The Dry Forests and Woodlands of Africa

Managing for Products and Services

Edited by
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Biodiversity of Plants

Enos Shumba, Emmanuel Chidumayo, Davison Gumbo, Cynthia Kambole and Mwale Chishaleshale

Defining Biodiversity of African Dry Forests and Woodlands

The Convention on Biological Diversity (CBD) defines biodiversity as the variation between ecosystems and habitats; the variation between different species; and the genetic variation within individual species. Biodiversity can therefore be described in terms of the diversity of ecosystems, species and genes. This chapter describes the floristic and ecosystem diversities in dry forests and woodlands of sub-Saharan Africa and their current status and management.

Floristic Diversity and Endemism

Sub-Saharan Africa has a wide range of dry forest and woodland formations, each with diverse flora. Some of these formations have been described in Chapter 2 but many more subtypes were described by White (1983) and Table 3.1 lists a selection of these.

Species richness (total number of species in a given area) and endemism (proportion of species restricted to a particular area) are often used to describe biodiversity. Endemic taxa are species or genera or families that have at least 75 per cent of their geographical range within one ecoregion. An ecoregion is characterized by a suite of plant taxa that respond to distinct patterns of landform, geology, soils and climate. Centers of endemism are areas of high

Table 3.1 *Diversity of vegetation types in African dry forests and woodlands*

Phytoregion	*Main vegetation types*
Guineo-Congolian/Zambezian Regional Transition Zone	Southern dry evergreen forest and transitional woodland Wooded grassland
Guineo-Congolian/Sudania Regional Transition Zone	Guinea dry forest
Zambezian Region	Dry deciduous forest and scrub forest Zambezian wooded grassland Itigi deciduous thicket Miombo woodland Mopane woodland Undifferentiated woodland
Sudanian Region	Sudanian *Isoberlinia* woodland Undifferentiated woodland *Acacia* wooded grassland
Kalahari-Highveld Regional Transition Zone	*Acacia* woodland Wooded grassland Semi-arid shrubland
Somali-Masai Region	*Acacia-Commiphora* bushland and thicket Evergreen bushland and secondary wooded grassland Semi-arid shrubland

Source: Based on White (1983)

concentrations of taxa that are endemic to an ecoregion. Because of taxonomic revisions, variable sampling effort and differences in delineating phytoregions, there are often large differences in estimates of species richness and levels of endemism among different workers. This problem is particularly acute in the case of dry forests and woodlands of Africa that are diverse and their delineations vary considerably among workers.

Floristic diversity in African dry forests and woodlands was assessed by White (1983) and has recently been re-evaluated by Linder et al (2005) (Table 3.2). Both the assessments by White (1983) and Linder et al (2005) indicate that the Zambezian Regional Centre of Endemism has the highest floristic diversity of dry forests and woodland types. Mittermeier et al (2003) focusing on the Zambezian woodlands also identified the miombo-mopane woodlands as one of the five ecozones (together with Amazonia, Congo, New Guinea and the North American deserts) needing to be prioritized for biodiversity conservation because of their irreplaceability in terms of species endemism. The Zambezian Regional Centre of Endemism has eight endemic genera compared to four in the Sudanian Regional Centre of Endemism; however, endemic genera in the Somali-Masai Regional Centre of Endemism are even higher at 50 (White, 1983). The Zambezian phytoregion is also a centre of diversity for the *Brachystegia* and *Monotes*. There are also considerable similarities in the flora of the different phytoregions; some flora in the Guineo-Congolian/Sudanian and the Guineo-Congolian/Zambazian are also found in the Sudanian and Zambezian woodlands. Similarly, about a quarter of the species in the Zambezian phytoregion are also found in the Sudanian phytoregion.

Table 3.2 *Floristic diversity and levels of endemism in phytoregions in which dry forests and woodlands are dominant formations in sub-Saharan Africa*

Phytoregion	*Plant species*		*Endemic species*		*Percent endemic species*	
	White (1983)	*Linder et al (2005)*	*White (1983)*	*Linder et al (2005)*	*White (1983)*	*Linder et al (2005)*
Guineo-Congolian/ Sudania RTZ[1]	2000	711	50	5	3	1
Guineo-Congolian/ Zambezian RTZ[1]	2000	571	50	28	3	5
Sudanian RCE[2]	2750	684	960	6	35	1
Zambezian RCE[2]	8500	1725	4590	377	54	22
Somali-Masai RCE[2]	2500	931	1250	103	50	11
Kalahari/Highveld RTZ[1]	3000	583	50	10	20	2

Notes: 1. RTZ is Regional Transition Zone.
2. RCE is Regional Centre of Endemism.
Source: White (1983)

