tree felling has been responsible for changes in species composition in terms of abundance and importance. Selective logging has mainly affected trees that produce high quality timber such as

Photo: APG/D Martin

Forest trees depend on a variety of pollinators, dispersers and pest predators. In turn these animal functionaries depend on other species to complete their life cycles, like the Simango monkey of the Bvumba region, Zimbabwe.

Pterocarpus angolensis (kiaat), *Pericopsis angolensis* (afrormosia), *Erythrophloeum africanum* (missanda), *Afzelia quanzensis* (chamfuta), and *Khaya anthotheca* (red mahogany).

Angolan forests, particularly in the Cabinda enclave, are heavily depleted of high value commercial timber trees due to excessive exploitation and export.[28] The destruction of these forests threatens the survival of primates such as the Gorilla and Chimpanzee though loss of habitat.[29]

In Tanzania, large tracts of forest were cleared in the Shinyanga district in an attempt to control Tsetse Flies.[30] While there are efforts to reafforest the area, the original biodiversity cannot be re-established.

Introduced species

Introduced species are responsible for extinction of other species, especially on islands. In such isolated ecosystems, a new predator, competitor or pathogen can rapidly suppress species that did not co-evolve with the newcomer.

Gum and Pine trees are examples of introduced species which can out-compete indigenous forests through vigorous growth and exudation of suppressive allelopathic compounds.

Some alien species, such as Lantana (*Lantana camara*), are also invasive, spreading naturally and producing significant change in terms of composition, structure or ecological process. Biodiversity is reduced by these invasive plants through replacement of diverse systems with a single species stand. Such replacements come about as a result of alterations caused by alien species to fire, water or nutrient regimes of the ecosystem. Invasive plants can also pose a threat to the native fauna. For example, Lantana can form dense impenetrable stands,

Photo: APG/D Martin

Gum and Pine trees are examples of introduced species which can out-compete indigenous forests through vigorous growth.

which impede foraging of animals and are not suitable habitats for breeding.

Hakea seicea (silky wattle) and *Melaleuca quinquinervia* (bottle brush) have been shown to alter fire regimes by producing volatile oils and excessive dry matter, a feature that increases the intensity of fires. The spread of Silky Wattle in South Africa has partly been blamed for the increase in fire intensity due to a rapid accumulation of inflammable matter.

Alien plant species may also alter soil chemistry through nutrient enrichment which occurs with nitrogen-fixing plants. In a nutrient-poor ecosystem, the changes induced by the alien species may facilitate aggressive plants to dominate those that are adapted to nutrient-poor soils. For example, Wattles (*Acacia mearnsii* and *A. dealbata*) are rapidly invading grassland areas such as Nyanga in eastern Zimbabwe, owing to their ability to fix nitrogen. Even after the trees are removed the soil remains enriched, and viable seed can remain buried for years awaiting suitable conditions for regeneration.

On the other hand, some alien plants create unfavourable soil conditions which may prevent native vegetation from establishing. For example, the plant *Mesembryantheumum crystallium* (ice plant) accumulates large quantities of salts, which are released when it dies, excluding other plants that do not thrive in salty conditions. *Gmelina aborea* (snapdragon tree), common in Malawi, makes the soil too acidic for the growth of many other plants.

Alien species can also interfere with native species by altering an ecosystem's hydrolo-

Farmers who fallow with trees Box 5.2

Jennifer Zulu, a farmer in Kalunga a village about 30 km south of Chipata in Zambia, struggles to educate her five children. Erratic rainfall and declining yields are not the only problems she faces. The soils are depleted of nitrogen and fertilizers are priced beyond her reach. Besides decreasing yields, she is also faced with lack of fuel wood and a shortage of land for traditional fallow (*chitemene*).

Enthusiastic now about agroforestry, she has been experimenting with improved fallows planted with Sesbania trees or Tephrosia shrubs. The Sesbania improve soil fertility by fixing nitrogen and adding leaf litter, and when they are removed after the fallow, their roots remain in the ground to decompose slowly. They also provide fuelwood as they grow.

Evaluation of the improved fallow technology over the past six years in Chipata has shown that short-term rotation fallows of one-to-three-years using Sesbania can significantly improve maize yields without any inorganic fertilizers. Yields are substantially higher than on continuously cropped fields but are not yet as high as on fields that receive full rates of nitrogen fertilizer. Apart from improved soil, physical and chemical conditions, one-to-three-year fallows produce substantial amounts of fuel wood, from 10-21 tonnes per ha.

In almost all parts of the miombo ecozone of southern Africa, shifting cultivation systems such as *chitemene* are no longer sustainable. If tree crowns are lopped, they need 20-30 years to regenerate to sustain the *chitemene* type of shifting cultivation in northern Zambia. If miombo woodlands are coppiced they need 43 years to regenerate.

SOURCE: Adapted from: ICRAF, International Center for Research in Agroforestry Annual Report, ICRAF, Nairobi, 1996

gy. This can be in the form of decreasing or increasing surface run-off, depending on their height and canopy. They also alter the rate of evapotranspiration, affecting the water table. For example Gum trees have a bad reputation in southern Africa for lowering the water table.

Forest diversity is also shrinking as a result of modern plant-breeding programmes and the resulting productivity gains achieved by planting comparatively fewer varieties of tree species, which respond better to water and pesticides, and have high yields. Extensive plantations of exotic species are widespread throughout southern Africa, and include those found in the Usambara Mountains and Mahale National Parks in Tanzania.

Tree planting is responsible for the replacement of the original vegetation by introduced species. This is evidenced by the abundance of exotic tree species such as *Pinus patula* (hang-leaf pine), *Cupressus lusitanica* (mexican cypress) and *Eucalyptus* throughout southern Africa.

People have been planting trees for hundreds of years for food, shelter, ceremonial and religious purposes.[27] The present development of artificial forestry has resulted from the ever-increasing demand for high-quality wood and related products.

The commercial exploitation of timber and related products for pulp and paper, construction, manufacturing and mining industries, has caused the demand for woodland and forest products to take on a new dimension in order to meet the required levels of sophistication. Throughout southern Africa, this twist of events has necessitated the introduction of exotic forests composed mainly of gum and pine trees.

The conversion of indigenous forests and woodlands into plantations of mostly monocultures of exotic species is usually considered legal as government sanctions the process. For example, the Malawian government sanctioned the clearance of a buffer zone around Machinga forest for replacement by Eucalyptus species despite public disapproval. The government argued that a buffer zone composed of exotic trees would protect the interior of the indigenous forest, that Gum trees are fast-growing and coppice easily and could be harvested at regular intervals to meet the high demand for fuelwood and poles. The same argument was also used to justify the conversion of Nalikule forest near Lilongwe to a Eucalyptus plantation to satisfy the fuelwood demand created by the expanding capital city's population.[51]

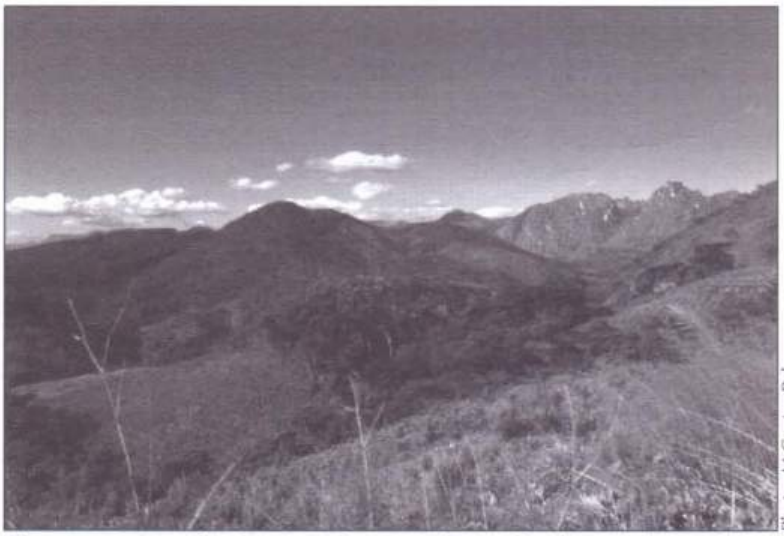

Photo: M Coates Palgrave

The conversion of indigenous forests and woodlands into plantations of mostly monocultures of exotic species is usually considered legal as government sanctions the process.

While these arguments may appear to justify the substitution of indigenous forests with plantations of exotic trees, it is becoming increasingly apparent that such conversion reduces forest productivity and leads to environmental degradation through loss of biological diversity. Plantations are often criticised for having little habitat diversity to provide room and protection for complex wildlife systems.

Exotic tree plantations usually consist of even-aged single species trees in a compartment or block, thus increasing the risk of attack by pests and disease.[32] While it may be argued that newly introduced species lack local pests, this advantage is lost when local pests adapt to the new host or when there is an invasion by an exotic pest species.[33] This can be illustrated by the devastation throughout southern Africa to such trees as *Cypressus lusitanica* (mexican cypress) and *Pinus patula* (hang-leaf pine), by the *Cinara cupressii* (cypress aphid),[34] and the *Pineus pini* (pine woolly aphid),[35] respectively. Similarly, *Pinus radiata* (monterey pine) has suffered heavy damage from *Dothistroma* blight.[36] Indigenous trees may not totally escape pest attacks, but the risk is less.

So far the comparison has been between natural forests and plantations. However, where plantations replace another simple vegetation type or are used to rehabilitate denuded industrial waste or eroded land, they can lead to increased diversity. For example, following afforestation on the Nyika and Viphya plateau in Malawi, the Leopard has returned to these regions.[37] In Tanzania the Sykes Monkey has adapted to the Cypress plantations, feeding on the tree's bark.[38] In the Usutu forest of Swaziland, the numbers and variety of animals have increased as the forest has become older and more varied in structure.

Today the number of wild animals greatly exceeds that of the pre-existing grassland: seven species of Antelope and Buck, Monkeys, Baboons, Porcupines, Ant-bears, Bush-babies, Warthogs, Guinea Fowl, Lynx, Spring Hares, Rock Rabbits, three species of Mongoose, Honey Badger, Cape Fox, Civet and Cerval.[39]

Photo: G Nealon

Following afforestation on the Nyika and Viphya plateau in Malawi, the Leopard has returned to these regions.

River impoundment

Demand for water in southern Africa is increasing rapidly, and many countries have started making plans for future water supplies. A massive scheme, the Lesotho Highlands Water Project, has been undertaken to replenish the Vaal River, which supplies South Africa's industrial heartland with supplies from the Senqu River in Lesotho, drawing from a network of dams, canals and tunnels, as well as a hydroelectric power scheme. Other efforts to improve the region's water supply include proposals to build dams along the Zambezi River at Mana Pools and Mpata Gorge.[40]

While the environmental impact of such alterations to river systems is not fully understood, it is clear that biologically important floodplains and wetlands will be lost, creating major impacts on habitat,

wildlife and livelihoods for the communities dependent on these ecosystems. Freshwater aquatic life will also suffer a setback due to temporary anaerobic conditions created by rotting vegetation.

Human settlement and infrastructure

Following concern about widespread deforestation, a national survey was conducted in Zimbabwe in 1978 in which it was shown that areas of moderate to high population densities suffered extensive loss of biodiversity through deforestation.[41] The situation is no better today given the increase in population and the associated landlessness.

In Tanzania, the creation of large towns and villages under the Ujamaa system in the 1970s introduced additional pressures on forests and other resources, especially in areas where new settlements were located.[42] Lack of proper planning worsened the situation with some villages exceeding the 600-family carrying capacity limit stipulated in the Ujamaa Villages Act of 1975.[43]

Environmental problems in Zambia may not have been widespread before the 1930s, however increasing pressure by European settlements, including changes in demographic patterns and economic life of the country's population caused noticeable environmental problems by the mid-1930s. The traditional response to the increasing pressure resulting from population growth would have been an expansion in the area of land under cultivation, leading eventually to an out-migration.[44] However, the land demarcation stipulated in colonial land rights restricted the operation of these traditional responses, which created localised pockets of high population density with increased pressure on the land and resources such as trees.[45] The areas occupied by European settlers were used to establish large commercial farms but the problem was that many Europeans had little knowledge of farming under tropical conditions.[46]

Concentration of settlements has often been driven by industrial development. While the expansion of such settlements is one process through which forests and woodlands are converted, it must be noted that pollution as a result of industry also

Heavy industry in a rural tropical ecosystem Box 5.3

In January 1977, the Tanzanian government formally authorised construction of an integrated pulp and paper mill in the Mufindi district. This establishment of such a mill has heavily influenced the local society. Not only has the influx of capital created a modern monetary economy, but also immigration has given rise to a complex set of forest resource conflicts. However, most of the environmental effects are yet to be manifested. Gas emissions, effluent discharges and solid wastes from the mill are being discharged into the atmosphere and the fragile tropical environment.

Following the substantial immigration into the new town, food requirements increased dramatically. Large tracts of grass, bush and woodland were cleared for cultivation and settlement.

Much of the effluent from the industry is discharged into the Kigogo-Ruaha River, but the effect on fish and other freshwater resources found in the river are not fully known. It is, however, known that suspended solids discharged into the river and the colour of the effluent restrict light penetration causing decreased algae growth.

SOURCE: Christiansson, C. and Ashuvud, J., *Heavy Industry in a Rural Tropical Ecosystem*, Ambio, Vol.14, No.3, Stockholm, 1985

plays a role in forest conversion. For example, South Africa's Eastern Transvaal Highveld produces the worst air pollution (particularly sulphur dioxide) in southern Africa due to the high concentration of coal-burning industries.[47] The effects of acid rain, resulting from the emissions on forest biodiversity are not well studied, although potentially vulnerable ecosystems and areas have been identified.[48]

Mining

Mining operations can lead to environmental degradation with significant impacts on forests and woodlands. In Zimbabwe, illegal alluvial and riverbed gold-panning activities, which intensified during the 1992-93 droughts and have continued despite good rains, have significantly converted some river ecosystems.[49] Trees have been destroyed, riverbeds excavated and sand piled along the Insiza River in Matabeleland South province due to gold panning. The Mazowe River, also in Zimbabwe, has undergone a similar process resulting in the distortion of its riverbed. Aquatic life has been greatly disturbed with fish and plants in the water dying in the muddy pools along the river.[50]

The number of gold panners in Zimbabwe is estimated at between 50,000 and 100,000.[51] The methods used in panning involve horizontal tunnelling, vertical pits and sand washing which lead to destruction of vegetation along the margins of rivers and, in addition, trees are used for fuel, construction, and as a source of timber for sifting pans.[52]

Mining also contributes to deforestation. Unquantified but extensive forests and woodlands have also been lost and turned into settlements and mine dumps through open-cast mining operations, particularly in the Copper Belt of Zambia. The eastern region of Botswana experienced significant deforestation in 1896 when the railway line from Kimberley to Bulawayo was under construction. Several thousands of tonnes of wood were used in the diamond mines. In 1896-1904 locomotives burned wood as fuel. The resultant deforestation caused the disappearance of all large trees in the Kgatleng region of Botswana.

Mining for diamonds and uranium have created huge open pits in some areas of Namibia. Besides destroying the landscape and flora, open-pit mining also drives away animals and causes soil erosion.

Photo: DNR

Mining operations can lead to environmental degradation with significant impacts on forests and woodlands.

Armed conflict

War has also contributed to the loss of southern Africa's biodiversity. IUCN estimates that Angola may have lost as much as 90 percent of its wildlife in protected areas since 1975.[53] The wild animals in Mozambique's Zinave National Park, in northern Inhambane Province, were also over-hunted to supply both urban and army centres with food and money to buy arms.

Photo: H McCullum

Population concentration due to the wars in Angola and Mozambique created additional pressure on forest and other natural resources in these and neighbouring countries to which refugees were forced to migrate.

Refugees displaced by the 16-year civil war in Mozambique that ended in 1992, also contributed to forest loss through cutting trees for construction and firewood. Such deforestation was particularly serious in Malawi, where more than one million Mozambicans sought refuge in the southern districts, denuding vast areas of their forest cover.

In Zambia considerable vegetation was defoliated and at times killed through use of chemicals such as Agent Orange during the liberation struggle for Zimbabwe. It is also important to note that war has, on the other hand, helped some forests to recover. In Mozambique, for example, mixed miombo woodland re-growth stands occur around rural towns such as Inhaminga and Inhamitanga in Sofala Province.

Population concentration due to the wars in Angola and Mozambique created additional pressure on forest and other natural resources in these and neighbouring countries to which refugees were forced to migrate.[54]

The wars destroyed the environment, both directly and indirectly. Fires, bombings, pollution from war chemicals, trenches, anti-personnel mines and traps and the cutting down of trees to remove cover resulted in forest degradation and conversion to lower forms of succession as climax vegetation was lost. Wildlife resources were over-exploited for food and cash. There was lack of management and law enforcement in protected and other areas. Refugees and displaced people, on the other hand, caused localised environmental problems.

The one million Mozambican refugees in Malawi[55] caused extensive deforestation in Dedza, Ntcheu, Mlanje and Nsanje districts in the southern part of the country. There was subsistence cultivation and firewood collection, which resulted in the clearance of about 2,500 ha of Malawian forest annually.[56]

The World Food Programme's (WFP) Project Design Service estimates an average fuelwood consumption rate of 1.7 kg per person per day or 1,400 tonnes per day for 800,000 refugees. This rate translates to 28.7 ha of natural forestland cleared every day.[57]

Nearly 50 percent of the land area of Angola is covered by forest,[58] but most of it is inaccessible due to landmines, hence the greatest damage is in the area surrounding the urban centres.

Over-exploitation of forest species

Numerous forest, fisheries and wildlife resources have been over-exploited, sometimes to the point of near extinction. Such over-exploitation is attributable to human harvests for food, as well search for precious commodities.

Today the Black and White Rhinocerous have been hunted to the verge of extinction in southern Africa, mainly because of their valuable horn. In Mozambique, the White Rhino has disappeared and shrimp catches are declining due to over-fishing and destruction of the mangroves.

In Zimbabwe, a number of wild flower species, notably the Lilies and Proteas, are threatened because of their aesthetic and commercial values. *Saintpaulia* species (African Violets), which are now threatened in their shaded habitats in northern Tanzania and southern Kenya, also illustrate how over-harvesting because of their commercial value can result in extremely rapid declines in species populations.

Photo: APC/D Martin

In Zimbabwe, a number of wild flower species, notably the Lilies and Proteas, are threatened because of their aesthetic and commercial values.

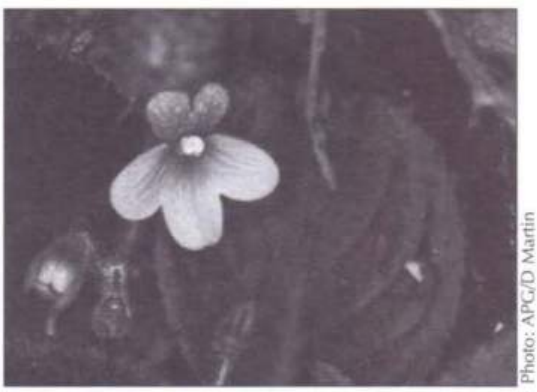

Photo: APC/D Martin

African Violets are now threatened in their shaded habitats in northern Tanzania and southern Kenya.

If properly done, harvesting could benefit the conservation status of species, illustrated by the harvesting of the protected *Rumobra adiantiformis* (Seven weeks fern) from the Knysna forests in South Africa. Controlled harvesting of the fern, and high production in shaded nurseries outside the forest contribute to the knowledge and conservation status of the fern even in private farms.

Pollution

Pollutants strain ecosystems and may reduce or eliminate populations of sensitive species. Contamination may reverberate along the food chain. Soil microbes also suffer from pollution as industry sheds heavy metals and irrigation causes salinisation.

Use of the pesticides, dieldrin and endosulfan, to eradicate Tsetse Flies in Botswana was harmful to wildlife and fish. The effect of the pesticides was compounded by their long life. In Zambia, endosulfan sprays also reportedly killed fish.

Although no data is available, it is probable that the Walvis Bay area in Namibia and the adjacent Atlantic coastal waters suffer from pollution from oil and petrochemicals. Such pollution is a threat to the Seal population, of which Namibia has one of the largest in the world.

The extent of ecological damage due to mineral extraction in South Africa is great, ranging from poisoned streams to strip-mined hillsides. For example, in the Umgweni River, mercury concentrations of as much as 1,500 times the level declared toxic by the US Environmental Protection Agency were found, and the effect on freshwater resources is unknown.[59]

The most serious and prevalent form of pollution in river and lake ecosystems in Zimbabwe is eutrophication. Lake Chivero, for example, outside Harare, is nutrient-enriched with large mats of the Hyacinth weed, which is threatening to choke fish and other freshwater resources in the lake.

Photo: M Chenje

The most serious and prevalent form of pollution in river and lake ecosystems in Zimbabwe is eutrophication.

Global climate change

Massive side effects could play havoc with living organisms in the coming decades due to global warming. Human-induced GHGs in the atmosphere are likely to commit the planet to a global temperature rise of some 1-3°C during this century, with an associated rise in sea level of one to two m.[60] Many species will not be able to redistribute themselves fast enough to keep up with the projected changes.

IMPACT AND EXTENT OF BIODIVERSITY LOSS IN SOUTHERN AFRICA

The variety of distinctive species and habitats influences the productivity and services provided by ecosystems. As the variety of species in an ecosystem changes through extinction and introduction of foreign species, its ability to absorb pollution, maintain soil fertility and micro-climates, cleanse water and provide other invaluable services also change.

The value of variety is particularly apparent in agriculture. For generations, people have raised a wide range of crops and livestock to stabilise and enhance productivity. The wisdom of the techniques, including their contributions to watershed protection, soil fertility maintenance and receptivity to integrated pest management strategies, is being reaffirmed today as farmers turn to low-input production systems.

Although loss of biodiversity is a major global concern, the greatest impact may be felt in Africa because of the direct dependence of the inhabitants on a great variety of biological resources. A loss of forest biodiversity would, therefore, mean a reduction in both quality and quantity of the benefits derived from the forests.

In addition to the obvious impacts of biodiversity loss on human well-being, the long-term effects could be more serious by inducing changes in the normal

functioning of ecosystems that form the foundation for sustainable development. Through loss of biological diversity, ecological instability may occur as species that occupy important ecological niches are lost. More significantly, biological diversity induces ecosystem resilience, and with its loss, ecosystems could fail to cope with stress such as drought, climatic changes and pest and disease outbreaks.

Biodiversity loss in southern Africa has been a consequence of human development, as species-rich wetlands and forests have been converted to relatively species-poor farmlands and plantations. Salt extraction and intensive tourism threaten Etosha Pan in Namibia.[61] Other threats to wetlands include natural causes such as sea-level rise and drought, and mining gypsum and peat in the Kafue flats of Zambia and the Zambezi valley in Zimbabwe.

Other parts of the region where biodiversity is under threat include Angola where the wildlife populations of national parks and reserves have been dramatically reduced to about 10 percent of their 1975 levels. People displaced by war, military activities or commercial enterprises, have occupied many of the parks. The research, management and administrative infrastructure of these protected areas has been destroyed or reduced to a level of insignificance.

Chisongole forest on Mount Mulanje, once the largest forest in Malawi at 3,800 ha in 1974, was reduced to about 2,500 ha in 10 years,[62] mainly due to an increased demand for agricultural land driven by high population growth rates.

In Swaziland, *Kniphofia umbrinus*, which is endemic to the north of Mbabane, is threatened with extinction. Of the 11,000 plant species that occur in Tanzania, 22 are reportedly threatened. These include the succulent herb *Garalluma distincta*, 20 species of African Violets (*Saintpaulia* species), and the Palm, *(Chrisalidocarpus pembanus)*.[63]

Photo: IUCN/ROSA

Stumps of former mangroves, cut down during the war years to prevent people hiding in them, now results in beach erosion, which threatens the city of Beira, in Mozambique.

The southwestern Cape Province of South Africa contains some 8,600 plant species, some of which are under severe threat. They include *Chondopetalum acocksii*, *Restio acocksii*, *Diastilla buekii*, Mountain rose *(Orothamnus zeyheri)*, *Serruria ciliata*, *S. roxburghii*, *Gladiolus aureus* and Tulp *(Moraea loubseri)*.

Most of Mauritius' natural forests have been transformed into sugar and tea plantations which threatens indigenous fauna with extinction. The extermination of the Dodo bird, is the best-known universally symbolic example. The island has 800-900 plant species, and threatened endemic species are mostly found in the Black River Gorge in the Macchabeebel Ombre Nature Reserve. They include *Crinum mauritianum*, *Tetrataxis salicifolia*, and *Xanthophyllum paniculatun*. On neighbouring Rodrigues, natural indigenous forest cover no longer exists, and the island is described as one of the world's most degraded.

POPULATION VIABILITY

Effective management of populations and their habitats is required to control the risk of extinction.

This quantification of extinction-probability is particularly crucial to management of endangered and rare species.

An understanding of population dynamics and factors that drive changes in population sizes is required when assessing extinction probabilities and minimum viable population sizes on non-genetic grounds. The many causes of extinction can all be classified as deterministic or stochastic. Among the latter are environmental, demographic, and genetic probabilities. Natural catastrophes such as drought are an extreme in the range of environmental probability that can lead to extinction. Demographic and genetic stochasticites are statistical phenomena that become increasingly more important as population size decreases. Demographic stochasticity involves chance variation in all components contributing to individual survival and reproductive success. Small populations are subject to random loss of vigour by genetic drift. Inbreeding may also increase as population size decreases, with an accompanying increase in genetic uniformity and decrease in fitness.

On the other hand, deterministic extinction results when something essential to the population is removed, or when something lethal is introduced.

A minimum viable population (MVP) is sufficiently large to minimise the probability of extinction over a long period. The conceptual basis of MVP has been developed largely within a population genetics framework, although in specific cases estimates have been made from non-genetic criteria. It is common knowledge that low population sizes may lead to loss of genetic variation, and hence loss of evolutionary flexibility.

Although population is usually considered the basic unit of interest in MVP studies, it is perilous to neglect the more inclusive metapopulation whose dynamics play crucial roles in the persistence of any plant species.

The International Plant Genetic Resources Institute suggests that as a rough guide, seeds from 50 separate individuals will encompass most of the genetic diversity of a population sufficiently to minimise inbreeding from conserved material, but 200 individuals are better. On the other hand, the revised IUCN Red List Categories, applicable to both flora and fauna, suggests that a species is threatened when there is:[64]

- a reduction of 50 percent in population numbers over 10 years or three generations;
- a population of less than 2,500 mature individuals and a decline of 20 percent over five years or two generations, or fragmented populations;
- a total population of less than 250 mature individuals; and
- occurrence over less than 50,000 ha with fragmented populations.

The effect of habitat fragmentation is variable. Some species can transfer their sexual propagules (e.g. pollen) over large areas and they include wind-pollinated plants. Others that are pollinated by specific — and only locally occurring, or weakly flying, insects — need a population of fairly close individuals to ensure breeding success. Some species disperse their seeds widely and can more readily colonise suitable new habitats.

In the Chirinda forest in eastern Zimbabwe, *Lovoa swynnertonii* (brown mahogany) and *Strychnos mellodora* (forest monkey-orange) have thriving populations, but the nearest known individuals outside of Chirinda are almost 200 km away in Mozambique or 2,000 km away in northern Tanzania. The possibility exists that there may have been populations in between, but it would appear that isolation over hundreds of years has not diminished the species viability.

LINKAGES TO OTHER CHAPTERS Box 5.4

1 A REGIONAL OVERVIEW
Forests and biodiversity are affected by various socio-economic, political and natural factors. The major cause of loss of biodiversity is loss of habitat from human-induced activities. The distribution, abundance and patterns of conversion of forests and wood lands in southern Africa depend on factors such as soil type, tenure systems, climate and topography, and national development policies.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
Land is cleared for agriculture while wood fuel continues to be the main source of primary energy. Forests are currently being cleared at over 0.8 percent per annum. Land area for agriculture and urban development has increased at the expense of forests and woodlands.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
Compared to a century ago, the areas currently occupied by forests and woodlands have greatly deteriorated. Biodiversity is lost through loss of habitat, over-exploitation of economically important species and introduction of alien species that compete for food with indigenous ones. Some species are destroyed because farmers see them as weeds.

4 ECOLOGICAL PROCESSES
Although loss of biodiversity is of global concern, it is most felt in Africa, because of the direct dependence of the inhabitants on biological resources for food, fuel and construction materials. As more forests are harvested, southern Africa loses its important resource for sinking carbon dioxide, the gas responsible for causing the greenhouse effect.

6 FOREST AND WOODLAND PRODUCTS
Wood products include fuel wood, timber and construction material, while non-wood products include forest extracts such as honey, medicines, mushrooms, wild game and services such as spiritual shrines and tourism. As forests and woodlands dwindle, so will the products, which in most cases are harvested free.

7 ECONOMIC VALUATION AND ACCOUNTING
Forests and woodlands are harvested rampantly in rural areas where they form pivotal means of survival. It is usually difficult to quantify the economic value of their contribution to the livelihood of the people.

8 POLICY ANALYSIS
Policy instruments addressing factors affecting loss of biodiversity in the region include land management and energy policies. National policies in these fields vary from county to country. The SADC Forestry Sector Technical Co-ordinating Unit in Malawi is the regional organ of SADC addressing regional forestry issues.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Sustainable management of forests and woodlands is the sole hope for future quality and quantity of biodiversity resources. It is important to address the root cause of the status of biodiversity experienced today if we want to maintain sustainable levels tomorrow.

10 TRENDS AND SCENARIOS
The factors affecting the trends in biodiversity include economic growth, trade, increase in population, governance and legislation, and awareness. As population increases, the region may experience projections of unsustainable resource depletion rates, which may be aggravated or eased by agricultural policies implemented.

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Photo: APG/D Martin

The resources of the woodlands and forests of southern Africa are central to the livelihood systems of millions of rural and urban dwellers.

6 FOREST AND WOODLAND PRODUCTS USES AND VALUES

The resources of the woodlands and forests of southern Africa are central to the livelihood systems of millions of rural and urban dwellers. A range of products supports rural living:

- cropping systems depend on the woodland to varying degrees — as bush fallow in the *chitemene* ash fertilisation system in Zambia, leaf litter in Zimbabwean systems and manure fertilisation, where the bulk of the graze and browse for livestock is found, which in turn provides manure;
- the primary source of energy in the form of fire wood and charcoal, and a crucial source of essential subsistence goods;
- poles and construction products, timber, materials for tool handles and household utensils, foods and medicines;
- foods which include fruits, leaves, seeds and nuts, tubers and roots, fungi, gum and sap;
- the spiritual needs of the people, with specified trees and even blocks of woodland and forest, conserved by communities for cultural reasons; and
- a service role in controlling soil erosion, providing shade, modifying hydrological cycles and maintaining soil fertility.

The benefits on farms for communal area households fall into the following five categories:[1]

- foods such as fruit from cultivated exotic and indigenous trees, as well as wild foods such as mushrooms and edible insects and the habitat for such activities as beekeeping and important medicines for people and livestock;
- soil nutrients such as leaf litter which is transferred from woodlands into farming systems and nutrients such as soil from termitaria and cattle manure. Protection from soil erosion and other environmental services are also provided by trees in farming systems;
- fodder and browse for livestock, which in turn provide manure, milk, meat and draught power;
- raw materials for processing into goods for household consumption or sale, including woodfuel, building materials, and support for small-scale industries; and
- indigenous hardwoods for the saw-mill industry, comprising a rapidly dwindling and seriously overexploited stock of a limited number of species. Communal area households only benefit indirectly from timber exploitation, because royalties accrue to district councils.

ANCIENT USE OF INDIGENOUS FORESTS AND WOODLANDS

Prior to the introduction of pastoralism and farming, the sub-continent was occupied by hunter-gatherers whose mode of existence was wholly dependent on subsistence. Unfortunately, the archaeological database on this utilisation has not been well-preserved so that there is only a rudimentary outline of the ancient peoples' activities.

What evidence there is, however, suggests that two-to-three million years ago, large tracts of land were

exploited by hunter-gatherers for whatever resources they were able to offer. These were the first communities to occupy the region and their presence lasted for a very long time before pastoralists and farmers occupied the region.

Hunter-gatherers had a nomadic settlement pattern that involved moving camps after short periods of occupation. In comparison, farmers tended to be more permanent in their settlement pattern, often labelled as "constrained mobility", while pastoralists, who have nomadic tendencies, depended heavily on fire to burn off the bush to promote growth of new vegetation for their animals.

The presence of pastoralists dates back to about the second millennium BC, and is significant in the destruction of vegetation by livestock which must have had a bearing on their utilisation of forest products. Evidence of livestock in the region comes from South Africa where early European settlers in Cape Province noted more than 20,000 sheep and cattle grazing near indigenous settlements, an indication also of over-grazing and overstocking.

Studies of hunter-gatherer camps in Botswana have revealed interesting aspects of environmental use in the presence of small windbreaks made of branches of brush, occasionally thatched with grass. These windbreaks, which ethnographic studies have revealed, were constructed for shelter and made of unmodified natural materials sandwiched between trees, which also provided much-needed shade. The windbreaks did not disturb the environment due to their temporary nature and unsophisticated construction.

The traditional hunter-gatherers identified many edible plants, the existence of which gave them vast knowledge of their uses for various purposes through many centuries of close collaboration. This knowledge allowed them to pick edible fruits, berries, roots and bulbs, gum and several other resources.

The establishment of their camps in forested and woodland areas, in contrast to open grassland, offered direct benefits in addition to plant products. Hunting provided them with animal products such as protein, hides, furs, skins, trophies and medicine. Honey was an important primary component of their diet. Certain trees species such as Albizia (*Albizia sp.*) are popular with swarms of bees.

Similar to the Western Cape, archaeological investigations in Central Zambia have established that original peoples were involved in seasonal exploitation of forest and woodland resources. This subsis-

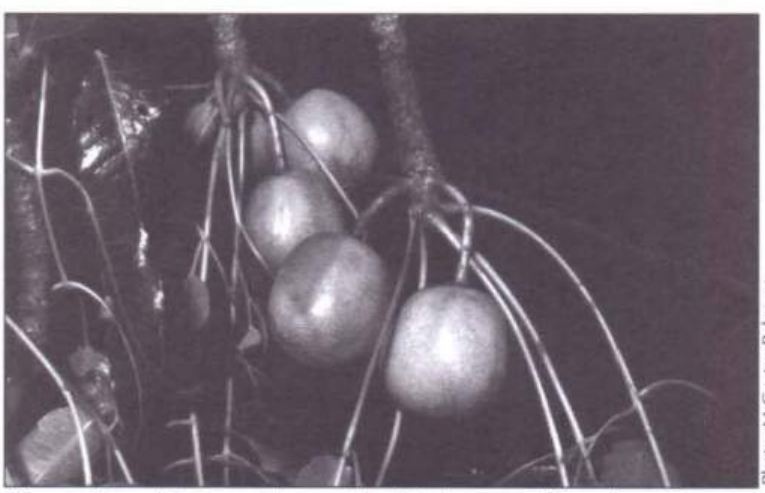


Photo: M Coates Palgrave

The traditional hunter-gatherers identified many edible plants, the existence of which gave them vast knowledge of their uses for various purposes, like the Marula fruit, above.

tence activity continues to the present day. Central Zambia and the Western Cape are made up of three physiographic zones – plateau, scarp slope and plain. The plateau and scarp slope zones lie to the west of the Muchinga Escarpment and are covered by decidous miombo woodland. The most dominant tree species are *Brachystegia*, and *Julbernardia*. The plain zone is essentially open grassland with relatively few scattered trees.

Plant and animal remains which have been recovered from archaeological sites in the two ecological zones suggest that the ancient peoples depended on hunting and gathering for many thousands of years using what resources were available and could be exploited. Procuring these resources must have involved both implements, such as bow and arrow, and facilities such as leather carrying bags.

An agricultural community within the region that continues to practice gathering on a sustained basis is the Tonga of Zambia. The inhabitants of the Zambezi Valley procure leaf relishes from plants such as *Corchorus olitorius* (Jute), *Commelina diffusa, Ceratotheca sessamoides, Triplochiton zambesiacus* (Zambezi-oak) and *Tamarindus indica* (Tamarind). Fruits are also collected from such tree species that owners of the garden in which the trees are found claim individual ownership of the fruit.

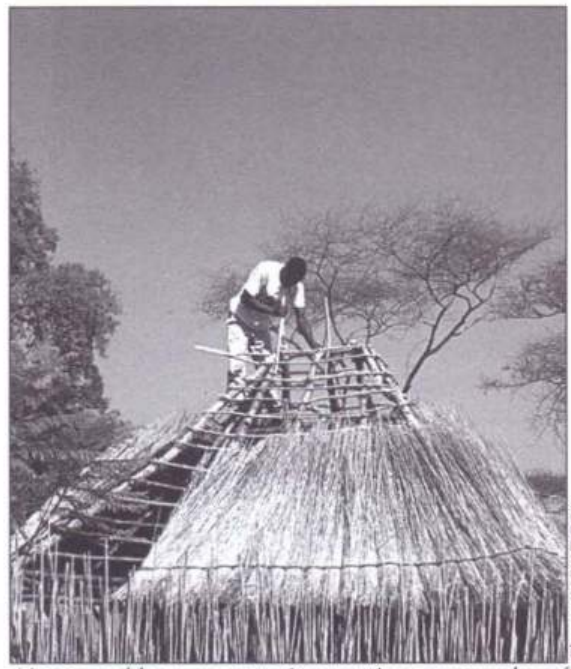


Photo: IUCN/ROSA

House and barn construction requires many poles of various dimensions and weights, as well as rope fibre for tying them together and grass for thatching.

PRODUCTS DERIVED FROM WOODLANDS AND FORESTS

Wood-based products

Poles and construction materials

The woodlands and forests still play a vital role in construction material, although in places where the resource has become degraded, large-diameter posts are now derived from planted exotic trees. House and barn construction requires many poles of various dimensions and weights, as well as rope fibre for tying them together and grass for thatching. Research in Malawi found the highest demand for poles was from trees above five cm in base diameter, and any recruitment (growth from younger trees) into these larger sizes is utilised rapidly.[2]

Withies, tough flexible branches, are required for weaving granaries and animal pens, and reeds are used for fencing. Rope fibre, made by peeling strips from beneath the bark, needs to be strong, long and easily separated from the stem and bark. Species commonly used are *Brachystegia boehmii* (musamba, mufuti, muombo), *B. longifolia, B. spiciformis* (muputu, musasa), *B. microphylla* and Coffee Bauhinia, *B. petersiana* for their desired attributes of fibre strength and ease of peeling. Rope fibre can be harvested from young coppice shoots.

Uses of some acacia trees Table 6.1

SPECIES UTILITY
Acacia Karroo
• Very good "bee tree" - produces large amounts of pollen and nectar;
• Provides excellent fodder (leaves, flowers and pods);
• Nitrogen-fixing tree, provides shade, is drought-and fire-resistant; and
• Wood is excellent for furniture-making, firewood and charcoal.
Acacia nilotica
• Provides good fodder for cattle and game;
• Wood used for fencing and as fuel wood; and
• Bark and roots used in medical preparations.
Acacia polyacantha
• In the wild is an indicator of fertile soils; and
• Provides good fuelwood.

SOURCE: Forestry Research Institute of Malawi, *"Tree Seed Catalogue and Price List"*, National Tree Seed Centre, June 1995, p9

Firewood

The woodlands and forests are an essential source of fuel. Biomass fuels are the major source of energy for rural industries like tobacco-curing, tea-drying, fish-smoking, brick-burning, pottery and salt production.