Protection of Biodiversity

The protection of biodiversity is closely linked to protected area (World Park Congress, 2003) and these can be divided into two broad categories, those meant for conservation and the other for resource utilization. IUCN, the International Union for Conservation of Nature (IUCN) defines the former as 'protected areas' (Chape et al, 2003) while those established as sites for controlled resource utilization in forests and woodlands are termed 'forest reserves' (Burgess et al, 2005, 2007). The early forest reserves established in Africa were not for conservation purposes (Lovett, 2003) but largely for timber extraction and at times for water harvesting but, ultimately, the two categories have been at the forefront of biodiversity conservation in Africa. In the dry forest and woodland countries, Burgess et al (2007) report that there are close to 4604km^2 of protected areas and 2027km^2 of forest reserves and the latter is made up of classified forests, reserved or designated forests, national forests, state forests and state reserved forests. It is critical to note that both protected areas and forest reserves have effectively conserved forests and woodland, but more so in the protected areas and those specialized forest reserves such as botanical gardens and sanctuaries. A noticeable development is the fact that over 70 per cent of the protected areas and forest reserves lies across international boundaries (Olson and Dinerstein, 1998; Brooks et al, 2004). These provide opportunities for trans-frontier conservation area initiatives on the continent.

The distribution of protected areas in the dry forest and woodland zones in sub-Saharan Africa is shown in Figure 3.1. The Guinea and southern dry forests are poorly covered by protected areas. Protected areas (6390 in all) of all categories cover about 2.4 million km^2 (World Resources Institute, 2003).

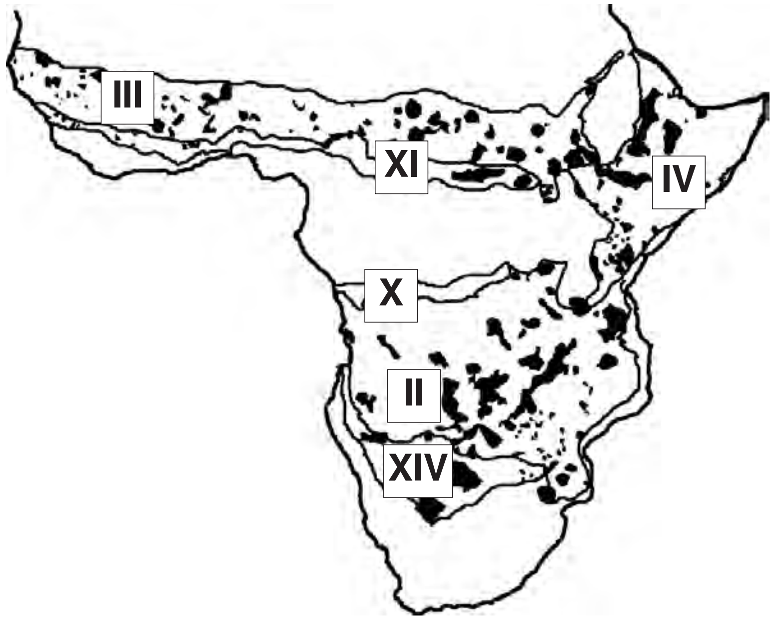

Figure 3.1 *Distribution of protected areas in the dry forest and woodland phytoregions of sub-Saharan Africa*

Note: (II) Zambezian Regional Center of Endemism, (III) Sudanian Regional Center of Endemism, (IV) Somali-Masai Regional Centre of Endemism, (X) Guineo-Congolian/Zambezian Regional Transition Zone, (XI) Guineo-Congolian/Sudanian Regional Transition Zone and (XIV) Kalahari Region of the Kalahari-Highveld Regional Transition Zone.
Source: Based on World Conservation Monitoring Centre (1997)

Figure 3.2 shows the extent and number of protected areas; the area under protection represents about 9 per cent of total land area in the Sudanian zone, 11 per cent in the Somali-Masai zone, 14 per cent in the Zambezian zone and 16 per cent in the Kalahari zone. The Conference of Parties (CoP7) of the Convention on Biological Diversity required that at least 10 per cent of each of the world's ecological regions be protected (Chape et al, 2005). This would imply that other than the dry forests and Sudanian woodlands, there is adequate coverage of woodland phytoregions in protected areas in sub-Saharan Africa. The average size of a protected area ranges from 260km^2 in the Sudanian zone to 430km^2 in the Zambezian zone and 670km^2 and 830km^2 in the Somali-Masai and Kalahari zones, respectively.