In Mozambique, annual woodfuel consumption is estimated at 16 million cu m. About 70-80 percent of the urban population depend on woodfuel.[3] In Tanzania, around 91 percent of all energy consumed in the country is wood, mostly derived from indigenous trees.[4] Similarly, little of the woodfuel consumed by the urban population of Zambia is derived from exotic plantations.[5] Numerous factors have led to increasing demands for this fuel in many parts of southern Africa:

- escalating oil prices;
- rapid population growth;
- urbanisation; and
- lack of realistic alternatives

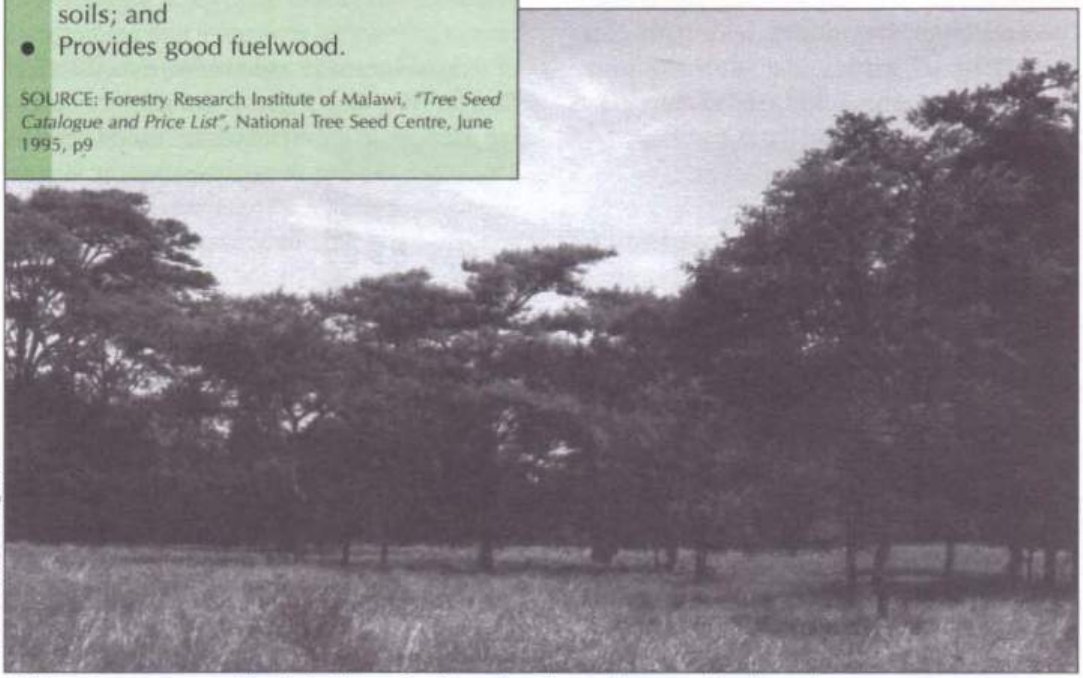


Photo: M Coates Palgrave

White-thorn tree woodland, indicates fertile soil and provides good fuelwood.

For example, the inability of Tanzania by the mid-1980s to import adequate petroleum supplies led some industries, including tea plantations, to switch to firewood. There is reason to believe that these fuels will continue to play a major role in energy needs, especially those of lower-income urban dwellers.

In the rural areas of southern Africa, women are the main collectors and consumers of firewood for domestic uses, and are highly selective in the species used. Typically, there are three or four preferred firewood species. In an area of southeast Zimbabwe, for example, the most frequently used species are *Julbernardia globiflora* (munondo), *Colophospermum mopane* (mopane) and *Brachystegia boehmii* (mufuti), which are also the most abundant.[6]

Mopane makes excellent charcoal and Malawians are willing to pay high prices for its better burning qualities.[7]

The characteristics of favoured firewood by southern African communities include a hot flame, burning with little smoke and long-lasting embers.[8] Different sizes and species of wood are selected for different purposes: smaller pieces which catch fire easily are used for kindling, large logs are used for preparing food which has to cook for a long time and hot- or cool-burning wood may be selected depending on the type of cooking required.

Wood is stockpiled in the dry season for use during the rainy season when people are busy working in their fields. When collecting this wood, women are selective about the species they gather, while in the rainy season they will take what they find. Men are generally responsible for the collection of firewood in larger quantities and diameters, such as for brick-burning or fish-smoking, often using a sledge or cart, and are not particular about the species collected.[9]

Cutting live trees for fuel in the forests and woodlands has in the past been associated with the emergence and growth of urban markets. Since charcoal has become the major urban household fuel in Zambia, wood-cutting has resulted in peri-urban clearance on a large scale, as well as in Malawi and Mozambique.

Traditional beliefs forbid the use of certain species. For example, in Malawi it is taboo to use the wood of *Psorospermum febrifugum* (Christmas-berry) for fires, as it is believed that its smoke causes family conflicts (its local name means 'trouble stirrer').[10] Taboos on use of certain species for firewood are also widespread in Zimbabwe, for example *Philenoptera violacea* [*Lonchocarpus capassa*] (rain-tree), *Ochna* species and spikethorns, *Gymnosporia* species.[11]

Smoking fish is a traditional method of preservation in most SADC countries. The amount of fuelwood required varies, depending on the oil content of the fish. Nile perch contains more oil than tilapia and more fuelwood is used to process them.[12] Being an open fire, most of the heat and smoke is wasted, with the result that the fuelwood consumption is high (one kg of wood to smoke one kg of fish).[13] Fish yields from Lakes Chilwa and Chiuta in Malawi, are about 18,000 tonnes per year, of which 65 percent (11,700) is smoke-dried. Thirty percent are sun-dried and the remainder sold fresh.[14]

In the SADC region, most of the wood is cut from natural woodlands and forests. In Lesotho, Angola and Zimbabwe, 65, 58 and 53 percent respectively of the total energy usage comes from wood supplies.[15]

In the Tanga region of Tanzania, the annual volume of firewood consumption for salt production alone, is estimated at 384,370 cu m. This amount is enough to meet the domestic firewood needs of

Tanga's population for about 16 months.[16] In Botswana, an estimated 85 percent of all wood consumed annually is used as fuel. For most Batswana there is often no alternative.[17]

Fuelwood consumption in the SADC region from 1988-1992 Table 6.2

Sector	1988	1992
Household	86.1%	90.0%
Agriculture	2.0%	4.1%
Industries	9.0%	5.6%

SOURCE: SADC FSTCU, for SARDC, Lilongwe, Malawi, September 1997

Photo: M Coates Palgrave

Umbrella-thorn Acacia, in flower.

Energy needs for small industries in southern Africa (general figures) Table 6.3

Industry	Product	Material	Fuel	Energy required
Brick-burning	Bricks	Clay	Wood	0.4-1.8kg
Lime reduction	Cement	Limestone	Coal	0.12-0.18kg
Tea-drying	Tea	Leaves	Wood & Oil	1.33kg and 0.4ltr/kg
Tobacco- drying	Tobacco	Leaves	Wood	1.33kg

SOURCE: Woodfuel Surveys, FAO/INT/ 365/ SWE, 1983

Photo: IUCN/ROSA

In the SADC region, most of the wood is cut from natural woodlands and forests.

Timber

The main commercial timber species are:

- *Pterocarpus angolensis* (kiaat), whose timber is durable, works well, shrinks little in drying and is one of the most valuable timbers in Africa;[18]
- *Afzelia quanzensis* (chamfuta), whose timber is straight-grained and hard, is used for internal and external joinery as well as being favoured for dug-out canoes;[19] and
- *Dalbergia melanoxylon* (African blackwood), considered one of the best turnery woods in the world and is used for making musical instruments.[20]

Other fine hardwood species include *Combretum imberbe* (leadwood), *Diospyros mespiliformis* (African ebony), *Androstachys johnsonii* (mzimbeet), *Khaya anthotheca* (red mahogany), *Milletia stuhlmannii* (panga-panga), Silver Terminalia, *T. sericea*, *Spirostachys africana* (tamboti), and *Swartzia madagascariensis* (snake-bean). Up to 85 percent of the total sawed wood consumed by the furniture industry in Tanzania is composed of Afrormosia *(Pericopsis angolensis)*. Most of the accessible stock has been felled in southern Malawi and the furniture industry relies on supplies from across the border in Mozambique.[21] In Malawi, *Pterocarpus angolensis* (kiaat) and *Khaya anthotheca* (red mahogany) are planted by smallholder farmers in woodlots or along stream banks in their gardens, for timber production.[22]

Photo: IUCN/ROSA

Panga-panga, dominant species of Nhamitanga Forest Reserve in Mozambique. Grows in high rainfall or riverine forests.

In Zimbabwe, as in most SADC countries where kiaat *(P. angolensis)* has been heavily exploited, warnings have been given that stock will soon be exhausted if current rates continue.[23] Mozambique still has large supplies of valuable indigenous hardwoods, and commercial logging operations are on the increase since the cessation of the civil war in 1992.

Household implements and curios

Wood is the principal material for making domestic implements: hoe and axe handles, pestles and mortars, cooking sticks, plates, bowls, bows and arrows, drums, knobkerries, walking sticks, ox harnesses and ox-carts. It is also used for carved curios, an important income-earner and sometime source of foreign exchange. A number of different species, among them *Dalbergia melanoxylon* (African blackwood), *Pericopsis angolensis* (afrormosia), *Spirostachys africana* (tamboti), *Afzelia quanzensis* (chamfuta) and *Swartzia madagascariensis* (snake-bean), are used in Malawi, Mozambique, South Africa, Tanzania, Zambia and Zimbabwe, for processing into wood-carvings or furniture for the market.[24] The harvesting of trees for furniture-making and carving, as well as the actual manufacture of products, is overwhelmingly a male pursuit.[25]

In Botswana, Namibia, Zambia and Zimbabwe, the most important tree species used for carving is the *Pterocarpus angolensis* (kiaat). Carving is now an important local industry promoting tourism.

As with firewood, specific attributes are required of the wood for each express purpose:[26]

- hunting tools, such as knobkerries and arrows are made from dense heart woods such as that of *Swartzia madagasciarensis* (snake-bean) and bows made from light, durable and flexible woods such as *Diplorhychus condylocarpon* (wild rubber) and Large-leaved Cordia, *C. africana*;

Indigenous wood use for hut construction Box 6.1

Rural Zimbabwe shows particular selectivity when choosing trees for hut poles and brick-making. A study to investigate the use of indigenous miombo woodland for hut construction (roofing poles and brick-burning) in Shurugwi Communal Farming Area in the Midlands Province of Zimbabwe is ideal. The mean annual rainfall of the area, which is variable in space and time, is 766 mm, falling largely between November and March. Soils are mainly infertile granitic sand, supporting light woodland dominated by *Brachystegia spiciformis* (musasa) and *Julbernardia globiflora* (munondo), which is reduced by heavy use in places to low scrub. The case study combines two pieces of research:

- a study of control over, and use of, wood products in communally managed areas, which draws from the responses to an informal questionnaire of 70 randomly selected local inhabitants from four villages; and
- a study of wood use for brick-making, taken from a wider-ranging study of wood use in the area.

Regulations governing tree cutting

Most of the farmers in the study affirmed the existence of laws governing the cutting of trees in communally managed woodlands. These laws were largely concerned with the maintenance of the resource, and administered by the traditional leadership (chiefs, headmen and elders), and government agents (councillors and extension workers). Tree-cutting in communally-managed lands was officially forbidden although people in need of poles could usually get permission from their leaders to cut limited amounts in specified locations. Farmers acknowledged that people regularly broke the ban on cutting. Many respondents also obtained wood products from the lands they managed privately such as fields, contours and field boundaries, a practice, which has increased as wood resources have become scarcer.

Selection of hut poles

Since the 1930s, farmers in Shurugwi have been encouraged to build their houses of unburnt bricks to reduce demand for poles from the indigenous woodland. For hut construction in this area, apart from some granaries, wooden poles were usually used only in the roof.

Men who usually cut down the whole tree, unless wood was particularly scarce, mainly did the selection of trees for roofing poles. The size of the pole, and the species selected, was determined by the intended use. Upright roof poles could be between six and 12 cm in diameter, while the smaller cross laths were between three and six cm. Twenty-two different species were selected for upright poles, the most popular species being Silver terminalia *T. sericea* and *Combretum apiculatum* (red bushwillow). The criteria farmers used in their choice of both types of poles were strength, durability, resistance to pests (largely borers and fungi), straightness (for uprights), flexibility (for laths) and ease of use. In many cases, however, the choice of species was affected by availability, the two sought-after species now being relatively scarce. For example, *Julbernardia globiflora* (munondo) is one of the co-dominants of the woodland, and although highly susceptible to borers, is used for lack of other more durable species. White-syringa *(Kirkia acuminata)* and mopane, *Colophospermum mopane,* on the other hand would make good strong rafters but the

species is rare in this area. People living on dolerite soils, which support a different range of tree species from those found on the neighbouring granitic soils, varied their choice of people species accordingly. Most of the species selected for wood products will resprout after cutting, an adaption to an environment shaped by drought and fire. In some instances, when harvesting poles, farmers will consciously reduce the number of shoots on a stump in an attempt to improve the growing conditions for the remaining stems.

The implement most often used for cutting trees is an axe; only a few people use saws. Trees are usually cut within 40 cm of the ground, although some people cut close to ground level if they needed longer poles. In general, farmers said the cutting method they used was chosen to facilitate re-growth, although in effect their action may not always have produced the desired result, their chopping action at times leaving a jagged v-shape in the stem which was liable to collect moisture.

SOURCE: Grundy, I., "Indigenous Wood Use for Hut Construction: A Case Study from a Communal Land in a Miombo Area in Zimbabwe", for SARDC, 1997

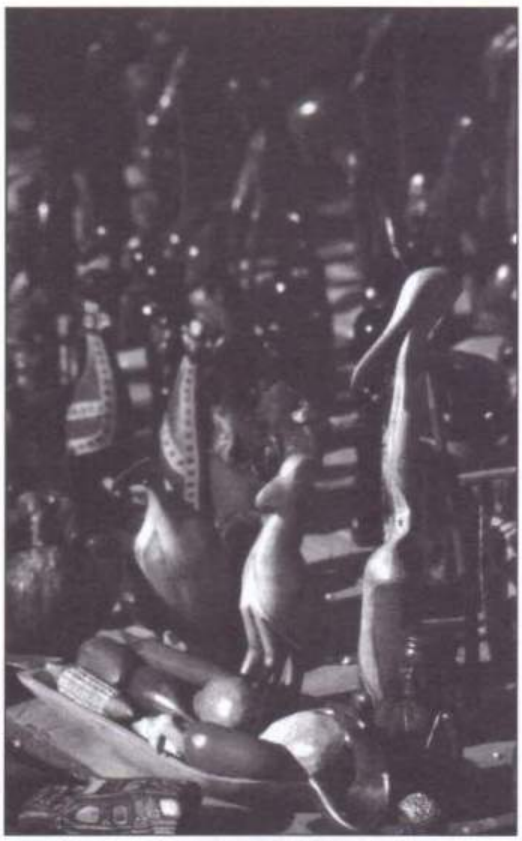


Photo: APC/D Martin

Carving is now an important local industry promoting tourism.

- axe and hoe handles use species with inter locked grain at the root collar, and which are strong, resistant to splitting and sand to a smooth finish, such as mutondo, *Julbernardia paniculata*, are preferred;
- *Terminalia sericea* is the preferred species for yoke-making for oxen, because of its flexibility;
- in Zimbabwe, *Artabotrys brachypetalus* (purple hook-berry) and *Sterculia quinquiloba* (large-leaved star-chestnut) are commonly selected to make musical instruments;[27] and
- carving utility items require a durable wood, with good form and density such as Afrormosia, *Pericopsis angolensis* and Marula, *Sclerocarya birrea* for pestle and mortars.

Non-wood forest products

While wood products have become major international commodities in modern times, non-wood forest products rank among the oldest traded commodities.[28] These consist of goods of biological origin other than wood, as well as services derived from forests and allied land uses.

An exhaustive list of thousands of non-timber goods include:

- gums, resins and latex to canes;
- edible nuts, fruits and vegetables;
- fungi and spices;
- meat and by-products of game, including mammals, fowl, reptiles, fish and insects;
- animals for pets, zoos and tourist trade;
- fuelwood and fodder; and
- bio-chemically active plants, micro-organisms, and insects for diverse pharmaceutical and medicinal uses.[29]

Indigenous fruits and mushrooms are of great importance in the diet of rural people, but their role in the cash economy appears to be much more variable, although a number of indigenous fruits do enter into trade. Species whose fruit is marketed include *Uapaca kirkiana* (wild-loquat), *Azanza garckeana* (snot-apple) and *Strychnos cocculoides* (corky-bark monkey-orange). Leafy vegetables are sold, sometimes in dried form. In Zambia, the roots of the shrub

Some uses of plant species from the Mopane woodland Table 6.4

Botanical name	Local use
Acacia polyacantha subsp. camphlacantha	Treating snake bite and gonorrhoea
Adansonia digitata	Edible fruit
Anthericum pterocaulon	Leaves eaten as vegetables
Azanza garckeana	Edible fruit
Cissus integrifolia	Boiled leaves eaten as vegetables
Colophospermum mopane	House, bridge and tobacco barn construction, wood carving, farm tools, pestles and mortars, firewood, charcoal Powder from leaves is a cure for sores and wounds Leaves are fed to livestock
Dalbergia melanoxylon	House construction and woodcarvings
Dichrostachys cinerea subsp. africana	Antidote to scorpion and snake bites, and an aphrodisiac
Euphorbia indica and E. inaequilatera	Fishing by poisoning, especially in stagnant water
Friesodielsia abovata	The stem is used for weaving food stores The fruit is edible by humans, and snakes
Panicum monticola and P. maximum	Fed to livestock
Setaria palustris	Grass commonly used as thatch for houses, stables and tobacco barns
Sterculia africana	Filtrate of burnt fruit used as potash for cooking vegetables Seeds are roasted pounded to powder and added to vegetables as substitute for groundnuts Bark is stripped for string fibre Oil is extracted from roasted seeds
Tamarindus indica	Edible fruit wine production Fruit in abundance is a drought indicator

SOURCE: Chikuni, A.C., "Conservation Status of Mopane Woodlands in Malawi: A Case Study of Mau-Tsanya Forest Reserve" in: L. J. G. Van der Maesen, X. M. Van der Burgt, and J. M. Van Medenbach de Rooy, (eds.), *The Biodiversity of African Plants, Proceedings of 14th AETFAT Congress, August 1994*, Wageningen, Kluwer Academic Publishers, pp. 250 – 258, 1996

The fruit of the Mahuluhulo or Mutambo have hard shells, which contain seeds and juice, eaten fresh or used to brew beer.

Photos: IUCN/ROSA

The Cashew tree prized for its nuts.

Rhynchosia *(Rhynchosia insignis)* are an essential input into sweet maize beer known as *munkoyo*.[30]

Edible plants and mushrooms are processed in a variety of ways including simple drying, more complex preservation techniques and the production of beverages. Drying or processing indigenous fruits to preserve them for consumption outside their normal season appears to be quite common in parts of Zimbabwe, but there is no indication of the nature of their markets. The nut of the Marula, *Sclerocarya birrea* requires considerable processing prior to its sale. Nuts are extracted manually, an arduous task given the hardness of the shell and the need to extract unbroken nuts for the best prices. Twenty-four working hours are required to fill a tin that holds 800 gr.[31]

A few products may be purchased and then processed further. One is the roots of Rhynchosia *(Rhynchosia insignis)*, sold fresh or dried for processing into *munkoyo* beer in Zambia.[32] Also in Zambia, National Breweries buy the fruits of musuku, *Uapaca kirkiana* from rural people for processing into *musuku* wine.[33] Marula fruit can be used to make an alcoholic drink used for work parties and occasionally sold. *Ziziphus mucronata* (buffalo-thorn) fruit is also made into an alcoholic drink, which is sold locally.

Wild foods

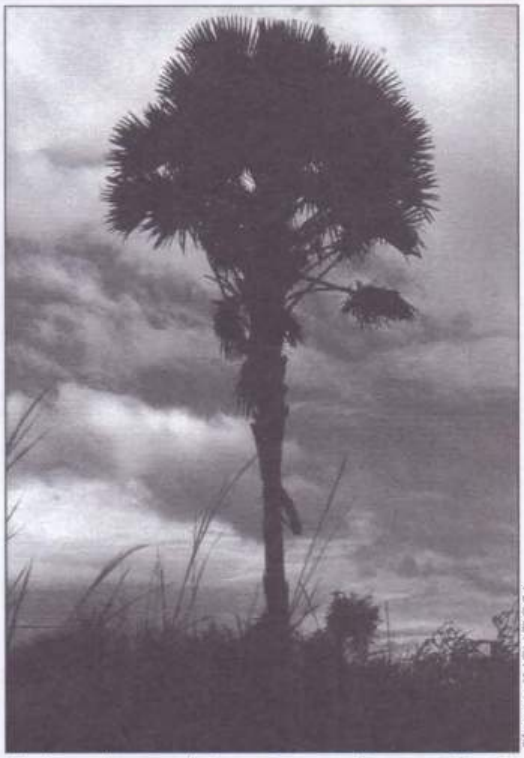
Many wild foods are derived from the woodlands and forests of the region. The miombo woodland produces more than 50 edible plants, including fruits of *Strychnos* (monkey-orange) and *Chrysophyllum bangweolense*, drupes of *Vitex*, *Parinari* and *Uapaca*; flowers and seeds of *Stenostylis*, tubers of yam *(Dioscorea)*, bulbs of *Cyanastrum johnstonii*, and young shoots of monkey-rope *(Adenia gummifera)*.[34]

Photo: M Coates Palgrave

Photo: APG/D Martin

Photo: APG/D Martin

The fruit of the Marula tree (top left) is used to make the popular commercial liqueur, Amarula. Picking the fruit (above), and a detail of the fruit (left).



Photos: IUCN/ROSA

Llala palm used for wine making, with the process (left) of filtering it through a leaf.

In Malawi, during the great famine of 1949, a wide variety of emergency foods were gathered in the bush including wild yam. Some grasses, fungi and roots require long and careful preparation to make them edible.[35] More recently, drought relief tends to take the place of "famine" foods.[36] While the consumption of fresh fruit is still important, some publications indicate that the use of other edible woodland products has declined. In southern Zimbabwe, a shift was found from foodstuff gathered in woodlands towards weeds and pests collected from arable and disturbed land.[37]

Wild vegetables, mushrooms and insects are most abundant in the wet season. Wild vegetables are eaten after boiling but in some cases they are cooked and dried in the sun for use in the dry season. In the case of caterpillars, branches (and even whole trees in some circumstances) will be cut to gain access to them. Young caterpillars may be transported close to home sites and left to grow on a marked tree.[38]

Fruit

There is a rich variety and quantity of fruit trees. In Tanzania 83 indigenous species have been recorded.[39] Wild fruits are mostly consumed by children, but are also eaten by adults when walking through the bush, herding animals or collecting other products.[40]

Wild fruit is not normally a major constituent in the diet but is an important supplementary source of food, as well as supplying vitamins and nutrients. Many fruits are a major source of iron and some, particularly *Parinari curatellifolia* (mobola-plum, mobura), have a high crude protein and calcium content.[41] Wild fruit is consumed mainly in the hot, dry and early rainy seasons before the cultivated crops are ripe. *Grewia flavescens* (donkey-berry) fruits, ground and made into a porridge, comprised

Marula — A tree with great potential Box 6.2

Marula *(Sclerocarya birrea)* is a fruit tree with tremendous potential for development. It has always been a highly valued food source and in terms of fruit yields and taste, it compares well with introduced fruit trees but yet has never been seriously exploited. Some facts about this tree:

- yields of fruit of up to 1.5 tonnes per tree have been recorded;
- vitamin C content of the marula juice has been measured at up to four times that of orange juice;
- protein content of the marula nut is 24 percent (cashews have only 19 percent); and
- the marula nut is also rich in oil; 56 percent of its weight is an oil which can be used either for cooking or industrial purposes.

Some of the commercial properties of this tree are jam, fruit juice, beer or liquor, nuts, oil and fresh fruit.

The major advantage of the marula over introduced fruit trees is that it is drought-tolerant and relatively easy to grow in the dry climate of Botswana. Rather than having simply a popular wild fruit, this tree can be developed into a dependable source of income for rural communities in southern Africa.

SOURCE: Moruakgomo, M., "Potential Utilisation of Veld Products in a Sound Ecological Manner", *Thusano Lefatsheng*, Gaborone, Botswana

nearly 25 percent of food during the dry season in a remote communal area in northern Zimbabwe after the 1981-1982 drought.[42]

A few examples are reported of fruit processing, one being the *Parinari* (mobola or mobura) fruit to make a type of porridge[43] and another, *Zizyphus* fruit into a distilled spirit.[44] Marula *(Sclerocarya birrea)* is made into a beer.[45] In Malawi, in the Mangochi and Lower Shire regions, *Syzygium* (waterberry) trees are managed for fruit production.[46] In the Kgalagadi, the Basarwa people use nuts of the tree *Schinziophyton rautanenii* (mongonogo, mugongo) as a dry season staple food.[47]

More than 50 species of trees indigenous to the miombo ecosystem of southern Africa bear edible fruits that provide people and wildlife with vital nutrients. Many of the fruits, Baobab *(Adansonia digitata)*, Bauhinia *(Bauhinia petersiana)*, donkey-berry *(Grewia flavescens)*, tamarind *(Tamarindus indica)*, Jujube *(Ziziphus abyssinica)*, Musawu *(Ziziphus mauritiana)* and Spiny monkey-orange *(Strychnos spinosa)* are reserves of food during seasonal shortages and famines. These species are under severe threat — rates of deforestation in the miombo woodlands are among the highest in the world.[48]

Some other common fruit trees in the region are *Vangueria infausta* (wild-medlar), *Schinziophyton rautanenii* (magnetti) and *Englerophytum magalismontanum* (milk plum) from which a variety of products can be obtained that include oil, vinegar, jam, jelly and wine.[49]

Ziziphus mauritiana bearing the Musawu fruit is commonly found on alluvial soils, mostly on river terraces of large rivers. It is present in the Muzarabani district in the eastern Zambezi valley, along the Muwamba River of Zimbabwe. Some families collect up to 150 bags of fruit, each weighing 90 kg. Musawu beer also provides a substantial income for some households throughout the year.[50]

Strychnos (monkey-orange) fruits can be decorated locally and made into salt and pepper pots, maracas and ornaments.[51]

Marula sweets and jam can be made from the fruit and an alcoholic drink (as well as a non-alcoholic one) from the flesh. The marula fruit is used to make the popular commercial liqueur, Amarula.[52]

Mushrooms

Moist miombo woodlands have abundant and diverse mushroom populations.[53] In Malawi 60 species of edible fungi have been documented.[54] In the Boni area of the Kasungu district, 26 species of edible mushrooms were identified.[55] In Zimbabwe, research in the Shurugwi area found mushroom populations to be declining. The decline is probably due to the decrease in woodland height and structure,

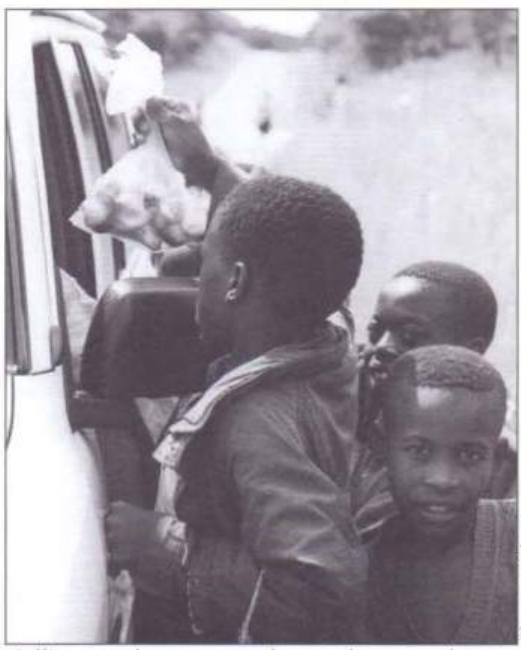


Photo: M. Chenje

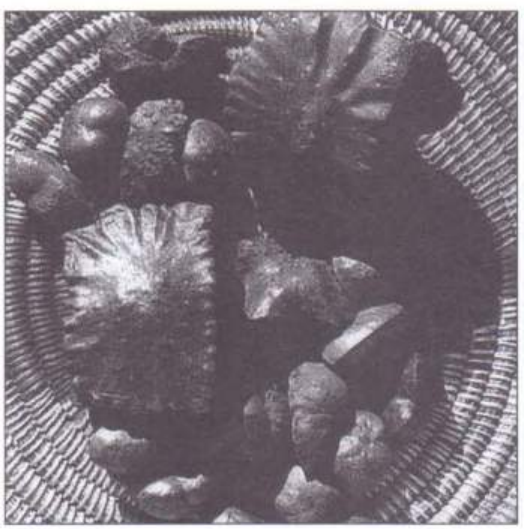
Selling mushrooms on the road to supplement income.

compaction of woodland soils under heavy grazing, felling of trees or collecting leaf litter (some mushroom species have mycorrhizal associations with the leaf litter of particular tree species). Nonetheless, 21 species were collected during one rainy season.[56]

More than 25 species of edible mushrooms including *Termitomyces letestui* and *Amanita zambiana* grow in Miombo woodlands.

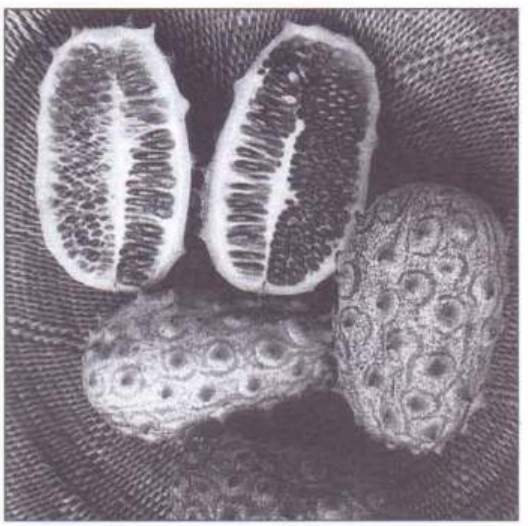
In Zimbabwe, the mushroom season begins with the rains in November-December, and continues to March-April. Mushrooms are eaten fresh and also dried. Fresh mushrooms are eaten by most households, but dried mushrooms are eaten only by the poor.[57] In a village in the Kasungu District of Malawi, 16 percent of journeys to the woodlands in a six-month period were for mushroom collection, second only to firewood.[58]

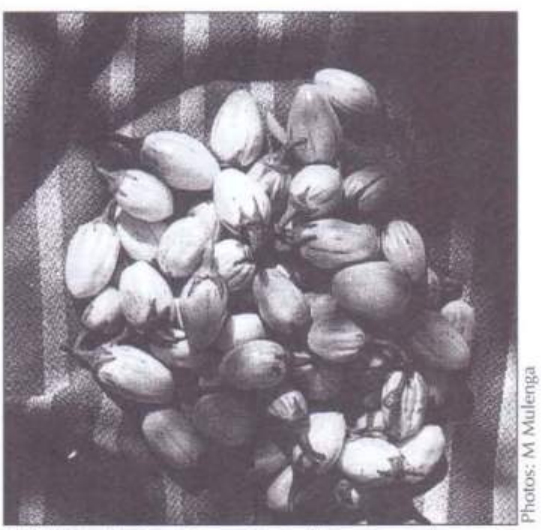
During the rains, the woodlands in Zambia yield between 15 and 25 species of edible mushrooms. These are an important source of food in rural areas, particularly before the first crops mature. One of the species is Chanterelle (*Chantharellus*), which has export potential, especially to Europe, due to its seasonal availability.[59]



Leaves and roots

Wild plant leaves and roots are another important source of food. Rural households in Lushoto, Tanzania consume 15 species of wild leaves.[60] In central Zambia, 10 species of edible wild leaves and four species of roots were recorded.[61] Only a few of the many wild vegetables eaten actually come from the woodlands, the rest are found in disturbed





Photos: M Mulenga

Wild foods form important dietary supplements, such as, yam (left), prickly cucumber (top) and aubergine (above).

Multiple use of indigenous forests and woodlands in central-north Namibia Box 6.3

Central-north Namibia, an area of 51,800 sq km, is the traditional land of the Owambo people. This flat, sandy region supports dry woodland, occupying an area of about 20,000 sq km adjacent to the Angolan border.

The woodland is dominated by hardwood species, especially *Colophospermum mopane* (mopane), *Terminalia prunioides* (purple-pod terminalia), *Pterocarpus angolensis* (kiaat), *Baikiaea plurijuga* (zambezi-teak) and various *Combretum* species. In addition, there is a wide diversity of fruit trees; prominent species being marula *(Sclerocarya birrea)*, bird-plum *(Berchemia discolor)*, sycomore fig *(Ficus sycomorus)*, jackal-berry *(Diospyros mespiliformis)*, manketti-nut *(Schinziophyton rautanenii)* and Makalani Palm *(Hyphaene petersiana)*.

The abundance of species varies over the 400 km width of central-north Namibia; being especially affected by rainfall and edaphic factors associated with the presence or absence of ephemeral watercourses.

Tree species and their uses in Central North Namibia

Species	Use
Mopane *(Colophospermum mopane)*	Poles (houses, roof struts, fences, kraals, well-protection), fuelwood, ladders, millet storage baskets, fodder, rope, pestles, well winches, furniture, food (Mopane worms), drinking troughs, medicine
Purple-pod terminalia *(Terminalia pruinioides)*	Poles (houses, fences, kraals), millet storage baskets, mortars, well winches, furniture, rope, drinking troughs
Leadwood *(Combretum imberbe)*	Mortar and pestle, thresher for grain, fodder
Commiphora species	buckets, cups, dishes
Worm-cure albizia *(Albizia anthelmintica)*	Plates, dishes
Burkea africana	Furniture, mortar and pestle
Makalani palm *(Hyphaene petersiana)*	Bakery, wine, drinking troughs, fencing (poles and droppers), fruit, fish traps, fodder
Bird-plum *(Berchemia discolor)*	Fruit; wine; shade; fodder
Jackal-berry *(Diospyros)*	Fruit, wine, indicator for fresh groundwater, shade, fodder
Marula *(Sclerocarya birrea)*	Fruit, oil, juice, wine, shade, fodder
Sycomore fig *(F. sycomorus)*	Fruit, wine, indicator for fresh ground water, shade, fodder
Baobab *(Adansonia digitata)*	Fruit, fodder
Collina bushwillow *(Combretum collinum)*	Medicine, fuelwood

SOURCE: Marsh, A.C., "The Multiple Use of Indigenous Forests and Woodlands: The Case of Central North Namibia", for SARDC, October 1996

areas growing as weeds. In Shurugwi, southern Zimbabwe, research showed that only two out of a total of 39 species of gathered vegetables came from the woodlands in that area.[62]

Wild leaves, either fresh or dried, are one of the most widely-consumed forest foods, as the base for soups, stews and relishes and to add flavour to rice and maize. Studies carried out in Lesotho and Tanzania found that people favoured the taste of wild leaves over cultivated vegetables.[63]

Many of the edible leaves are of herbaceous plants. The common herbaceous vegetables include *Amaranthus hybridus* (pigweed), *Bidens pilosa* (blackjack), *Sesamum angustifolium* (Sesame) and the edible tree leaves include the tender foliage of *Afzelia quanzensis* (pod-mahogany) and *Zanthoxylum chalybeum* (Kundanyoka knobwood).

Edible roots of several herbaceous plants, for example the tubers of the orchids, (*Satyria siva*); yam (*Dioscorea hirtiflora*) and a legume (*Rhynchosia insignis*) are also eaten.

Insects

Edible insects are another important source of protein, vitamins and energy for local people.[64]

Fourteen species of caterpillars were recorded in the Kasungu district of Malawi[65] of which four were preferred due to taste and availability. Caterpillars are consumed fresh and also dried and stored for up to six months or sold in local markets. Some species are host-specific; others feed from a variety of vegetation.[66]

In Zimbabwe the availability of caterpillars is reported to have diminished markedly. In Shurugwi, of 14 species commonly said to have been consumed in the past, most have decreased in abundance and some are rare.[67] Caterpillars are harvested by shaking the tree or branch and occasionally cases have been reported of people cutting trees to obtain them.[68]

Caterpillar harvesting has an impact on indigenous vegetation if tall trees are cut to collect the insects.[69] The normal practice is to leave the trees on which caterpillars are found intact so that the next season, they can be collected from the same trees.

The most common species of *amacimbi* (Ndebele for Mopane worm), *Imbrasia belina* and *Gynanisa maia*, feed on the Mopane leaves and are usually collected by women and children.[70]

A comparison of the nutritional value of Mopane caterpillar with other food types (based on 100g food) Table 6.5

Food type	Energy content (calories)	Protein (g)	Fat (g)	Carbohydrates (g)	Calcium (g)
Caterpillar	444	56.8	16.4	13.8	458
Cooked beef	172	22.6	8.0	0	16
Raw chicken	146	20.5	6.5	0	10
Whole milk (cow)	79	3.8	4.8	5.4	95
Whole milk (goat)	85	3.4	4.9	7.0	?

SOURCE: Moruakgomo, M. B. W., "Commercial Utilisation of Botswana's Veld Products: The Economics of Phane, the Dimensions of Phane", in Gashe, B. A. and S.F. Mpuchane., *PHANE, Proceedings of the First Multi-disciplinary Symposium on Phane*, Department of Biological Sciences and Kalaharo Conservation Society, Botswana, June 1996, p.33

Termites are another important source of relish. In Zimbabwe, soldier termites are a food for the poor and elderly[71] if consumed as part of a main meal, but the stigma drops away when the insects are consumed as a snack in beer halls where they are popular. There are other claims that eating caterpillars is beginning to be seen as un-modern among some rural people who now reject the practice.

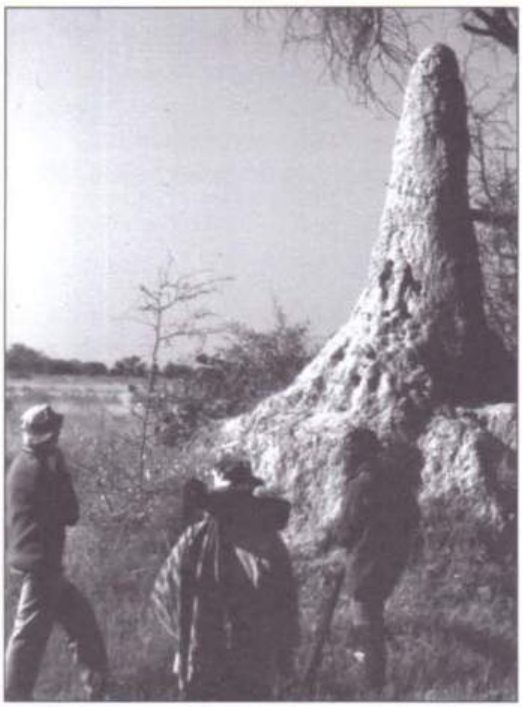


Photo: APC/D Martin

In Zimbabwe, soldier termites are a food for the poor and elderly if consumed as part of a main meal, but also the insects are consumed as a snack in beer halls where they are popular.

As with edible mushrooms, deforestation and, to some degree, over-harvesting have been blamed for declining availability of commonly consumed caterpillar species. In Shurugwi communal area of Zimbabwe, all of the 14 caterpillar species consumed in the past have declined markedly.[72] Although Mopane worms may be exceptional due to their high value, harvesting these caterpillars for sale is sometimes accomplished through highly destructive means such as cutting whole trees.[73] Overall, the availability of insect foods is difficult to assess. While some species appear to be in decline, other insects which do not rely on woodlands but are found in agricultural or other disturbed ground may actually be increasing in importance.