Species Conservation Status

Species are declining to critical population levels, important habitats are being destroyed, and ecosystems are being destabilized through climate change, pollution, alien invasive species and direct human impacts. Thus, the conservation

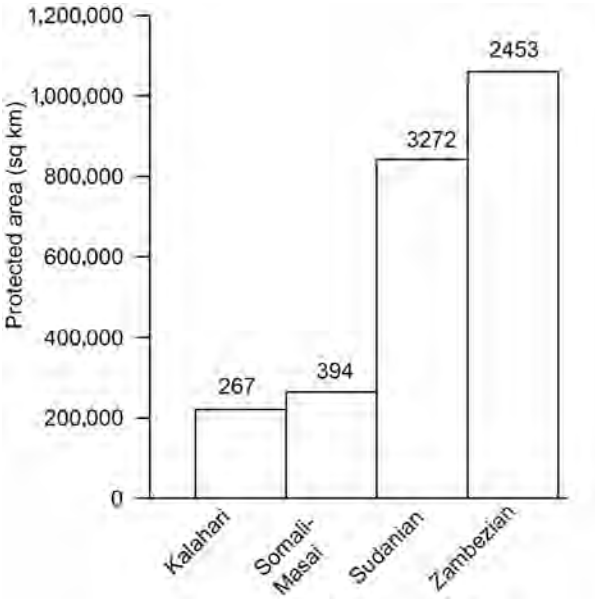

Figure 3.2 *Protected area in dry woodland phytoregions in sub-Saharan Africa*

Note: Numbers on top of bars indicate number of protected areas.
Source: Based on World Resources Institute (2003)

status of a species is a good indicator of the impact of threats as the likelihood of a species remaining extant either in the present day or the near future has a bearing on planning and management (Hamilton and Hamilton, 2006). An assessment of the conservation status of a species should not however be limited to the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on. This means that even a species with high levels of regeneration, both sexually and vegetatively as is the case with many dry forest and woodland species (see Chapter 2), must be evaluated as threatened on the basis of reproductive adults.

Figure 3.3 shows threatened higher plant species in African dry woodland phytoregions. It is difficult to determine the number of threatened plant species by phytoregion from data that are often presented by country and, in addition, some countries contain vegetation formations that are not dry forest and woodland. Nevertheless, the data in Figure 3.3 indicate that the number of threatened plant species per country increases from the Kalahari zone to the Somali-Masai and Sudanian zones and is highest in the Zambezian zone.

Loss of some tree species has been largely through trade – an aspect that the Convention on International Trade in Endangered Species (CITES), signed by 164 countries, has been trying to address by controlling (Appendix II of CITES) or curtailing (Appendix I of CITES) trade. In Table 3.3 we list 13 tree species from dry forests and woodlands of Africa that are on Appendix II and we note that these are not necessarily threatened with extinction now but may

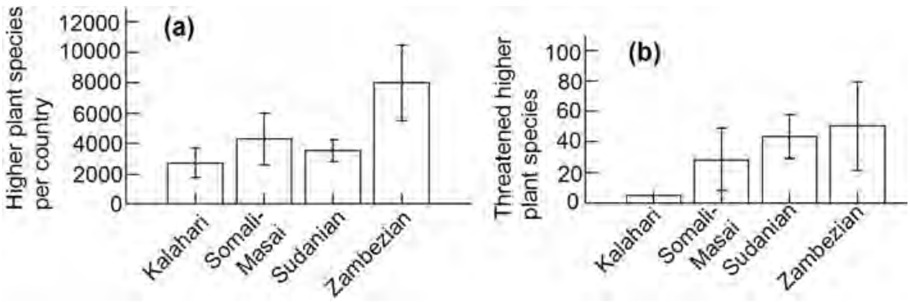

Figure 3.3 *Average higher and threatened plant species in protected areas in woodland phytoregions in sub-Saharan Africa*

Source: Based on data in World Resources Institute (2003)

become so unless trade is closely controlled. Of these, five (39 per cent) of the species are found in the Sudanian zone while two, *Hallea stipulosa* and *Khaya anthotheca*, are found in this zone as well as the Zambeziana zone. In addition, *Pouteria altissima* and *Vitellaria paradoxa* are found in the Sudanian and Somali-Masai zones and *Pterocarpus angolensis* in zones II and XIV. The Zambeziana zone holds two trees species that are exclusive to this regional centre of endemism and these are *Baikiaea plurijuga* and *Entandrophragma caudatum* while C*ordeauxia edulis* and *Pericopsis elata* are exclusive to the Somali-Masai zone. This suggests that the majority of threatened tree species are in the Sudanian and Zambezian zones, which also share 25 per cent of flora (White, 1983).

Table 3.3 *Tree species on the CITES list occurring in dry forests and woodlands of sub-Saharan Africa*

Species	*Conservation status*	*Threats*	*Distribution*			
			II	*III*	*IV*	*XIV*
Afzelia africana	Vulnerable	Exploitation		X		
Baikiaea plurijuga	Lower risk	Exploitation	X			
Cordeauxia edulis	Vulnerable	Local use/ browsing			X	
Entandrophragma caudatum	Lower risk	Local use	X			
Hallea stipulosa	Vulnerable	Habitat loss	X	X		
Khaya anthotheca	Vulnerable	Exploitation	X	X		
Khaya grandifolia	Vulnerable	Exploitation/ Habitat loss		X		
Khaya senegalensis	Vulnerable	Exploitation/ Habitat loss		X		
Pouteria altissima	Lower risk	Exploitation		X	X	
Pterocarpus angolensis	Lower risk	Exploitation	X			X
Pericopsis elata					X	
Vitellaria paradoxa	Vulnerable	Local use		X	X	
Warburgia salutaris	Endangered	Exploitation	X			

Note: II Zambezian regional centre of endemism, III Sudanian regional centre of endemism, IV Somali-Masai regional centre of endemism, XIV Kalahari-Highveld regional transition zone
Source: IUCN, 2009

Threats to Plant Biodiversity

The demand for certain species lies at the very base of their survival (Stedman-Edwards, 1998). Hamilton and Hamilton (2006) place the blame for loss of plant materials on increasing human populations, increased demand for these resources, destruction and modification of habitats, expansion and intensification of agriculture. These threats do not necessarily operate alone but in combination with others. There are many threats to plant biodiversity in dry forests and woodlands of sub-Saharan Africa (Burgess et al, 2005; IUCN, 2009) but the important ones are those cited by Hamilton and Hamilton (2006) above and include poor management of protected areas, population and land-use pressures, climate change, over-harvesting of plant resources and proliferation of invasive species.

Poor management of protected areas

In the majority of sub-Saharan African countries investment in protected areas and forest reserves is chronically low. As a consequence of this, there is poor infrastructure and inadequate personnel, equipment and law enforcement and research: important components of good and effective management of protected areas. The minimum budgetary requirements for effective law enforcement for African protected areas is estimated at US$200–230 per km^2 (Lindberg, 2001) but expenditure on protected areas in most southern African countries, for example, is below the minimum requirements (Figure 3.4). In addition, the history of the establishment of protected areas is dominated by opportunistic acquisitions of land often at the expense of rural people (Siegfried, 1989) who over time have sought to reclaim their rights and often do so through encroachment and counter claims (Palmer, 2001). After the Rio Earth Summit of 1992, there has been an upsurge in the number of new protected areas and these are having negative impacts on the livelihoods of local communities through a loss of rights, exclusion from natural resources and displacement from traditional lands (Wittemeyer et al, 2008). These encroachments have huge implications for the management of these protected areas as well as the status of the biodiversity found in them.

Population and land-use pressure

The population inhabiting dry forests and woodlands in sub-Saharan Africa was estimated at 320 million people in 2000 (Eva et al, 2006). Despite the adverse impacts of the HIV/AIDS pandemic, the continent's population is growing at an average rate of 2.4 per cent per annum and the highest human footprint in dry forests and woodlands in sub-Saharan Africa is in western Africa where population densities are in the range of 30–45 per km^2 (Table 3.4). One of the challenges facing the continent is how to increase agricultural

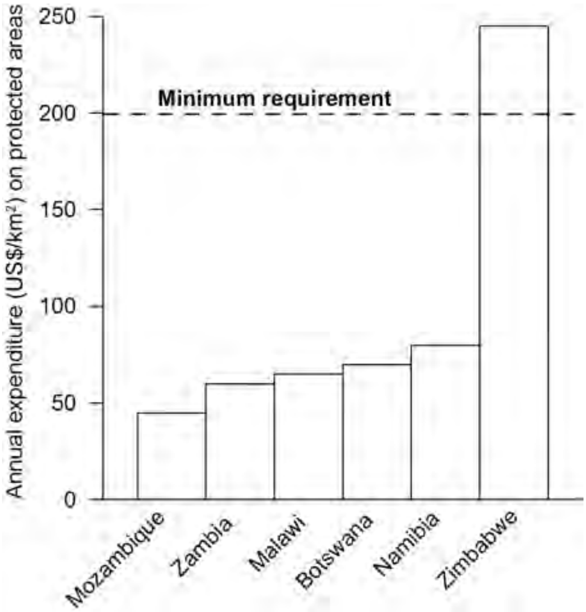

Figure 3.4 *Expenditure in government protected areas in dry forest and woodland countries in southern Africa*

Source: Based on Lindberg (2001) and Cumming (2004)

output in order to adequately feed the growing population. Given the limited availability of suitable agricultural land, there is increasing pressure to convert remaining dry forests and woodlands to agriculture. This is contributing to loss of biodiversity.