Ants, grubs and caterpillars have similar energy, protein and fat contents as beef liver. Some insects have a higher iron and protein content than fish.[74]

Honey and beeswax

Apiculture is a traditional occupation throughout the miombo zone but rapidly disappearing forests have led to a decline in honey and beeswax production in some areas.[75] A stand of mature miombo has high potential for producing honey and beeswax. Important nectar-producing genera include *Acacia, Brachystegia, Julbernardia, Syzygium* and *Combretum*.[76] Productivity estimates from Tanzania indicate that one sq km can support more than 44 bee colonies, producing 100 kg of beeswax and 1,300 kg of honey per year.[77]

Some tribes are traditional beekeepers, notably the Wanyamwezi in central Tanzania and the Lunda and Luvale in northwestern Zambia. In these areas, it is often possible to introduce improved methods of management and to build up an export of beeswax, as well as a supply of honey for the local market.[78] The existing forested areas, excluding those occupied by the national parks, give Babati District in Zambia the potential for about 75,000 productive bee colonies, representing an annual production capacity of approximately 1,250,000 kg of honey, and about 75,000 kg of beeswax.[79]

Bush meat

In southern Africa, bush meat also provides a major source of protein. Smaller animals are more important than larger game.[80] Wild game, including mam-

Traditional uses of honey Box 6.4

Honey is traditionally used for four main purposes. It provides complementary nourishment, medicine, a good, lasting beer and it is important in many rituals performed by the various ethnic groups of Babati district, in Tanzania:

- Food: Raw honey provides a ready source of energy. Mixed with cereal flour, it is eaten by mothers who have recently given birth to help them recuperate. Honey is also used as a famine reserve during periods of scarcity. The Sandawe people mix sorghum with honey and form it into a cake, which can be stored for many years;
- Medicine: Honey is popularly used as an ingredient in many local medicines. Mixed with animal fat, it is taken for dysentery and general stomach problems. Applied as a lotion, it is used to heal burns and wounds. Mixed with tea, it is drunk to cure coughing and sore throats; and
- Honey beer: The majority of honey is reserved for brewing honey beer, gesuda the Barbaig name that is widely known among all the other ethnic groups of the district. Gesuda has a magic-religious significance for the Barbaig, as well as for the Iraqw and Gorowa tribes. They believe that honey beer is a sacred drink made known to man through divine revelation. If a baby is a breech birth, a gesuda ceremony is necessary to lift the curse of evil spirits. Boys drink gesuda immediately before and after circumcision to reduce the pain. Among the Barbaig, gesuda is drunk on the day when the circumcised boys leave for ritual purification of the area.

SOURCE: Ntenga, G. M. and B.T. Mugongo., Honey Hunters and Beekeepers: A study of Traditional Beekeeping in Barbaig District, Tanzania, Uppsala, 1991, pp. 31-32

mals, fowl, reptiles, and fish, can also be considered non-timber forest products that have potentially high commercial value, but are not generally included in calculations of forest values.[81]

In Botswana, despite large-scale cattle production, people still obtain about 80 percent of their meat from wild game sources.[82] In southern Africa there is an increasing commercial market for dried game meat (biltong).[83]

Photo: IMERCSA

In southern Africa, bush meat also provides a major source of protein. Smaller animals are more important than larger game.

Indigenous forests and woodlands are home to a wide range of non-plant organisms such as insects, lizards, birds, rodents, and large game which are hunted and collected for food. Small mammals such as hares, antelopes, rodents and birds occur widely outside national parks and game management areas. In Zambia they are a common source of game meat for subsistence purposes. However, despite laws and regulations prohibiting illegal hunting, it still occurs for subsistence and commercial purposes by poachers. Most wildlife areas in the region have a long history of traditional hunting for meat, but the decline in wildlife species began with the emergence of commercial poaching.

Photo: M Mulenga

Medicinal stall in Luburma Market, Lusaka, displaying tortoiseshell, bird feathers, snakeskin, assorted vertebrae, porcupine quills, honeycombs, lion skin, twigs, live caterpillars, roots, bark and many other traditional medicaments.

Medicines

The roots, leaves and bark of many different species are used in health care, both as medicine and for sorcery. Plant material combinations are used in self-treatment of such common ailments, such as coughs, headaches, sores and diarrhoea, and people know well which plants can be used and how to prepare them. In a number of African languages the words for tree and medicine are similar. In Zimbabwe, perhaps 10 percent of the country's flora are used by traditional healers with roots and bark of native trees and shrubs making up a significant proportion of the total usage.[84] A traditional medicine, an extract from the miombo shrub *Gymnosporia buchananii*, has been used to treat cancer, and small plantations of the shrub are being grown in Zambia.[85] In KwaZulu-Natal, in South Africa, more than 400 indigenous and 20 exotic species are regularly harvested, processed and sold for medicinal purposes.[86] *Kigelia africana* (sausage-tree) fruit are used to cure skin cancer.[87]

Traditional healers are consulted for some serious complaints and they travel long distances to find the parts of plants they need. The lack of formal health care facilities in the rural areas means that people are dependent on plant medicines which are normally regarded as more effective than European methods. The disappearance of woodlands makes it harder to find the traditional materials and is identified by rural people as a factor in

reducing their well-being. Parts of trees and shrubs are also important components in the treatment of people suffering from spirit possession.[88]

Forest habitat conversion threatens not only the loss of plant resources but also traditional community life, cultural diversity and the accompanying knowledge of the medicinal value of several endemic plants.

More than 80 percent of the world's peoples depend on traditional medicinal plants for their health care and about 20 percent of the drugs in modern allelopathic medicine derive from plant sources.[89]

South Africa exported to the US in 1994 and 1995 about 11,116 kg (US$55,635) and 23,787 kg (US$150,809) of medicinal plants respectively. These were plants with anaesthetic, prophylactic and therapeutic properties, mainly used as medicines or ingredients of medicaments.[90]

Plant medicines are often sold dried or occasionally kept in water, others are ground into powder.

Some medicinal plants from indigenous forests Table 6.6

PLANT NAME	MEDICINAL USES	PART USED
Annona senegalensis	Wound healing, chest colds, diarrhoea, dysentery	Gum, roots
Sclerocarya birrea	Bark infusion used for dysentery treatment, tonic, used for skin diseases	Fruit, leaves
Gymnosporia buchananii	Wound-healing, ulcers, boils, mouth infections, toothache, dysentery	Bark, leaves, roots
Olea europaea	Intermittent fever, laxative, diarrhoea	Leaves, bark, fruits
Aloe esculenta	Treatment of burns	Leaves
Pterocarpus angolensis	Treatment of skin problems such as sores, ring worms	Exudate
Acacia mellifera	Anti-venom – provides relief from snake bite	Leaves, bark
Ziziphus mucronata	Treatment of malaria and diarrhoea	Leaves, bark
Albizia anthelmintica	Used as worm expeller	Leaves, bark
Afzelia quanzensis	Relieves toothache	Bark
Albizia antunesiana	Prophylatic against colds and coughs	Root
Combretum molle	Treatment of wounds and sores	Leaf paste
Diospyrus mespiliformis	Treatment of ringworm, wounds and sores	Root
Pterocarpus angolensis	Treatment of skin ailments	Bark
Tamarindus indica	Leprosy treatment, fevers, laxative, cardiac diseases and constipation	Fruits, leaves, roots, bark
Trichilia emetica	Parasitic skin infections and inflammation, anti-epileptic, bronchial inflammation	Bark, roots

SOURCES: Iwu, M. M., *Handbook of African Medicinal Plants*, Boca Raton: CRC Press, 1993; Ngozi, M. A., "Report on Consumption of Non-wood Forest Products from Namibia", Unpublished report, 1996; Chidumayo, E. N., *Handbook of Miombo Ecology and Management*, Stockholm Environment Institute, Stockholm, 1994, p.51

Leaf litter

Small-scale farmers in Masvingo province of Zimbabwe use woodland leaf litter to increase soil fertility in arable lands.[91] Leaf litter is particularly valuable to farmers who lack access to other soil-enriching inputs and is critical to those who have no land other than their home yards.

Browse

The dry season flush of leaves that occurs in Miombo woodlands during September to November is a vital forage resource at a time when grasses are dry, a month or two before the rains begin. At this time cattle spend up to 60 percent of their feeding time using trees.[92] The new leaves are high in crude protein and mineral content.[93] Cattle, goats and wild animals browse leaves from regeneration, short trees and shrubs.

The fresh leaves from mopane, produced before the rainy season, provide fodder for livestock.[94] The foliage, flowers, green pods and parasitic mistletoes of Acacia karroo are important sources of browse for livestock and game.[95]

Tannins, dyes, oils, resins and gums

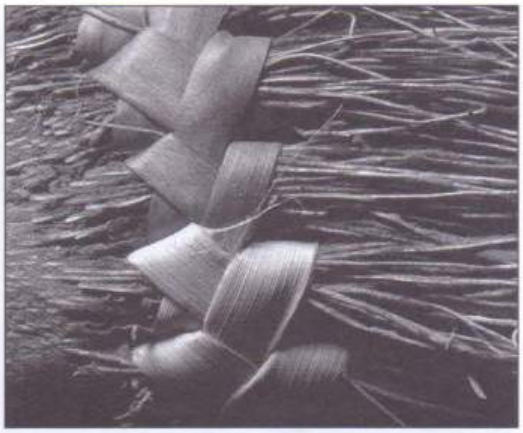
A wide variety of tannins, dyes, oils, resins and gums exists in the region and many of these products are unknown outside of the area in which they are used. There is a high potential for added value and commercialisation.

The only country in which Sweet-thorn *(Acacia karroo)* gum is collected and used as a substitute for Gum Arabic is Zimbabwe, although it does not have emulsifying properties (as for example, *Acacia senegal* further north). The gum is used in various glues, stockfeed, printing, ink, pharmaceutical, mining and pottery. The gum is also widely used as a confection in southern Africa by humans, and eaten by Vervet monkeys and Bushbabies.[96]

Fibre and bark

Bark fibre has a small market in rural areas where it is used to bind leafy vegetables together and is also marketed as a component of handicrafts.[97] The leaves of various palms such as Wild date-palm *(Phoenix reclinata)*, Lala-palm *(Hyphaene petersiana)* and African fan-palm *(Borassus aethiopium)* are also utilised in the rural areas to weave handicrafts.[98] Leaves can be harvested in a sustainable fashion by climbing the palms, but is sometimes done by cutting down the entire tree. It is not known to what degree the harvesting of bark fibre actually destroys the tree, but the degree of damage probably depends on the age of the tree and the part used. Whole saplings are sometimes cut for their fibre, while stems of older trees, stripped of bark are usually unsuitable for poles in future due to the damage.[99]

Photos: APC/D Martin



Photos: IMERCSA

The leaves of various palms are utilised to weave handicrafts, and the fibre of the Baobab tree is widely used for the production of mats and baskets around the region.

The fibre of the baobab (*Adansonia digitata*) is widely used for the production of mats and baskets around the region. The bark from *Acacia karroo* is used to make twine and rope.[100]

The bark of some trees provide cork, made into simple cord (the main building material of half of the world's population), and is a source of chemicals and medicines (quinine and aspirin). The inner bark of certain tree species provide latex, the main ingredient of rubber.[101]

Spiritual and cultural uses of indigenous forests

In Mozambique trees such as rain-tree *Philenoptera violacea* and Kudu-berry *Pseudolachnostylis maprouneifolia* are dominant in areas where people pray for the ancestors and can only be entered with permission of the chief. It is believed that the sacrilege of breaking this rule would end with death or other misfortune of the violator. In Namibia, the Leadwood *Combretum imberbe* is regarded as an ancestral tree.

Photo: IUCN/ROSA

In parts of the region, cutting trees around burial sites, is forbidden.

Forests also have cultural importance as burial sites. In Zimbabwe, as in other parts of the region, the cutting of trees around burial sites, is forbidden.[102] The Thathe forest of the Vhavenda in Northern Province, South Africa[103] is a sacred forest as well as the Hlatikulu Forest in Kwazulu-Natal, where the Zulu chief Dingaan is buried.

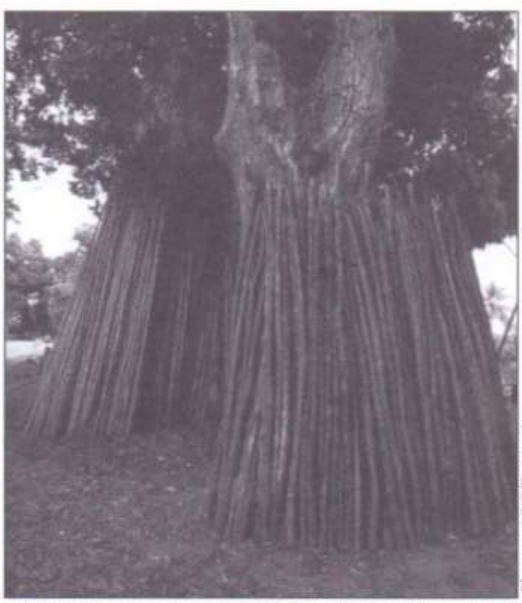
Many southern African communities believe that some tree species provide useful information and indicators of the future. When Donkeyberry (*Grewia flavescens*) produces a lot of fruit it signifies good rains, and the presence of Waterberries (*Syzygium guineense* and *S. cordatum*) indicates high groundwater levels.

Rural livelihoods and uses of products

It is important to understand that products from forests and trees are not all used in a uniform way by all community members. Understanding how collection, use, value and marketing of wild resources is differentiated by wealth, gender, age and ecological situations is essential to assess the overall economic value of these products.

Patterns of different uses in relation to gender need to be explored, given that women are so heavily involved and dependent on woodland product activities. There is a marked differentiation between male and female involvement. Communities are not homogenous groups, and it is highly likely that certain wealth strata may benefit to a greater extent than others from woodland and forest use. Current thinking suggests that it is the poorer rural households which are most dependent on woodlands.[104]

An example of this differentiation can be found in southern Chivi in Zimbabwe. At an aggregate level, the contribution of woodland resources to cash income is not large, reaching only 8.2 percent of the total cash income of about US$200-a-household per



Photos: APC/D Martin

The Mangrove swamps of Zanzibar, with a detail of the seed (top right), and the poles that are sold illegally (bottom).

Photo: APG/D Martin

year. However, this average masks important differences across households. While the top 20 percent of households derive just 2.6 percent of their total cash income of about US$570-a-household from woodland uses, the lowest 20 percent derive 18.5 percent of about US$50-a-household per year.[105]

The composition of woodland-derived cash income also differs across income quintiles. For the three lowest quintiles, the largest source of such income is labour income-based (i.e. thatching, carving, roof-mending, carpentry and digging termitaria). This is consistent with the common observation that the poorest in rural societies are often those with the lowest education and skills who can only sell their unskilled labour for low wages.[106]

Excluding the top 20 percent, there are some activities whose importance rises with income while seemingly similar activities decline. Shares of cash income derived from sales of large carpentry items and large wild animals increases as income rises, while those derived from small carpentry and small wild animals fall as income rises. The explanation of this lies largely in the different nature of these activities.

Making small items (e.g. implement handles, yokes, cooking sticks) is a low-skill, low-return activity with flexibility of species and little time commitment. These activities are more likely to be carried out for cash generation by lower income households who are unable to exploit more lucrative opportunities. By contrast, making large items (e.g. carts, doors, tables, furniture, mortars) requires skill, investment of time in searching for rarer species, working the wood and investment of capital in tools. These activities have higher entry costs and can only be carried out by households which have sufficient access to capital and a large enough labour pool to spare the diversion of (usually male) labour that skilled carpentry requires.

Likewise, hunting and selling smaller animals (mice, birds, rock rabbits) is an activity which can be carried out by many household members, usually children. Hunting and selling larger animals (game) is risky due to its illegality and is only carried out by adult males.

There are a range of activities whose importance in cash income generation declines as income rises, such as sales of wild vegetables, fruits, wood, thatching grass and wine from wild fruits. Some of these like thatching grass and wine, are largely carried out by women and reflect the majority of female-headed households among the rural poor: indeed it may be that access to, and use of, woodland and forest resources are crucial to these households' survival. Sales of wild fruits point to the dependence of the lowest income households on low-skill, low-return activities.

Woodlands and forests provide a wide range of products and services to rural households which make an appreciable contribution to rural income and welfare. These include providing food, non-food and durable goods, inputs into income-gener-

ating, agricultural and other production activities, and inputs into asset formation and maintenance (construction, livestock foods). In addition, woodlands provide a range of indirect values, whether environmental (watershed protection, soil preservation), aesthetic or spiritual.

Classification of forests and woodland products, their importance for various sectors and for trade at various levels Table 6.7

Category of Products	Importance of non-wood forest products					
	Importance to sectors			Importance to trade at different levels		
	Large scale sector	Small scale sector		Local	National	International
		Subsistence	Trade			
Wood						
Fuelwood	**	****	**		****	
Timber	*	***	*		**	***
Craftswood		**	**	*	*	*
Animal Foods						
Bush meat	*	*			*	*
Insects		**	*	*	*	
Fish		**	*	*		
Honey	*	*	*	*	**	
Plant Foods						
Fruits		***	**	*	*	
Fungi	*	**	**	*	*	
Leaves		*				
Nuts		*	*		*	
Roots, Tubers		*				
Flowers		*				
Bark, sap		*				
Fibres and Materials						
Bark		***	*	*		
Thatch	*	***	*	*		
Reeds		**	**	**	*	*
Fertiliser		**				
Live plants	*				*	
Cosmetic and Medicinal						
Medicines		***	**	*	*	
Toxins		*				
Plant Extract						
Dyes		*				
Gums			*		*	

SOURCE: Campbell B. M. & Brigham, T. "Non-wood forest products in Zimbabwe", Arusha, 1993

LINKAGES TO OTHER CHAPTERS Box 6.5

1 A REGIONAL OVERVIEW
The people of southern Africa have for centuries directly survived in the natural environment, hunting wild animals and gathering fruits, berries and nuts.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
Forest products can be grouped as wood and non-wood products. Wood products include firewood, timber, construction materials and other wood materials and services. Non-wood services include game, forest products such as honey and bees-wax, tourism and other indirect services.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
Indigenous forests have traditionally supported the livelihoods of indigenous people. Most biodiversity components have a direct use in people's lives, and this symbiotic relationship is increasingly being disrupted by human development activities.

4 ECOLOGICAL PROCESSES
Ecological process such as the hydrological cycle, carbon cycle and other nutrient cycles are closely linked to forests and associated biodiversity and may be classified as some of those indirect products from forests.

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Factors affecting forests and biodiversity directly impact on the quality and quantity of products realised. As indigenous forests and woodlands are cleared annually for further human development, more biodiversity is lost and present trends depict a future that is not sustainable.

7 ECONOMIC VALUATION AND ACCOUNTING
Indigenous forest products, direct and indirect, have traditionally been taken for granted, and therefore economically undervalued.

8 POLICY ANALYSIS
Sustainable management of forests and woodlands in southern Africa is the sole hope for future quality and quantity of biodiversity resources.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Integrated conservation policies such as ADMADE and CAMPFIRE in Zambia and Zimbabwe ensure sustainable use of natural resources by involving the grassroots in all areas of conservation.

10 TRENDS AND SCENARIOS
Woodfuel continues to be the major source for household fuels in the region. As the population increases, forest and woodland products become scarcer.

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7 ECONOMIC VALUATION AND ACCOUNTING

The value of the environment is widely recognised in southern Africa, with any sustainable[1] and meaningful economic growth being viewed as dependent on the sound management of these resources. To help guide decision-making on the variety of options available to improve management, concerted efforts are being made to value and account for the region's forest and woodland resources.

Accurate valuation is essential to appraising projects affecting forests. Results from valuation efforts can be incorporated into cost-benefit analyses of projects, including conservation, to determine their economic viability. They also have implications for policies, investment decisions, resource mobilisation and project design and management. Valuation can help governments decide how to allocate scarce capital resources among competing land-use activities, and to choose and implement investments for natural resource conservation and development.

At the local level, valuation of forest resources can be used to determine appropriate compensation for local villagers for such things as designation of national parks or dam construction. In addition, the exercise can show the value of recreational facilities like parks as global environmental assets to foreigners, thus influencing external assistance for conservation programmes at the local level.

One of the reasons for the gradual decline in southern Africa's environmental quality can be attributed to the fact that its value is not always reflected fully in economic transactions. This means that the full cost of products or services from forests is not adequately paid. The portion not paid for is usually subsidised by the environment and manifests itself as costs. These include pollution, derelict land, siltation, deforestation and loss of biodiversity.

An environmental management concept that has gained significant support in recent years is the so-called market approach of supply and demand. Its basic premises are that the environment is finite, meaning that natural capital is a scarce resource, and that the most efficient allocation of resources can be attained through the market.

Environmental resource economics views damaging activities as a normal consequence of economic activity rather than the result of illegal acts. It seeks continuous routine and regular means of monitoring and control by treating environmentally damaging activities in the same way as electricity and water supply, to be metered, billed and paid for.[2] Once instituted, this approach operates more or less automatically, unlike the conventional system of direct controls, which requires constant monitoring by the authorities.

The increasing scale of human activity worldwide has prompted the search for approaches that are more sustainable. As economies grow, so does the strain on the finite natural environmental systems that support life on the planet. The natural envi-

ronment provides three main types of services necessary to sustain life:

- a source of raw materials vital for all human activity;
- a sink for waste and residue generated by human activity; and
- a means of maintaining essential life support functions.[3]

VALUE OF FORESTS

The products and services derived from forests are diverse and benefit people at the local, national and global levels. Communities that live on the fringes of forests rely on the resources for most of their consumption goods, shelter and even clothing. Their well-being depends extensively upon the forests. At the national level, forest resources are considered a source of foreign exchange and energy. In Tanzania forests contribute four percent of Gross Domestic Product (GDP).[4]

Forests are regarded as new land for expansion of food production and settlements. They also ensure a regular supply of fresh water, prevent flooding, protect crops from wind damage and prevent soil erosion and siltation of riverbeds downstream.

The global community relies on tropical forests to stabilise global climate conditions, protect the diversity of biological species, support natural ecological systems and provide recreational benefits. People at all levels derive benefits from the amenity value of forests and the knowledge that they contribute to existence.

Forests and woodlands are the source of many non-wood products as well. These include:

- extractives such as bark, dyes, fibres, gums, incense, latex, oils, resins, shellac, tanning compounds and waxes;
- parts of plants and animals are used for medicinal, ceremonial or decorative purposes; and
- food such as bush meat, flowers, fruits, honey, nuts, leaves, seeds and spices.

Most non-wood products are consumed locally. Nevertheless they constitute a valuable resource, and their commercial value per hectare can exceed that of wood products. Certain non-wood products have considerable international markets as well. Rattan, latex, palm oil, cocoa,

Photos: IUCN/ROSA

Mungongo tree and fruit, from the Western Province in Zambia, used for cooking oil and the light wood for carving.

vanilla, nuts, spices, gum and ornamental plants are commodities for which markets exist and are expanding in developed countries.

Forests support about half of all known surviving species. The species and genetic diversity, as well as the diversity of ecosystems found in these forests, are vital for maintaining the balance of natural ecosystems. Loss of genetic diversity can cause maladaptation of species to changing environmental conditions and increased susceptibility to diseases. The diversity of species also has tremendous medicinal value to humans. In 1960, a child suffering from leukaemia had only a 20 percent chance of survival; today a similar child has an 80 percent chance of survival due to treatment from a drug containing active substances from the Rosy Periwinkle, a tropical forest plant from Madagascar.[5]

Biodiversity includes genetic, species and ecosystem diversity implying that its value falls under both the use and non-use categories. Its value has often been understated since it has to take into account the direct use value, the indirect use values, the option values, and the existence values.[6] Undervaluation of genetic diversity diminishes the importance of the forestry sector.

Biodiversity is vital because linkages of species and ecosystems confer existing benefits to all natural life. Its maintenance is essential since there is a potential value of discoveries yet to be made by biologists, botanists, ethno-botanists and modern and traditional medicine from species either unknown or those that are known but have not yet been researched adequately.

While seed-gene banks are generally viewed as a last resort in preserving genetic resources since they store only a narrow part of species diversity, a regional initiative to safeguard biodiversity for the future has been taken in southern Africa by establishing a SADC gene bank in Zambia.[7] However, *in situ* genetic preservation is usually preferred.

Photo: APG/D Martin

Biodiversity is vital because linkages of species and ecosystems confer existing benefits to all natural life.

In Namibia the government is focusing on endemic 'hotspots' so that preservation of biodiversity can be achieved without costly large protected areas.[8]

From the direct use perspective, it is generally acknowledged that genes from wild plants and animals have been the source of agricultural innovation since the beginning of plant and animal domestication and the current high food and commercial timber production in many areas has come about as a result of the wide genetic base throughout the world. Genetic improvement of crops comes through cross-breeding domesticated material with wild relatives for resistance to pests, diseases, drought and adverse soil conditions. The importance of plant genetic diversity is becoming increasingly important with the current environmental threats such as greenhouse gas emissions and climate change, which call for crops that are adaptable. It is envisaged that the long-term food security for the world's increasing population will

continue to be dependent on wild genetic resources.

The majority of the world's poor subsist directly on biodiversity. The wide range of foods obtained from forests play an important role in meeting rural households' food security and improving their nutritional status.[9] In addition, community-based management programmes for wildlife, such as CAMPFIRE, are contributing immensely to the livelihood of rural populations in the region through direct sale or use of products, sale of rights to hunt and exploitation of tourist potential.[10] It is also estimated that 70-80 percent of the population in developing countries rely on traditional plant medicines.[11]

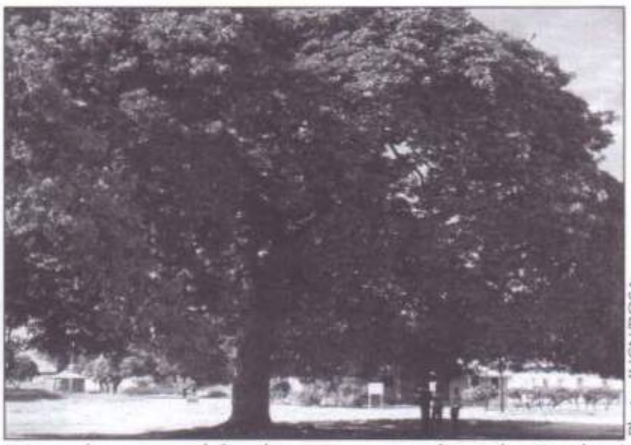


Photo: IUCN/ROSA

Mwande tree used for dugout canoes, along the Zambezi river.

In general terms, the environment provides natural capital on which agriculture, mining, tourism and other economic activities depend.

Until recently, forests and woodlands have normally been assessed in terms of timber extraction value without due regard to non-use values derived by communities, as well as environmental functions such as biodiversity and preservation of watersheds. Thus, conventional methods of forest resource accounting understate the many direct and indirect ways in which forests and woodland resources contribute to the improvement of food security, meeting rural subsistence needs, rural income generation, agricultural productivity and the protection of the environment.

The undervaluation of forest resources is also attributed to the absence or failure of markets for some of the goods and services and policy failure.[12] There are a number of reasons why the market may not function efficiently which calls for intervention. From a resource economics point-of-view, market failure exists when they fail to reflect the real value of an environmental resource. Incomplete information, the existence of public goods, externalities, imperfect competition and prohibitive transaction costs all contribute to market failure. Usually some form of corrective government action involving regulation, incentives or other measures are required to overcome these problems. Policy failures come in many forms, including inadequate property rights regimes, underpricing of natural resources and subsidies on energy, fertilisers and pesticides that lead to negative impacts on the environment.

Concept of total economic value

In analysing the total economic values of forests, it is critical to appreciate that private and social rationality varies greatly. Where a resource is subject to open access, some users generally utilise it with little regard for others.[13] Communal resources such as grazing land are one such example often referred to as the "tragedy of commons".

Economic value, as it relates to natural resources, consists of use values (UV) and non-use values (NUV).[14] The values are either held or assigned and can be used to measure the level of human welfare

provided by both marketed and non-marketed goods and services. Held or ethical values are beliefs that individuals or groups share (e.g. sacred, revered or taboo forests and sites) whereas assigned values are defined as the relative value or worth of forests and woodlands. Held values are usually stable over time while assigned values are less stable not since they reflect adaptations to changing conditions in goods and services, in supply and demand, or in the general environment.

UV arises from the benefits of using the environment and which can be divided into direct use value (DUV), indirect use value (IUV) and option value (OV). NUV, on the other hand, comprises mainly existence value (EV) and it covers the option to use the environment at a future date. The intrinsic valuation of the presence of endangered species or the existence of diverse forest resources, even if they have no immediate use, is an example of existence value. Bequest value, which reflects the desire to conserve environmental assets for the benefit of future generations, is sometimes classified as a component of NUV as well.

Total economic value (TEV) can, therefore, be stated as:

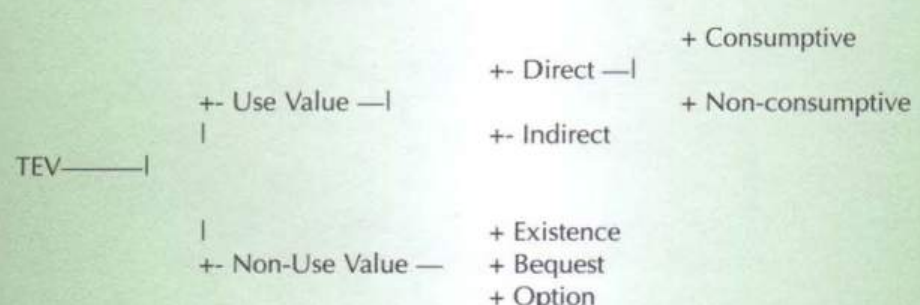
TEV = UV + NUV or
TEV = [DUV + IUV + OV] + NUV

DUV is determined by the contribution that an environmental asset makes to current production or consumption, while IUV includes the benefits derived basically from functional services that the environment provides to support current production and consumption, and it includes ecological functions such as natural filtration of polluted water or recycling of nutrients. The use values include value to individuals who extract timber, food, medicine and other products from the forest as well as those who consider the forest a source of nutrients by means of slash and burn agriculture. They also include the value to foreigners and locals who use an intact forest for recreation, religious and cultural purposes, and scientists who use the forest for research.

OV is the premium that consumers are willing to pay for an unutilised asset, simply to avoid the risk of not having it available in future. It is like an insurance premium to ensure the future supply of forest products, the availability of which would otherwise be uncertain.

Several empirical techniques have been developed to measure the monetary value of environmental assets and impacts. The results from implementing some of these techniques have been controversial, even in developed market economies, and must be interpreted with caution and sound judgement.

Components of total economic value Figure 7.1



SOURCE: M. Mukwekwerere, for SARDC, 1997

The basic concept underlying all valuation techniques is the willingness to pay (WTP) of individuals for an environmental service or resource. Another measure of the economic value is what people are willing to accept (WTA) in the way of compensation for environmental degradation. Empirical evidence shows that WTA compensation for being deprived of an environmental amenity yields higher values than corresponding WTP estimates to retain the same amenity. While there is no explanation for such a discrepancy based on economic theory, several behavioural and psychological explanations have been proposed, all of which centre on the fact that people are less willing to spend actual income or wealth as opposed to opportunity income or wealth — money they do not have but may obtain.

The challenge for valuation and hence natural resource accounting is to consider all environmental components ranging from ecological values, use values to economic values, if sustainable development is to be achieved. Valuation of unpriced natural resources completes the monetarisation of national accounts, and provides governments with a basis on which to determine taxation, charges or subsidies on the use of scarce resources.

Market values for natural resources usually do not reflect true social costs because the institutional and economic context in which they are determined is inadequate to capture features of interest due to:

- lack of properly defined markets in the relevant areas;
- uncertainty regarding future demand and supply of key natural resources;
- the way in which societies make decisions of present versus future consumption;
- government interventions in markets undertaken for other justifiable motives resulting in prices that are not conducive to natural resource conservation; and
- incomplete information on the external effects of economic activity.[15]

Natural resource accounts, considered together with economic accounts and indicators, provide policy-makers with measures of progress towards environmentally sustainable development. They highlight the critical role that policy and market failures play in the degradation of the environment. Gross National Product (GNP) often masks the depletion of natural resources and presents an incomplete picture of the costs imposed by the polluting by-products of economic activity. As a result,

Total economic value of wild lands Table 7.1

USE VALUES		NON-USE VALUES	
(1) Direct Value	(2) Indirect Value	(3) Option Value	(4) Existence Value
harvested products recreation tourism genetic material education	ecological functions protection functions waste assimilation carbon sink	future uses as per (1), (2) and (4)	biodiversity culture, heritage

SOURCE: Barbier, E.B., Natural Resource Degradation: Policy, Economic and Management, LEEC Gatekeeper Series No. 90-01, IIED, London, 1990

people are bound to conclude that the difference in the treatment of natural resources and other tangible assets in national accounts reinforce the false division between the economy and the environment that leads policy-makers to ignore or destroy the latter in the name of economic development.

VALUATION METHODOLOGIES

Paying explicit attention to the economic value of wild products ensures that they are taken into account in planning and policy decision-making. A complete valuation of forests needs to take into account both marketed and subsistence benefits and costs.

Since national accounts include values for certain non-marketed goods or services such as the flow of benefits from owner-occupied houses, national accounts should also include values for environmental goods and services. The challenge is to adjust national accounts for forest depletion, which should include household consumption of forest-based products, and the various functions that forests perform.

Where environmental goods and services are not included in national accounts, a number of biases occur, most important of which are output anomaly, and input asymmetry. The output anomaly can be demonstrated by environmental damage, such as deforestation, that does not negatively affect national income but whose repair (afforestation) causes personal incomes to rise, providing a disincentive for preventive action. With the input asymmetry, certain business expenditures divert labour and materials away from items counted in GDP towards the production of a cleaner environment, which is not counted in GDP. Such expenditures can be incurred in pollution control.

Forest and woodlands resources pose several difficulties with regard to the estimation of their economic value. Examples are:

- absence of markets for many forest products and services;
- difficulty in placing a monetary value on all resources;
- lack of knowledge regarding the value and utility of some forest functions; and
- the difficulty in isolating the benefits of interrelated functions.

It is also difficult to value cultural and traditionally held values of some forest products (ie totems, signs of spirit guardianship and sacred groves within forests). Values of natural resources also vary depending on season or year. In drought periods, most resources may become scarce and their prices increase. Wild products also have different val-

Photo: IUCN/ROSA

Environmental damage, such as deforestation, that does not negatively affect national income but whose repair (afforestation) causes personal incomes to rise, provides a disincentive for preventive action.

ues for different people. Wealth, gender and age may affect natural resource values and hence incentives for conservation.

One problem with valuation of natural resources in southern Africa is the skewed distribution of income. In Namibia, the bottom 50 percent of households receive approximately 10 percent of national income so that if degradation of natural resources were to reduce their incomes by more than 40 percent over 10 years the annual difference would be 0.4 percent in GNP if it were not measured.[16] Since most environmental changes are less extreme and GNP measurements have wide margins of error, many statistical offices choose not to calculate the value of natural resources.

Photo: IUCN/ROSA

The objective is to integrate environmental concerns into the conventional economic decision-making process by providing policy analysts with better information upon which to base decisions involving alternative land uses.

The localised and temporal nature of the values and their variation with the method used, limit the extent to which the values of natural resources can be extrapolated or generalised. Perhaps what is more important is the determination and improved understanding of the economic contribution of tree and woodland resources to individual households.

The true value of environmental goods and services is usually given by their marginal social cost for which there are three components:

- direct costs of production, extraction or harvesting;
- external costs of production, extraction or harvesting, including the cost of damage inflicted or benefits conferred on third parties which are not compensated within the existing structure of property rights; and
- the user costs of production, extraction or harvesting, being the opportunities presented through present consumption of environmental goods and services.

There are, accordingly, several ways in which environmental goods and services may be inappropriately valued in the accounts. The worst scenario is found in communally-owned natural resources that are available free of charge and, as such, have no value in the accounts.

Environmental functions that cannot be valued in monetary terms can be examined using other techniques such as multi-criteria analysis. This may require the development of additional biological and physical indicators of sustainability.[17] The objective is to integrate environmental concerns into the conventional economic decision-making process by providing policy analysts with better information upon which to base decisions involving alternative land uses.

Traditional economic analysis often only accounts for the commercial value of forest resources. Disregarding the non-market value of forest resources – including amenity value – may cause certain alternative land uses to appear more desirable.

Despite the problems associated with valuation of environmental goods and services there are several economic techniques to estimate the value of natural resources such as forests based on conventional, implicit and artificial markets.

Conventional Markets

This set of methodologies is based on the fact that many environmental impacts are closely linked with conventional markets, and can be used for valuation. These include:

- the direct use approach, which relates to the direct on-site production from woodlands or forests of products such as fruit, fuelwood, honey, construction material and wildlife for human use. These products are fairly easy to quantify and assign a monetary value as most of them have both local and non-local markets;

Cost of soil erosion in Malawi Box 7.1

Erosion of topsoil and the exhaustion of soil fertility under continuous cultivation are the most serious form of resource degradation occurring on farmland in Malawi. In recent years declining yields of maize, the major crop, have become noticeable and this is attributed to loss of soil fertility, leaching and removal of crop residues, compaction and loss of soil structure, as well as the physical erosion of topsoil by rainfall.

In a 1990 study (Bishop, 1990), physical erosion of topsoil by rainfall was used as a proxy for overall loss of fertility in evaluating the cost of soil erosion. In the study, yield losses were expressed in terms of foregone farm income to determine gross economic losses from land degradation. The estimated mean rate of soil erosion for Malawi as a whole was 20 tonnes per ha a year.

Soil erosion can impose economic costs in two ways: through on-site reductions in crop productivity and farm income, and through off-site effects resulting from increased run-off, siltation and water flow irregularities. The quality and reliability of urban water supply, the life-span of hydro-electric power facilities, dredging costs for irrigation schemes, and fisheries productivity are all affected by the off-site effects. Although data to estimate the off-site costs of erosion in Malawi are unavailable, the study indicates that the abundance of ground water in most areas suggest the off-site costs may be low.

The on-site costs of soil erosion were captured and evaluated in a number of ways: reduced crop yield; replacement cost of eroded nutrients; and most directly, in terms of the reduced resale of rental value of agricultural land. According to the study, the estimated annual loss of agricultural income arising from soil erosion was roughly MK18 million (about US$360,000 at year 2000 exchange rates) for the low impact erosion and MK116 million (US$2,320,000) for the high impact erosion.

SOURCE: Adapted from: SADC, 1992, *The Fundamentals of Natural Resource Policy Analysis for the SADC Region*, SADC ELMS, Maseru

Photo: IUCN/ROSA

Environmental values are often implicitly linked to ordinary goods and services sold on conventional markets.

- the effect on production of some economic activities may impact the production costs and income of individuals in an economic market through changes in the surrounding natural environment. Deforestation results in increased soil erosion, which subsequently affects crop yields. Using the effect on production approach, the change in crop production, put in monetary terms, is translated as the value of the forest; and
- the replacement cost-preventive expenditure (RCPE) approach considers opportunity cost analysis and uses standard economic measures of market values to determine the net economic benefits associated with the alternatives of one or more uses. The opportunity costs for a park can be the alternative land uses by people living around it. Given the dependence of the villagers on the forests for a significant portion of their livelihood, creating a national park out of a large tract of forest and imposing restrictions over future uses causes a considerable economic burden on the local villagers. By determining recent use in and around the park and projecting future land use changes in the absence of the park, one can estimate the cost to the villagers from losing the opportunity to exploit the park area for agricultural or forestry products.

The RCPE approach also involves productivity analysis by considering the cost of actions designed to return an environmental good or service to a given state of productivity. For instance, clearing woodlands results in the elimination of productivity that can only be replaced at a cost (afforestation). The cost of re-establishing the woodland to its previous productivity levels is taken as the value of the woodland. Productivity analysis can also be illustrated by benefits to farmers of reduced flooding due to reduced deforestation resulting from the establishment of a park and buffer zone.

RCPE is useful where a process has physical effects which are well perceived, and for which there is a possibility of prevention or restoration. The basic premise of the approach is that changes in environmental quality can reduce or increase the quality and quantity of products being marketed. Once those physical changes are identified and estimated with the help of natural scientists, the productivity changes can be valued through economic analysis.

Implicit Markets

Environmental values are often implicitly linked to ordinary goods and services sold on conventional markets. Approaches, which use implicit markets, seek to determine values for a non-market good or service based on observations of actual human behaviour in another economic activity. These approaches require good data and are therefore of limited use in most southern African countries:

- hedonic methods infer values of environmental attributes that are not directly observable from related markets. Common examples include housing and labour markets. The presumption in these studies is that peoples' willingness for houses or

wages will depend on the quality of the environment in which the house or job is located. The methods attempt to break down property prices or wages into their component parts. Property prices are a function of air quality, noise, nearness to schools and other amenities, prevalence of crime, as well as the structures of the building themselves. If all the determinants of the property value can be controlled, the residual can be taken as the impact of differences in environmental quality; and

- the travel cost (TC) method depends on information about money and time people spend to get to a site for recreation or other forestry needs. Although in theory TC can be used to value almost any non-market good or service, in practice it is only used for the valuation of recreational sites such as parks and beaches.