Given the difficulties of modelling deforestation and degradation of tropical open woodlands (Grainger, 1999), estimates of woodland cover loss in Africa tend to vary greatly depending on the methodology used to estimate deforesta-

Table 3.4 *Human population density in dry forest and woodland regions of sub-Saharan Africa in 2000*

Phytoregion	*Area (km^2)*	*Population size*	*Population density per km^2*
Guinea-Congolia-Zambezia	779,911	1,516,8813	19.45
Somalia-Masai	1,974,420	3,366,6625	17.05
Guinea-Congolia-Sudania	1,225,983	52,659,006	42.95
Kalahari-Highveld	1,277,340	13,298,317	10.41
Zambezian	3,924,240	70,158,185	17.88
Sudanian	3,641,240	112,929,909	31.01
Sahel	2,570,970	21,557,690	8.39

Source: Based on Eva et al (2006)

tion and degradation. Estimates of woodland loss therefore can only be indicative of the extent of the problem of deforestation in woodland areas.

During 1990 to 2000 it was estimated that dry forest and woodland countries in sub-Saharan Africa lost nearly 5 million ha of forest cover annually or nearly 1 per cent of the forest cover in 2000 (FAO, 2005). Much of this loss occurred in the Sudanian zone (2.5 million ha) and southern Africa (2.3 million ha). According to Kigomo (2003) the causes of woodland cover degradation and loss in semi-arid Africa are overgrazing, agricultural expansion and overexploitation of forest resources. Mayaux et al (2004) estimated that nearly 15 per cent of the Zambezian woodlands has been converted to agriculture while similar values for the Sudanian and Somali-Masai woodlands are 60 per cent and 80 per cent, respectively.

It is therefore not surprising that sub-Saharan Africa is experiencing human-induced biodiversity decline. The trend continues unabated as human activities (e.g. agriculture, exotic timber plantations, mining and urban development) transform habitats and replace indigenous biota. The loss of biodiversity results in the loss of ecosystem goods and services and translates into reduced economic opportunities for present and future generations.

Climate change

Dry forest and woodland vulnerability to climate change refers to the degree to which these vegetation types are susceptible to or unable to cope with adverse effects of climate change, its variability and extreme events. Some of the possible impacts of climate change on African dry forests and woodlands have been mentioned in Chapter 2. Therefore only a few additional examples are given in this chapter.

Observations made in acacia woodland in central Zambia involving five species revealed that temperature significantly affected seedling emergence in 80 per cent of the species and germination rate under a 1°C warmer climate was predicted to decline in three of the species while an increase was predicted in one species (Chidumayo, 2008). Temperature also significantly affected seedling mortality in all the five species such that under a warmer climate, mortality was predicted to increase in two of the species and decrease in the other three species. The conclusion was that woodland trees would respond to climate warming in different but predictable ways. Results of tree growth monitoring at the same woodland site showed that the radial growth of the majority of trees declined due to additive effects of temperature factors, suggesting that different species will respond differently to climate change (Chidumayo, in preparation; Table 3.5).

The study by McClean et al (2005) revealed shifts in ranges of individual species in African woodlands as a result of climate change. These authors through modelling have predicted that 25–75 per cent of the plant species in African woodlands might lose all their currently climatically suitable ranges under a future warmer and drier climate.

Table 3.5 *Climate factors affecting radial growth of woodland trees at a Zambezian woodland site in central Zambia, 1998–2008*

Species	*Significant predictor factors*	*Growth variation caused by climatic factor(s) (%)*	*Predicted annual growth rate under a 1°C warmer climate*
Acacia polyacantha	Rainfall	16	No change
Acacia sieberiana	Average temperature	20	Decrease
Combretum molle	Rainfall and minimum temperature and average temperature	39	Increase
Piliostigma thonningii	Average and maximum temperature	30	Decrease

Source: Based on Chidumayo (in preparation)

A recent study by Maranz (2009) in western Africa has also shown that the high mortality of mesic woodland tree species in the northern portion of the Sudanian zone and their apparent retreat southwards has been due to the return of arid conditions during the latter half of the 20th century (Figure 3.5). The disappearance of tree species has been particularly noticeable in parkland landscapes where *Vitellaria paradoxa* and *Parkia biglobosa* are either disappearing or retreating to more mesic habitats. In addition, the savanna areas of northern Nigeria are reported to be losing plant species as a result of increasing desertification due to inadequate rainfall, excessive drought and sand dune encroachment.

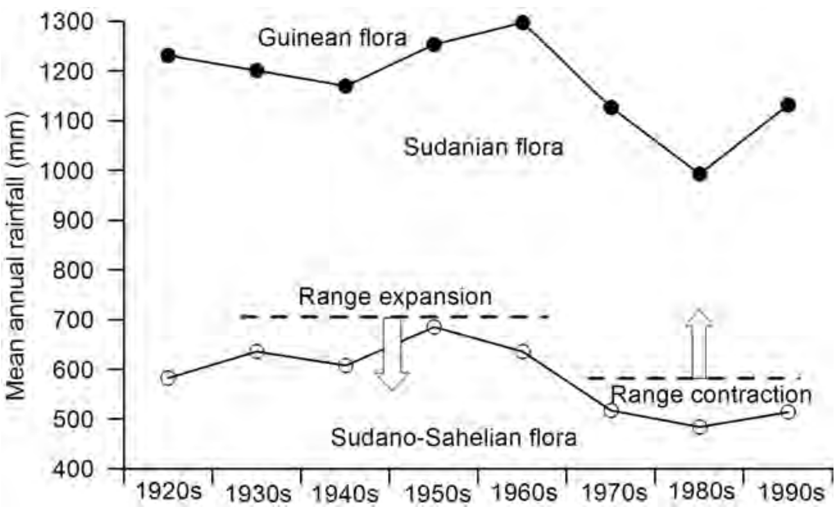

Figure 3.5 *Decadal rainfall pattern averaged for seven western African weather stations representing the Sudano-Sahelian zone (low mean rainfall, bottom line) and seven stations representing the southern Sudanian zone (high mean rainfall, top line)*

Note: Expansion in the range of some Sudanian tree species occurred from the 1930s to 1960s while range contraction occurred from the 1970s to 1990s.
Source: Based on Maranz (2009)

Overharvesting of plant resources

Overexploitation of plant resources is a growing threat to biodiversity in dry forest and woodland countries in sub-Saharan Africa. For example, of the 13 tree species on the CITES list (see Table 3.3), nearly 90 per cent of them are threatened by overexploitation and 11 per cent are threatened by habitat loss. Over-reliance on traditional medicinal plants for primary health care by the majority of the sub-Saharan population has contributed to the overexploitation of some other species, such as *Walburgia salutaris* in Zimbabwe and *Albizia brevifolia* in Namibia and many others that are now threatened. Similarly, the commercialization of crafts, like baskets and wood curios, has led to a decline in tree species such as *Berchemia discolor* which is used as a palm leaf fibre dye in Botswana and Namibia. There has also been overharvesting of *Afzelia quanzensis* and *Pterocarpus angolensis* in a number of woodland countries in response to the flourishing woodcraft industry (Cunningham et al, 2005; Shackleton, 2005). Some of these shortages and losses can be at local level (site specific) while this may not be the case at the regional level, e.g. *Berchemia discolor* which is under threat in Namibia but actually spreads from Ethiopia to northern parts of South Africa. Some tree species may be facing acute pressure at a country level, but because of their abundance at regional level may not qualify to be placed on the IUCN Red Data List or CITES Appendix II.

Management and conservation measures in the past had always been influenced by taboos that restricted people from destructive harvesting (Osemeobo, 1994). But, these have become largely dysfunctional under increasing pressures and have not been replaced by alternatives. Indeed, management services provided by the government are weak and ill equipped. Alternative lesser known substitutes need to be brought to light so as to reduce the pressure on over-sourced species. The importance of some species for multiple uses should also be highlighted. As a management strategy, proper records of plant status must be kept and abundance and collection rates monitored. The perception and orientation of harvesters must also be changed for they believe that plants can never be overexploited.

Proliferation of invasive alien species

Invasive alien species are species introduced deliberately or unintentionally outside their natural habitats where they have the ability to establish themselves, invade, out-compete natives and take over the new environments (IUCN, 2000). The problem and impact of invasives is likely to increase as more plants move across borders and destabilize natural vegetation (Hamilton and Hamilton, 2006) especially in areas where phytosanitary regulations are lax. Such species are found in all categories of organisms and all types of ecosystems. Some of them have significant environmental and economic impacts. In its compilation of the Red Data List of threatened species, IUCN cited alien species as directly affecting 15 per cent of all threatened plants (Carlton, 1998). Alien species disturb nutrient recycling, pollination and the regeneration of soils and energy, among other things; they also threaten the integrity of natural systems. For example, the 'fixing' or sequestration of carbon is becoming a major consideration regarding global warming and where fire-promoting alien species have replaced indigenous vegetation, the release of carbon has accelerated.

Opportunities for Conserving Biodiversity

Preserving trees in transformed landscapes and tree domestication

Under subsistence farming some tree species, such as indigenous fruit trees, are left in the field and may contribute to biodiversity conservation. For example, Dean et al (1999) found that large *Acacia erioloba* trees in semi-arid scrubland in the Kalahari-Highveld phytoregion of southern Africa increased biodiversity through provision of habitat for fleshy-fruited plants, frugivores, nectivorous and tree-nesting birds, raptors, weaver birds, tree rats and shade-seeking large mammals. Similarly the parklands of western Africa contain a high number of fruit trees, thereby contributing to the maintenance of tree biodiversity in transformed landscapes (Maranz, 2009; Figure 3.6). In addition there is a growing interest in the domestication of fruit trees throughout the dry forests and woodlands of sub-Saharan Africa (Akinnifesi et al, 2006; Schreckenberg et al, 2006).