The premise of TC is that users travel from various places to spend time at a recreational site. Although no fee may be charged to access the site, there is a cost involved in travelling to and from the site. This cost, which is the amount of time and money individuals expend travelling to the site, can be used to derive a demand function for the site.

The TC method is used to derive consumer surplus measures (willingness to pay above the actual price) pertaining to the recreational value of woodlands and other scenic sites. The recreation demand analysis (RDA) model uses the amount of time and money visitors spend travelling to a site, as price proxies, together with participation rates and visitor attributes, to estimate the recreational value of the site.

The method is also used in obtaining the price of fuelwood in areas where there is a limited delivery system. This is applicable to most of rural southern Africa due to the low quality of transport services. A value of labour can be estimated and combined with the number of hours per week spent collect-

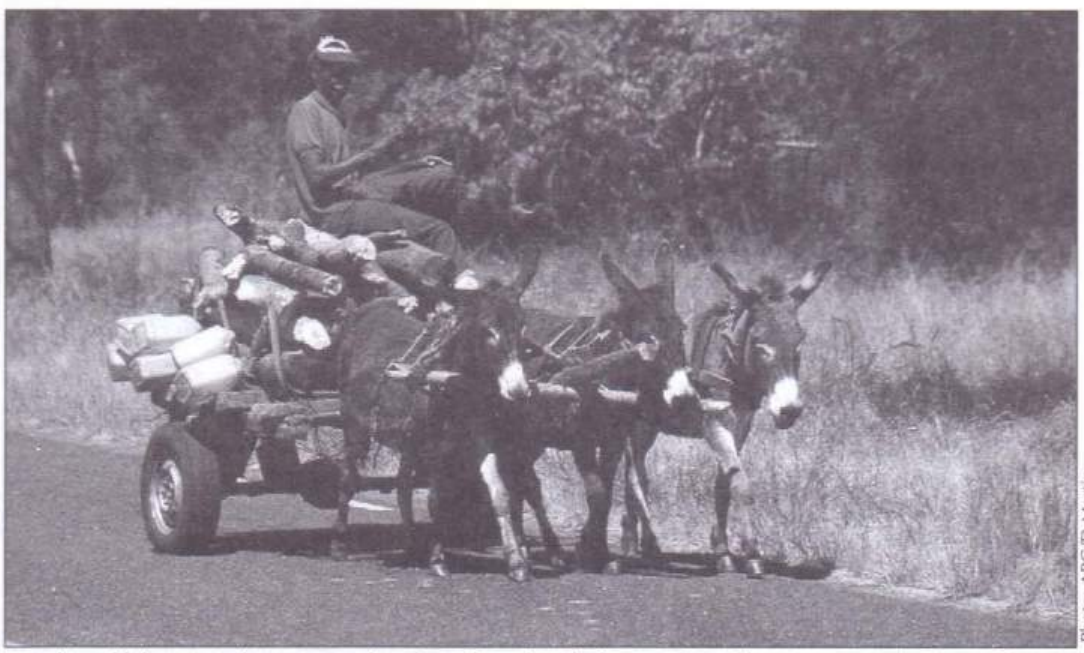


Photo: APG/D Martin

A value of labour can be estimated and combined with the number of hours per week spent collecting and transporting firewood.

ing firewood to gain an estimate of the minimum value of that wood.

Artificial Markets

The contingent valuation method (CVM) is becoming one of the most widely used valuation tools in both developed and developing countries. CVM attempts to elicit information about preferences for a good or service by asking individuals questions about how much they value it. This information can then be used to estimate the total economic value of the goods or services, or it can be used to estimate expected revenue from providing a specified level of these at a given price. The method is suitable for valuing a wide range of non-priced environmental goods and services. Although the respondents are provided with information before hand on the nature of the good or service under consideration and its availability, the method is subject to biases since it hinges on assumptions that:

- people understand their own preferences;
- they are able to transfer the understanding of their preferences to a commonly understood relative scale; and
- they are willing to reveal these preferences.

EXAMPLES OF NATURAL RESOURCE VALUATIONS

Timber products are commonly perceived as the only benefits accruing from forests, although there are numerous other non-timber benefits which relate to conservation, recreation, tourism, ecological functions and biodiversity. More importantly, even local direct uses of non-timber products are not valued, compromising local communities' interests in preference to macro-economic considerations. Apart from market and policy failures, local level valuation is constrained by the variations in local communities and the resulting divergent interests regarding natural resource utilisation. Economic outputs of woodlands and forests can be classified into:[18]

- direct local private benefits: fruit, woodfuel, construction material, wooden utensils, honey, wild foods and medicines;
- indirect, local private benefits: leaf litter, grazing grounds for livestock and termite mounds for soil fertility improvement;
- indirect, regional, semi-public benefits: soil retention and preservation of biodiversity; and
- indirect, global public benefits: carbon sequestration and preservation of biodiversity.

Studies surrounding local forest values have tended to focus mainly on direct local private benefits and to a lesser extent on indirect benefits, using direct methods of valuation.[19] Although the markets for most of the forest products are rudimentary and small, with the monetarisation of most rural economies, local markets for forest products are

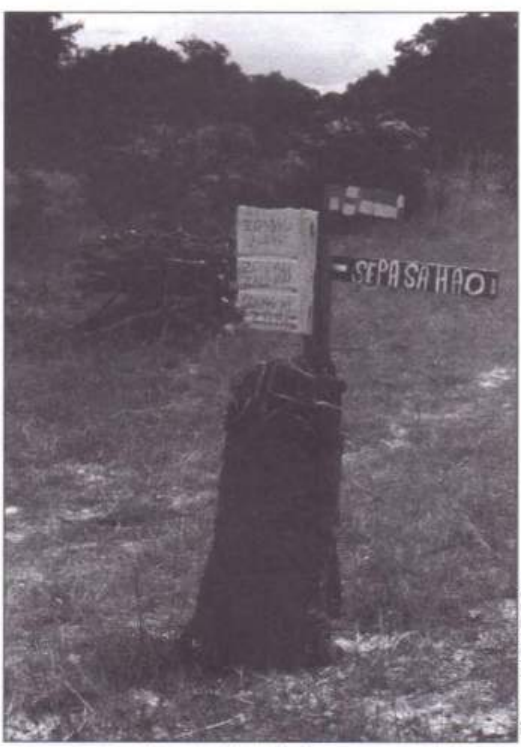


Photo: IUCN/ROSA

In 1995, Zambia produced about 721,000 tonnes of charcoal from 4.3 million tonnes of wood.

becoming active and increasingly integrated into the national, regional and international economies, especially for products such as crafts. Such markets are thriving partly due to government policies on economic reform, which have resulted in the diminished income base of most rural households, which under economic constraints turn back the environment to acquire some of their immediate needs.

Markets for woodfuel are relatively well developed in some of the countries in the region due to the dependence on the resource by most urban households. In Mozambique, annual urban woodfuel consumption is estimated at around 16 million cu m.

In Tanzania, about 91 percent of energy consumed in the country is woodfuel, of which over 500,000 tonnes of charcoal are consumed annually. Seventy percent of the urban population relies on charcoal for its energy needs.[20]

In Zambia, probably the biggest charcoal consumer in the region, about 41,000 people are engaged in charcoal production on a full-time basis while many more participate in seasonal production depending on their economic circumstances. Many more are employed in downstream transport and marketing activities.[21] More than 85 percent of all the charcoal produced is used by urban households. In 1995, the country produced about 721,000 tonnes of charcoal from 4.3 million tonnes of wood.[22]

A study in Zimbabwe,[23] using both direct and indirect valuation methods, established that fruits contribute significantly to the household income share. Crafts also make a substantial contribution, with individuals in marginal rainfall areas, redirecting a greater part of their effort from agricultural production to the craft industry.[24] For example, a thriving woodcraft industry has emerged along the Bulawayo-Victoria Falls road.

Rangelands have also been valued in some countries in the region. In Namibia, the costs of communal rangeland degradation are roughly estimated at about US$100 million.[25] This estimate is restricted to some user costs such as loss of

Value of woodlands in Zimbabwe Table 7.2

Rank*	Product	Value (Z$/ha)	Share[a] (%)
1	Fruit	65	34
2	Woodfuel	42 (32-51)	22
3	Improved crop production through leaf litter	32 (24-39)	17
4	Construction wood	27 (20-33)	14
5	Wild foods	15 (11-18)	8
6	Improved livestock production through better grazing	5	3
7	Wooden implements	4 (3-5)	2
8	Wooden crafts	3 (1-5)	2
	Total value	193 (161-221)	100

* - refers to the mid-interval value

SOURCE: Adapted from Bojo, J., 'Economic Valuation of Indigenous Woodlands', *Living with Trees: Policies for Forestry Management in Zimbabwe*, World Bank Paper, No.210, Washington, D.C., 1993

draught power and loss of milk production. The costs are even higher when meat production losses are included.

Although not quantified in monetary terms, rangeland degradation on commercial farms has led to reduced cattle production rates in Zimbabwe.

Using non-market valuation techniques to elicit information on people's perceptions of a state forest's non-use values (watershed, sacred groves, inheritance, aesthetic and option values), it is generally noted that the local community's perception or value of a forest depends on the community's location relative to the forest as well as the community's access possibilities to forest benefits.[26] Although some forest values are not put in monetary terms, local communities perceive them as having important social and environmental values, which include watershed protection, prevention of desertification, preservation of fresh air, habitat for animals, amelioration of local climate and windbreak value.

Expressing losses of three major plant nutrients in terms of the cost of applying equivalent quantities of chemical fertilisers, the total cost of replacing such nutrients lost due to erosion on communal agricultural lands of Zimbabwe stood at around US$1.5 billion in 1986 (equivalent to 3.5 percent of GDP at that time) or about US$50-a-ha per year.[27] Off-site costs in terms of dams being silted and water needing treatment make the values even higher. Around 50 tonnes per hectare of topsoil is lost annually due to soil erosion in Zimbabwe.[28]

ENVIRONMENTAL ACCOUNTING AND PLANNING

The concept of environmental accounting and planning seeks to bring the environment to the

External costs of rangeland use activities Table 7.3

	Cattle	Wildlife	Useful plants and wood
Cattle		predation	
Wildlife	reduced habitat marketing constraints		
Useful plants and wood	plants; species and numbers decline wood; species decline, but biomass increase	unknown, but probably varied	
Others	decline in ground water recharge reduced CO_2 sink loss of biodiversity adverse distributional impacts	probably a moderate influence on vegetation and watering	risk of loss of biodiversity

SOURCE: Arntzen, J., *Revolution of Communal Rangelands: The Southern African Experience*, Paper presented at the ISEE Conference Down to Earth, Oct. 1994, Costa Rica, 1994

Agroforestry in Malawi: a case study Box 7.2

The rapid disappearance of extensive areas of woodlands in Malawi has been a subject of concern, particularly at the policy and planning levels. However, there is little information on how the woodland resources relate to the wider rural agricultural economy and to the costs and benefits of alternative agroforestry projects. This study evaluates a Tree Planting Bonus Scheme for *Faidherbia albida* (apple-ring thorn), an agroforestry species indigenous to Malawi, which can return substantial amounts of nitrogen to the soil. The principal benefits of an agroforestry system which would increase nutrient availability, are:

- increased yields;
- costs per unit of nutrient that are lower than the costs of chemical fertilizers;
- lower risks of losing benefits from chemical fertilizers in the event of the failure of rains;
- improved soil structure due to the addition of organic matter; and
- increased availability of other outputs such as firewood and fodder.

The principle costs are:

- the relatively long time period involved before benefits are realised;
- the sometimes labour-intensive requirements of agroforestry management;
- problems of establishment; and
- importance of timing of the planting.

In this study farmers needed a stand of 25 trees per ha in order to gain maximum benefits. This cost a total of MK3 (US6 cents) in this analysis, it is assumed that 100 seedlings are bought at MK0.2 (to account for subsidies) plus two days of labour to plant and another day of labour per year to protect. Labour was costed at MK3.30 per-person-per-day. The present value of the establishment costs over 30 years of project life would total little more than MK40 (US80 cents) per ha. Because of higher yields, additional labour of 12 person days per tonne for harvesting, and 5.5 person days for shelling, would be required.

The yields of local maize varieties increased by 15 percent and that of hybrid maize by 50 percent, over initial yields of 850 kg and 1,021 kg per ha, respectively. Added benefits included the production of fodder and firewood.

To produce similar maize yields using the best crop management and chemical fertilizers instead of *Faidherbia* (apple-ring thorn), a farmer would have to use at least 20 kg of chemical fertilizer per ha every year. Under poor crop management, as much as 63 kg of fertilizer per ha would be required. At current prices this would cost at least MK67 for the 43 kg of urea, which would be required in the former instance, or at most MK212 for the 134 kg of urea, which would be required under poor management. Compared with these very high annual costs for chemical fertilizers, the use of *Faidherbia* (apple-ring thorn), for increasing crop yields, at a one-time capital cost of MK40 per ha for tree planting, makes an enormous amount of sense.

SOURCE: Commonwealth Secretariat, *Integrating the Economy and the Environment: Policy and Practice*, Formara Limited, London, 1997, p.31-32

centre of the development debate. Environmental accounting improves the assessment of a country's economic performance and provides better criteria for the choice of development projects.[29] The two major issues of interest in environmental assessment are:

- how to account for the depreciation of the natural capital. In principle, forests can be cleared, soils eroded, and wildlife hunted to extinction without affecting the national income, other than as positive flows from these activities; and
- how to incorporate the costs of environmental damage that do not entail any market transaction and, therefore, go unrecorded in national accounts. The environmental accounting process needs good physical data, which is often lacking in developing countries.

In order to place aggregate economic activity in a policy perspective, the national accounts should attempt to capture all components. Generally, each forest-based good or service in the current account has a counterpart in the capital account, which represents the impact of any change in the standing forest asset on the value of future production of the good or service in question. Undervaluing one component of the account suggests that the component will receive less attention than it should.

Although many issues on the methodology of monetary accounts remain unresolved, it is imperative that respective countries adopt accounting systems (consistent within the country) which at least highlight areas where serious environmental damage is likely, and indicate inter-sectoral impacts of changes in economic activity and damage.[30]

The process of environmental accounting begins with the description of natural resource stocks and flows given in terms of quantitative physical indicators. These indicators are used in the construction of physical accounts or, alternatively, monetary indicators when linked to economic production and consumption. This process enables one to construct monetary accounts, which attempt to estimate the depreciation of natural capital on national or regional level, or aggregate welfare losses due to environmental damage.[31]

The task of developing environmental accounts and their subsequent incorporation into national accounts is not easy and therefore, a staged approach will be more appropriate, especially for most countries, given that there is a general lack of good physical data. A number of countries are developing separate satellite accounts covering

Photo: IMERCSA

Due to such desertification (above) in southern Africa, Botswana has taken the lead in developing environmental physical indicators.

Botswana national conservation strategy Box 7.3

Botswana's rangelands are severely degraded due to soil erosion, depletion of soil fertility, high soil aridity, and undesirable alterations in the biomass and the diversity of fauna and flora. A set of accounts has been constructed for the stocks and flows of the environmental assets on which the economy depends. The table below shows how the national economy has been subdivided:

- extractive resource sectors, which use resources in the natural, form and convert them into raw materials;
- non-extractive resource sectors, which do not generate a product for intermediate or final consumption;
- resource dependent sectors, which process the raw materials supplied by extractive resource sectors; and
- other sectors.

This is envisaged as a first step in the preparation of monetary accounts. So far, user accounts and stock accounts for livestock have been constructed for the years 1979/80-1985/86.

Sector type	Sector Groups	Sectors	Economic Activity
Extractive resource sectors	mining	copper-nickel, diamonds, gold, construction, aggregates, coal, other	mining, quarrying and prospecting
	water extraction and distribution	surface water, ground water	agriculture, water and electricity, mining
	livestock and crop production	traditional, commercial	agriculture
	wood use	forestry	
	wildlife use	subsistence and non-resident hunting, game farming, game-viewing, fishing	fishing, forestry, trade, hotels, restaurants, bars
	landscape use	tourism	trade, hotels, restaurants, bars
	veld products use	mophane and morana worms, marula fruit, mokala palm, grapple plant, thatch grass, silk moth	food, crafts, medicine, construction, clothing
Non-extractive resource sectors	waste disposal and pest control		
Resource dependent sectors	electricity, meat processing, food manufacturing, wood and by-products, hides and skins, crafts, construction	other, own housing	water and electricity, manufacturing, construction
Cultural resource centres	tourism		

SOURCE: Adapted from Markandya, A. and Perrings, C., *Resource Accounts for Sustainable Development: A Review of Basic Concepts, Recent Debate and Future Needs*, LEEC Paper DP91-06, IIED, London, 1991

changes in environmental conditions, usually in physical rather than monetary units. The rationale is that physical indicators will in the long-term be turned into monetary indicators as valuation of environmental goods and services improves. In southern Africa, Botswana has taken the lead in developing environmental physical indicators.

Namibia is in the process of building satellite natural accounts focusing initially on fish, minerals, water, wildlife and livestock. The accounts will show whether stocks are rising or declining and the relative value of different economic activities. For instance, results released so far show very high value of water for fish processing relative to irrigation.[32]

In Zimbabwe, increasing awareness and the development of statutory requirements to consider the environment, have resulted in EIAs increasingly becoming a prerequisite to obtaining government permission to proceed with development.[33]

ENVIRONMENTAL TAXES

Environmental resource economics, which is the most preferred approach by advocates of the free market system, makes use of instruments such as taxes, fees and tradable permits. Taxes used for environmental resource management are often called green taxes. These include levies based on the quantity and/or quality of resource extraction or the discharge of effluents and emissions that are harmful to the environment. It also includes product charges based on commodities that result in environmental cost during their life cycle. Both taxes and fees are important in their role of modifying environmentally unfriendly behaviour.

Economic instruments used for environmental resource management have a considerable potential for generating revenue through taxing both activities that are harmful to society as well as the environment, and the judicious use of natural resources. The process of levying such revenue has great potential to stimulate positive changes in the behaviour of producers and consumers regarding unsound environmental practices and purchases. However, it can also have inequitable impacts throughout the economy that may have to be mitigated by well-targeted welfare-related subsidies. A clear distinction is, however, necessary between the subsidisation of products or services, which cause harmful distortions of market signals, and subsidisation of impoverished persons. The financing of such

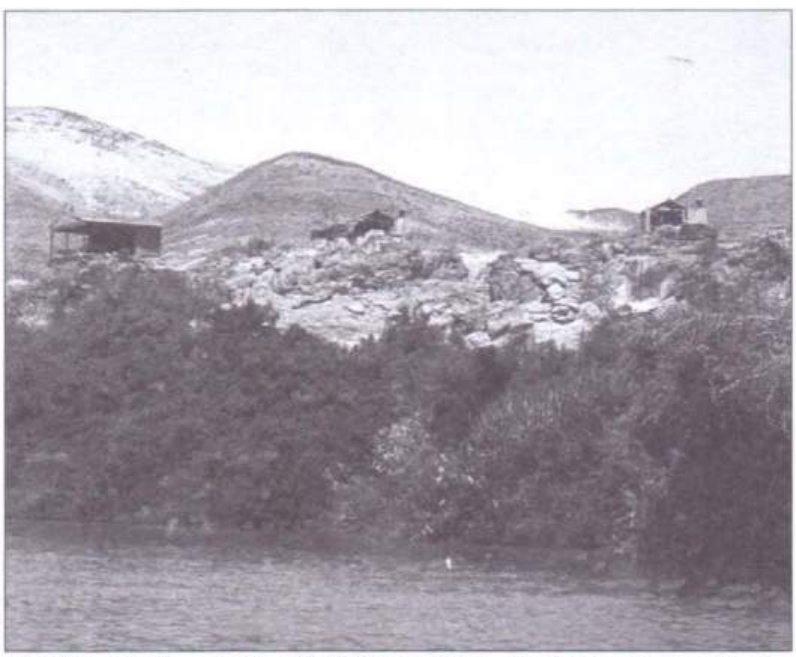


Photo: H McCallum

Namibia is in the process of building satellite natural accounts focusing initially on fish, minerals, water, wildlife and livestock.

Photo: IUCN/ROSA

Economic valuation of forest goods and services and their inclusion in national accounts provides more acceptable criteria of assessing the performance of a country's economy.

subsidies should not place an additional burden on already overstretched budgets.

With the free market system, the right to use the environment should be auctioned to the highest bidder. For example, the right to:

- mine a specific mineral or prospect in a certain geographical area;
- pollute;
- extract a certain amount of water from a river system;
- farm state land; and
- cull game in a national park as part of the parks management plan.

It should also be noted that the free market system which encourages competition normally leads to the rapid depletion of natural resources, since there will be many producers in the market who sell their products at the same price as there will be information in the market. For producers to maximise profits in such a market they have to increase their output, hence the fast depletion of the resources. On the other hand, monopolists in a market aim to maximise profits by bidding up the price and cutting down the volume of output. In a sense a monopolistic market is considered to be conservationist while a competitive one leads to the depletion of environmental resources.

In industrialised countries, most market-based environmental resource management measures focus on pollution abatement. While pollution is important in southern Africa, the allocation, utilisation and property rights with regard to resources are just as important especially when one considers that the region relies heavily on resource extraction and benefaction.[34]

SUMMARY AND CONCLUSIONS

The subject of economic valuation and accounting of environmental resources is increasingly getting more attention in economic development debates due to the pivotal role played by the environment in development. Forests have social, aesthetic, genetic, existential and economic values.

However, it is difficult to value forests in monetary terms as not all of the goods and services they provide are traded in competitive markets. Even more difficult in some cases, markets do not exist for some of the goods and services obtaining from forests, and thus the underestimation of forest values, resulting in less attention being paid to their conservation. Economic valuation of forest goods and services and their inclusion in national accounts provides more acceptable criteria of assessing the performance of a country's economy.

Timber products, perceived by many people as the only benefit of significant value accruing from forests, are supplemented by other important benefits, which relate to conservation, recreation, tourism, ecological functions and biodiversity. Of importance is the recognition and appreciation of the role played by non-timber-forest products in the livelihoods of rural communities, a development that has greatly improved woodland management since direct tangible benefits from resource conservation act as an incentive for sustainable management. This has been the case with some CAMPFIRE programmes operating in Zimbabwe, and People and Parks in South Africa.

Due to their social and economic circumstances, many people in developing countries depend on the environment for their livelihood. Forests are becoming sources of income as commercialisation of products such as fruits, woodfuel and crafts is on the increase. This, to some extent, brings about associated impacts such as soil erosion, loss of watershed protection and biodiversity.

In order to bring the issue of the environment high on national, regional and global agendas, methods of resource valuation have been developed. These range from methods that use conventional and hypothetical markets (effect on production, replacement cost and contingent valuation) to those that study behaviour and assess the explicit trade-offs that individuals make in choices. By combining forest values derived from these methods with environmental physical indicators, monetary values, which can be incorporated into national accounts, are established.

However, due to the poor quality of the underlying environmental physical data in most southern African countries, and the imperfection of valuation techniques, construction of physical indicators will be a good start in environmental accounting.

It is envisaged that food security and health needs will continue to be dependent on wild genetic resources. There is need to safeguard our forests which harbour a large genetic diversity. The establishment of gene banks and protected areas in many parts in the region will play an important role in the maintenance of biodiversity, but this should be done in recognition of the needs of local communities since they play an important role in conservation initiatives.

LINKAGES TO OTHER CHAPTERS Box 7.4

1 A REGIONAL OVERVIEW
The input of the environment to economic growth is widely recognised in the region, with any sustainable and meaningful economic growth being viewed as dependent on sound management of the region's environmental resources.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
While forest products from managed forests and plantations can be easily quantified economically, the economic significance of natural forests and woodlands can only be qualified, and in most instances under-reported.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
As in the case of the general forests and woodlands, the economic importance of their biodiversity is usually under-reported due to the absence of sufficient resource use reporting mechanisms.

4 ECOLOGICAL PROCESSES
Ecological processes such as the hydrological cycle, carbon cycle and other nutrient cycles are closely linked to forests and the associated biodiversity. Their economic importance, however, can only be imagined, and equations linking the different actors in the environment still have to be put in place for the region.

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Factors affecting forests and biodiversity directly impact on the quality and quantity of products realised. As indigenous forests and woodlands are cleared annually for further human development, more biodiversity is lost and present trends depict a future that is not sustainable. Indigenous forests and woodlands continue to supply the basic wood and non-wood forestry products for a growing regional population and, as such, these resources' base continue to dwindle.

6 FOREST PRODUCTS
Indigenous forest products, direct and indirect, have traditionally been taken for granted, and therefore economically undervalued.

8 POLICY ANALYSIS
Evaluating the economic importance of all the aspects indigenous forests and woodlands helps sustainable policy formulation for the whole forestry sector. The region boasts a forestry sector policy implemented by the SADC Forestry Technical Coordination Unit (FSTCU), aimed at equitable distribution of forestry resources.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
As rural and other grassroots communities directly benefit from integrated natural resources management programmes such as ADMADE and CAMPFIRE, they learn to appreciate the economic significance of these resources more.

10 TRENDS AND SCENARIOS
Past forestry policies exhibit the dominance of communalism in pre-19th century times, followed by colonialist-era practices and of late post-independence initiatives.

ENDNOTES

1 In this context, sustainability refers to harvesting no more than would be replaced; sustainable harvest would preserve the interests of future generations by assuring that the volume of remaining timber was not declining over time. It would conceivably be possible to make future generations better off even if the volume of wood were declining over time by providing a compensating amount of some commodity or service they value even more (E. Kula, 1994)

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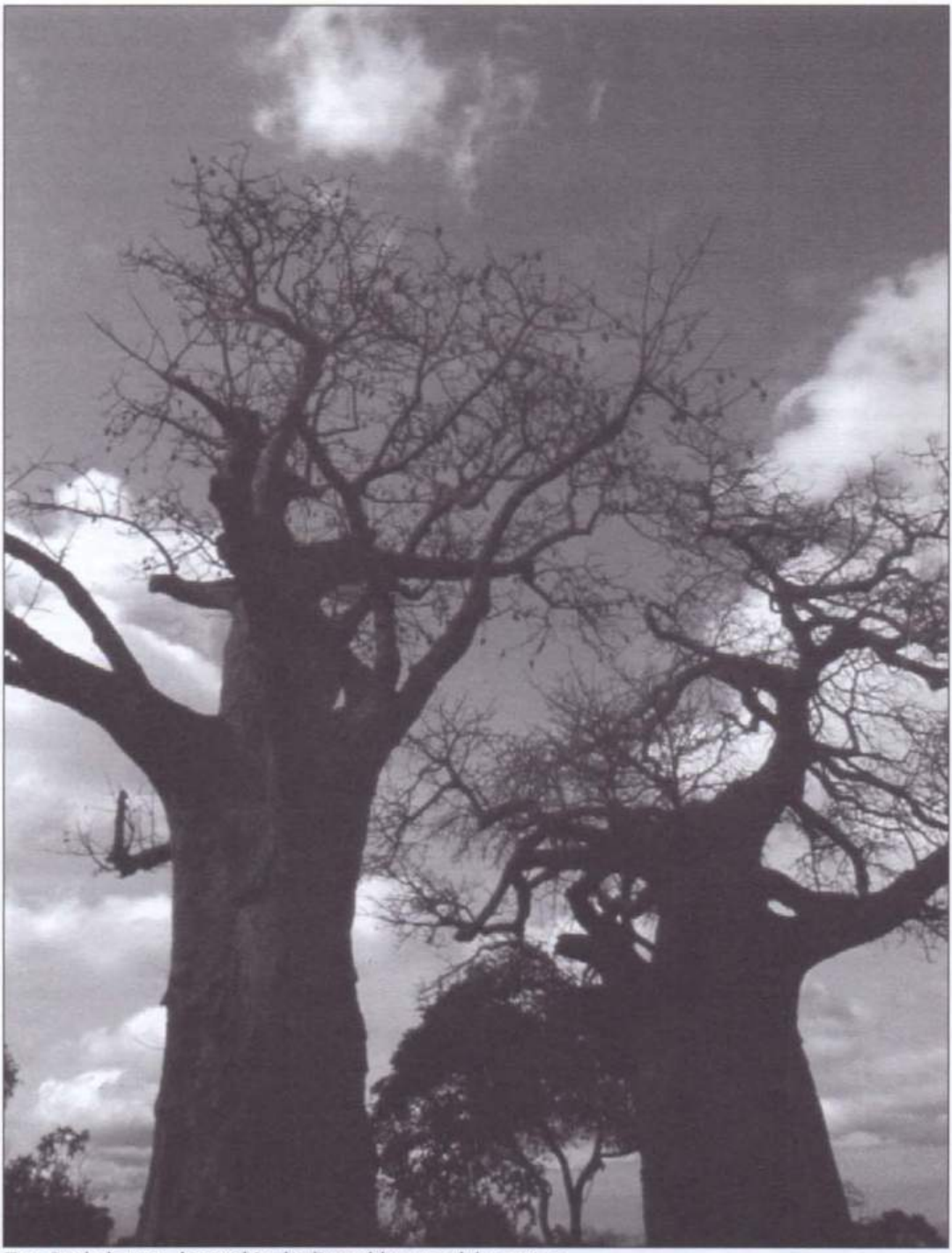

Photo: APC/D Martin

Two Baobab trees, located in the lowveld areas of the region.

8 POLICY ANALYSIS

The performance of the forestry sectors in SADC countries has been at the dictates of their history and needs to be viewed from that perspective. All countries maintain a forestry policy, the instrument which governs the development, management and use of forests and woodlands as well as their associated products. The major objective of each of these instruments is to exploit the resources in a sustainable manner for posterity and national development.

While all policies strive for this goal, there are inherent problems with some national and sectoral policies so that they become more of an ordinary blunt instrument than spearheading the effective implementation of the goals, objectives and aspirations of the people. Policies should not conflict with the aspirations of the people who live with these resources but rather, provide hope for sustainable use and effective management guaranteed to exist into the future.

A number of directions towards specific objectives can be outlined from the forest policies of the member countries, which are similar. Yet, the meaning of policy is only vaguely understood, particularly when it should conflict with access to, and use of, forest and woodland products and other related resources. This conflict is pronounced in those countries where indigenous forests are rare and the policies do not promote development and conservation, or are so restrictive that use is inhibited.

It has been recognised that the major problems facing forestry in Africa include all the issues, which hamper development and the misallocation of all natural resources.[1] These deficiencies include:

- low household incomes;
- weak education levels;
- high population growth rates;
- lack of infrastructure;
- small investment in research, training and extension;
- inappropriate or weak economic policies; and
- poor international market structures.

In view of the fact that the pre-colonial period had within communities, its own set of rules on the use of forest resources, the development of centralised government institutions and the policies that went with them meant that there was now a direct intervention by government in the management of forest and woodland resources. This might also be seen as a direct usurpation of free access and use. To put it more harshly, the traditional management systems had been overthrown by colonial society. It was (and still is) the case that with new forest policies, there would be a better system of forest management and resource use. However, until the policies adequately define the objective, only been modest success is recorded since there is direct conflict between policies that hardly reflect the needs and the realities of today.

The peoples of southern Africa have always had close traditional links with their local environment,

utilising natural resources for sustenance and development. With the advent of colonialism and the introduction of centralised bureaucratic controls over national forests, the rights to land and access to natural forest resources were removed. These controls were introduced on the basis that traditional practices are destructive to the environment.

The colonial policies led both to heightened conflict among users and further assaults on the environment through destruction of natural forests for timber, cropland, fuelwood, pasture, urbanisation and commerce. The resultant deterioration exposed watersheds, accelerated soil erosion and siltation of rivers and reduced the natural resilience and capacity of forests to regenerate and sustain their productive functions.

Colonial forestry policies tended to focus more on plantations in order to meet the growing and specialised demands of industry and commerce. This practice, while greening the environment, led to the erosion of species diversity as large plantations were cleared of indigenous trees and substituted with monoculture of mainly the fast-growing and easily germinable Eucalypts. For example, the Usutu Forest Plantation in Swaziland, covers 65,000 ha but consists of only two species, Hang leaf pine *(Pinus patula)* and Cuban palm *(Pinus elliottii)* species.[2]

The creation of protected areas is an important conservation strategy in the southern African region. More than one million sq km of the region's total land area of almost seven million sq km are designated as protected areas. These amount to 15.66 percent of the total land area of the region.[3] These areas are based primarily on non-consumptive management, which is enforced through command and control legislative strategies. Hunting is prohibited. An underlying basis for the creation of

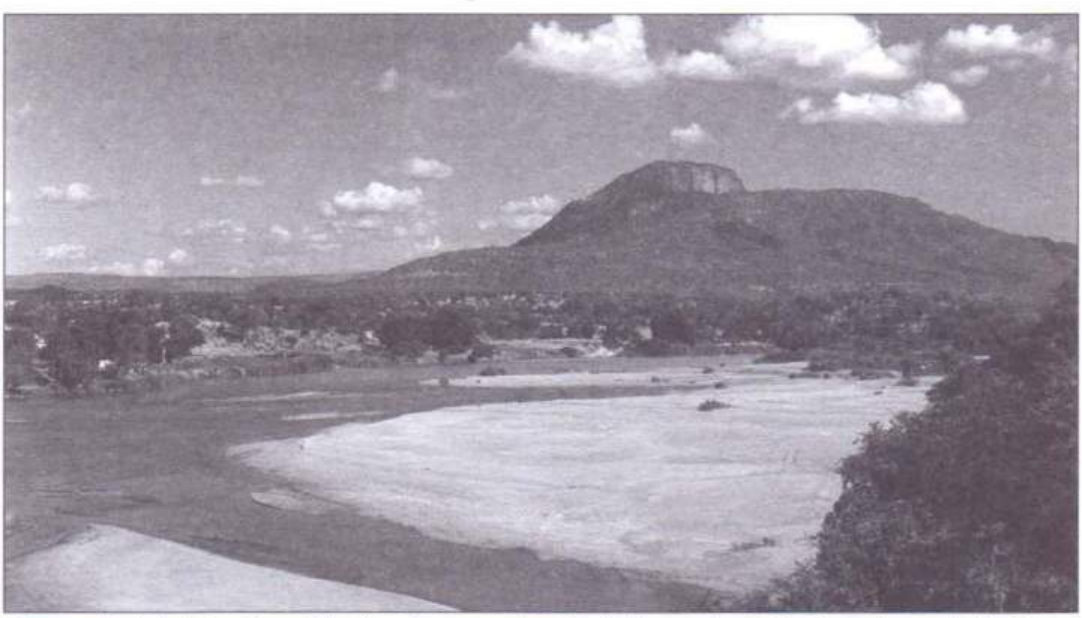

Photo: P Wade

The resultant deterioration of the forests exposed watersheds, accelerated soil erosion and siltation of rivers and reduced the natural resilience and capacity of forests to regenerate and sustain their productive functions.

these areas is the juxtapositioning of development and conservation needs and a belief that one is always at the expense of the other.

Local communities living on the periphery of the protected areas, bear numerous conservation costs, in the form of loss of ancestral land, wildlife damage to crops, livestock and human lives. Additionally, they may be denied access to important food and medicinal sources, building materials and other important values while tenure regimes vary from country to country, however, there are certain commonalities.

Photo: IMERCSA

Local communities living on the periphery of the protected areas, bear numerous conservation costs, in the form of loss of ancestral land, wildlife damage to crops, livestock and human lives.

While government statements indicate that conservation policy is increasingly driven towards community participation, this is poorly supported in national legislation and only partially realised through the establishment of state-initiated programmes. Planning and management processes are primarily centralised and even where there is devolution of authority, effective local participation is not created.

There are a myriad of institutions at the communal level that impact directly upon the management of woodland resources. These include state institutions and their departments or implementing agencies, local government institutions, non-governmental organisations (NGOs) as well as community-based organisations (CBOs). Traditional institutions, knowledge systems and customary practices continue to play an important planning and managerial role today, not withstanding progressive weakening and distortion of these systems.

Current policies on the development, management and use of forests and woodlands are geared towards sustainable development. The policies seek to ensure that management of natural resources contributes to improved agriculture and increased incomes, while not reducing or impairing the richness of the region's natural resource base. To demonstrate their commitment to environmental protection some countries in the region — Mozambique, Namibia, South Africa and Zambia — have enshrined environmental issues in their constitutions.[4]

It is also increasingly evident throughout the region and beyond, that broad-based participation of all interest groups is required to define problems, and to set priorities and goals for environmental management and sustainable development.

Within the context of the region, its natural resource policies and development strategies have been framed with specific objectives achievable within the spectrum of integrated regional natural resources management. SADC's natural resources policy and development strategy "seeks to ensure that the management of natural resources will contribute to improved agricultural productivity and increased incomes, especially for the rural population; while at the same time, ensuring that agricultural and other forms of economic development do

not reduce or impair the diversity or richness of the region's natural resource base."[5] The strategy aims to:

- ensure the conservation of natural resources not only for sustainable production, but also in order to maintain and enhance the quality of the region's environment and natural heritage;
- relate the conservation and utilisation of natural resources to sustainable development, particularly with a view of maintaining and increasing the productivity of the land for the benefit of the rural populations, and the society at large; and
- highlight the outstanding economic, nutritional, scientific, educational, cultural, recreational and aesthetic values inherent in the natural resources of the region.

Photo: P Wade

The interests of the policies on forests and woodlands seem to concentrate more on the timber products of these systems while non-timber products are given low priority.

With increased population growth, many countries in Africa face the challenge of land distribution for settlement and agriculture. With a dynamic population structure and a static resource base, the policies in modern Africa need to take this into account to reflect national population change and associated needs *vis-à-vis* the national gross production from the resource base. However, the interests of the policies on forests and woodlands seem to concentrate more on the timber products of these systems while non-timber products are given low priority.

Designing strategies around civic society

The importance of including local communities in the development of rural afforestation projects is widely recognised but seldom achieved. It is essential that peoples' needs are identified and ranked, that constraints in meeting these needs are recognised and that appropriate technologies are developed. The only way to ensure this is to support localised projects. The community should be able to develop its own projects, having been provided with advice and options available and given access to inputs and markets where appropriate.

Full responsibility for distributing the costs and benefits from projects must be given to the local community (or individual farmer) and the aim should be localised management. A number of interesting projects have been developed in Zimbabwe under CAMPFIRE, where local communities are given direct control of their indigenous hardwood and wildlife resources. The state had controlled these resources on behalf of the communities for decades. The result has been alienation of the resources from the local farmers and poorly controlled laws resulting in open access. The crucial

interest seems to lie in making quick national economic gains in the case of state-controlled production processes such as timber manufacturing while for the communities, especially the rural poor, it is either to make ends meet or simply a matter of survival.

Agroforestry, as a rural development strategy in the SADC region, has the potential to address a wide range of community and household needs – including nutrition, energy and home construction – with few external inputs and on a sustainable basis. The advantages of agroforestry also come with certain disadvantages, often due to poor planning. Problems may arise, for example, when the wrong tree species is selected for a particular situation.

The present trend in southern Africa seems to indicate that policies on forestry may not be the root cause of problems associated with deforestation and land degradation. Forests and biodiversity are being lost despite having policies to prevent this loss.

Land tenure policy debate

The southern African region is characterised by polarised land property rights and differential access to other resources such as finance, technology and in the administration of land. The preoccupation with tenure and capital markets for land and associated products has tended to distort the nature of the debate. Natural resource management in South Africa, for example, is burdened by a long history of dispossession of land from non-whites; legal structures that favoured narrow economic interests and a total disregard for customary law.[6] Tenure rights are generally limited, with the state retaining a large degree of managerial control.

Tenure rights in Lesotho, although described as communal, are essentially usufructory. In

Photo: IUCN/ROSA

The southern African region is characterised by polarised land property rights and differential access to resources such as finance, technology and administration of land.