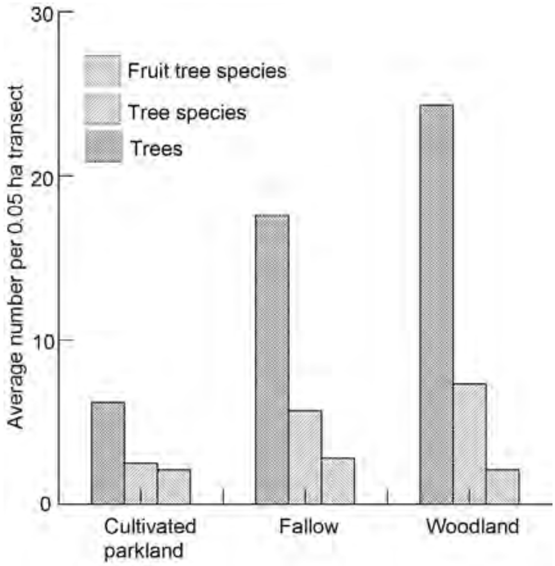

Figure 3.6 *Density of trees, tree species and fruit tree species in three landscapes in western African woodlands*

Source: Based on Maranz (2009)

Community and private sector involvement in biodiversity management

Sustainably harvested and fairly traded indigenous products offer a significant opportunity to improve the livelihoods of poor communities living in rural areas with access to natural resources. This industry has the potential to benefit both the natural environment and those in the supply chain – including the rural poor primary producer groups, buyers, processors and exporters (PhytoTrade Africa, 2005). The use of resources, which are accessible to and owned by the poor rural people and are ecologically and culturally adapted to local conditions, underpin a 'biodiversity-friendly' industry, with low barriers to entry. As will be shown under Chapters 4 and 5, forests and woodlands are important sources of income from wild foods, fuel, fodder and thatch grass (Vedeld et al, 2004). Use and access are often based on local rules as well as resource tenure and property rights (Bruce, 1989; Ostrom, 1999) but recent trends have shown a greater interest from private capital and calls for resource concessions. At the same time, through various decentralization schemes, local and community level institutions have become more assertive in the management of local forests and woodland resources and importance of resource tenure. Thus for any efforts targeted at biodiversity management to be successful, local communities must be involved and these can be linked to private capital in a number of innovative ways (FAO, 2002b).

For more than two decades, some African countries have been implementing strategies that support human livelihoods through the sustainable use of biological resources within the context of community-based natural resource management (CBNRM). In this approach, communities are given rights of access to wild resources and legal entitlements to benefits that accrue from managing the resources (Kellert et al, 2000; Child, 2004). This creates positive social and economic incentives for the people to invest their time and energy in natural resource conservation (Crook and Clapp, 1998). Typically, CBNRM initiatives have been implemented in ecologically marginal areas, with limited potential for agriculture.

Operationally, CBNRM involves the following:

- the devolution of control and management responsibilities for natural resources from the state to local people through appropriate legislative and policy changes;
- building the technical, organizational and institutional capacity of local communities to assume management responsibilities over natural resources.

The success of CBNRM has depended on the level of devolution, donor commitment and policy changes; and links with tourism and hunting. The key economic driver of CBNRM has been wildlife (large mammals), mostly through trophy hunting and eco-tourism outside protected areas.

The potential role of natural products is only beginning to be realized through value addition and commercialization (PhytoTrade Africa, 2005). Such

Box 3.1 Public–private sector partnerships to commercialize plant resources in Africa

1. Makoni Tea in Zimbabwe

Fadogia ancyalantha is used to produce the herbal Makoni tea. The Southern Alliance for Indigenous Resources (SAFIRE), an NGO (non-governmental organization), has facilitated the establishment of a community-based enterprise by encouraging members of Ward 23 of Nyanga district in Zimbabwe to form an indigenous tea producers association. The association consists of 200 members who collect leaves of the herb and pre-process them for the production of Makoni tea. This is done in partnership with private companies, Katiyo, Tanganda and Speciality Foods of Africa. The companies are involved in the final processing and packaging of the leaves and marketing and selling the tea. The association earns revenue from the sale of the pre-processed leaves and receives dividends based on returns from tea sales locally and abroad. However, revenue receipts have been limited due to competition with established herbal teas and inadequate promotion and marketing. It is however noted that some *Fadogia* species have phytochemicals that are known to be toxic to livestock and potentially to people, but that marketing has occurred without health and safety checks.