Botswana, by contrast, land rights in terms of the Tribal Land Act, are perpetual and inheritable. In Malawi, communal land is held under customary law and is inheritable but not transferable.[7]

In Namibia, about 43 percent of land is communal, mainly in the north of the country where at least 50 percent of the indigenous population lives. Most of the communal land continues to be allocated by traditional leaders under differing customary rules. Legally the administration of communal land is under the Development Land and Trust Act of 1936, which is now well behind Namibia's new constitution, and is to be replaced by the Communal

Land Tenure Act. The main thrust of the proposed new act is the creation of land boards responsible for the allocation of land on a regional basis. Communal residents will be eligible for leasehold title for arable land and community title for the commons. Community title will enable the community to exclude new settlers and it effectively dilutes the role of traditional authorities in the allocation and management of land. To avoid total marginalisation of traditional leaders, the government

The Sukuma and Chagga home gardens of Tanzania Box 8.1

The Sukuma, occupy 50,000 sq km in the northwestern Shinyange region of Tanzania, an area composed of gently undulating plains, low ridges and small ranges of hills. Annual rainfall varies from 600 to 950 mm.

The Sukuma practise rain-fed agriculture, composed mainly of mono-cropping but with some small-scale inter-cropping together with animal husbandry. Within this system, they designate some land as dry-season grazing reserves *(ngitira)*, in which one section is completely grazed before the next is opened. The villagers maintain strict control over the grazing areas and impose severe sanctions on trespassers.

The system enables farmers to obtain sustained production with minimal external inputs. Because the system is both intensive and sustainable, it has supported large numbers of people for many years.

Chagga farms consist of a home garden and a plot on the lower plains. Each family has another plot about 10 to 16 km away on the drier and less fertile plains. This plot has few trees and is used for growing annual crops. Although land use on the plots is different, the activities are related and draw on the same family resources.

Sustained cultivation in the home gardens is closely linked to the less sustainable agriculture of the lowland areas. Much of the crop residue from the lowland is carried up the slopes and incorporated into the home gardens. This practice, combined with extensive deforestation, is contributing to rapid depletion of the topsoil on the plain.

The Chagga have an intimate knowledge of the various crops and plants and their ecological requirements. They apply interesting management practices, including the protection of plant species known to repel or eradicate various pests. Each home garden is part of a network of irrigation and drainage furrows that tap runoff from the forest reserve at the top of the mountain.

An important feature of the home gardens is high biomass production resulting from an efficient use of solar energy, water and nutrients. This is due mainly to continuous inputs of organic matter through decaying plant material and farm manure.

SOURCE: Agroforestry in Sub-Saharan Africa: A Farmer's Perspective. World Bank Technical Paper No. 112

intends to consider appointing them to proposed land boards.[8]

Mozambique, struggling to re-build its ravaged economy has also constituted a land commission. In a country where all land is held by the state, the commission must recommend the nature of Mozambique's future tenure, including the issue of resource tenure. The draft land policy maintains the principle that land belongs to the state as vital to protecting community interests. More importantly, the proposed changes to current land policies and legislation will recognise the legitimacy of customary law and the rights of local leaders to manage land and natural resources and associated conflicts.[9]

The new policy seeks to promote rural investment and enterprise without compromising the rights of local people. The land debate should go beyond traditional agricultural considerations and should complement other government policies. The emphasis of the proposed changes is towards greater decentralisation of natural resource management to the lowest appropriate level.[10] The new land policy does not, however, directly address the issue of resource tenure including key resources such as water and forests.

In Zambia, ownership and use of land are determined by the community through traditional leaders. Chiefs also establish rules of land use in communal woodlands and grazing areas. However, the government is calling for the modernisation of the present land code and land administration system so that uniform 99-year leaseholds can be granted on all state land, recognise the role of chiefs and customary rights and the equality of women.

In Zimbabwe, the government constituted a Land Commission to solicit views and consensus on the nature of Zimbabwe's future land tenure. The Land Commission concluded its work in 1994, recommending that communal tenure be retained and the role of traditional leaders with respect to land allocation and resource management be restored. Government will continue to pursue the issue of land distribution with a focus on existing commercial farms for resettlement of farmers from crowded communal areas or landless households that meet the criteria for resettlement.

Macro-economic considerations

The globalisation of trade and markets, and environmental debates has had a major impact on macro-economic policies and development priorities in the region. A case in point is the call for SAPs in Africa, which have been a response to the economic crises of the past decade, and the difficulty for governments to contain expenditure and control inflation.

Photo: IMERCSA

The neglect of the environment and natural resource sectors will impact negatively on socio-economic development.

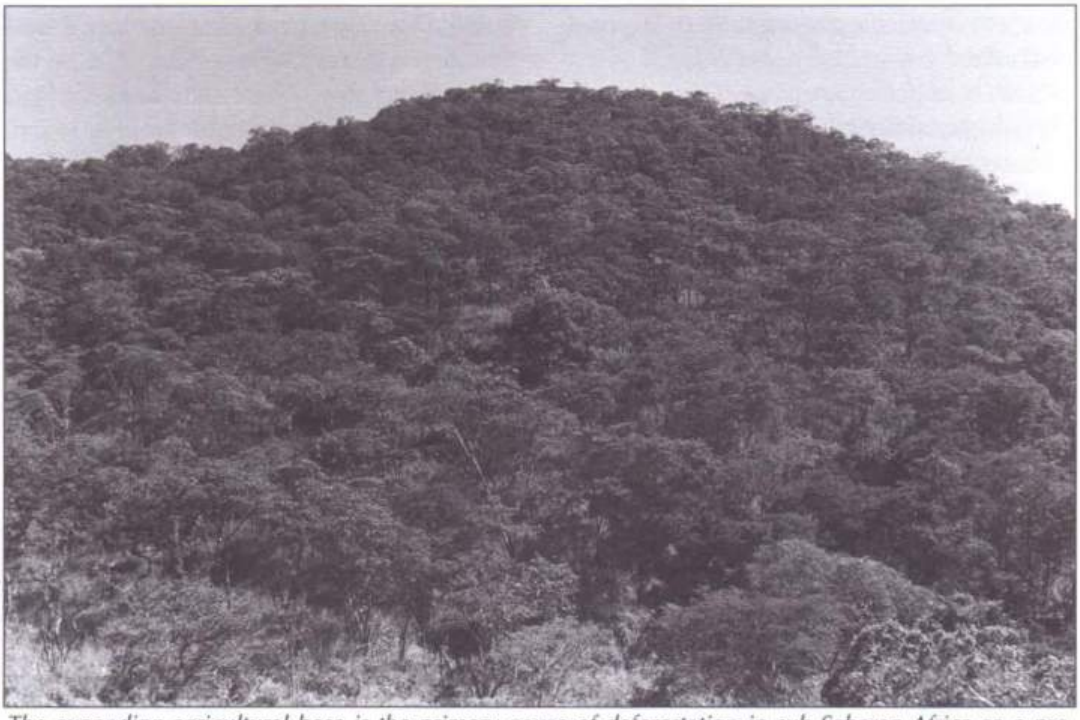

Photo: M Chenje

The expanding agricultural base is the primary cause of deforestation in sub-Saharan Africa so a precondition for the conservation and sustainable use of forest resources would be the improvement in the productivity of agriculture.

SAPs have had a negative impact on the environmental sector because governments have responded to the demand for fiscal discipline by reducing investment in such areas as training, skills enhancement, extension, rural infrastructure, research and other essential programmes. For a region whose economy is highly dependent on the exploitation and processing of natural resources, neglect of the environment and natural resource sectors will impact negatively on the socio-economic development.

SADC governments need to consider relevant factors outside the forest sector that impact on forest development. For instance most agrarian reform programmes view forests as land banks for agricultural expansion. The World Bank observed that the expanding agricultural base is the primary cause of deforestation in sub-Saharan Africa and therefore a precondition for the conservation and sustainable use of forest resources would be the improvement in the productivity of agriculture. In many countries existing policies encourage deforestation by undervaluing and under-pricing forest products. For instance, in Zimbabwe, the Income Tax Act provides tax incentives to farmers to offset costs for clearing indigenous woodland for agricultural purposes. Such incentives have resulted in the clearing of forestland without consideration of its suitability for agricultural purposes.

Designing strategies around new institutions

Decentralisation and empowerment are now considered key to any new natural resource management projects and initiatives. NGOs, donors and

academics are all calling for new policy frameworks that embrace the principles of empowerment and decentralisation.[11] To be successful, these new institutions have to be backed by a commitment to institutional capacity building for both local communities and development agencies including state institutions. This implies a different role for governments because the new approach places less emphasis on central planning and blueprints for development. For governments to respond to the demands of a new professionalism requires that they become more efficient and accountable. Unfortunately there is an observable weakening of regional governments through the imposition of global initiatives such as SAPs, which can threaten Community-Based Natural Resources Management (CBNRM) efforts.

The trend in the region is a shift from communal use rights to *de facto* and *de jura* management by restriction and exclusion. This has come about because the political and economic authority system is changing from traditional authorities to the state in most countries of the region. Customary authority is becoming subordinated, and elected officials of local authorities are becoming more acceptable to the general populace than traditional leaders to deliver and provide wise stewardship for natural resource management. This trend is part of the overall modernisation introduced with SAPs. In Malawi, for example,[12] bureaucratisation of local institutions is such that local authorities administer customary land issues through the ministry of local government.

The lingering question which remains is the weakening of the state as result of global trends and associated conditionalities, the imposition of SAPs and requirements for democracy which combined, have diluted its role in providing leadership with respect to defining a vision of the required economic development for the region. A weakened state is unlikely to mobilise the requisite means to develop governance structures able to facilitate community participation and devolution of the control of natural resources to local level institutions.

It should be understood, however, that greater governance and decentralisation are not a panacea to the current natural resource management problems of the region. The state should not exercise a monopoly over development but forge appropriate partnerships with local communities, NGOs and the private sector in those areas where state structures are weak. People must enjoy the freedom to choose a particular development path based on perceived needs and also to influence the choice of the mechanisms for achieving social and economic objectives.

The manner in which rural people seek to exercise greater control over the natural resources they command must be recognised and supported by the regional governments by involving them in policy formulation processes and provision of other resources. In supporting policy initiatives associated with land and natural resources local people would not expose themselves to greater risk and uncertainty than is necessary.

If indeed the traditional institutions are in a state of disarray and are being substituted by state institutions through the introduction of new land legislation and administrative systems, then the suggestion for devolution of authority to the local level is inadequate as a solution. Even if governments were to sanction unconditional devolution and decentralisation, the problems of power relations, inter- and intra-community conflicts and inequities would not simply go away. The current institutional dilemma requires innovations to create new institutional arrangements that promote adaptive trends able to combine elements of traditional management prac-

tices with newer, modern and formal ones initiated by science and the governments.

If the common property regime is being threatened by outdated and inappropriate rules, then different types of rules especially at the local level, need to be developed.[13,14]

The solution and the way forward is not necessarily a radical shift from central to community-based planning or a rejection of science in preference to traditional resource management systems. Rather it requires a re-think and re-construction of a new resource management science that synthesises the traditional and the modern resource management wisdom on the one hand and an appropriate balance between empowerment of rural poor and involvement of the state on the other.

If this is to work, a shift from the present sectoral approach to an interdisciplinary one is required so that forests and woodlands are not managed outside the farming system. This will demand that concerted efforts towards harmonisation of legislation and policies be made and that the macro-economic planning framework recognises the forests and woodlands as major contributors to the regional economy.

The type of institutional development necessary for a more sustainable future is slow and requires conscious management and support. It should also be responsive to the micro-economic, political, social and cultural issues. A commitment to democracy and good governance and increasing consciousness that the environment is a source of immense economic, ecological and social opportunities offers hope for new forms of partnerships between the state and other stakeholders including communities. This new partnership requires that the state acknowledge that it does not have a monopoly over knowledge, wisdom or development and that it has to seek out new strategies.

Planners and developers acknowledge that only when communities are involved in projects from the beginning, do they support and regard them as their own. Strategies for social forestry should recognise that the life of rural people living within or near forests, revolves around these forests. The rights and successes enjoyed by them should be fully protected. The key lies in associating local people closely in the protection, regeneration and development of the forests as well as to provide gainful employment.

Photo: IMERCSA

Strategies for social forestry should recognise that the life of rural people living within or near forests, revolves around them.

Land tenure issues need to be clearly addressed by forestry policies and law, particularly in regard to the links between tenure and participatory planning and management. These policies should include long-term, inheritable tenure in communal land, as well as redistributed land. If strategies around civic society are to be successful, the question of legislation governing land tenure systems must be reviewed by the SADC states. Top-down methods used from colonial times did not seek either popular participation, or community involvement and should be discarded.

The guardians of tradition Box 8.2

Traditional rules, once established, controlled people's access to resources. Some of the rules prohibited cutting certain trees, methods of harvesting some fruits and other tree by-products as well as access to sacred groves and mountains. Cutting fruit trees was particularly prohibited, as were large trees. In Zimbabwe, it was almost inconceivable for anybody under traditional tenure to cut *Uapaca kirkiana* (muzhanje or mushuku) without the express permission of the guardians of the land. Other trees like *Sclerocarya birrea* (marula) and *Parinari curatellifolia* (muchakata) are directly linked to ancestral spirits and rituals, and were protected by a standing penalty system enforced by the chief and his lineages. Rules governing fruit-gathering were straightforward:

- never pick up mushuku fruit with two hands;
- shake the tree, using a stone or some instrument, as a way of dislodging fruit; and
- no cursing or expressions of delight on quality or quantities of fruits;

In all cases it was generally agreed that if any of the offences were committed, the person would surely disappear in the *jiri* or forest of mushuku trees. Most fruits were supposed to be harvested for use in the home and not necessarily for sale. Some rules limited the amount of unripe fruits leaving the *jiri*, so trees were not damaged by picking. The measures, where enforced, led to the conservation of fruit trees. In terms of woodland management, the rules went further. In almost all of Zimbabwe's communal areas, there exists some *rambotemwa* (a place where there shall be no cutting of trees).

The declaration of such places and their subsequent protection, lay in the land-guardianship phenomenon. At times, such sites were burial places for chiefs, a spring or just a forest whose sacrilege would come through the chiefs. Usually, the *rambotemwa*, once established, could serve to enhance the political position of some lineages. Knowledge about these land units was at times scanty and often led to a gradual loss of the groves as the tradition was eroded.

SOURCE: Adapted from Gumbo, D.J., "Is There Traditional Management of Indigenous Forest Resources in the Communal Lands of Zimbabwe?", in: *The Ecology and Management of Indigenous Forests in Southern Africa: Proceedings of an International Symposium, Victoria Falls, Zimbabwe, 27-29 July 1992*, Zimbabwe Forestry Commission/SAREC, Harare, 1993, p83-85.

Traditional structures and processes

It is still possible to find institutions that are "guardians of tradition". Over the years, they have created rules and regulations that governed ownership and access to resources. Since at least two-thirds of the region's population is rural and directly dependent on natural resources (land, forests, water, wildlife) for economic activity, it is necessary to look at the social, institutional, administrative and legal issues of communal tenure.

Communal or common property is essentially private property for the group of co-owners, each of whom has structured rights and duties within the regime. A strict communal property regime is no different from private property in the exclusion of non-owners. The essential features of communal property regimes are common interests, common cultural norms, indigenous authority systems and some interaction among community members.[15] In most of southern Africa, distinct individual use of

resources under common property is permitted. Designated leaders such as chiefs and kraalheads can allocate user rights on portions of land to individuals or families for their exclusive use.

Under these arrangements the user cannot alienate or transfer use to another individual. However, under increasing population pressure and commercialisation of agriculture, there is a tendency for communal property regimes to evolve towards *de facto* fuller and more secure individual tenure rights.[16]

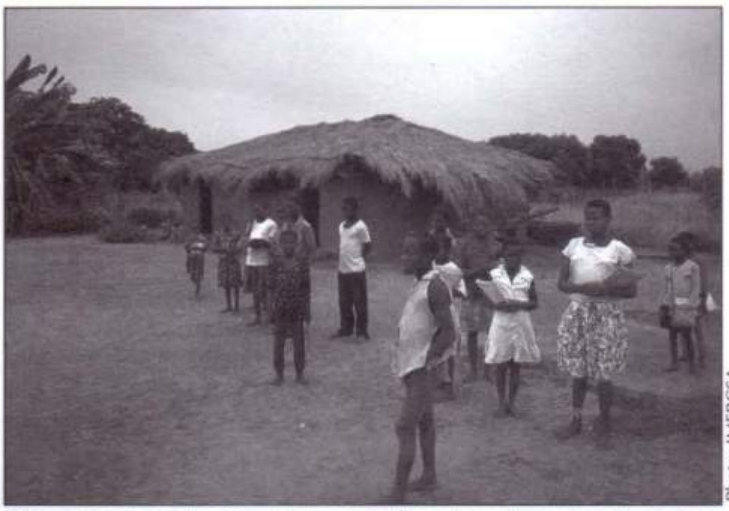

Photo: IMERCSA

The pressure on the natural resource base have been largely responsible for unsustainable land use practices and poverty common in many communal areas.

This general trend holds true for men, whereas women's access to secure tenure in their own right has always been a problem since men have always been the centrepiece of land distribution and use. Yet women are a critical element in providing labour and a source of knowledge about land and are the key managers of natural resources.

Land and natural resource-based conflicts being witnessed in the region are fuelled in large part by the weakness of land and natural resource administrative institutions, lack of clarity of roles of the responsible institutions and poor enforcement of existing laws and regulations.[17] The fundamental issue concerning communal tenure relates to problems arising with respect to land allocation, woodland management, access to water and to conflicts between different social groups. The situation is compounded by the presence of numerous interest groups ranging from the state, public enterprises, district councils, entrepreneurs, migrant workers and landless households, all competing for land and natural resources. These competing demands also put pressure on the local institutions and limited financial resources with respect to control, regulations and planning.

The crowding and subsequent pressure on the natural resource base have been largely responsible for unsustainable land use practices common in many communal areas of the region. In general, this means where a resource is abundant relative to the demand on it, its value is low and user's rights tend to be poorly developed. In both Malawi and Zambia the leasehold system was found to exacerbate tenure insecurity since large land allocations can be made to outsiders. The leasehold system has also encouraged land speculation and marginalised women.[18]

The insecurity and confusion that abounds at the local level must ultimately impact negatively on any efforts at resource management. The confusion around insecurity of tenure is further exacerbated by the fact that trees are not always part of the land on which they grow. In Zimbabwe, the rights to trees also depend on the nature of their intended

Traditional resource management rules and practices Table 8.1

FUNCTION	FEATURE OBSERVED	RULE	SANCTION
Spiritual	Protected sacred mountain groves and also water bodies.	Prohibited entry into sacred mountain groves except on special occasions; Prohibition against harvesting wood or woodland products in these areas.	Getting lost if entered without appropriate purpose; seeing a snake, which leads to death by virtue of seeing it; being threatened by a lion.
Medicinal	Protection of certain species of trees and plants of medicinal value.	Prohibition against excessive or unauthorised plant collection. in kind.	Children becoming ill; divorce; financial sanctions; sanctions
Scientific	Protected sites used to observe weather patterns. Sites used for specific identification.	None known.	None known
Aesthetic	Restricted entry to unusual geographical sites.	None known.	None known
Energy	Protection of certain woodlands, tree species. Prohibition against cutting wet wood.	Prohibition against cutting a variety of important tree species; Prohibition against reaping wet wood; Prohibition against cutting wood for poles in certain woodlands.	Children becoming ill; divorce; If all trees are removed around the homestead, lightning will strike; Financial sanctions; sanctions in kind.
Food	Protection of certain fruit trees; Protection of fruit.	Prohibition against cutting certain species of fruit trees; Prohibition against collecting unripe fruit.	Children becoming ill; divorce; financial sanctions; sanctions in kind.
Cultural/ Historical	Protection of historical sites including: • Old burial grounds; caves; • Sites associated with battles; • Ancient terraces and abandoned settlement; Protection of folk law and myth through: • Protection of sites where there were unusual occurrences; • Protection of certain tree species; • Protection of unusual geological sites.	None known.	None known.

SOURCE: Derived from Clarke (1994) Lüe-Mbizvo and Mohamed (1993), produced in Mohamed-Katerere (1995)

use. Communal and commercial farmers are permitted by the Communal Land Forest Produce Act of 1987 and the Forest Act of 1982 to harvest for the use of residents without a permit. However, in the event of commercial use, a permit is required. The former vests the management of common woodlands in the communal areas in the Rural District Councils (RDCs). The RDCs have a right to grant concessions to outsiders to utilise communal woodland resources for commercial purposes without necessarily consulting the local residents.

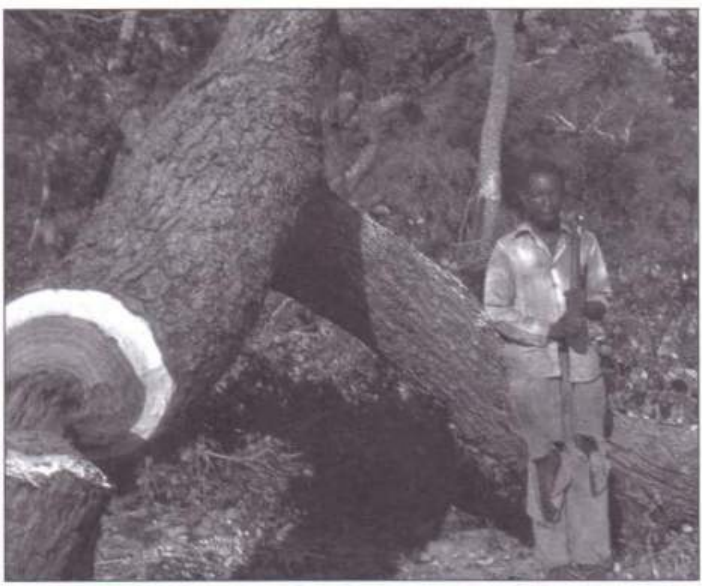

Photo: IMERCSA

Local peasants are arrested for what is considered illegal harvesting of both commercial and non-commercial species.

The lack of institutional clarity at the local level is cause for additional concern and confusion. In Zimbabwe for example, the RDCs have claimed ownership over all indigenous hardwoods and entered into harvesting contracts with timber concessionaires. Local peasants are arrested for what is considered illegal harvesting of both commercial and non-commercial forest species. In granting these timber concessions there is little evidence of community participation in most of the countries in the region.

In Mozambique, undermining community interests and rights in preference to foreign interests continues to the present day.[19] For the rural population in Mozambique, community rights are threatened by the concept of occupation. While people are still recovering from the impact of civil war, the land and natural resources are under unprecedented demand from investors for tourism, hunting safaris, timber concessions and, more recently, commercial farming by settlers from South Africa.

The key to economic growth and poverty reduction in the region has to be rural transformation since the bulk of the region's population lives there. Local land and resource control has to be the key material basis for any rural enterprise approach backed by appropriate institutional arrangements such as decentralisation, governance, power-sharing, investment, access to markets, skills-development, technology-transfer and infrastructure development. Rural people require assurances over present and future cost-benefit streams from the land as well as the right to change from a supply- to a demand-driven rural economic development agenda.

Conservation policies for forests and woodlands

The IUCN World Conservation Strategy considers conservation as a process rather than an activity. Conservation is geared toward three major objectives:

- maintain essential ecological processes and life support systems on which human and other organisms' survival and development depends;

- preserve genetic diversity on which breeding programmes depend, necessary for the protection and improvement of plants and animals, as well as scientific advance, technical innovation and the security of many industries that use natural resources; and
- ensure the sustainable utilisation of species and eco-systems, which support millions of rural communities as well as major industries.[20]

SADC has recognised that "there is a close relationship between good management and conservation of natural resources on the one hand and sustainable social and economic development on the other. Such good management and conservation are essential for breaking the vicious circle of increasing livestock and human population pressure, combined with increasing poverty which causes ecological degradation and in turn, diminishes the natural resources base, further aggravating poverty".[21]

In order to achieve its aims, SADC's critical areas of consideration and emphasis have been identified:

- formulation of concise national policies on natural resources;
- evaluation of natural resources;
- review of legislation;
- training of personnel;
- environmental education;
- assistance to rural communities to conserve natural resources; and
- the implementation of international conventions.

Within the framework of the policy on forestry, SADC aims to maximise the productivity of the resources to attain regional self-sufficiency in forest and wood products.

In pursuing this objective, it is intended that such a policy will also involve the increment of forest plantations and woodlots under national and regional protection, control and sustained utilisation for domestic and industrial purposes and, by so doing, reduce the dependence and over-use of indigenous resources as well as reducing the dependence on imported products.

In order to achieve viable outputs, it will be incumbent upon national policies to focus on issues like land tenure and access to land including empowerment of people and institutions at the central, local and rural levels. In following up, it is recognised that in the case of Botswana, there is a deliberate policy, which serves as a solution package toward reducing the depletion of wood resources. This involves ensuring that each community has good access to woodlands.[22] Incentives would promote the good management of natural resources and the policy intends to put in place a multi-sectoral forestry advisory committee to implement the improvements required in the forestry sector.

The distribution of resources and their quality in SADC are not even from state to state, nor is the demand on them since they have varied value, only some of which is apparent. Similarly, policies also differ from country to country and the degree of conservation and use of different resources is equally dissimilar. What is crucial, however, is a declining supply, in the presence of increasing demand. An examination of different policies on biodiversity in the region is worthwhile.

In Botswana "there is clear evidence that many of (the) resources are under pressure. In some cases this has given rise to concern about the ability of the resources to sustain the needs of future generations".[23] The concern expressed by the government centres on the observation that there is evidence of depleting fuelwood, groundwater, wildlife species and indigenous veld resources, accompanied by land erosion, urban and rural pollution and rangeland degradation.

It is also recognised that for sustainable development to gain meaning, "the present generations consume no more than the annual output or yield of those natural resources which are renewable and that future generations have access to capital stocks of natural resources at least similar to those "presently available".[24] Botswana's strategies on natural resources are well geared to achieve the intended goals of resource conservation and utilisation as they seek to address the following issues:

- increased effectiveness with which natural resources are managed, so that beneficial interactions are optimised and harmful environmental side-effects are minimised; and
- integrate the work of the many sectoral ministries and interest groups throughout the country and thereby improve upon the development of natural resources through conservation.

In the forestry sector, Botswana intends to provide opportunities which seek to improve its contribution to the national economy through improved management methods. Specifically, the forestry policy intends to:

- improve the management of existing resources;
- establish additional woodland areas; and
- develop an economically viable industry where the community will have good access to woodland resources.

In order to improve the wildlife and tourism sectors of the economy, Botswana has moved cautiously, but decisively, to develop a comprehensive package for this area of the economy. The government will review the designated wildlife management areas (WMAs) with a view to re-gazetting them. It also plans to upgrade some of the game reserves to:

- extend protection to all forms of wildlife;
- re-delineate some national park boundaries to include those areas of botanical interest; and
- consider the Lenient-Sauté Triangle as part of the Choke National Park.

In most southern African countries, the economy is highly dependent on agriculture. In Zimbabwe agriculture employs 25 percent of the formal sector and makes up 40 percent of merchandise exports. Even in countries like South Africa and Zimbabwe where the economy is diversified, it is primarily sustained by a production base that is dependent on the exploitation of natural resources. The leading economic sectors of these countries such as agriculture, mining, tourism and manufacturing are all based on the exploitation of primary natural resources.

In Malawi, extensive agriculture dominates the means for increasing productivity, yet this has been the predominant cause of biological diversity loss.[25]

The majority of people lack entitlement to finance, land and natural resources, which are mediated through the market. In all countries, with the exception of South Africa and Zambia, the vast majority of the population is based in the rural areas. These areas tend to be poor ecological zones and are largely unsuited for intensive dryland cropping and most of the uncultivated land is used for livestock grazing on unimproved natural pasture. In most cases there are competing demands on communal lands for grazing, cropping and forestry. With increasing population pressure, more land is being converted to crops with a consequent reduction in grazing land. These factors, together with an increasing demand for construction timber and fuelwood, have put pressure on woodland resources in the communal areas.[26]

Angola has recognised the need to adjust its form and content of economic development in accordance with social needs and ecological capacity. The role of managing the economy at the macro

Photo: IMERCSA

The majority of people lack entitlement to finance, land and natural resources, which are mediated through the market.

level will be to balance the interests of beneficiaries against social needs of the majority of the population while avoiding the degradation of the natural resources to which all want to gain access. There is need to form citizens' associations to work with NGOs concerned with the environment which could guarantee active participation by ordinary people in defining and carrying out environmental policies and education.[27]

To avoid unforeseen increased population problems, Namibia has concentrated on changing land use patterns and introducing family planning initiatives to reverse the current trend of deforestation especially in the Owambo, Kavango and Caprivi areas[28] The strategies involve:

- protecting and conserving existing forests and forest lands and increasing their productivity;
- a rapid increase in forest and vegetation cover in valleys, *mulapos, osbanas*, in catchment areas of the Chobe, Kwando, Okavango rivers and on the semi-arid and arid tracts of the Namib Desert to compensate for loss of forests and vegetation occurring in the country;
- all uninhabited land covered with forests or vegetation to be administered by the government and that land should be declared forest reserves or managed areas to secure the protection and conservation of the country's green heritage;
- in the case of biological diversity, national parks, sanctuaries and other protected areas are to be strengthened; and
- providing fodder, fuel and pasture especially in the hinterland of protected areas as substitutes to the natural resources required for fuel and feed, in order to avoid the depletion of forests and rangeland beyond sustainable levels.

These strategies are also aimed at improving wildlife management so that forests will provide corridors to link protected areas in order to safeguard the genetic continuity between possible subsections of wildlife that may be separated. Supporting structure to these strategies include:

- enhancement of professional competence;
- retention of qualified and motivated forestry officers;
- institution of forest surveys for collection of data required for research and associated needs; and
- establishment of appropriate legislation consistent with these aspirations.

In South Africa, the government has taken steps to address crucial issues affecting the forestry industry as well as including the related biological diversity housed in the country's forests.[29] The government has considered the revision of its policy, which will emphasise support of forestry especially by promoting social forestry coupled with the strengthening of the extension service. Other areas to concentrate on involve:

- monitoring and evaluation of state forests and woodlands to determine if national and international practices are maintained;
- people-driven initiatives in the development and implementation of policy;
- integrated rural development to afford rural communities an opportunity to implement the best options in social, economic and environmental activities;
- negotiated settlements in land disputes especially for the "commons";
- participatory planning and project development at the local and district levels; and
- provision of seedlings and other inputs in the view of promoting forestry development.

There are no significant tax incentives to invest in woodland management. In Zimbabwe, there are clear disincentives. Special tax deductions may be claimed for some costs of stumping and clearing of land. However, similar deductions may be claimed in relation to the development of wells, conservation works and timber plantations, which may facilitate investment in conservation. Positive tax incentives for wildlife management only exist where they are held under captive breeding and this does not include ranching.[30]

Similarly, in the case of wildlife, the law in Tanzania provides that all wildlife belongs to the state meaning a person who leases or owns land is not able to utilise the wildlife found on it and hunting licences are costly.[31] It is a difficult burden to own wildlife

Policy on animal life management in SADC Box 8.3

Policy on animal life management in the Southern African Development Community (SADC), emphasises the following:

- provision of food and hides to the region's population as well as other wildlife products;
- generation of local employment opportunities and cash revenue in areas where there are no other resources;
- contribution of other forms of land use such as ranching, forestry and watershed management to the region's total productivity;
- enhancement of environmental stability and acting as an indicator of its quality;
- conservation of the region's reservoir of genetic resources; and
- protection of the aesthetic, scientific, cultural and recreational values.

SOURCE: SADC; Natural Resources and the Environment: Policies and Development Strategy, SADC FSTCU, ELMS, Lilongwe/Maseru, 1988

and hunting game using traditional methods is prohibited. This state of affairs leaves no room for the people to feel responsible for the resource or incentives to utilise it.

Noting the disadvantages its policies have on wildlife management, Tanzania plans legislation, which provides for the management of these resources by those who own them. The ownership of game, excluding protected areas, would be transferred to those on whose land the game exists and the landowner would have the right to utilise the resource and manage it for benefit. This would reduce, or end, conflict between landowners having wildlife on their land and the state. Landowners would have the sole right of using resources without being obligated by state laws, while the government bears responsibility for looking after those wildlife resources that are specifically limited to protected reserves and parks.

The most telling factor of most existing policies from the past is that there was no consultation by the central government with anyone, including the communities, directly affected. The communities were usually forcibly resettled elsewhere. In the case of areas within rural councils, the local inhabitants subject to any by-laws of the local council, were permitted to fell, take, burn, injure or remove any of the species of trees without a licence.[32] On the other hand, in protected forest areas a licence was generally required to remove forest produce, including removing a tree growing within a specified distance from a riverbank.

Furthermore, the protection of species in the Forests Acts of Tanzania was limited to conserving trees on state lands outside forest reserves by listing them as reserved trees in the schedule to the Act, without specifying the process.

The development of the forestry and wildlife industry in Tanzania required review. As far as wildlife development is concerned, a long-term approach is encouraged,[33] based on the fact that wildlife development projects do not yield immediate benefits or quick financial gains. Emphasis is put on having donor aid used for rehabilitation of existing protected areas, the implementation of village wildlife utilisation schemes, the training of wildlife personnel and the support for research, monitoring and planning.[34]

As elsewhere, the colonial authorities in Tanzania created a number of protected areas whose main benefit rested on providing timber and protecting

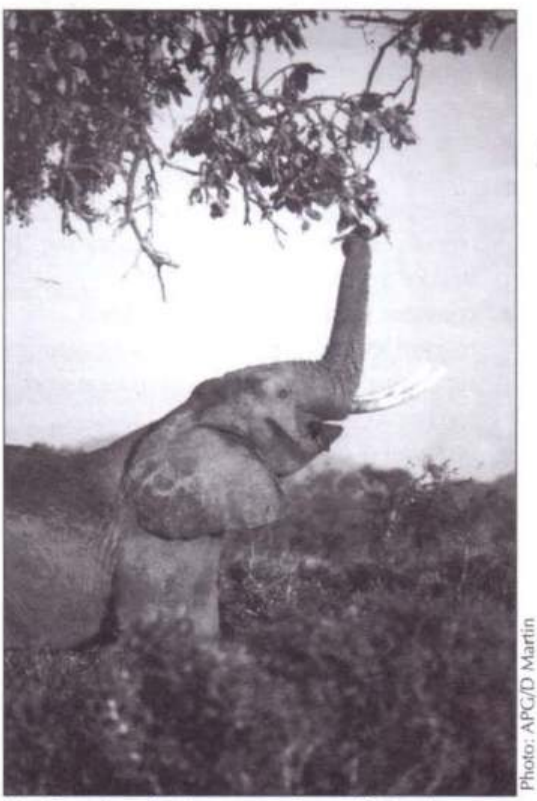

Photo: APG/D Martin

Noting the disadvantages its policies have on wildlife management, Tanzania plans legislation, which provides for the management of these resources by those who own them.

the environment. It was also designed so that the forests would assist in the conservation of water supply, soils and maintaining the climate regime. There was, however, no consideration given to having these protected areas deliver direct benefits to the communities that lived close to them, nor was it ever considered worthwhile in rehabilitating marginal lands. Instead, suitable land was afforested with plantations, which involved displacement of people, creating conflict between governors and governed.

The proposed Tanzania forest policy desires to bring incentives for the promotion of better forest and wildlife management. The policy underlines the importance of bringing forward direct benefits to local citizens so as to serve as a catalyst towards the protection of natural resources.[35] This would involve:

- removal of incentives to use the forests unsuitably such as the present district financing system where individual rights to land depend officially on using it and usually clearing the land for agricultural purposes;
- economic incentives for conservation at national levels like tax concessions for agencies supporting or carrying out conservation work and research; and
- provision of economic incentives for conservation to local communities close to forests such as financial support for individual conservation efforts like terracing or afforestation, revolving community development funds, access to timber and other forest resources.

Under its policy for biological diversity, Tanzania considers that the forest policy should clearly define the objectives of establishing a network of nature reserves. In this regard it is thought that, as much as possible, nature reserves should encourage scientific research, education and appropriate recreation and tourism, excluding consumptive use of the resources.

In several of the economies in the region, mining is an important activity. The cost of economic activities on the environment however, is not adequately reflected in most national legislation. Where economic activities have direct impact on resources, there is virtually no obligation on the developer to undertake restoration activities. One of the most significant economic activities that has direct impact on woodlands is mining which, however, has traditionally been regulated to leave out restoration because it was considered a disincentive.

In Zimbabwe, most mining activities do not require any prior environmental impact assessments (EIAs). Legally only special mining leases require EIAs, but it is now government's policy to encourage companies to undertake EIAs prior to any mining establishment where it might have significant impact on the environment.[36]

In Botswana, the government has moved to address the problems of industry and settlement

Photo: APG/D Martin

One of the most significant economic activities that has direct impact on woodlands is mining.

patterns in the country to improve existing policies and to include the establishment of waste-processing factories and the introduction of incentives to encourage recycling.

Sectoral policies

There appears to be little compatibility between policies and realities. The fact that the colonial forestry and wildlife policies did not take into account management issues for harmonising sustainability with access and right, generated antagonism between the government and local people. The deliberate and stringent policies on natural resources gave no room for communities to feel responsible for their management. Instead, they were seen to be the responsibility of the government. The policies failed to define conservation and sustainable use of forest and wildlife resources and emphasised instead, generating revenue, very little of which was ploughed back to resource management.

However, Botswana views its wildlife resources in terms of their potential contribution to the economic well-being of the nation, as well as in terms of heritage and aesthetic values. In this regard, land-use planning must accord the wildlife resource a position that is commensurate with its considerable potential economic significance. Without this recognition, the imperatives of other programmes, such as the expansion of the livestock industry under the Tribal Grazing Land Policy, mineral development and the arable farming, might inadvertently threaten the long-term survival of wildlife as a major resource.[37] Under the Tribal Grazing Land Policy, land-use activities are divided into commercial farming, communal grazing and reserved areas.

In order to harmonise wildlife management with economic development, the Zimbabwe government, on the other hand, insists upon EIAs for all

Photo: APC/D Martin

In the Okavango delta of Botswana, people are now using plastics to make the mkorikori (canoe), instead of trees.

developments that threatens to affect wildlife and protected land adversely.[38] In addition, the government discourages the indiscriminate exploitation of all indigenous wildlife, particularly rare and endangered species, which are threatened by collecting and trade.

Agriculture, and the deliberate push for cultivation to increase output even on marginal lands have had a marked influence on forestry and woodlands. This impact on land resources can be attributed to land tenure systems and user rights in the SADC countries. Ownership policies and legislation are essential for the management of forests and woodlands in Tanzania.[39] Coordination of activities in the private sector is encouraged with a view to promoting planned development of forestry and forest industries. It is also important that market arrangements should take into account the distribution of forest products as well as the standing international market requirements.

Tanzania's woodlands (and the associated biodiversity) are deteriorating every year due to land clear-

Land tenure systems and resource management Box 8.4

Agricultural holdings: The majority of farm units in most countries consist of individual or household farming operations. Tree planting on these holdings takes a variety of forms: mono-cropping, alley cropping and windbreaks. In such a system the tenure issue is thought to be the extent to which the farmer has the security of tenure needed to invest in trees. Trees are slow maturing and so, constitute a long-term investment. Their costs, including opportunity costs, may not begin to be recovered for some years, and complete recovery will require a long period. The farmer will want to be sure he/she can hold onto the trees until those costs can be recovered; there is a need for secure tenure.

Commons: A communal forest or a village woodlot is a "commons". Tenure and management are vested in the community, and the critical issue is the effectiveness of community resource management. The community may be a lineage, an age-set, a religious group or a cooperative. In the classic commons, the members have rights to utilise land or trees concurrently or sequentially as individual producers. But unlike the holding, no user has the right to exclude others. The group does have the right, however, to exclude non-members from the use of the resource. Common property situations may involve broader or narrower rights of exclusion by the community and greater or lesser effectiveness in the exercise of those rights.

Government forest reserve: Government (national, regional or local) may own forests and seek to protect these resources. The forest may be natural, sheltering biological resources and genetic diversity of great value; or it may be managed for commercial production, with areas periodically cut and replanted. Governments have asserted the need to create reserves to protect forests from non-sustainable use in free access or ill-controlled commons situations. While exclusion of farmers is of critical concern in creation of reserves, ineffective control by the state means that use sometimes continues on an open basis.

SOURCE: Bruce, J.W. *Community Forestry: Rapid Appraisal of Tree and Land Tenure* Forestry Department, FAO, Via delle Terme di Carcalla, Rome, 1989.

ance for agriculture, uncontrolled fires and local over-exploitation for firewood and charcoal. Aggravating this is excessive deforestation close to towns caused by the demand for charcoal and firewood. In some areas there is significant industrial consumption of firewood from natural woodlands for curing tobacco in Iringa and Tabora, salt-making in Tanga and Kigoma, and by the Kilombero Sugar Company, or for brick making and smoking fish.[40]

The threat from industry on forest and woodland resources in the SADC region should not be regarded as minimal. Various industries have consumed forest resources for quick financial gain, with little regard for conservation and sustainable management.

Clear examples can be seen in tobacco-producing countries where large volumes of wood are harvested from natural woodlands for curing. In Malawi, tobacco estates use a quarter of all the fuelwood consumed in the country. In Zimbabwe, an estimated 700 sq km of woodland are cleared each year to grow tobacco.[41] While governments strive to

Photo: M Chenje

In Zimbabwe, an estimated 700 sq km of woodland are cleared each year to grow tobacco.

reduce deforestation, they have failed in many cases to provide alternatives for energy needs. This trend can also be attributed to the high cost of electricity in many countries of the region, as well as its spread to rural areas where once it was almost non-existent. The need for household income serves as yet another cause of deforestation and over-exploitation or illegal use of forest and woodland resources. Poverty may be the driving factor behind forest and woodland misuse.

International conventions

In southern Africa, the conservation of biological diversity has to be perceived through the recognition and respect of community rights and the contribution of traditional communities and farmers to its evolution and conservation based on the fact that until recent times, it was local communities who conserved biological diversity, who were the custodians of the wealth of the planet. It is their control, their knowledge and their rights that need to be strengthened if the foundation of biodiversity conservation is to be strong and deep.[42]

The four criteria for measuring the effectiveness of the policy and legislation in the context of the forestry, woodlands and the conservation of wildlife as well as the environment, is based on:

- protected areas for the forestry sector which should be established for the purposes of pre serving biological diversity at the ecosystem, species and genetic levels;
- land use in protected forest areas planned through a zoning system so that the area will be a mosaic of individual, smaller protected areas of strict nature reserves to zones where certain regulated activities are permitted;
- protected areas for forests established for the conservation of viable population of species of wildlife in its broader sense and the variety of associations in which they exist in order to ensure the conservation of ecosystems. Species are the building blocks of ecosystems and the loss of biological diversity is directly linked to both plant and animal species extinction;[43] and
- a system of recovery plans for the species threatened or in danger of extinction.

International conventions with relevance to indigenous forests and woodlands Box 8.5

Ramsar Convention (1971): This convention provides the framework for cooperation in the conservation of wetland habitats. Wetlands are sensitive to trans-boundary air and water pollution. Many wetland fauna are migratory species whose conservation and management requires international cooperation. Under this convention, which came into force in 1975, the contracting parties should, among other things, designate one or more wetlands for inclusion in the List of Wetlands of International Importance. One of SADC's initiatives to implement the Ramsar Convention is the Regional Wetlands Programme coordinated by the World Conservation Union Regional Office for Southern Africa (IUCN-ROSA) and the Southern African Development Community Environment and Land Management Sector (SADC ELMS).

CITES (1973): The Convention on International Trade in Endangered Species of Wild Fauna and Flora regulates, and in some cases bans, trade in endangered species to preserve genetic diversity. The convention came into effect in 1975 and the agreed endangered species covered by the convention are classified into three appendices. Species can be removed or transferred from one appendix to another, with approval of the states, which are party to the convention. In 1989, the conference passed a resolution listing the African elephant in Appendix I, banning trade in elephant products (ivory and hide) despite opposition from some SADC countries such as Botswana, Namibia and Zimbabwe. These countries believe that sustainable utilisation of elephant is the right approach, since it is beneficial for the habitat, the local people and the elephants themselves. The elephant was, however, down listed from Appendix I to Appendix II by the CITES conference held in Harare in 1997 for Botswana, Namibia and Zimbabwe.

Basel Convention (1989): The control system provided by this convention, adopted in 1989, ensures that no hazardous wastes are shipped to a country, which has banned their import. Every country has the obligation to reduce hazardous wastes to a minimum, and dispose of them as close as possible to the source of generation. The problem of international traffic in hazardous wastes gained prominence in 1989, which prompted worldwide public awareness of the growing threat to human health and the environment due to toxic wastes, which were being dumped in the millions of tonnes across national boundaries, especially in Africa.

Bamako Convention (1991): The Bamako Convention bans the import into Africa, and is responsible for the control of trans-boundary movement and management, of hazardous wastes within Africa. This convention came into force as a result of refusal by most African countries to ratify the Basel Convention, due to their concern that it was not strong enough to stop dumpers from using Africa as a landfill for dangerous chemicals. The Bamako Convention, adopted by all SADC countries, aims to promote the development of clean production methods, for the sound management of hazardous wastes produced in Africa.

Convention on Biological Diversity (1992): The Convention on Biological Diversity was signed by more than 150 countries at the Rio de Janeiro conference following its adoption in Nairobi, Kenya, in 1992. The convention came into force in 1993. The objective of the convention is to conserve biological diversity, promote the use of its components and encourage equitable sharing in the benefits arising from the utilisation of genetic resources. Successful programmes aimed at implementing this convention are taking place in southern African countries, for example, the Communal Area Management Programme For Indigenous Resources (CAMPFIRE), in Zimbabwe, and the Wetlands Programme in the Kafue and Bangweulu Flats, in Zambia.

Convention to Combat Desertification (1994): Africa was given priority and particular attention in this convention, because desertification has its greatest impact on the continent. Two-thirds of the African continent is desert or dryland and 73 percent of its agricultural dry lands are severely or moderately degraded. Due to physical factors (plant cover, fire, drought) management factors (grazing intensity, cultivation of marginal lands) and historical and socio-economic factors (inequitable land allocation, population densities and poverty), land degradation in SADC countries is now a growing phenomenon.

SOURCE: SARDC; Southern African Environmental Issues NO. 14, SARDC, Harare, 1996.

Photo: IMERCSA

Two-thirds of the African continent is desert or dryland and 73 percent of its agricultural dry lands are severely or moderately degraded.

Recommendations for legal framework Box 8.6

Public participation in the conservation of natural resources in general and in the forestry sector in particular, is important because it:

- increases the probability of developing sound, acceptable decisions by enabling the decision-makers to take into account the collective experience, knowledge, values and judgement of the relevant stakeholders;
- provides the public with access to the decision-making process in the conservation, management and use of forestry resources ensuring that decisions reflect the public interest, and promote individual rights and democracy; and
- promotes the enforcement of public policy by the public itself and enhances the legitimacy of the regulatory and legislative framework due to the collective involvement of potentially affected individuals.

There is provision for the conservation of forests for timber supplies, protection of the environment and wildlife, provisions to deter floods, erosion, desiccation, maintaining river flows and in the purposes relating to the protection of land and water supplies.

The making of conservation plans, affords opportunity for public participation through holding local inquiries and consultations with landowners.

Inadequacies in the forestry policies and the existing and implementing legal framework are apparent:

- the purposes for establishing protected forest areas make little or no mention of the requirements to protect ecosystems and species for the conservation of biological diversity;
- there is no provision for public involvement, especially among local communities and other stakeholders in the establishment and management of protected forest areas and no provisions for affording the affected communities benefits from the protection and sustainable use of forest produce within their jurisdiction except under CAMPFIRE and ADMADE; and
- there is no system for ecologically based planning in the forestry sector involving all the relevant stakeholders.

The provisions of management plans should include the designation of areas, such as nature reserves, areas for stabilisation of watersheds and other fragile ecosystems as well as areas for species protection, particularly those which indicate the health of an ecosystem. Agro-forestry and sustainable traditional agriculture, as well as recreation areas, should be planned to provide buffer zones to the core of the protected forest areas. Commercial timber production and commercial agriculture would be planned for the outer edges of these areas.

SOURCE: Hughes, A., Lucas R. and W.A. Tilleman, (eds.), *Environmental Law and Policy*, Montgomery Publications Limited, Toronto 1993 p277; Anand, R. and I.G. Scott, *Financing Public Participation in Environmental Decision Making* Canadian Bar Rev. 60, 1982, p81-87; M. Jackman., *Rights and Participation: The Use of the Charter to Supervise the Regulatory Process*, Canadian Journal of Administrative Law and Practice, Vol. 4, 1991, p95

LINKAGES TO OTHER CHAPTERS Box 8.7

1 A REGIONAL OVERVIEW
All the countries of the region maintain a forestry policy that is the tool they use to develop, manage and deplete forests and associated products at the national level.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
With the advent of colonialism and the introduction of bureaucratic controls over natural resources, the rights to land and free access to forestry resources were removed for the majority of people, and most of the forested areas.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
Some national forestry policies emphasise the need to expand forested area by planting fast-growing exotic trees. This usually results in large forested areas being deprived of species diversity.

4 ECOLOGICAL PROCESSES
Most national forestry policies do not consider the indirect benefits (such as regulating ecological processes) of forests and woodlands.

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Within the context of the region, its natural resources' policy and development strategy has been framed with specific objectives achievable within the spectrum of integrated regional resource management. As indigenous forests and woodlands are cleared annually for further human development, more biodiversity is lost and present trends depict a future that is not sustainable. Current regional policies, however, are geared towards sustainable management.

6 FOREST AND WOODLANDS PRODUCTS: USES AND VALUES
National policies are in general geared towards managing demand and supply of forestry products.

7 ECONOMIC VALUATION AND ACCOUNTING
Indigenous forest products, direct and indirect, have traditionally been taken for granted, and therefore economically undervalued. National and regional policies aim to reverse this.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Integrated conservation policies such as ADMADE and CAMPFIRE in Zambia and Zimbabwe ensure sustainable use of natural resources by involving people at the grassroots level in all areas of conservation.

10 TRENDS AND SCENARIOS
Current and future forest and woodlands policies at the national and regional level depict a strong move towards sustainability.

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9 SUSTAINABLE MANAGEMENT

Good management is essential for the conservation of biological diversity and ecological stability. Ecological processes, including the maintenance of water cycles, regulation of climate and control of soil erosion, function best in a well-balanced ecosystem.

Most of southern Africa has been troubled by deforestation, mainly as a result of clearing land for agriculture. Lesotho is an example of a country with very few indigenous forests remaining owing to severe, long-term overuse of natural resources, including the wholesale clearance of habitats for agriculture and settlement.

Most of the uncontrolled exploitation of the forests in the past was followed by a conservation-orientated multiple use approach.[1] An emerging theory of forest management holds that forests and the people who influence them should be regarded as a single, integrated ecosystem.[2]

Appropriate conservation and management of SADC's natural forests can definitely produce high environmental benefits. The most important functions of natural forest resources for the SADC countries' economies are:

- forest environmental protection;
- provision of specialised local forest products; and
- support to wildlife activity and ecotourism.[3]

CURRENT FOREST MANAGEMENT APPROACHES

There are three main categories of management of the biological resources of woodlands and forests in southern Africa:

- management initiated, implemented and imposed by the state;
- systems initiated and implemented by local communities and individuals; and[4]
- co-management by the two authorities mentioned above.

Management by the state

Management by the state involves setting aside pieces of land gazetted under legislation such as forests and parks and wildlife acts. Such land includes national parks, safari areas, sanctuaries, recreational parks, forestlands, strict nature reserves and forest reserves. These are called State Protected Areas (SPAs), and were originally designated to save particular ecosystems and species. These protected areas comprise more than 15 percent of the total land area of the region, well above the recommended UN minimum of 10 percent.

There have been concerted efforts in recent decades to improve management of biological diversity by most governments and environmental organisations. There has been a major shift from the focus on spectacular game animals and important timber species to a more holistic approach. National parks and other kinds of protected areas serve a vital role in conserving biological diversity.[5]

The Canadian forest model Box 9.1

The Canadian Council of Forest Ministers (CCFM) has played an important catalytic role in promoting sustainable management of Canada's forests and in implementing the forest-related commitments made at UNCED.

The forest principles negotiated during UNCED, recognised the need to formulate scientifically based, internationally accepted criteria and indicators of sustainable forest management. Criteria and indicators would provide the basis for formulating innovative approaches toward the management of Canada's forests as ecosystems and for monitoring its achievements relative to goals established under the National Forest Strategy. The forest criteria and indicators are:

(1) Ecological criteria and indicators
Conservation of biological diversity
- ecosystem diversity;
- species diversity; and
- genetic diversity.

Maintenance and enhancement of forest ecosystem condition and productivity
- incidence of disturbance and stress (biotic and abiotic);
- ecosystem resilience; and
- extant biomass (biota).

Conservation of soil and water resources
- physical environmental factors;
- policy and protection forest factors;

Forest ecosystem contributions to global ecological cycles
- contributions to global carbon budget;
- forest land conversion;
- forest sector CO^2 conversion;
- forest sector policy factors; and
- contributions to hydrological cycles.

(2) Socio-economic criteria and indicators
Multi benefits to society
- productive capacity;
- competitiveness of resource industries (timber/non-timber related);
- contribution to the national economy (timber/non-timber sectors); and
- non-timber values (including option values).

Accepting society's responsibility for sustainable development
- Aboriginal and treaty rights;
- participation by aboriginal communities in sustainable forest management;
- sustainability of forest communities;
- fair and effective decision-making; and
- informed decision-making;

This is an international model on integrated sustainable development of forest ecosystems, which can be followed by other parts of the world, particularly SADC countries.

SOURCE: Canadian Council of Forest Ministers, *Defining Sustainable Forest Management: A Canadian Approach to Criteria and Indicators*, Ottawa, Canada, March 1995, pp v-22

Photo: IMERCSA

Protected areas comprise more than 15 percent of the total land area of the region, well above the recommended UN minimum of 10 percent.

The representation of protected areas in most countries is satisfactory, the highest being Botswana at 39 percent.[6] The state of biological diversity conservation in Swaziland is largely unknown[7] with relatively more information available on Angola,[8] Lesotho,[9] Malawi, Namibia,[10] Mozambique,[11] Tanzania, Zambia and Zimbabwe.

Forest reserves fall under the jurisdiction of conservation and forestry authorities, and access by local people is usually restricted. However, in some southern African countries forestry authorities have legitimised local people's access to forest products within reserves in return for their compliance with reserve regulations.

In Zimbabwe, the Forestry Commission recently embarked on a pilot resource-sharing programme in the Mapfungautsi Forest Reserve in an attempt to address the conflict with neighbouring communities, many of whom where forcibly removed from the reserve. The community has access to a range of non-timber forest products from the forest reserve.[12]

The forest or conservation authority maintains overall control of the forest, and issues permits to local communities for specific resources. This arrangement falls short of joint forest management in a number of respects:

- terms and conditions are set by the forestry authority and are not negotiated between the parties; and
- local communities have access to a limited range of products, which are specified by the forestry authority.

The Dwesa-Cwebe coastal forest in South Africa, offers a more equitable resource-sharing approach among involved parties. The forest was first demarcated in 1890 and traditional access rights of the surrounding community to forest and marine resources within the reserve were respected until 1981 when wildlife was introduced. Since then a policy of complete exclusion of the community was enforced, resulting in suffering and hardship which finally led to organised mass protest by the community in 1994. The conservation authority later recognised the need to allow the local community to have access to the forest and marine resources, as well as revenue sharing from ecotourism.[13]

If conservation of species diversity is the primary aim for forest reserves, then commercial exploitation of some tree parts should not be allowed. Legislation may slow the rate of exploitation, but it does not provide a solution. If alternative sources

of supply (fuelwood, building materials, medicinal plants) are not available, then managers face two scenarios:

- increasing conflict with people surrounding the reserve which may bring pressures to bear that threaten the long-term future of these areas; or
- provide alternatives to these sources outside the forests.

Malawi has established more than 60 forest reserves in all regions of the country to protect water catchment areas and to conserve the soil, particularly in environmentally unstable upland areas. Firebreaks mark boundaries with customary land and people venturing into any of the reserves to collect wood or non-wood material without permission from the forestry department are liable to prosecution. The same applies for indigenous forests on public and customary land, where it is illegal to graze or depasture protected hill slopes, fell, cut, work, burn, injure, or remove any tree or forest produce. This protection accorded by law, also ensures the preservation of genetic resources for future potential use.[14]

More recently, the global trend is towards privatisation, including that of forest reserves. Its main advantage is that owners strive to maximise productivity and create employment for local people. Management is thought to be more efficient, contributing to the general productivity of the area. The disadvantages of private land include the fact that its resources are for the exclusive use of the owner and are not usually accessible to the public.

A balance has to be struck between the management of forest resources by individuals and governments. This arrangement would ensure that national projects could benefit from the revenue accrued from forestry and woodlands managed by the state as well as by individuals. In Botswana, Mukwa (Bloodwood) and mokusi (Zambezi-teak) are being exploited commercially by a private company but are regulated by the government, reducing the danger of over-exploiting the vegetation because there are guidelines such as cutting mature trees with a minimum diameter of 30 cm.

Nature reserve management should encourage scientific research, education and appropriate recreation and tourism in defined areas, but there should be no consumptive utilisation at all. Where possible, the nature reserve should be surrounded by a buffer zone, preferably of natural forest, managed to provide sustainable produce for adjacent communities. This will benefit both local development and biological conservation. Whether or not a buffer zone is feasible, measures should be taken to ensure that adjacent communities benefit economically from the estab-

Photo: IUCN/ROSA

In Botswana, Mukwa (Bloodwood) shown above and Mokusi (Zambezi-teak) are being exploited commercially by a private company but are regulated by the government.

Categories of protected areas Box 9.2

The IUCN recognises the following international system of categories of protected areas, based on management objectives:

- Strict Nature Reserve/Wilderness Area: protected area managed mainly for science or wilderness protection;
- National Park: protected area managed for ecosystem protection and recreation;
- Natural Monument: protected area managed mainly for conservation of specific natural features;
- Habitat-Species Management Area: protected area managed mainly for conservation through management intervention;
- Protected Landscape-Seascape: protected area managed mainly for landscape/seascape conservation and recreation
- Managed Resources Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

SOURCE: Robinson, R., *African Heritage 2000: The Future of Protected Areas in Africa*, Proceedings of the IUCN Commission on National Parks and Protected Areas, African Regional Working Session, Skukuza, Kruger National Park, South Africa, 11-17 October 1994, IUCN, 1995, pp5-6

lishment of the nature reserve, e.g., through utilisation of the buffer zone, employment, and assistance with farm forestry. In some cases, nature reserves will stimulate the local economy through tourism and research programmes.[15]

Zoning proposed for a forest should not stop at the reserve boundary. Land-use planning in adjacent villages can also help stabilise resource-use systems and prevent the build-up of pressure on the forests. Village land-use plans must be simple, accommodate the villagers' needs and be based on their decisions.[16]

Management by local communities

There are many instances where forests and woodlands are protected outside the proclaimed or gazetted areas but their conservation status is largely, and sometimes incorrectly, considered insecure. Included are those managed and protected by local communities for cultural and traditional purposes. For many years the management strategies adopted by many countries have overlooked the social realities that determine the interaction between the people and wildlife.[17] Given the values of forests and woodlands to local communities, it is not surprising that they have developed a wide range of local management strategies in order to conserve their resources.

These indigenous knowledge systems have not been taken seriously by regional governments whose major thrust has been the modern management system. People living within or close to woodlands and forests have, over the years, studied their environment resulting in the evolution of indigenous management systems. However, these communities have been viewed as intruders in the very forests and woodlands they have managed for centuries.[18] Although recently regional governments are gradually changing attitudes to accommodate indigenous management. Examples of community management of resources include:

- management by conservative and judicious use of resources;
- selective clearance of forests and woodlands;
- promotion of valuable species;
- management by taboo or religious sanction; and
- management of individual trees such as those left in agricultural fields.

Some management programmes are started by both state and local communities, the former mainly offering technical expertise and the initial funding while the projects are increasingly community-managed. A number of southern African countries have community-based natural resource management programmes seeking to demonstrate that sustainable use and management of wildlife is a viable economic alternative for communities living in marginal areas. These programmes also increase local employment and income-generating opportunities from community-managed natural resources. Such programmes include:

- Administrative Management Design (ADMADE) project involving 30 game management areas in Zambia;
- Living in a Finite Environment (LIFE) in four regions in Namibia;
- Natural Resources Management Project involving between 400 and 21,000 people on 30 sites in Botswana;
- Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) involving 103,000 households in 26 RDCs in Zimbabwe;[19] and
- Tchuma-Tchato project in Tete province of Mozambique, initiated in 1995.[20]

CAMPFIRE, in particular, has recorded resounding successes as in a number of districts in Zimbabwe.[21] In Malawi, a SADC Sustainable Management of Indigenous Forests programme is under way aimed at managing forestry and other natural resources to ensure better living standards for the people in the Mwanza district.

Other regional programmes involving, but not managed by, communities such as the WWF's People and Plants project, seek to explore the use of plants by people and how best such schemes can be run effectively and sustainably. The Biodiversity Support Program[22] has also made great strides in conscientising various interest groups about the conservation of biodiversity.

Although difficult to implement, communal forest management can be centred around the principles of allowable cut for trees and carrying capacity for livestock grazing. While forestry exploits the growth of trees, animal husbandry exploits the growth of grass, herbs and even shrubs and trees. There are limits to the harvesting rates these resources can support before the ecological system deteriorates, which means the carrying capacity in animal husbandry corresponds closely to the allowable cut in forestry.[23]

In Zimbabwe, as in other SADC countries, there are some well-established management rules that prevent cutting fruit trees and trees associated with spirits and that encourage selective cutting of woodland. In some instances, the rules are reinforced by modern institutions and in others by traditional leaders especially woodland patches associated with protecting grave sites.[24]

Co-management of forests and woodlands

The co-management of natural resources involves both the state and local communities. The most common type of co-management is resource-sharing but there are only a few such projects within the region and they are still in the experimental stages. One such project, still in the pilot stage in Zimbabwe, is where the state and local

Traditional management of indigenous forest resources in communal areas of Zimbabwe Box 9.3

Though rare, institutions that can be regarded as "guardians of tradition" exist in some communal areas of Zimbabwe. Over the years guardians and "spirits of the land" have created rules and regulations that govern ownership and access to resources, and are enforced by chiefs and the ruling lineages. The system created taboos and rules that were in turn used for the management of forests under traditional tenure. For instance, some of rules prohibit cutting certain trees, methods of harvesting some fruits and other tree by-products, as well as access to sacred groves and mountains.

It is almost inconceivable for anybody under traditional tenure to cut *Uapaca kirkiana* (mahobohobo) without the permission of the guardians of the land. Other trees like *Sclerocarya birrea* (marula) and *Parinari curatefolia* (mobola-plum) are linked to ancestral spirits and rituals and are protected by standing penalty systems enforced by chiefs.

Fruits are supposed to be harvested for use in the home and not necessarily for sale. Such a move limits the harvesting of unripe fruits, while fruit-picking rules such as *gumha* (shake using a stone or some such instrument) prevent destruction of trees during the process of fruit harvesting.

In terms of woodland management, the rules go even further. In the majority of Zimbabwe's communal areas there exist some place where tree cutting is prohibited *(rambotemwa)*. Such places are usually burial places for chiefs, spring sites or just forest areas.

In addition to sacred areas, there are some trees that enjoy a certain level of sacredness. For instance, in Masvingo Province, Donkeyberry trees enjoy special protection due to their assumed linkage with rainfall and God. This linkage explains why the tree is not removed from arable lands.

SOURCE: Adapted from Gumbo, D.J., "Is There Traditional Management of Indigenous Forest Resources in the Communal Lands of Zimbabwe?", in: *The Ecology and Management of Indigenous Forests in Southern Africa: Proceedings of an International Symposium, Victoria Falls, Zimbabwe, 27-29 July 1992*, Zimbabwe Forestry Commission/SAREC, Harare, 1993, p83-85.

communities manage Mapfungautsi State Forest[25] which has not been successful because significantly fewer benefits are offered, compared with those which communities obtained illegally from the forest before the project was started, and to community demands made during the feasibility study for the project. This is due to the statutory agency responsible for forests which demands a project friendly to its current mandate, emphasising the maintenance of ecological functions of the forest.[26]

Despite efforts to conserve biological diversity by most regional governments and NGOs, indications are that the region is still losing its biological resources. There are opportunities for building on, and improving, existing management practices, which have until recently gone largely unnoticed and

unsupported by policy-makers and extension services. The same basic approach as in forest reserves, remains valid. There is need for negotiations between different stakeholders, including local users, groups with prior ownership claims, as well as state authorities and support services, to agree on rights and responsibilities. The negotiation process and the implementation of the resulting agreement needs institutional, legal and technical support, stemming from an enabling policy environment.

Over the last 20 years, there has been a major shift towards greater participation by stakeholders in the management of forests and woodlands worldwide. This follows the realisation that many of the problems associated with depletion of natural resources are mainly due to the exclusion of the public from the conservation agenda and the associated removal of ownership.

Southern Africa is quickly realising the importance of co-management of forest resources, with policies based on centralised state control of forests giving way to more diverse and participatory approaches to natural resource management.

Photo: IUCN/ROSA

Woodland in the Zambezi river delta, Mozambique.

The current trend towards participatory forestry is best understood in relation to the historical background to forest management in southern African countries, most of which were colonised during the last century. State involvement in forest protection and management dates back to this era, and was motivated primarily by the desire to secure a supply of tropical hardwoods.[27] It is only in the past two decades that forestry authorities have seriously questioned their role and policies, and joint forest management has begun to take root as an alternative approach. This shift has been prompted by the realisation that forest authorities alone cannot hope to effectively manage and protect forests without the involvement and co-operation of local communities and other stakeholders.

Joint Forest Management

Common Property Resources (CPR) management is based on the concept of local communities successfully managing communal resources provided they have the legal rights, knowledge and institutional capacity to do so. Resource degradation is not the result of the inherent failing of common property regimes, as the tragedy of commons scenario,[28] but rather a result of the erosion of local community rights, responsibilities and capacity to manage resources.

The aim of Joint Forest Management (JFM) is to provide incentives for biologically sustainable, socially equitable and economically effective forest management.[29] Through JFM, livelihood security for local people is ensured, as well as long-term conservation of forest resources.

In many cases, gazetted forests and woodlands are those which have high value timber, although in

some cases, forests and woodlands were gazetted to protect catchments. There are two fairly distinct contexts where local communities have a role to play in improved management — woodland reserves and common property woodlands. Although the current patterns of ownership and control differ, similar basic principles apply in achieving the long-term goal of sustainable forest management in support of local livelihoods.

In the Duru-Haitemba forest in the Arusha region of Tanzania, the JFM concept has not only ensured an equitable distribution of the proceeds of the forest, but has gone further in empowering local communities as managers and custodians of the forest.[30] The JFM approach followed a period of destruction of forests, which were then under state control. Before the concept was implemented, a survey of needs and opinions was carried out, and each village was asked to prepare management plans. Elected village committees supervise and enforce rules to ensure sustainability in the use and availability of forest resources.

Photo: IUCN/ROSA

Lumbering operation, north of Katima in Zambia, using a pit saw.

MULTI-STAKEHOLDER MANAGEMENT OF FORESTS AND WOODLANDS

The sustainable use of indigenous forests and woodlands in southern Africa can be achieved by striking a balance between forestry management by communities, private groups, individuals and governments.

Forests and woodlands could be managed in such a way that they can provide firewood for the rural population, timber for industries, traditional crafts for sale to tourists and cover to protect the soil from erosion. This multiple approach to utilising forests will ensure that benefits derived will go to a cross-section of people in each nation.

Future policies should consider that management of natural vegetation is part of an integrated land-use planning, based on a multi-disciplinary approach and regional cooperation.[31] Such an approach must develop appropriate resource inventories which contribute to identification and

description of the resource base and its potentials and constraints, and a zoning of the resource area into priority land-use categories to provide for the needs of different stakeholders. Their knowledge is needed in order to assess what local communities require, how they utilise their resources and what is required for local and regional socio-economic development.

Improved sustainable management of forests and woodlands should be planned and carried out by all stakeholders, including small farmer producers and sellers, resource owners, processors of forest products, end-users such as national and international markets, financial institutions, donors and governments. Key aspects include:

- better utilisation of local knowledge on the utilisation of forest resources, and ways of coping with environmental stress;
- improvement of community structures and organisations, and people's participation in the management and utilisation of forest products;
- influence of land tenure and ownership rights on the management of natural resources;
- compatibility or impacts of local traditions and customs, including gender responsibilities and rights, with contemporary forestry and tree-farming;
- valuation and quantification of short, medium and long term gains from forestry, including income and employment generation; and
- impacts of macro-economic factors and policies of other sectors of the economy on forestry.

On the part of stakeholders, the following criteria could play an important role in ensuring success of the JFM concept:

- vested interest is the basis for community-based management when there are strong links with a particular forest or woodland area which depends on this resource for a variety of different products and services. The people must have a vested interest in improved access to the resources and in investing in the management of the resource. The value of forest products needs enhancement through improved marketing and introduction of processing activities to add value to raw materials;
- enabling policy environment is needed to change to support multi-stakeholder involvement in forest management. Without the commitment of national, provincial or state governments, the necessary institutional and legal reform cannot take place;
- the rights and responsibilities of the various stakeholders must be enshrined in law, so that all parties have security. Currently, many forest acts give authorities the right to arrest and imprison local people if they are caught trespassing in forest reserves. There is a need for comprehensive legislative review to remove anomalies, and ensure the principles of co-management. It is also necessary to distinguish between rights of access and ownership rights so that the most appropriate rights can be granted in a given situation;
- JFM and community-based management require transformation within forestry and conservation authorities. Fundamental shifts in attitudes and behaviour are needed to move from a policing service, which operates on the basis of reprimanding, punishing and educating people, to one which facilitates, supports and learns from local people. Support includes a wide range of services including conflict-resolution, institution-building and marketing and technical advice on sustainable harvesting of a wide range of non-timber forest products; and
- strong and representative local institutions to negotiate effectively on behalf of the community, as well as make and enforce rules governing access. It is important that these

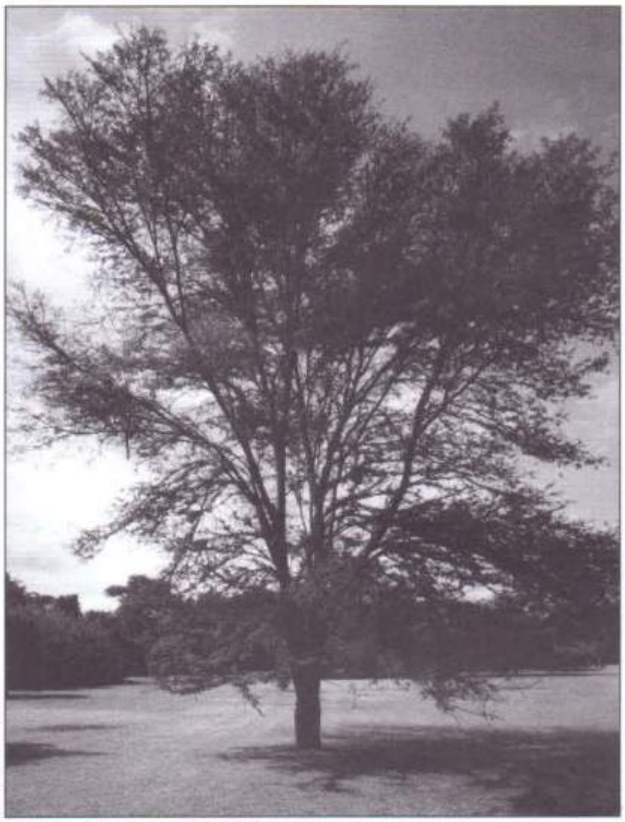

Photo: P Wade

Ankle-thorn or splendid acacia.

institutions are truly community-based, and do not have other stakeholders, such as forestry authorities in their membership.[32]

SUPPORTING STRATEGIES FOR SUSTAINABLE FOREST MANAGEMENT

Agroforestry

Agroforestry practices among individual farmers in the communal areas are a way of promoting reafforestation. Once wood supplies are adequate on individual farms, however, there could be a sharp decrease in the use of the natural woodland by villagers, which might allow it to regenerate to a level of sustainable yield without human assistance. This is only likely if the existing tree populations are not seriously depleted.[33]

Schoolchildren are good disseminators of information to the community, making schools an ideal target group for reafforestation programmes. Many schools also have vegetable gardens, which provide ideal sites for agroforestry pilot projects at the same time as broadening the children's experience of plant production processes.[34] The incorporation of woody perennial vegetation into existing crop and livestock production systems – agroforestry – for the production of food, fodder, poles, fuelwood for environmental protection and improving soil fertility is considered sound practice for most agricultural systems in southern Africa. It is also a strategy for conserving tree biodiversity. An important role of agroforestry could be the improvement of income and food supply for nutritionally vulnerable groups and individuals.[35]

Agroforestry practices such as silviculture, silvipastoralism and woodlots and shelterbelts, are some of the most common management strategies in SADC countries.

Community forestry through fostering propagation of trees for fuel and conservation, as well as more shrubs for fuel and livestock fodder, will contribute to an improved farming system that curtails erosion and increases output of food crops, animal products and fuel.[36]

Plantations

Plantations of trees on abandoned, little-used or low-productivity lands (communal or private) are increasingly common. These low-potential lands are often the only areas available for tree planting. Some strategies for plantation forestry, which will enhance people's livelihoods and national economies, include:

A participatory approach to village afforestation – North Pare Mountains, Tanzania Box 9.4

Over the past two decades, an alarming increase in the utilisation of the natural woody vegetation has been registered in Tanzania's North Pare Mountains. Affecting public lands and restricted areas, this problem is caused by such factors as a rapidly increasing population, shortage of arable land, a high demand of fuelwood, and the loss of traditional conservation values. Against this background, the Tanzania Action Plan, introduced a participatory village afforestation approach through the North Pare Project.

The project area, which has a population density of 140-200 people per sq km and covers, an area of 420 sq km, uses a customary land tenure system, in which land is inherited and held in perpetuity by each family.

Traditionally trees are planted in combination with cash crops or on marginal areas no longer suitable for agricultural crops. Gum is usually favoured over other tree species, mainly because they are fast growers and dry quickly. However, they are hard on the environment, as they draw-up great amounts of water (at least 40 l per day for a mature tree), and their leaves produce toxins, which suppress grass growth.

The JFM approach

The single biggest problem in village afforestation has been that of ownership. Experience has shown that the past approach of communal tree planting fails because villagers feel that benefits from the trees will be taken by the whole village, and as such are not keen to tend and manage them. A more sustainable solution, one which assures villagers rights over the use of the trees and promotes awareness and a sense of self help, responsibility and commitment, is clearly needed.

The North Pare project has adopted a village-based, participatory approach to land use planning, implementation and evaluation of the activities according to workplans developed by the villagers. The approach involves the following processes:

- a natural resource planning meeting selects catchment areas and villages for the high-intensity land use planning approach;
- participatory rural appraisal is conducted in the selected villages, with special emphasis on the issue of natural resources;
- a video film is shown to introduce the meaning of land use planning and clarify the role of villagers in the process;
- with the support of a facilitator, the villagers elect a Village Land Use Planning Committee (VLUPC);
- the VLUPC conducts village level, public debate meetings, where problems related to natural resources are inventoried, and possible solutions discussed;
- various committees meet regularly to exchange experiences and stimulate group discussions; and

- the committee carries out self-evaluation and results are discussed during the regular meetings.

Each area earmarked for afforestation is surveyed by the VLUPC, the divisional forester and project facilitators, and a rough estimate of the area is made. The forester prepares a map of the area, indicating individual plots.

Interested individuals are allocated plots and an agreement is signed between the plot-holders and village authorities. The agreement is to the effect that the land shall remain the property of the village authority, but at the same time assuring the plot-holders control and right to utilise the trees and their products subject to guidelines laid down by the forester. Failure to comply with the agreement by the plot-holder results in repossession of the plot by the village authority.

SOURCE: Adapted from Mndeme, K.C.H. 'A Participator Approach to Village Afforestation North Pare Mountains', *Splash*, Vol.12, No.2, Maseru, 1996

- plantations of fast-growing pioneer species, which do not displace important ecosystems or occupy rich agricultural land, for national industrial timber requirements and possible export;
- planting of multi-purpose species at the community or village level, where the household controls what, where and how to plant;
- planting to provide environmental services to reduce erosion, provide shelter or revegetate waste or degraded ground; and
- enrichment planting of degraded natural forests.[37]

In plantation forestry, the focus has been on the management of trees to maintain or enhance the productivity of forestlands, particularly those that have been degraded or are of inherently low fertility.[38]

Woodlots provide two of the physical requirements for living – fuel and construction material. In areas devoid of tree cover, establishment of woodlots is an effective means of raising rural living standards. Produce from woodlots is usually marketable hence they are a source of income for the people responsible for them. Such income-generation is an important feature and reflects the role of trees as savings and security for many people in rural areas.[39]

Reafforestation

Deforestation in the rural areas could be a problem with no technical answer, because any realistic solution requires a change in the attitudes of the local people towards recognising the need for managing and using woodstocks on a sustainable basis. Such a shift in attitude is possible since people can successfully change their way-of-life if the need arises.[40]

A combination of reafforestation strategies can be useful in cases where the indigenous woodland populations are no longer capable of producing enough wood to meet the demand. Large planting programmes, in conjunction with sustained use of indigenous trees and a ban on any further destruction of the natural woodland for agriculture is one method, another is integrated silvo-agricultural systems which cater for the wood requirements of individual households.[41]

School children could again be encouraged to grow up with this natural resource conservation spirit. The general public should also be made aware of conservation issues. Demonstrations of the control of soil erosion in order to achieve sustainable production can help educate people.

In Zimbabwe, former Mozambican refugee camps are now nurseries for indigenous and exotic trees, especially those bearing edible fruits. The camp's seedling nursery could be turned into a central nursery to provide surrounding communities and could also be used for training members of community groups on tree-planting techniques.[42]

Research

Research into sustainable wood production is essential to ensure that harvesting levels do not exceed recommended limits. Industrial plantations and processing plants create jobs and if production operations are not sustainable, these jobs could be jeopardised.

National forestry institutions should be supported to increase their capacity so that they engage in high profile research on indigenous woodlands and forests, which can benefit the entire SADC region. Information flow between individual countries can be used directly or indirectly to assist efforts to conserve forests and woodlands. However, for this work to benefit local people, it must be applicable to them as users so they can be involved during the research process. In this way, they can identify with solutions to the problems they are facing. Extension services can play an important role.[43]

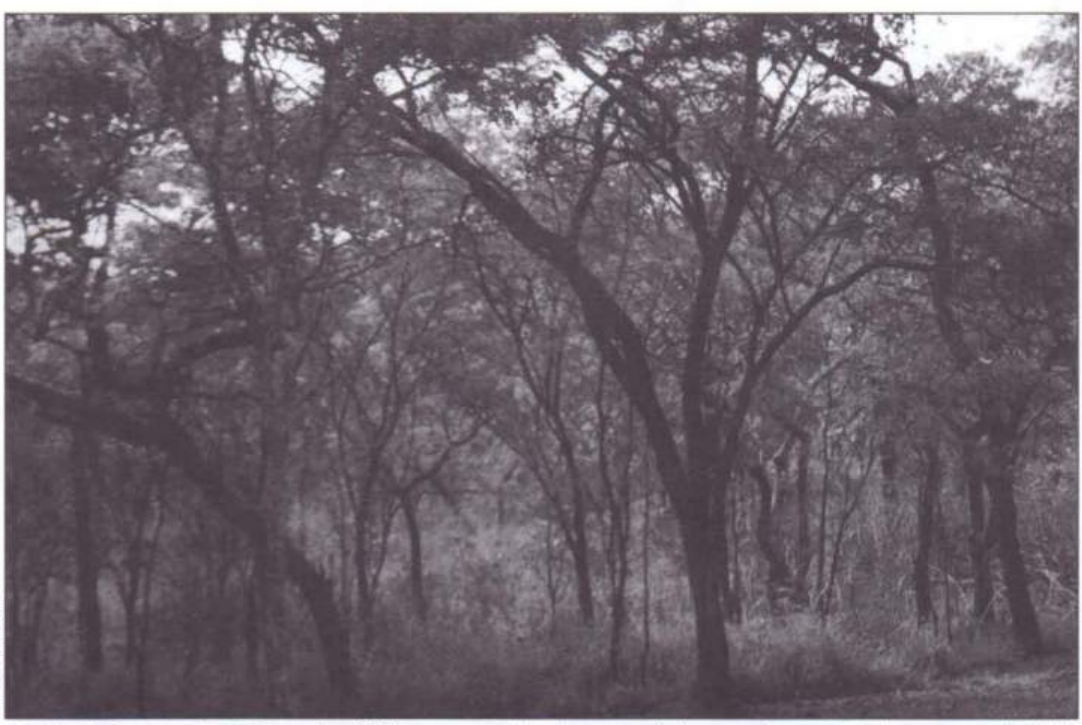

Photo: P Wade

National forestry institutions should be supported to increase their capacity so that they engage in high profile research on indigenous woodlands and forests, which can benefit the entire SADC region. Above, highveld savanna woodland.