2. The Swazi Secrets project in Swaziland

The Swazi Secrets project harvests marula fruits (in the wild) for processing into a variety of products. The project is working with 14 producer/collector communities (comprising 2500 individual suppliers) who sell marula kernels to Swazi Indigenous Products Pvt. Ltd. The project has a strong capacity building component that trains communities on appropriate harvesting techniques.

Since the community derives direct economic benefits from harvesting wild Marula fruits and since fruit harvesting is non-destructive, the sustainable harvesting of the tree species can be guaranteed. This demonstrates how economic incentives can promote biodiversity conservation.

Source: SADC (in press)

products have potential for nutritional, pharmaceutical and industrial use, as well as for generating income and a number of initiatives involving rural local people; local and international companies have been set up in a number of dry forest and woodland countries (Grote, 2003; Hailwa, 1998; Moyo and Epulani, 2002; Sola, 2005; Shackleton, 2005) and these new initiatives are broadening the economic viability of CBNRM initiatives through their wider distribution when compared to wildlife (Machena et al, 2005).

There has been limited investment in bio-prospecting and natural product value addition by national governments in Africa. This is partly because most development models on the continent consider biological resources as a source of sustenance and not as a source of wealth. There is, however, growing interest in adding value and commercializing biological resources on the continent. For example, the Southern African Natural Products Trade Association (PhytoTrade

Africa) is developing commercial opportunities from natural products (products derived from indigenous plants) for the benefit of rural communities in the sub-region. It does this through investment in research and development (R&D) and market development, whilst facilitating linkages between rural producers and private sector processors and manufacturers. Through the creative use of public funds, PhytoTrade Africa has been able to leverage significant private sector investment into R&D. However, it remains one of the very few cases in which favourable conditions for private sector investment have been successfully created (Le Breton, personal communication).

Challenges

Sub-Saharan Africa is experiencing increased pressure and demand on agricultural land and biodiversity due to limited alternative livelihood opportunities. The need to explore other livelihood opportunities and to refocus national policy development models beyond the primary sectors of production cannot therefore be over-emphasized (Frost et al, 2007). In fact, this is the development route that was followed by the currently developed nations and highlights the fact that natural resources alone are not a panacea to Africa's development problems. How can forest biodiversity contribute more to livelihoods on a sustainable basis?

There have been limited national, sub-regional and regional level inventories of various biodiversity components on the continent as illustrated by the following:

- Only large and commercial species of wildlife are regularly monitored (because of their importance in national economies). Similarly, regular inventory and monitoring programmes are usually in place for commercial indigenous timber species and exotic timber plantations. Other species that provide a range of timber and non-timber forest products to local communities have not been catered for.
- The monitoring of biodiversity habitats, some of which are under extreme pressure, is often lacking. However, such information is critical for the effective management of protected areas, including trans-frontier conservation areas (TFCAs).

The inadequacy of up-to-date information on biodiversity and limited ability to handle the available information makes it difficult to effectively plan, manage and monitor biodiversity conservation and its sustainable use in Africa. It also makes it difficult to demonstrate the value and impact of biodiversity losses to national, sub-regional and regional economies. There is therefore need to develop and implement comprehensive but simple biodiversity inventory and monitoring programmes covering key species and habitats. Skills to handle and package the information are needed to improve knowledge and management of biodiversity.

Africa's protected areas have been a cornerstone of biodiversity conservation. However, existing legislation precludes neighbouring communities from accessing goods and services from them. This has created 'islands of green' surrounded by degraded communally owned landscapes. The result has been increased illegal timber and game harvesting and illegal settlements in some protected areas. How can community participation and the development of appropriate access and benefit sharing arrangements be advanced to facilitate sustainable management of protected areas?

TFCAs offer opportunities to raise funds for biodiversity conservation in protected areas through tourism. However, their success depends on the creation of a conducive environment for public-private sector partnerships through targeted incentives and appropriate legislation that ensures that part of the generated revenue is ploughed into biodiversity management and promotion of TFCAs and trans-boundary tourism through appropriate national policies and legislation and capacity building at various levels.

The bulk of the continent's biodiversity lies outside protected areas and is under extreme pressure from various threats. In spite of efforts to conserve biodiversity outside protected areas through joint management, especially in community forestry, these efforts to improve the management of biodiversity in off-reserve areas through CBNRM initiatives are being hampered by the inadequacy of incentives to local communities. There is therefore need for:

- concerted R&D efforts that unleash the economic potential locked up in the region's biological resources through bio-prospecting and value addition and finding innovative ways to equitably share benefits there from;
- building the capacity of local communities that live with the biological resources in the management of common property resources;
- formulating policies, legislation and bye-laws that regulate access to and use of biological resources.

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