Appropriate research programmes are also important for JFM to generate information which promotes an understanding of ecological processes (disturbance and recovery, plant-site relationships, recruitment, growth and mortality) as the basis for development of appropriate, site-specific, cost-effective and practical silvicultural options for sustainable multi-use management. Information generated from research also helps in monitoring the impacts of resource-use practices and in the restoration of degraded areas.

Research should be part of a management plan with the objective of providing important information, such as data to determine the life cycle of the most important trees and the time scale for management activities and yield regulation for specific communities.

Participatory research involving diverse groups, such as farmers, industrialists, traditional medical practitioners or conservation agencies has become an important part of developing innovative approaches to plant use and resource management.[94]

Photos: P Wade

Chirinda Fig tree and leaves (Ficus chirindensis).

Ecological inventories to identify and classify areas of indigenous forests can also provide information for a rational conservation-management programme.[95]

Conservation of forest genetic resources

In order to preserve the genetic resources of the region, genetic banks for SADC should be strengthened. With modern biotechnology techniques, those species that are in danger of extinction can be propagated and redistributed throughout the region.

Sustainable management can only be realised if forestry institutions are provided with the necessary capacity and strength in terms of trained professional and technical personnel. This will ensure that reliable forestry databases throughout SADC are created and the exchange of information is facilitated. Those plant species, which are under threat of extinction, can be conserved ensuring that the plant genetic diversity of the region is maintained.

Conservation of natural resources demands a multidisciplinary approach meaning that research on the most suitable plant species to conserve soil requires the input of plant scientists as well as those of soil scientists.

Many indigenous tree species have been conserved *in situ* (forest reserves), *ex situ* (botanical gardens, gene banks and seed banks) or even *in vitro* (culture techniques in a laboratory environment). These strategies are in place to make up for the loss of genetic diversity as a result of increasing deforestation in the SADC region. High priority should be given to the study of how of indigenous trees are used by people (ethnobotany) in addition to basic studies, in order to enhance understanding and increase the capacity for conservation of certain species and biodiversity as a whole.

Integrated watershed management

Integrated watershed management involves a comprehensive holistic approach, taking all bio-physical, socio-economic and political factors into account.[46] It also considers the inclusion of non-technical and scientific information in order to increase benefits from given projects.

There are good reasons for maintaining undisturbed or "protection" forests on watersheds:

- the habitat for endangered species that require undisturbed forest for their existence;
- Important *in situ* gene banks of material for present or potential use in forestry, agriculture, industry and medicine;
- the last wild places where a country's urban citizens can find sanctuary from crowded and stressful living conditions or where tourists can find recreation; and
- sacred forests, held in reverence by local residents or an entire religious group.[47]

Forests play a protective role for watersheds by ensuring a sustained flow of water from catchments throughout the year[48] and preventing soil erosion and drift-sand formation in coastal and inland areas.[49] Springs and rivers originate from mountainous areas covered by forest vegetation. The presence of vegetation enables falling rain to be absorbed, infiltrated and stored in the soil and the water is subsequently released slowly. Loss of vegetation cover, on the other hand, exposes the soil to raindrop impact, causing erosion and flooding, and consequently loss of land and water resources.

Photos: P Wade

Forest fever-tree and their large leaves (Anthocleista grandiflora).

ZACPLAN — A regional initiative on integrated watershed management Box 9.5

Perhaps the single most ambitious watershed development planning ever put together in the SADC region is the Zambezi River Action Plan (ZACPLAN). Its main thrust is to set up a centralised inventory of all planned and unplanned developments, which would affect flows in the Zambezi River, its water quality and its general environment.

The main reason for the creation of the ZACPLAN is the high potential there exists for the development of the region in the Zambezi River watershed. Such potential could ignite conflicts between interested countries or groups in future, unless development is controlled so that all states have access to an equitable share of the available resources and the environment is preserved. The Zambezi River, which is 3,000 km long and drains an area of 1.3 million km^2 comprises parts of Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe as riparian states of the river system.

Major elements of the ZACPLAN include environmental assessment, environmental management, environmental legislation and some supporting measures. Between countries, it has even been necessary to introduce international agreements by which one country's water supply does not negatively affect that of another country or where necessary, pollution on the upstream state does not lead to the suffering of another country downstream. Since ZACPLAN came at a time when there were already some large development projects in the SADC region, such as hydroelectric power schemes at Kariba and Cahora Bassa, it was designed to include completed, ongoing and potential development projects in the area. These include hydropower generation, flood control, low flow regulation or augmentation, dam construction, irrigation, water supply, channel improvements, industrial development and waste disposal, sanitation, fishing in international water bodies (rivers and lakes), regulation of lake levels, use of pesticides, known soil erosion problems affecting water quality, and known and potential resources of pollution.

At the national level some of the objectives of ZACPLAN can be achieved through national planning. Most SADC countries are preparing their national conservation strategies. The main objective of these National Environmental Action Plans (NEAPs) is the integration of environmental concerns into social and economic development planning process. This objective will be achieved by obligatory EIAs of major activities. The NEAPs also highlight the importance of community involvement in the development of policy and the identification of environmental programmes. The NEAP programme fits well with integrated management approach as it is designed to provide an integrated inter-sectoral approach to support lending for environmental improvement.

Within an integrated watershed management planning process there exists an opportunity to address sediment issues be they toxic or simply a physical characteristic capable of limiting bio-productivity and hence biodiversity.

SOURCE: Sichingabula, H. "Integrated Watershed Management: A Holistic Approach", for SARDC, 1996, pp6-9

By preventing floods and soil erosion and the associated destructive sediment transport by floodwaters, forests in watersheds also give valuable protection to water resource investments in irrigation, hydropower and urban water supply.

Natural or artificial changes that take place during development of an area in a drainage basin, often result in a series of responses by the river system as a whole. Development of urban infrastructure, which may involve clearing an area, digging drainage lines and, in the process disturbing the soil, causes increased runoff and accelerated soil erosion which leads to dramatic increase in the sediment loads transported by rivers.

Domestic and industrial waste from urban centres is sometimes discharged into rivers and streams causing pollution detrimental to aquatic life, vegetation and communities located downstream who are dependent on these sources for their water supply and also adversely affects the biodiversity of the area.

Since planning and development of various economic activities is based on political and administrative boundaries, which often cut across drainage basins, it is necessary to integrate all activities in order to minimise disruption of natural systems. While drainage basins and administrative boundaries do not always coincide, this incongruity becomes a crucial source of difficulties in the management of natural resources. The integrated watershed approach is a means of minimising such conflicts.

In Africa, a number of river basin planning projects have been carried out, mainly for hydroelectric power generation, flood control and irrigation. These projects, which include Lake Volta in Ghana, the Aswan Dam in Egypt, Lake Kainji in Nigeria, Lake Kariba between Zambia and Zimbabwe and Cahora Bassa in Mozambique, involved construction of dams and creation of reservoirs.

For regional economic development to be meaningful, it must include ecological criteria, principles and guidelines in order to ensure the long-term well-being of people and their environment. In order to minimise negative environmental impacts, different areas in a watershed can be designated land-use types suited to their physical conditions:

- critical zone areas approaching ecological thresholds of irreversibility, such as those experiencing accelerated erosion, extending areas of landslides and mass movements;
- unique zones could be designated to forestry, fauna, scenery, archaeological or other natural or cultural values before a detailed evaluation is conducted to determine appropriate uses to follow and the final management system to adopt;
- would-be multi-purpose zones to cover permanent vegetation on slopes, river catchments, swamps, lowland stream banks and highly erosive soils. Such zones would allow vegetation to produce, on a flexible basis, goods and services such as timber, water, minerals, wildlife, hunting and fishing, tourism, forest industry and other uses;
- areas distant from markets, yet which possess materials of high future value, could be designated as holding zones or government reserves. In the future, when more intensive resource evaluation is warranted by increasing demands and pressures, the area can be allocated to permanent uses according to determined objectives; and
- only those areas of high potential yields in agriculture, livestock and fast-growing fibre crops can be designated as agriculture development zones. In these areas, losses from floods, erosion, soil depletion, plant succession, animal damage and other biotic factors can be reduced and controlled.[50]

The Lesotho Highlands Water Project:
a good example of international integrated watershed management Box 9.6

In the SADC region one of the modern water projects, which has incorporated a holistic approach to water development, is the Lesotho Highlands Water Project (LHWP), a joint venture between Lesotho and South Africa. The three main objectives of the project are to:

- provide revenue to Lesotho and to meet the growing demand for water in South Africa's major industrial and population centres to the south of Lesotho;
- generate hydro-electric power for Lesotho; and
- promote the general development of the remote and underdeveloped mountain regions of the country.

The concept of integrated watershed development has been shown to be relevant and has been applied in a variety of ways in the SADC region. It appears to be the approach which best answers problems of regional development within large watersheds such as the Zambezi, Okavango, Orange and Limpopo rivers among others, covering more than one state. To be widely accepted, the integrated watershed management approach should be a means of forecasting future socio-economic and environmental changes in order to realise long-term benefits for entire river basins. Thus, a holistic approach to watershed management should give recommendations concerning the dynamics, structure and utilisation of natural resources and promote research and development.

In the case of the southern African region, such a model can be demonstrated by the LHWP, which was put in place because socio-economic and environmental issues are of major concern to the government of Lesotho. Bearing in mind the necessity for comprehensive planning for such a colossal project the Lesotho Highlands Development Authority fully recognised the potential for such a large project to cause adverse social and environmental effects especially if these concerns were not integrated into the detailed design. A proactive approach was needed to ensure that the quality of the environment was not reduced but rather enhanced. This included, among others, a heritage plan, health care, rural development, production, animal husbandry and range management, mountain horticulture and field crops, community forestry, education programmes, infrastructure development including roads, water supply and sanitation.

Since the LHWP is still in its early stages, its medium to long-term impacts on the environment in Lesotho in particular, and the SADC region in general, are awaited.

SOURCE: Sichingabula, H. *Integrated watershed management: a holistic approach* for SARDC, 1996, pp. 13-14.

The management goal must be to maintain the biological stability and resource productivity of the areas. Under this type of management plan, different areas are treated according to their physical characteristics and how they may respond to human interference. However, some development projects cover more than one country within a single drainage basin. In such cases, the cooperation of all riparian countries is needed to ensure meaningful sustainable development for all peoples.

Watershed management should be considered synonymous with multiple uses or multiple resource management, but with the condition that such use and management be in harmony with sound soil, water and wildlife conservation principles. Reforestation, agroforestry practices and other vegetative measures should be integral parts of the project.[50]

Environmental Impact Assessment

The Convention on Biological Diversity (CBD) obliges parties to develop and strengthen EIA procedures, which take biodiversity parameters into account. In the SADC region, most countries now have EIA laws and regulations.

However, problems continue to exist and EIA has been criticised for its ineffectiveness as a planning tool because it:

- is often done too late and in a reactive manner, only after technical and economic feasibility studies are finished when it has become too late to control undesirable projects;
- tends to favour project-by-project assessment instead of ecosystem, approaches and often does not accurately incorporate social factors or predict and evaluate future impacts;
- has a retrospective assessment, it depicts many problems which go beyond the initial predictions. Even though a given project is accompanied by an EIA, negative social, economic and biodiversity effects can often be experienced;
- often proceeds with limited participation while difficulties exist in determining when information should be made accessible and to which interest groups;
- faces a severe shortage of trained manpower and guidelines for the incorporation of EIA into project development cycles. This problem is compounded by the fact that consultants often have low technical capabilities and are paid or controlled by project proponents;
- has inadequate knowledge of the taxonomy and ecology of species an habitats is often a limiting factor; and
- is uncertain about the quality of information with respect to industry and the methodologies for assessing the significance of impacts have generally been less than perfect.[52]

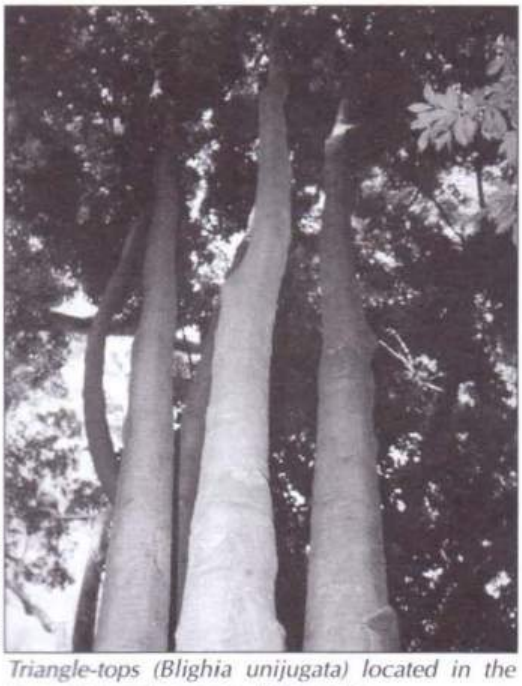

Photo: P Wade

Triangle-tops (Blighia unijugata) located in the lowveld riverine areas of the region.

Incorporating EIA at the policy level into the development and planning process early in the project cycle would include application of these procedures to national policies, programmes, legislation, donor packages, specific projects and the development of specific biodiversity criteria for EIA policies and laws. A comprehensive database on soils, climate, topography, geology and biological diversity is needed to monitor trends of genes, species and ecosystems and to predict the impact of future changes which could be used as baseline information (i.e., basis for prediction, evaluation and

impact management). Development of a systematic framework for EIA in relation to biodiversity and bio-safety would further the process of establishing responsible but effective regulatory procedures. Including socio-economic benefits of habitats and species to rural communities in EIA and the increased involvement of industry, can assist by providing support to improving the required databases and the actual quality of EIAs.[53]

International conventions on conservation of biological resources

Under the World Heritage Convention certain sites can be designated as having outstanding universal value. Sites such as Serengeti National Park and Selous Game Reserve in Tanzania, the Mana Pools complex in Zimbabwe and Lake Malawi National Park in Malawi[54] have been designated. These sites include vast areas of indigenous forests.

Under UNESCO's Man and the Biosphere programme (MAB), a network of biosphere reserves creates management objectives — which include conservation, for present and future use — of the diversity of plant and animal communities within the ecosystem, and safeguarding genetic diversity. A biosphere reserve should comprise a core nature reserve, where research and monitoring are undertaken, and a surrounding buffer zone of natural and semi-natural ecosystems for sustainable use, providing a transition to the surrounding human communities. MAB emphasises sustainable development of local communities and their involvement in conservation planning and resource management.

The main benefit of these two conventions derives from the local, national and international recognition of the chosen sites, which can greatly assist sustainable development and conservation of the area, by:

- consolidating the political will to conserve the area and to develop adjacent areas through sustainable use of the resources;
- increasing national and international awareness about the area;
- strengthening the claims for national and international funding; and
- stimulating research, scientific training, education and tourism.

The CITES Convention tackles the problem of endangered species protection by controlling the international market. It is an important component of conservation, especially of heavily poached animals such as the Rhinoceros and Elephant so there is a need to monitor such trade as ivory, birds, primates and ornamental plants.[55]

Forests and woodlands are important sources of a wide range of products and services essential to rural livelihoods, and both suffer from mismanagement and degradation as a result of confused and contested rights and unclear responsibilities of stakeholders.

For sustainable management, governments and communities must work hand-in-hand to ensure that the resources are not used beyond levels of possible regeneration.

SADC member states share concerns regarding irregular or uncertain supply of raw materials, overexploitation (particularly of natural forests), and insufficient reforestation. All national forestry programmes are intended to ensure the conservation and sustainable development of forest resources. Agenda 21's programme objectives include effectively ensuring the sustainable utilisation and production of forests' goods and services. Associated objectives shared by most countries are:

- sustainable supply of goods and services from their forests;
- maintenance or enhancement of forest productivity; and
- rationalisation of forest resource utilisation.[56]

SADC forestry policy and legislation

Table 9.1

	Angola	Botswana	Lesotho	Malawi	Mauritius	Mozambique	Namibia	South Africa	Swaziland	Tanzania	Zambia	Zimbabwe
Forest Policy	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes 1972	Yes 1953	Yes	Yes
Forest Policy reviewed				Yes	-	Yes	Yes	Yes	Yes	Yes	Yes	-
Review Forest Policy finished awaiting approval	-	-	-	Finished and approved 1996	-	Finished and approved 1997	Finished and approved 1997	Finished and approved 1997	No	No	Finished and approved 1997	-
Attempt to prepare a Forestry Policy year	1989	1990	National Forestry Policy 1996	-	-	-	-	-	-	Draft Forest Policy 1994	-	-
Similar strategy paper prepared year	1996	-	1996	-	-	-	-	1996	-	-	-	-
Actual Forest Legislation year	1962	1968	1978	1997	1983	1965 /1980	1996	1984	1910 /1951	1982	1973	1984 /1987
Forest Legislation under review/ last attempt	Yes	Yes	Yes	Yes, finished	No but amend-ments (1984)	Yes	Yes	Yes	Yes, 1994	Yes	Yes, finished	Yes
Review Forest Legislation finished, pending approval	Yes, review finished, but no further information available	No	Draft Forestry Act (1996)	Approved, Forest Bill (1997)	No	No	Draft Forest Act	No	No	No	Draft Forest Act 1997	No

SOURCE: Strategy papers: Angola: Report on Implementing Forest Principles: Promotion of National Forest and Land Use Programme, 1996
Lesotho: Lesotho National Forestry Action Programme 1996 – 2005
Swaziland: National Development Sectoral Plan for 1997/98 –1999 /2000
SADC FSTCU.

LINKAGES TO OTHER CHAPTERS Box 9.7

1 A REGIONAL OVERVIEW
Conservation of indigenous forests and woodlands in the region is closely linked to existing agricultural practices and government policy. Sustainable management practices include integrated approaches to conservation.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
Linking conservation with production at all sectors of the socio-economy is key to conservation of indigenous forests and woodlands.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
Land cleared for agricultural purposes is usually harvested of its rich biodiversity, which is replaced by a monoculture of crops. This is not sustainable from an environmental point-of-view.

4 ECOLOGICAL PROCESSES
Ecological process such as the hydrological cycle, carbon cycle and other nutrient cycles are closely linked to forests and the associated biodiversity, and may be classified as some of those indirect products from forests. Sustainable management of indigenous forests and woodlands is therefore pivotal for continued supply of these services.

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Factors affecting forests and biodiversity directly impact on the quality and quantity of products realised thereof. Management practices such as integrated agriculture and wildlife conservation programmes such as CAMPFIRE in Zimbabwe help curb factors affecting loss of biodiversity. A move from the existing unsustainable conversion path to one that is desirable, sustainable and achievable is the goal of most national forestry policies.

6 PRODUCTS AND SERVICES
Sustainable management of our forestry resources will ensure a continued supply of forestry products and services for our growing population.

7 ECONOMIC VALUATION AND ACCOUNTING
Evaluating and accounting the economic value of forest resources to all sectors of the socio-economy is the starting point to sustainable management.

8 POLICY ANALYSIS
Sustainable management of forests and woodlands in southern Africa is the sole hope for future quality and quantity of biodiversity resources. Policies at the national and regional level hope to achieve these goals through among other things, instituting integrated management practices.

10 TRENDS AND SCENARIOS
A sustainable future can only become a reality if we act now.

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10 TRENDS AND SCENARIOS

The current trends in the management of biodiversity of indigenous forests and woodlands signal the opportunities and constraints that governments and people must consider in ensuring their sustainable use. Trends indicate that the current activities of resource exploitation are unsustainable. However, what is not clear is the projected status of the region's indigenous forests in the first two decades of the 21st century and onwards. The forests could become further degraded and their spatial extent reduced; or they could be well-conserved for the benefit of both present and future generations. Whatever happens will depend on the action taken today by both governments and stakeholders.

The first step is hindsight – the precursor of foresight. Hindsight provides the opportunity to implement change from an unsustainable direction to a sustainable one. There are both positive and negative trends – social, economic and environmental – which have an impact on either conserving or further eroding the extent of forests and their biodiversity.

Socio-political factors include:

- prevailing peace in member states;
- governance and institutional arrangements;
- management policies and laws;
- enhanced stakeholder participation in the decision-making process; and
- empowerment of communities (in areas such as land) so that they are involved in articulating the problems and suggesting possible solutions.

Socio-economic factors include:

- population growth and distribution;
- land availability and tenurial rights;
- economic growth in areas such as industry, tourism, and technological development; and
- proper valuation of forests and woodlands.

Trends are also influenced by natural events such as droughts, floods and degradation which includes desertification, deforestation and pollution of water resources.

CURRENT TRENDS

Economic growth

Forest and woodland resources and their biodiversity are valuable national and regional assets to propel economic growth. Under proper management, they can provide employment to a considerable number of the people and contribute to the health of the society through the sale of timber and other non-wood products.

The economic importance can be highlighted by the contribution to GDP of the forestry sector in DRC (21 percent), Swaziland (20 percent), Zambia (17 percent), and Malawi (15 percent).[1] The continent's and global averages are six and two percent respectively.[2] However, it is necessary to base economic growth on sustainable use since the cost of mismanagement is high. Industry in these countries depends on the existence of small economies, requiring a need to expand the base and shed some of the economic

load borne by the forestry sector in order for it to regain sustainability.

Trade in forestry products

In countries where forests occupy a large geographical area and where the products play a role in international trade, there is often a lack of access roads or railways to and from the interior to transport harvests to markets. As a result, production and sales are inhibited and the forestry sector cannot adequately play its role in contributing to GDP. This results in a situation where, due to its small contribution to the government revenues, the sector receives little or no funding.

On the other hand, the greed with which these resources are being exploited gives little chance for survival and existence of vulnerable species. International trade in endangered species may continue at the expense of the environment and this has a disastrous effect on the species themselves, their habitat, the ecosystem at large, as well as humankind. Sustainability in forest resources and the need to control trade in forest and woodland products in southern Africa are an urgent priority.

Statistics for trade in forestry products in SADC show that its share is generally lower than 10 percent. The main problem with statistics, however, is that they do not reflect the contribution to other uses such as firewood.

Commercial exploitation of forest products is usually timber, and should take cognisance of the required balance of the indigenous forest reserves needed to sustain non-timber resources in order to guarantee diversified livelihood strategies.

Livelihood and land use patterns

The majority of rural communities rely heavily on forests and forest products for their livelihood. Fuel for rural inhabitants and some urban dwellers, wild fruit, traditional medicines, building materials and soil protection may be regarded as the most common uses of trees for peoples' livelihood. The future supply of forest resources needs to take into account the growing demand for these uses. Biomass harvesting in the region stood at over one million ha per year for the period 1990-1995, and 0.8 percent of total land was cleared annually. Forests and woodlands support a range of benefits such as tourism, which can supplement rural incomes through employment by diversification.[5]

Existing land use patterns show that natural forest is cleared annually for agriculture. Biodiversity is lost in the process and land is degraded. Worst of

Photo: IMERCSA

Existing land use patterns show that natural forest is cleared annually for agriculture. Biodiversity is lost and land is degraded.

all this process is usually irreversible. Equitable distribution of land and sustainable land-use patterns are necessary for forestry stability. This is unfortunately lacking in southern Africa, and some governments (e.g. Malawi, Mozambique, South Africa, Tanzania and Zimbabwe) are still battling with the redistribution of land to encourage sustainable agriculture.

Population

As has already been noted, the SADC region has a population of more than 145 million (about a fifth of Africa's) people, which is growing at an average of 2.7 percent annually, meaning that the population will double in less than 25 years.[4] This trend is unlikely to change in the short-term, resulting in a situation where the people will continue to place heavy demands on both human-made (infrastructure and services) and natural capital (resources). Even though the urban areas are growing, the majority of people in the region will continue to live in rural areas. Fuelwood demands will increase, although areas under natural forests are likely to remain constant or decrease. Measures currently being instituted by African governments to curb population increase include family planning, but a population boom is inevitable, arising mainly from poverty and lack of awareness. Forestry resources in the rural areas will undoubtedly dwindle.

Associated with large populations is its density. Although the average regional population density is relatively small, in some countries such as Malawi, Mauritius and Seychelles it is large. Pressure on forestry resources will be more severe in these countries. Others, such as Zimbabwe still exhibit colonial tenure patterns where indigenous rural people are settled in crowded areas which face a

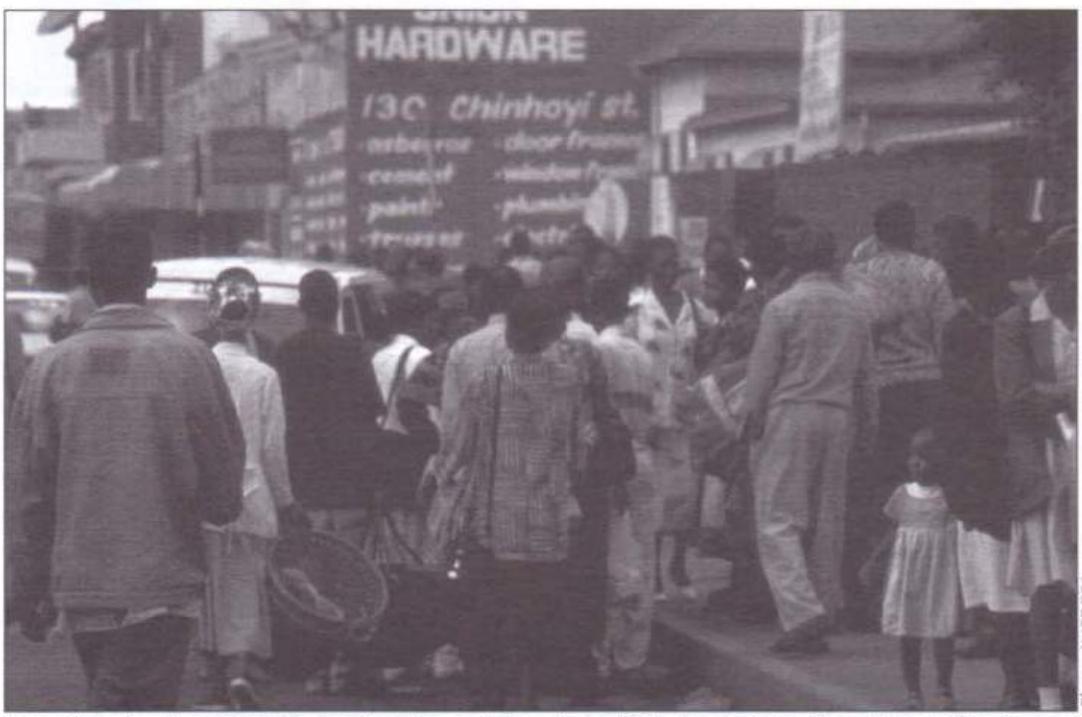


Photo: IMERCSA

Even though urban areas are growing, the majority of people in the region will continue to live in rural areas.

shortage of forestry resources, although the country as a whole enjoys a surplus of resources if effective transport was in place. As the region continues to have an increasingly younger population, the demand on resources will increase.

Governance, legislation and policies

Although legislation is being constantly reviewed in the region, there is still a lack of efficient and strong technical mechanisms to guide effective decision-making at national levels. The laws at present offer lenient penalties for offences that are serious if the opportunity-cost of forest and woodland resources is considered. Where legislation has been reviewed as in the case of Malawi, stiff penalties may be put in place, but law enforcement still lacks resources, rendering the effort useless.

The Malawi Forest Bill of 1996 states that "any person who knowingly receives forest produce illegally, or is found in possession of forest produce without a permit, or traffics in forest produce without a licence, shall be guilty of an offence," and if convicted, "shall be liable to a fine of not less than MK10,000 (US$500) and not more than MK20,000 (US$1,000) and to imprisonment of 10 years".[5] This legislation would be most useful if effective law enforcement was in place but it is not and, in countries such as the DRC and Angola, the system has broken completely down because of wars.

It has to be recognised that rural communities have guidelines even though their policies are not written. However, these unwritten laws and policies have been passed on from one generation to another from youth to adulthood in the form of norms and traditions that have effectively safeguarded the healthy existence of natural resources. In Zambia, for instance, chiefs can banish people for certain offences, which contravene the village laws.[6]

Photo: IMERCSA

It has to be recognised that rural communities have guidelines even though their policies are not written. These unwritten laws and policies have been passed on from one generation to another.

There is also a serious need to co-ordinate planning and implementation of policies to avoid inefficient methods of exploitation of resources. In the majority of urban areas in the region, there is high intensity wood-harvesting, particularly for energy needs as the alternatives may be poorly developed (solar energy) or unaffordable for the majority of the urban dwellers (electricity). In Botswana however, there are guidelines that only trees of at least 30 cm diameter should be harvested for timber.

Another developing trend is the contradiction of some global conventions with local interests. Ecosystem management efforts by local governments often suffer maladministration because

Deforestation rates in the SADC region: 1980-90 Table 10.1

COUNTRY	LAND AREA Sq km ('000) 1994	LAND AREA Share of arable land (%) 1994	RURAL POP DENSITY People per sq km in 1994	FOREST AREA Sq km 1990	ANNUAL DEFORESTATION Sq km ('000) 1980-90	ANNUAL DEFORESTATION % Change 1980-90
Angola	1,247	2	239	231	1.7	0.7
Botswana	567	1	238	143	0.8	0.5
Lesotho	30	11	470	-	-	-
Malawi	94	18	493	35	0.5	1.4
Mauritius	2	49	661	1	0.0	0.2
Mozambique	784	4	356	173	1.4	0.8
Namibia	823	1	145	126	0.4	0.3
South Africa	1,221	10	162	45	-0.4	-0.8
Swaziland	-	-	-	-	-	-
Tanzania	884	3	732	336	4.4	1.2
Zambia	743	7	91	323	3.6	1.1
Zimbabwe	387	7	269	89	0.6	0.7

SOURCE: World Bank, *1997 World Development Indicators*, International Bank for Reconstruction and Development, Washington, D.C., 1997

some international conventions make it illegal to implement regionally suitable management strategies. The elephant herds in countries such as Zimbabwe, Botswana and Namibia grew to unsustainable levels because the CITES convention made it illegal to trade in elephant products. The result: massive destruction of biodiversity.

Future disagreements may be expected under the Climate Change Convention as African governments maintain that climate change through global warming is mainly being caused by emissions of greenhouse gases from the industrialised North.

Institutions

At the institutional level, there are inadequate law enforcement systems. For a long time, the prevailing laws have been those of the colonial past and only now, in some instances, is legislation being reviewed.

Centralised management of resources reflects hangovers from past traditions in times of change. Local empowerment and decentralisation is not yet well developed and even in cases where decentralisation is in place, problems of low capacity and skills at the local level are prominent due to financial limitations and central government interference. This institutional incapacity stems from economic hardships as people are being trained but getting no employment. The weak institutional capacity is also due to ineffective partnerships between communities, government and other interested stakeholders.

The region's forestry experts are usually trained in industrialised countries where the expertise acquired may not be adequate or relevant to deal with local situations.

Traditional management institutions too, are weak. In many cases, the political authority has overpow-

Grassroots Zambia programme:
working for safe, sustainable use of the forest Box 10.1

Zambia's exciting new programme, the Provincial Forestry Action Plan (PFAP) promises to work closely with stakeholders and users at the provincial, district and local levels, in order to increase levels of institutional cooperation and public participation in forest management.

The government, with financial and technical support from the Finnish International Development Agency (FINNIDA), decided in 1993 to decentralise the Zambia Forestry Action Plan (ZFAP) through the PFAP. While the ZFAP will undertake work at the national level to create a favourable policy framework in which the PFAP can operate effectively, the PFAP will feed ideas and provide pilot activities from which the ZFAP will benefit.

Under this programme, the Central, Copperbelt and the Luapula provinces were selected. These provinces exhibit different types of forests, which serve different needs. Forestry in the Central Province focuses on supplying fuelwood to Lusaka (mainly charcoal), from indigenous forests and local tree plots. In the Copperbelt, the emphasis is on industrial forestry (mainly plantations of eucalyptus and pine) which supplies the mining industry and associated dense urban population. Forest activities in Luapula Province centre around the fishing industry (smoked fish), pit-sawing and charcoal production.

The institutional framework within which the PFAP operates, is determined by the actors involved in each of the forestry activities. Local forest-users, both women and men, are significant in all aspects of forestry utilisation and management; and so all stakeholders and users are being considered, including small-scale commercial users of forest products, farmers, large-scale industry and parastatals. The forestry sector plays a vital role just as chiefs do on areas under their jurisdiction and control.

To date, the programme is going well with the Forestry Department, and other government line agencies, NGOs and communities working together to consolidate the PFAP process. Some of the results include production of two video documentaries on forestry for public awareness and education, initiation of school forestry programmes on indigenous trees, establishment of a database for forest resources and forest management, development of satellite imagery and forest inventory. In addition, the marketing of plantation-grown eucalyptus charcoal is being investigated to see how to make this product more acceptable to consumers who prefer charcoal from threatened indigenous hardwood trees.

The long-term development objectives are to increase the direct and indirect benefits from forests and trees to all citizens of the PFAP provinces and facilitate greater involvement of forest-dependent communities and resource users in sustainable management of the forest resources.

In addition to the long-term strategies for organisational development and peoples' participation, immediate action plans focus on specific areas of weakness which can be addressed while the PFAP process is being initiated. These include participatory rural appraisal (PRA) training and implementation, a public relations campaign and awareness raising, improved charcoal production and strengthened charcoal producers associations, forest resources assessments and data base establishment and management, re-introduction of village forest officers, forest products research with emphasis on consumption and marketing of non-wood products, training of agency staff and forest guards and chiefs.

Perhaps the most positive component of the PFAP, which is likely to have an impact on the forest resources and the lives of people is the Joint Forest Management Plan (JFMP).

Forest legislation in Zambia has not encouraged participation of the local communities in management of the forest reserves. However, villagers' participation in sharing the benefits and carrying out responsibilities in forest management has been seen as one of the best solutions to sustainable management during the development of the ZFIP.

Presently, the potential of many forest reserves is not efficiently utilised where illegal encroachment is the major form of utilisation due to lack of facilities in the supervision and lack of proper management plans. The JFMP is an operative working plan of five to 10 years and is based on a land-use plan reflecting environmental, social and economic factors. The plan will be prepared in cooperation with local communities and other stakeholders. Participatory rural appraisal will be used as a major tool in facilitating the participation of villagers in planning the use of the resources. So far, some 30 PRAs and 21 Village Resource Management Plans (VRMPs) have been prepared in villages that surround forest reserves or are adjacent. Willingness to cooperate by the local communities is encouraging and many villagers have taken the role in guarding the forest reserves from outside encroachers.

SOURCE: Tany D. Cohen, "A Grassroots Forestry Programme in Zambia - The Provincial Forestry Action Plan", for SARDC, 1997

ered the traditional authority, which relies on information passed from parents to children, but is now dying out as the extended family structure disappears. Efforts are in place to decentralise institutional responsibilities to the local level: Zambia's ADMADE programme, Tanzania's Selous Conservation Programme, South Africa's Lebtlane Community Game management programme and Zimbabwe's CAMPFIRE are examples.

The advantages of decentralisation are many but most importantly, it offers a high probability that natural resources, especially forests and woodlands, would benefit from indigenous knowledge systems as well as modern management methods.

Due to a number of factors, some of which are shortages of financial resources, SAPs demands and priority choices, support for forestry institutions by central governments is reduced. As a result, retrenchments and downscaling of activities ensue. The lack of adequate financial resources reduces motivation and morale in government institutions. Public participation, especially when the majority of the population are already living within or around the rural forests and are able to manage them, is a

clear option even without formal government remuneration.

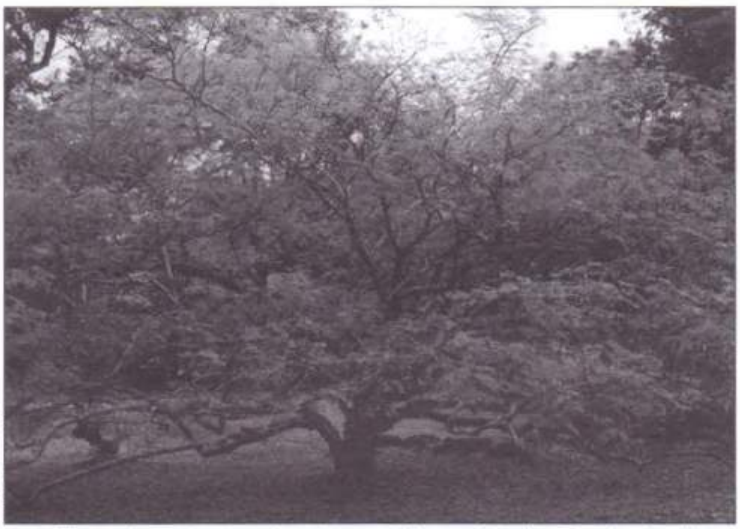


Photo: P Wade

Woolly-pod acacia (Acacia eriocarpa) *located in the Zambezi valley.*

If the forestry institutions and others indirectly linked to forest ecosystems are to perform effectively, a review of legislation is required. New laws should consider devolving power to local authorities or other relevant institutions. However, this initiative also calls for strong support in the form of financial resources, for policy reformulation, institutional rearrangements, and provision of material resources at the local level.

Of particular interest, is the increasing compliance among SADC states with international conventions and regional initiatives. This harmonises practices within the region and trans-boundary monitoring of natural resources is made possible. In some instances, disasters can be prevented such as forest fires or illegal trade of forest and woodland products. Inter-state arrangements against poaching are another welcome development.

Local government initiatives are getting stronger. This trend may be due to the realisation by local councils of the direct benefits that go with sustainable resource utilisation. In Zimbabwe, there is a general realisation by rural communities of the vast opportunities that local resources are likely to provide, especially through the development of tourism. As a result, a number of forest areas, some with relics of legend, are being opened up and the resources received from such schemes could offer support to rural communities apart from the ability to reinvest in the sector.

Another positive development is the increasing partnership between local government, the private sector and NGOs. The CAMPFIRE programmes and the IUCN-Masvingo Save River Catchment Area Programme in Zimbabwe are good examples.

While there is a need for greater empowerment of communities in natural resource management, private sector participation must also improve. However, some sectors are only interested in reaping profits and ignore laws by polluting or harvesting and then paying the relatively small fines. Under such circumstances, it is necessary that stringent measures are provided for in legislation and increased monitoring to reduce the incidence of resource misuse. Monitoring for programmes and projects should be implemented at all stages, and should involve all stakeholders.

A promising and commendable development is the increasing use of EIAs. In Mauritius it is illegal to undertake any development programmes without an EIA. In Zambia, EIAs are now enshrined in law, while in Botswana and Zimbabwe there are similar

moves. EIAs are a new concept to the region, but have potential for changing environmental perceptions for the better.

Education and the environment

Klaus Berkmüller[7] observes that "educators [for] protected areas are employed...for the benefit of the visiting public...to prevent human impact in whichever form it may take. Visitors litter, disturb wildlife and damage vegetation. Locals clear and burn patches of forest. Gunshots may be heard frequently. Business interests seek to weaken protection to allow [for] mineral exploitation. Pleas to the administration to change policies or regulations fall on deaf ears. All of these are problems which could become the subject of an education programme."

Although Burkmüller refers specifically to the rain forest, the problems he has outlined also apply to southern Africa. There is a general lack of curriculum-based environmental education strategies and tools. Under such conditions, the actions to take are similar to those proposed by IUCN, UNEP and the WWF[8] as they apply to forests in southern Africa. These include:

- mounting broad campaigns to persuade people and groups to change their attitudes and practices;
- catalysing and supporting actions by individuals and communities;
- persuading governments to take action; and
- working with governments, business and other sectors where they have begun action.

Thus an integrated approach on the part of those who lobby for the incorporation of curriculum-based environmental education is necessary, while at the same time the serious commitment and interest of government is essential.

"Awareness" seems to have become just a buzzword, as there is too much focus on awareness-building and too little on education. More work is needed in perfecting curricula to include environmental education at all levels so as to build a norm among youth. With more education this would change attitudes and actions. There is need for adequate advocacy skills, development of technical knowledge at different levels and simplification of research outputs if they are to be understood and appreciated.

Photo: IMERCSA

More work is needed in perfecting curricula to include environmental education at all levels so as to build a norm among youth.

Economic values and markets

Market values threaten the survival of some of the preferred species of trees such as *Pterocarpus angolensis* (kiaat) and *Dalbergia* species, African blackwood and Purple-wood. With high market value, attention to harvesting these trees is greater compared with other species and they remain threatened by increased international commercial interests. It is a challenge to use economic value as an incentive for local people to sustainably manage their resources. History has shown that even putting a ban on the use of some resources (such as the Rhinocerous) may still not save them. Countries like South Africa, Norway and Portugal have shown increased interest in forest products,

Energy production and use in the SADC region Table 10.2

COUNTRY	COMMERCIAL ENERGY PRODUCTION ('000 tonnes of oil equivalent)		TRADITIONAL FUEL % of total energy use		ELECTRICITY PRODUCTION	
	1980	1994	1980	1993	Average annual % growth 1980-94	Kwh per capita 1994
Angola	7,700	24,914	65.4	59.1	2.4	92
Botswana	260	248	-	-	-	-
Lesotho	0	0	-	-	-	-
Malawi	99	152	83.1	86.4	5.5	86
Mauritius	21	34	47.8	47.2	7.1	901
Mozambique	1,293	161	72.5	85.3	-21.5	31
Namibia	0	0	-	-	-	-
South Africa	69,065	117,691	-	-	4.2	4,670
Swaziland	-	-	-	-	-	-
Tanzania	86	165	89.0	89.3	5.3	66
Zambia	1,146	890	54.9	71.0	3.1	893
Zimbabwe	2,024	3,567	33.5	25.6	7.0	-

SOURCE: World Bank, *1997 World Development Indicators*, International Bank for Reconstruction and Development, Washington, D.C., 1997

illustrated by their eagerness to invest in Mozambique's hardwood timber industry.

While other tree species are not good timber, they are not saved from the axe. There is a big export market for charcoal in Zambia and Mozambique.

Technology

Technological developments and innovations are equally insufficient in the use of appropriate and alternative approaches like using fire as a hunting tool or cutting trees to get honey or caterpillars. Due to inappropriate processing, such as wasteful sawmills, there is a correspondingly high level of deforestation in order to meet the desired quantities of forest products. Partly, this has to do with existing policies which offer poor, or no, incentives for cleaner production or sound management methods.

Research

Examining national and regional efforts in forest research, there is little if any collaboration between institutions. Research is done at sectoral levels and much of the results are academic and too technical for the policy-maker to understand and implement. However, there are some efforts being undertaken to establish an Environmental Information System/Geographic Information System (EIS/GIS) database within the region. The advantage would present researchers and users with information on issues that have already been undertaken and avoid repeating the same experiments in an environment of scarce financial resources.

The hindering factor is, of course, based on the fact that there are many priorities in developing

Industrial charcoal production in northern Namibia Box 10.2

Though Namibia has a low population density, environmental problems are occurring in some heavily-populated areas of the country, mainly in the former Ovamboland in the north of Namibia, where 45 percent of the population is concentrated on less than 10 percent of the country's land mass, is already facing a grave fuelwood crisis.

Near Tsumeb, about 200 km south of Ovamboland, an ultra-modern charcoal factory is already working with the supply of species from commercial farmland areas. With Belgian technology and South Africa capital, charcoal is produced at an industrial pace. One tonne of wood is produces 250 kg of charcoal. Each of the 20 furnaces can produce two tonnes of charcoal daily. Unfortunately the product is too expensive for the local population and the charcoal is exported to rich industrial countries who use it for private barbecue and restaurant activities.

The technical concept of this charcoal factory may solve the bush encroachment problem and produce large amounts of high quality charcoal. However, it totally neglects the basic needs of the nearby indigenous population for a rare product. To export charcoal from Namibia for leisure activities in Europe and Japan seems to be morally doubtful in view of the fuelwood scarcity and deforestation menace in the north of Namibia.

The government should use its financial resources to support this charcoal production approach with bush encroachment species, but make its products available for their population.

SOURCE: Lemhoefer, D. P., SADC-FSTCU, Lilongwe, Malawi, for SARDC, 1997

economies such that telecommunications may not be at the top of the agenda. As a consequence, there are decreasing financial allocations and assistance for awareness-building towards natural resources roles, use and management.

For a majority of the SADC countries, there are positive trends in the introduction of environmental education in school curricula and this development offers opportunities of increasing awareness among the school-going population. With the introduction of adult literacy schemes in many countries, there is bound to be an increase in the level of literacy, which will allow access to print media on the environment. There is also increasing global sharing of information, which can be utilised in decision-making processes.

Due to the same shortages in financial resources, research activities in the SADC region are declining. The levels of applied research in forestry institutions are low and, as a result, brain drain is on the increase.

Despite these shortcomings, however, there are indications of positive trends in regional initiatives such as in the standardisation of land degradation and vegetation monitoring through the initiatives of SADC ELMS. Coupled with these efforts, there has been a vigorous thrust in regional and national

SOE-reporting in recent years, improving information access for policy-makers, and for advocacy and lobbying

A VISION FOR THE FUTURE

Overview

Current trends seem to suggest a not-so-glowing future, especially when projected onto the horizon. Population growth, land-use patterns, industrialisation, and general poverty will certainly impact negatively on biodiversity, while other factors such as governance and research-education will impact according to how they are implemented. Scenario-building requires some assumptions such as changes in technology, evolution of policy and unpredictable events that may take place in the future.

Stating a vision of a southern African future in which biodiversity and forest exploitation is sustainable, requires imagination. Unlike prediction, which is a futile exercise which hardly ever gets things right, a future scenario can be a reality.

For that to happen, the scenario-building must be grounded in reality from the beginning, using appropriate materials that people can relate to in SADC such as:

- the region's geographical location;
- geophysical and climatic features;
- population growth and distribution;
- economic growth;
- food security;
- water availability, distribution, and management;
- democracy and governance;
- institutional arrangements; and
- regional and international cooperation.

A group of environmental experts from different SADC countries who gathered in Harare for a one-day workshop used these and other materials in building a future scenario for the region in biodiversity and indigenous forest management. The objectives of the workshop were to:

- assess the current state and trends in biodiversity and forests issues in the SADC region;
- identify the pressures that are being exerted on the region's biodiversity and forests, highlighting the way they are impacting on the state of the environment;
- identify the responses, positive or otherwise, being implemented at both national and regional levels to reduce the impact on biodiversity and forests in particular and the regional environment in general;
- suggest the necessary intervention measures needed to effectively manage the region's biodiversity and forests, and ensure the sustainable use of these resources; and
- paint a picture of the desired future, taking into account issues, which need to be addressed to make this possible.

The 20 experts had varied professional backgrounds, ranging from foresters, ecologists and geographers to crop scientists, biologists and communications experts. The participants first looked at the major current state and trends in biodiversity and forestry issues in the SADC region. These varied from institutions, forest management, research and monitoring to public knowledge and awareness of biodiversity and forest issues to trade and markets.

The starting point for the experts was the first draft of this book which provided background information on the current state of biodiversity and forests in the SADC region. Following analysis of the issues in different chapters, the participants worked together in plenary, writing the major issues and their influence on the environment. Further input to the picture was through contributions made to the review of this chapter before publication.

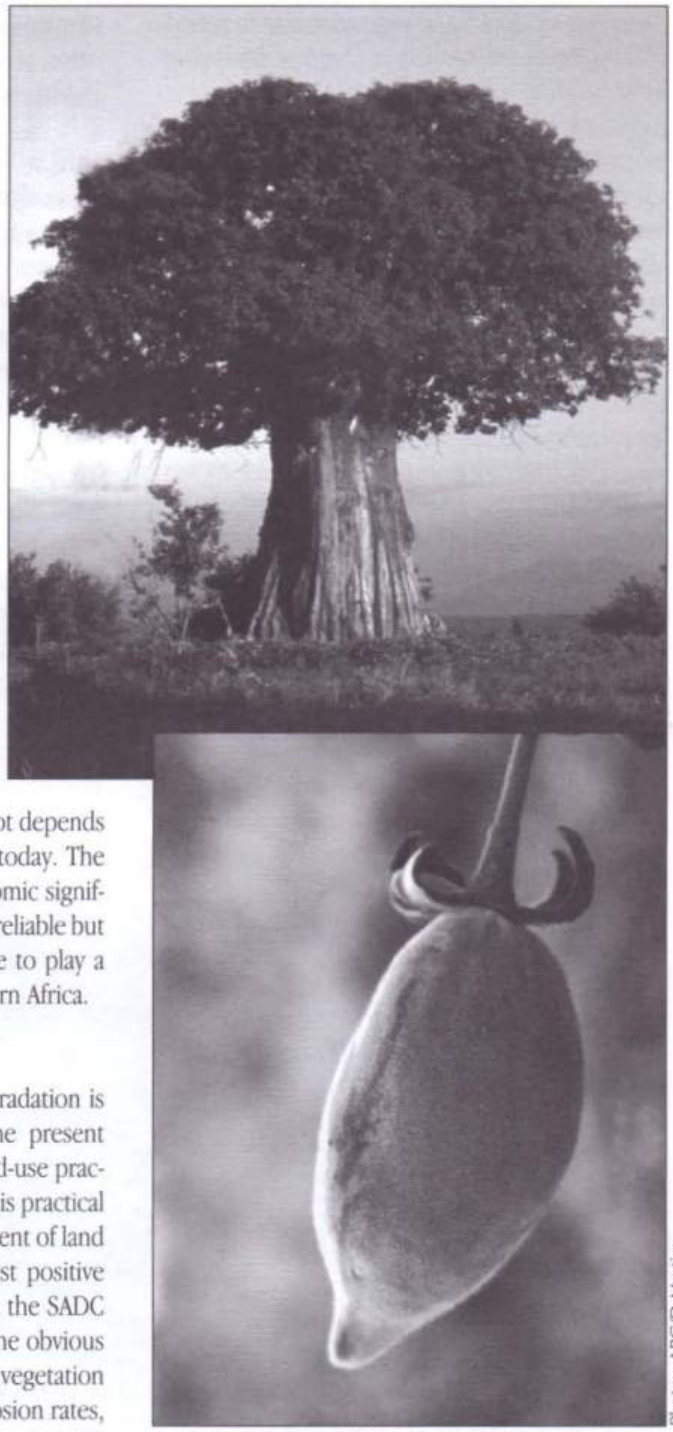
Reviewers were drawn from government, SADC, private sector and experts with interests in safeguarding biodiversity. The picture below was then painted, and at the end of this section is a best case scenario vision for southern Africa.

Future economic significance of forestry

It has been noted that the contribution of the forestry sector to GDP is high in most countries. The projected contribution will be affected by population growth, industrialisation, conservation measures and other factors. The rising population will increase pressure on the land and on indigenous forests, especially in most countries where this resource is regarded as free. Industrialisation will probably reduce forestry's share of GDP, help cut the percentage of population relying entirely on forestry resources but a lot depends on conservation measures put in place today. The variables for predicting the future economic significance of the forestry sector are quite unreliable but it can be said that forestry will continue to play a pivotal role for the economies of southern Africa.

Land use

While it is a fact that land resource degradation is an issue of concern in the region, the present efforts in extension services towards land-use practices are likely to yield dividends if there is practical appreciation and participatory management of land resources by the beneficiaries. The most positive situation would have more land area in the SADC region covered by indigenous forests. The obvious advantages of such a desired mosaic of vegetation are many, including reduction in soil erosion rates, flood control, as well as building an otherwise



Photos: APG/D Martin

A Baobab tree in full leaf and its fruit.

dwindling stock of native vegetation able to provide fruit, timber, bark, medicines, food and other products.

Energy needs and consumption will continue to grow in both urban and rural areas, exposing the remaining limited forests to extinction. The dependence of rural and some urban areas on firewood means that forest resources will continue to be exploited well into the foreseeable future. The need to try and get more out of tired soils may lead to further degradation, worsening the people's ability to sustain themselves from forests and agriculture.

Potential conflict areas in southern Africa

With population growth projected to double by 2025, southern Africa faces the potential of continued conflict over land use, especially the share between agriculture and forest reserves and access to the resources. In this regard, it is imperative that checks be developed where other industries absorb the increasing demand for land and assures the maintenance of existing forest reserves. Land problems are particularly acute today because of the rise in population and the decline in natural resources. This is why land issues in most African countries are of highest priority.[9]

Observations made on existing forestry policies in some African countries, are "the result of co-existence between customary law and modern law, often ill-adapted and based on values totally foreign to local tradition, is that the land problem will find solutions in a sustained effort for planning of rural space, accompanied by an appropriate revision of legislation".[10]

Thus, a "rural code" must be prepared which integrates all the existing sectoral law codes (e.g forest, water, pastoral law). It should take into account customary systems of managing natural resources and establish a legal code for rural populations to take charge of their environment. Various areas in the region have the potential for future conflicts including potential border disputes. Existing borders inherited from colonial regimes and set at the Berlin conference of 1885 do not consider existing social boundaries, and in most cases, chiefdoms were divided into different countries. People indigenous to these areas are in continual disregard of colonial boundaries. Conflicts may result in refugee migration and a destruction of the ecosystem leading to biodiversity loss.

Ecosystems and habitats

In a dynamic environment where there is interdependence between species the restoration and maintenance of the natural continuum is impor-

Photo: M Chenje

These petrified trees are a constant reminder of how reservoirs destroy ecosystems.

tant. Where land and forest resources are degraded, there is a relative influence over other resources where ecosystems and habitats are lost. Under such circumstances, the probabilities of losing species are high. In this case, a total rehabilitation of degraded forest and woodland reserves and other lands is required where there are diversified ecosystems and habitats.[11]

Potential problem areas for the future include the disappearing equatorial rain forests of the DRC, desertification of much of southern Africa's tropical regions, loss of freshwater habitat (and diversity) through siltation and general loss of habitat through opening up new areas for settlement and agriculture. Larger ecosystems such as the Zambezi River basin calls for regional cooperation to enhance conservation, and makes it important to promote regional initiatives such as the ZAPCPLAN.

Water resources

Earlier studies on southern Africa indicate that erosion is prevalent, and siltation is threatening many wetlands.[12] In a region where the incidence of drought is pronounced, the value of water resources is high especially during dry periods. Siltation of rivers and reservoirs has a tremendously negative impact on the socio-economic well being of the communities in the region because it results in water pollution, reduced quantities of available water supply, possible smothering of wetlands and reduction of useful life of hydraulic structures such as reservoirs.[13] The viable option for the region is to recognise the vital role that forests and woodlands play in maintaining a regulated environment where erosion and siltation is controlled. There is an urgent need for a future where there is reduced siltation of water systems in the region.

Photo: M Chenje

Larger ecosystems such as the Zambezi River basin calls for regional cooperation to enhance conservation, and makes it important to promote regional initiatives such as the ZACPLAN.

There is general agreement that global climate is changing. Climate change impacts in southern Africa will largely be negative: less rainfall, increased droughts, floods, increase in temperatures and general desertification. Loss of biodiversity under climate change is inevitable, and measures to ensure adaptation need to be put in place. These may include planting (indigenous) resistant tree species, irrigation and practising sustainable farming methods. The (global) positives associated with climate change include shorter growing periods for plants such as maize (from increased carbon dioxide concentrations), and increased arable land as ice melts in the Northern Hemisphere. Southern Africa will certainly experience a net loss.[14]

Demand for water in the region is increasing rapidly. Namibia, for example, registered an annual increase of 4.5 percent for the period 1970-1993, to reach a demand of 95 million cu m in 1993, while the region as a whole is projected to have annual demand increasing by three percent per year to 2020.[15]

Ownership and property rights

The key principle of forestry policy is to encourage the participation of population in the management of natural resources.[16] One of the most important conditions would be to ensure the security of the rural producer on the land, allowing for its acquisition by those who have none. The people should be given responsibility to conduct their own affairs in their areas, particularly in the use and management of forests and biodiversity. Under such arrangements and complementing these efforts with extension and training in resource-management, a healthy scenario can be achieved in property rights and ownership.

There are major lessons to be learned from the traditional models of ownership where resources are shared by everyone who then contributes to its management. Shared ownership of resources further reduces the chances of conflict, especially when the commons provide equal benefits and advantages to the stakeholders.

In cases where access to forest resources is restricted to those with concessions or under situations where such access is denied, there is usually illegal harvest and use when no alternatives are available or provided, and under such circumstances the encroacher is bound to have acted against the law and is subject to penalties. Efforts being undertaken in Zambia under the Provincial Forestry Action Plan[17] are worth considering regionally since they promote common responsibility for forest resources.

Biodiversity regimes

Emphasis on forest exploitation for timber, with little or no regard to biodiversity, cannot sustain the present and future levels of demand, so there is a certain scenario of accelerated levels of extinction of the majority of species.

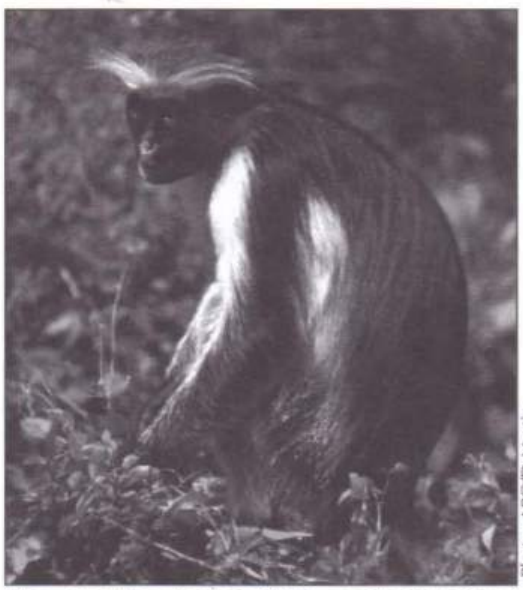


Photo: APG/D Martin

The Zanzibar Red Colobus, needs its natural woodland habitat to survive.

The biodiversity of southern Africa Table 10.3

COUNTRY	MAMMALS		BIRDS		HIGHER PLANTS	
	Species 1994	Threatened species 1994	Species 1994	Threatened species1994	Species 1994	Threatened species 1994
Angola	267	16	909	13	5,000	25
Botswana	164	8	550	5	-	4
Lesotho	33	2	281	3	1,576	7
Malawi	195	6	645	9	3,600	61
Mauritius	4	3	81	9	700	222
Mozambique	179	9	678	13	5,500	92
Namibia	154	12	609	6	3,128	23
South Africa	247	25	790	16	23,000	953
Swaziland	-	-	-	-	-	-
Tanzania	322	16	1,005	30	10,000	406
Zambia	229	7	736	10	4,600	9
Zimbabwe	270	9	648	7	4,20	94

SOURCE: World Bank, *1997 World Development Indicators*, International Bank for Reconstruction and Development, Washington, D.C., 1997

It has been observed that "foresters are increasingly seeking combinations of forest uses which are compatible. They are finding that conserving biodiversity and indirectly regulating climate are highly compatible forest services. These uses can also allow the production of non-timber forest products, the conservation of soil and water and recreation and tourism. The trend is clearly away from single product forestry, and back to diversity and benefits for people living in and around the forests".[18] It is important that these values be adopted in the future.

Awareness

Public awareness of the important role forests and woodlands play with ecosystems is slowly rising. Equally, there is a slow increase in knowledge about the environment, the delay being attributed to weak communication channels within the southern African region. The installation and development of Internet in most of the institutions and organisations in the region, as well as free provision and access to environmental information and general telecommunications improvement, are some of the strategies that could speed up the process. Indeed, as developing nations, a sizeable amount of work is being carried out to improve the communications infrastructure. As SADC develops into a stronger economic unit, general awareness will be high. It is possible though, that forests will continue to be harvested unsustainably in the future – even with awareness in place – due to other driving factors such as poverty.

Legislation and policies

The recognition of the incompatibility of old colonial laws with the realities of today has made it possible for countries in the region to embark on improving legislation and policies. The constitutions of Malawi, Mozambique, South Africa and Zambia have enshrined environmental land in the law. These new laws have also provided for

increased participatory approaches by all stakeholders. The fundamental problem, however, still remains: there are gaps that need to be addressed by central governments especially towards harmonising sectoral policies. The policies remain fragmented and government ministries and departments carry out their functions separately under wildlife and forestry, water resources, agriculture, tourism and mining, exhausting more funds than would otherwise have been the case. These efforts could best be dealt with under National and District Environmental Action Plans, which are not yet fully recognised as valuable programmes.

The current state of biodiversity and forests presents a grim picture for the future if no intervention measures are introduced urgently. This is characterised by biodiversity loss and over-exploitation of forests and woodlands, leading to severe reduction of the area, which they cover. Such losses not only have negative impacts at local and national levels, but also regionally and globally.

National economies of the region have started moving away from traditional state policing towards participatory management practices. As communities are encouraged to participate in their environment, they generally appreciate its importance more, and sustainable future conservation is guaranteed. International conventions and agreements aim at protecting global ecosystems, and these are assimilated into local policy.

CONCLUSION

The most desirable picture for the future of southern Africa can be summarised in the following vision;

1. Further losses of biodiversity and forests as a result of extensive agricultural activities and over-exploitation of forests for fuelwood, have been stopped through:
   - elimination of poverty;
   - provision of alternative energy sources;
   - clearly defined tenurial and property rights;
   - intensive agriculture;
   - proper valuation of the natural capital; and
   - effective policies and institutions.

2. A comprehensive forestry programme, which takes into account all codes of conduct and an integrated appraisal and management system of forest and woodland resources, must be in place.

3. The apparent deliberate disregard of the role and value of forests and woodlands, by politicians especially when their call is to maximise output from the land —which is seen as economic development or growth — even when such maximisation is from fragile mountain slopes, has been removed. Incidents such as in Zambia and Malawi where politicians promise state forest land in exchange for votes should not be repeated.

4. Production and output on one hand and economic development or growth on the other, have been weighed against time and balanced for sustainability. Leaders take control over sustainable use of forest and woodland resources even if it is at the cost of losing a vote. On the whole, general awareness has risen and with integrated approach and commitment on the part of implementers and leadership, the aspirations of the people are accommodated.

LINKAGES TO OTHER CHAPTERS Box 10.3

1 A REGIONAL OVERVIEW
The linkages between the different sectors of the economy are discussed on a regional perspective in the Introduction.

2 THE FORESTS AND WOODLANDS OF SOUTHERN AFRICA
Forested land is currently being cleared at nearly one percent per annum.

3 THE BIODIVERSITY OF INDIGENOUS FORESTS AND WOODLANDS
Biodiversity is lost annually from loss of habitat caused by expansion of human settlements. Future scenarios will be affected by factors such as the continued growth in population.

4 ECOLOGICAL PROCESSES
As forests continue to dwindle, greenhouse gasses such as carbon dioxide will continue to accumulate in the atmosphere at larger rates.

5 STATUS OF FORESTS AND WOODLANDS, AND PATTERNS OF CONVERSION
Human related factors affecting the status of biodiversity need urgent attention, as the biggest threat to its survival. As indigenous forests and woodlands are cleared annually for further human development, more biodiversity is lost and present trends depict a future that is not sustainable.

6 PRODUCTS AND SERVICES
Pressure on indigenous forests and woodlands resources will continue to rise due to the increase in population and other factors.

7 ECONOMIC VALUATION AND ACCOUNTING
Indigenous forests and woodland resources have to be correctly accounted for, should effective conservation strategies become a reality.

8 POLICY ANALYSIS
The region is in the process of establishing and instituting forestry policies aimed at effective and sustainable resource use.

9 SUSTAINABLE MANAGEMENT OF INDIGENOUS FORESTS AND WOODLANDS
Integrated conservation policies such as ADMADE and CAMPFIRE in Zambia and Zimbabwe ensure sustainable use of natural resources by involving the grassroots in all areas of conservation.

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A1 ACRONYMS AND ABBREVIATIONS

ADMADE	Administrative Management Design
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CBO	Community Based Organisation
CBD	Convention on Biological Diversity
CBNRM	Community-based Natural Resources Management
CCFM	Canadian Council of Forest Ministers
CFCs	Chlorofluorocarbons
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
CPR	Common Property Resources
CSD	Commission on Sustainable Development
DEAT	Department of Environmental Affairs and Tourism
DRC	Democratic Republic of Congo
EIA	Environmental Impact Assessment
ENSO	El Niño-Southern Oscillation
FAO	Food and Agriculture Organisation
FSTCU	Forestry Sector Technical Coordination Unit
GDP	Gross Domestic Product
GHG	Greenhouse gases
GIS	Geographical Information Systems
GMA	Game Management Area
GNP	Gross National Product
ICRAF	International Centre for Research in Agroforestry
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
IUCN	World Conservation Union
JFM	Joint Forest Management
LHWP	Lesotho Highlands Water project
LIFE	Living in a Finite Environment
MAB	Man and the Biosphere Programme
MVP	Minimum Viable Population
NEAP	National Environmental Action Plan
NGO	Non-governmental organisation
RDC	Rural District Council
RETOSA	Regional Tourism Organisation of Southern Africa
SAC	Scientific Advisory Committee
SADC	Southern African Development Community

SAESD	Southern African Environment and Sustainable Development programme
SAPs	Structural Adjustment Programmes
SARDC	Southern African Research and Documentation Centre
SHARED	Southern African Environment and Sustainable Development
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Education, Scientific and Cultural Organization
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VLUPC	Village Land Use Planning Committee
WMA	Wildlife Management Area
WRI	World Resources Institute
ZACPLAN	Zambezi River System Action Plan

A2 GLOSSARY

Aa

afforestation – planting trees in an area where there have not necessarily been trees before

agroforestry – agriculture using trees, which serve multiple purposes including shelter from wind and sun, improving soil fertility, and providing fruit, fodder and fuelwood

agro-industries – industries supporting or dependent on inputs from agriculture agrosilviculture

albedo – ability of surfaces to reflect radiation

alley-cropping – planting between ridges

allelopathy – the release into the environment by an organism of a chemical substance that acts as a germination or growth inhibitor to another organism. The phenomenon was described originally for heath and scrub communities, but is now known to be a widespread anti-competition mechanism in plants

anthropogenic activities – activities that are associated with humans such as fire, agriculture or mining

Bb

bee-keeping – practice of taming bees in hives for honey

biltong – dried, salted (and sometimes spiced) beef or game meat

biodiversity (biological diversity) – the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part which includes diversity within species, between species and of ecosystems

biodiversity valuation – takes into account genetic, species and ecosystem aspects. The loss of a particular species is assessed according to the substitution costs of replacing its direct use value

biomass – total quantity of living tissue per tree, per unit of area or in a community of plants

biome – a biological classification that reflects the ecological and physiognomic character of the vegetation. Biomes are the largest geographical biotic communities that it is convenient to recognise. They broadly correspond with climatic regions, although other environmental controls are sometimes important.

biosphere – that part of the earth's surface and atmosphere inhabited by living things

bush fallow – when the fallow period includes the development of woody plants

bylaw – regulation made by a local authority or corporation

Cc

catchment area – the entire area drained by a stream or river, equivalent to drainage basin

carbon dioxide sequestration – removal of carbon dioxide especially from the atmosphere

carrying capacity – the maximum number of livestock, human beings or other living organisms, which can be sustained by an area without damage

caterpillars – an early life history stage of butterflies and moths

chitemene – a system of cultivation characteristic of wet miombo woodland in which trees are cut without removal of the stumps, the logs and vegetation material are piled in a central area and burnt, and cultivation takes place in the ash bed

climate change – change in the average conditions of the global weather system and patterns

climax vegetation – the final stage of a plant succession in which vegetation reaches a state of equilibrium with its environment

commercial logging – private business of cutting trees in designated forests and woodlands for industrial purposes like manufacturing of furniture

commons – piece of open public land, which is shared or used for joint interest

conservation – the saving of natural resources for future consumption, including the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs of the future

cultivar – the variety of a plant which has been developed under cultivation and which does not occur naturally in the wild, but which is a distinct sub-species

Dd

dambos – a shallow, seasonally or permanently waterlogged, grass-covered depression

degradation – the failure of land to produce adequate forest and woodland biodiversity resources through both human-induced and natural disturbance and ultimate collapse of supporting ecosystems

deciduous forests – forests that shed their leaves in winter

deforestation – removal of trees and shrubs and their replacement by activities such as shifting or permanent agriculture, ranching, mines, dams and other infrastructure

desertification – turning into a desert, often due to mismanagement

droughts – periods of little or no rainfall in areas where the mean annual rainfall is adequate to support life and activity

drupe – fruit with a single seed and a fleshy body (i.e. a peach)

Ee

ecology – the study of the relationship between living organisms and their environment

ecosystem – a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit

ecotourism – tourism, which is sensitive to the environment and is supposed to benefit local communities. It is being promoted as an alternative to mass, commercial tourism

El Niño – Spanish for "the boy child", a name given to the periodic warming of sea surface temperatures in the Pacific around Christmas time

endemic – species that are believed to exist only in a specific area

endemism – situation in which a species or other taxonomic group is restricted to a particular geographic region, owing to factors such as isolation or response to soil or climatic conditions

environmental accounting – the inclusion of environmental information in national accounting, planning and budgeting systems to reveal the productive and economic value of natural assets and provide the basis for more judicious policy decisions. The system is also referred to as "green accounting"

environmental degradation – destruction of living or non-living things and a reduction of the productivity of the area

epiphytes – a plant that uses another plant, typically a tree, for its physical support, but does not draw nourishment from it

ethnobotany – study of how plants are used by people

eutrophication – also known as nutrient enrichment – the process of over-fertilisation of a body of water by nutrients that produce more organic matter than the self-purification reactions can overcome

evaporation – the process by which a solid or a liquid turns into vapour; loss of moisture as vapour

evapotranspiration – water that evaporates from plants, animals and other surfaces

exotic species – species not indigenous to a particular area

***ex-situ* conservation** – saving of natural resources outside their original habitats such as in field and seed gene banks and arboreta

external cost – cost or benefit arising in a process of production or consumption, which is not reflected in market prices. Communal area households' decision-making processes are not guided by overall economic concerns; they respond to financial signals, which often omit external costs

extinct species – species that have ceased to exist, either at a given locality (locally extinct) or throughout the world (total extinction)

Ff

fauna – the animal life of a region or geological period

fertiliser – substances added to the soil to make it more fertile

flora – all plant species that make up the vegetation of a given area. The term can also be used to mean assemblages of fossil plants from a particular geological time, or from a geographical region in a former geological time

forage – plants that can be use as feed for livestock

forest – a plant formation that is composed of trees, the crowns of which touch forming a continuous canopy

forest reserve – forest exempted from public use and access for conservation of the biodiversity

fuelwood – wood that can be used to supply energy for heating

fungi – a botanical grouping for a specific type of lower plants. The most-commonly known fungi are the mushrooms

fynbos – Afrikaans word for fine-leafed bush, an ecozone in South Africa's southern Cape area, comprised of shrubs and shrubby woodland, which grows up to three m high, with patches of hardwood forest

Gg

game – wild animals and birds

gene bank – a central place where genes (hereditary material) from different plant and animal species are stored for reproduction purposes

genetic diversity – the heritable variation within and between populations of organisms, species and ecosystems

geomorphology – study of the physical features of the earth's surface, their development and how they are related to the core beneath

granary – structure built to store grain. In the context of small-scale farmers, these are usually built with mud and wood

grassland – an area dominated by grass, but differing from savannah woodland by being generally cooler and drier
greenhouse gases – gases that prevent radiant heat from escaping back into the atmosphere

Hh

habitat – the living place of an organism or community, characterised by its physical and biotic properties
herbivores – animals that feed on plants

Ii

imperfect competition – a violation of the efficiency of markets caused by market domination of one or two major producers, or caused by special arrangements to limit competition
indigenous forests – forests that are native to a particular region
infiltration – penetration of water into the ground
inselberg – steep-sided isolated hill that stands above nearby hills
***in-situ* conservation** – saving and maintenance of natural resources in their original habitats
invasive alien plants – plants introduced from other areas or countries and invading and becoming established in areas in which they do not naturally occur

Kk

kraal – homestead

Ll

La Nina – reverse of the *El Niño*, La Nina (Spanish for little girl) takes place when a cold phase occurs resulting in unusually heavy rains in the region. During this period, the western Pacific is cooler than the Indian Ocean and the wind systems move from the Pacific
lianes – any wiry or woody, free hanging, climbing plant

Mm

mangrove – tropical forest or shrub growing in shore mud with many tangled roots above ground
marginal land – land with poor soils, not suitable for cultivation
marsh – area of permanent wetland and the plants that grow on it
metapopulation – group of specific populations that exist at the same time, but in different places
miombo – the vegetation formation dominating south, central and eastern Africa, stretching from Tanzania in the north to Zimbabwe in the south, and spanning the continent from Angola to Mozambique. The miombo is a woodland formation that is dominated by the genera *Brachystegia*, *Julbernardia* and *Isoberlinia*.
model – simulation of real situation
monoculture – the practice of growing a single plant species over a large area
molapi – type of agriculture practised in Botswana around floodplains
mono-cropping – the planting of a single crop over an area, a system vulnerable to soil erosion because the soil is left bare and exposed after harvesting
morphology – study of the structure and shape of living organisms
mushroom – a fungus with a stem and a domed cap; some can be edible and others poisonous
mycorrhizal associations – associations between plants and fungi which are based on physical connections between the roots of the plants and the fungal bodies

Oo

oshanas – local name for the system of interconnected drainage channels that flow through central Owambo in Namibia
ornamental plant – a plant cultivated in home gardens or domesticated for the purposes of adding beauty to the surroundings
overgrazing – grazing by livestock or wild fauna to a point where grass cover is depleted, leaving bare, unprotected patches of soil with a corresponding increase in water and wind erosion, and encouraging the growth of poisonous plants and thorny shrubs
oxidation – A reaction in which molecules gain oxygen or lose hydrogen or electrons

Pp

pathogen – any micro-organism that causes disease. Pathogens are ecologically important in controlling the distribution of species and interspecific and intraspecific competition
percolate – to trickle slowly through a quantity of solid particles
photosynthesis – a biological process by which plants take in carbon dioxide and release oxygen
physiognomy – the form and structure of natural communities
phytochoria – broad areas with similar suites of plant species
plantation – area planted especially with trees
poacher – a person who harvests flora or fauna illegally
policy – a set of government or corporate objectives and guidelines deliberately chosen to influence future decisions
preservation – primarily saving natural resources from use

propagule – any structure that functions in propagation and dispersal such as a seed or spore
protected areas – territories with legally defined boundaries, established to afford protection to certain natural characteristics of particular value or interest

Rr

rangeland – area or park usually reserved for grazing
reafforestation – planting trees in an area, which previously had trees
resilience – shows the ability of ecosystem's components and their populations to recover from, or adapt to, disturbances while maintaining the same levels of productivity potential
respiration – breathing
rhizome – plant stem, which lies under the ground and contains leaf buds
runoff – movement of water on the earth's surface and through rivers, streams and other channels

Ss

sanctuary – place where birds or other wild animals are provided with protection
satellite measurements – measurements that are remotely determined through sensors at an average altitude of 36,000 km above the earth's surface
savannah mosaics – varieties of vegetation characterised by grasslands
sclerophyllous – Typically shrub, but also forest in which the leaves of the trees and shrubs are evergreen, hard, thick, leathery and usually small
seedling – a young plant
sink of carbon dioxide – an agent, such as vegetation, that removes carbon dioxide from the atmosphere
soil erosion – the removal of topsoil by agents such as water and wind, which usually occurs where the soil is not well protected.
sponge – area saturated with water usually yielding this to lower ground in the form of base flow
spring – place where water wells up naturally from the ground
stochastic – representation of a system that takes account of probability, so that a given input yields a number of possible results
swamp – area of waterlogged ground
succession – the sequential change in vegetation and the animals associated with it, either in response to an environmental change or induced by the intrinsic properties of the organisms themselves
succulent plant – plant with thick fleshy leaves for water storage and mostly found in arid or areas susceptible to periodic moisture shortage
sustainable development – development whose benefits continue over a long-term and are ecologically, economically and socially acceptable
sustainable use – level at which a system is able to continue optimally supporting a function
silvipastoralism – in search of forest products

Tt

taboo – a custom that is not permitted within the context of the local culture
termitaria – structures which termites build and which are central to life in termite colonies. The structures may be large and conical built out of sub-surface soil or they may be underground not visible from the surface
traditional healers – specific persons within African society that are responsible for the physical and spiritual health of people. They treat physical, psychological and spiritual problems, and many of their remedies are based on local plants and animals
transpiration – loss of water from a plant through its stomata
tubers – swollen underground stems

Vv

valley – area between to high ranges or grounds

Ww

watershed management – an undertaking to maintain the equilibrium between elements of the natural ecosystem of vegetation, land and water on the one hand and human activity in utilising the elements on the other
wildlife – wild animals and plants collectively
windbreak – breaking the force of the wind.
woodfuel – wood specifically to provide energy for various purposes like heating, lighting and cooking
woodland – vegetation community that includes widely spaced trees. The tree crowns are more widely spread than those of a forest. Crowns do not touch or form a closed canopy. Woodland is normally defined as having 60-80 percent canopy closure. Between the trees, grass or scrub communities typically develop
woodlots – plot planted with trees for domestic use

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Southern African Development Community (SADC)

SADC, an intergovernmental organisation, of 14 member states, structurally organised into several development sectors, whose respective coordination is entrusted to the government of a specific member state. The Government of Lesotho is responsible for coordinating activities within the SADC Environment and Land Management Sector (ELMS) and has established a Coordination Unit within its Ministry of Agriculture, Department of Conservation, Forestry and Land Use Planning.Environmental reporting and information activities are key components in the SADC-ELMS programme of work and, for several years now, ELMS has been collaborating with SARDC and IUCN-ROSA in this area.

The World Conservation Union (IUCN)

IUCN is the only union whose members include both governments and non-governmental organisations (60 in southern Africa) providing a medium for effective conservation and development action on the ground. The Regional Office for Southern Africa (ROSA) based in Zimbabwe, and its country offices in Botswana and Zambia, act as focal points for IUCN's conservation and development programmes in the region. IUCN's aim is simple, as manifested in the Union's Mission Statement to "influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature to ensure that any use of natural resources is equitable and ecologically sustainable." Among other activities in the framework of the CEP programme, IUCN-ROSA has awarded investigative reporting fellowship for journalists in the region and facilitated training workshops for environmental writers

Southern African Research and Documentation Centre (SARDC)

SARDC is an independent information resource centre whose primary mandate is the collection, analysis and dissemination of information about the southern African region with offices in Harare and Maputo. SARDC's objective is to improve the base of knowledge about economic, political, cultural and social developments and trends, and their implications by disseminating information to a wide regional and international audience. SARDC is also a documentation centre containing more than 9,000 subject files on regional issues, a library of books and periodicals, and computerised databases of select material with reading room facilities for researchers and others studying issues with a regional perspective.

The Musokotwane Environment Resource Centre for Southern Africa (IMERCSA) is the environment programme of SARDC. The Communicating the Environment Programme (CEP) is implemented under IMERCSA. CEP has produced state-of-the environment fact sheets and established a regional environment resource centre with a computerised database and library on southern Africa. The library and database are at the core of SARDC's ongoing reporting and analysis of regional environmental issues. SARDC is also able to undertake consultancies on environmental and other issues.

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IUCN
The World Conservation Union

SARDC
Southern African Research and Documentation Centre