

The status of agrobiodiversity management and conservation in major agroecosystems of Southern Africa

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Abstract

This paper reviews the agroecosystems and agricultural biodiversity in Southern Africa and highlights the importance of the agricultural landscape in biodiversity conservation and the important role that the traditional farming systems play in conserving biodiversity. The review established that agrobiodiversity is of great importance to both small scale and large commercial farmers in Southern Africa through its provision of ecosystem services. The paper also highlights the significant loss of agrobiodiversity as a result of human population pressure and the transition from traditional mixed farming systems which is characterized with high agrobiodiversity, to modern monoculture farming resulting in decline of species diversity. Although concerted efforts are being made to promote the sustainable use and management of this agrobiodiversity, there need to have a multi-stakeholder approach so that conservation efforts are successful, a role that is currently played by the SADC Plant Genetic Resources Centre in Southern African conservation of agrobiodiversity.

Authors' Keywords: agriculture; agrobiodiversity; conservation; farming system

1.0 Introduction

Agroecosystems are “biological and natural resource system managed by humans for the primary purpose of producing food as well as environmental services” (WRI, 2011). Indeed while some studies show that food production has kept pace with population growth, this has been at the expense of agrobiodiversity, clean water, carbon storage capacity and the quality of soils. Three major levels of diversity have been recognized including ecosystem diversity, species diversity and genetic diversity (Atta-Krah et al., 2004). Species biodiversity has also been expressed in terms of species composition along an environmental gradient and within similar habitats at different sites (Whittaker 1965 in Atta-Krah et al., 2004). On the global scale, 20 to 30 % of the world’s forest areas have been converted to agriculture, resulting in extensive species and habitat loss (WRI, 2011). Furthermore, agriculture has introduced alien species that are both advantageous and detrimental (alien invasive weedy species) to species diversity (Monier et al., 2004). Soil degradation, including nutrient depletion, erosion, and salinization, is widespread in Southern Africa. Moreover, many water sources are being polluted by excessive use of fertilizers and pesticides. For these trends to change, management of agroecosystems needs to meet the double challenge of increasing food production while continuing to provide much-needed ecosystem goods and services.

Some traditional farming systems such as slash and burn shifting cultivation (e.g. *chitemene* in Zambia) have replaced forest related vegetation with a wide variety of crops such as maize, beans, bananas, pumpkins, cassava, sweet potatoes, sugar canes, tomatoes, peas and many more (see Moyo, 2008; Eriksen, 2007). These smallholder farming systems grow a diverse number of crops, usually involving intercropping (Moyo, 2009), which is referred to as

mixed cropping that include keeping of various types of livestock such as chickens, goats, pigeon, cattle, pigs, sheep and increasingly now guinea fowls (see Peters, 2002). Such systems thus increase and maintain biodiversity. African Agriculture (2010) notes the discovery of a cancer cure yam *Dioscorea* *strydomiana*, which despite being known locally to have healing properties, had escaped identification by scientists. It is not surprising that over relying on a few crops, especially in monocrop form (modern high yielding) threatens crop biodiversity (Bentley, 2009).

This paper presents the general agroecosystem of Southern Africa and highlights how some management approaches have either maintained or resulted in the loss of agrobiodiversity. The paper further gives insight into how conservation goals can be achieved through traditional agricultural practices and policies that encourage *in-situ* conservation of genetic agrobiodiversity at national and regional level.

2.0 Agroecosystems distribution in Southern Africa

The Southern African vegetation is generally referred to as the Zambezi Phytoregion. The region covers over ten countries in central and Southern Africa lying between latitudes 3° and 26° south with a total area of 377 million ha (White, 1983). The region falls within the tropical summer-rainfall zone with a single rainy season (November-April) and two dry seasons, a cool season from May to August and a hot season from September to November (Geldenhuys and Golding, 2008). Annual rainfall ranges from 500-1500 mm which decreases from north to south (Figure 1). The dominant soils of the region are rhodic and Haplic Nitisols and Chromic Xerosols with Calci-Chromic Cambisols and Pellic Vertisols in some

places (Chidumayo, 1997). The flora includes more than 8, 500 species of which 54% are endemic (Geldenhuys and Golding, 2008). Based on variation in rainfall and soils, a varied type of agroecological systems is found.

INSERT FIGURE 1

Within the sub-region (Southern and Central Africa), the savanna environments constitute the largest physical ecosystem (Eriksen, 2007; Solbrig and Young, 1993). The ecosystem in the sub-region has been influenced by both natural and anthropogenic factors such as fire, cultivation practices and charcoal production. These factors have had an impact on biodiversity and its occurrence in the region. Degradation of the agroecosystems in the sub-region has been associated with massive loss of nutrients, fauna, flora and productive ecosystems. For example, it was observed that about 191 tree species are endangered while a number of animal species and small plants are threatened due to conversion of agroecosystems to agricultural land (Kalaba et al., 2010). Additionally, the anthropogenic influences have had an impact on the distribution of the woodland ecosystems in the region. For example, the current distribution of miombo woodland, the principal vegetation in the sub-region is a function of fire regimes and anthropogenic practices. Agricultural land takes up more of the land surface of Southern Africa than any other type of landuse and holds a vast diversity of life, ranging from pests and associated organisms in cultivated lands through to natural vegetation containing rare and endemic species that need protection.

3.0 General agroecosystems/farming systems

Farming systems in Southern Africa have largely remained subsistence practiced on ever-decreasing plots of lands with declining soil fertility. These farming systems have become inadequate to cope with population growth explosions that are experienced in the region. It has been argued that apart from lack of investment in African farming systems, there are changes in agricultural production systems- shifting from diversified cropping systems towards ecologically more simple cereal based systems- which have contributed to poor diet and crop diversity; thereby inadvertently impacting on biodiversity (Musinguzi, 2011)

The general agroecosystems/farming systems in Tanzania, Zambia and Malawi is the *maize mixed farming* but Tanzania and Zambia also have the *forest based farming and root crop farming systems* (see Musinguzi, 2011). The *Forest based farming system* is practiced characteristically in humid forests in the region and farmers practice shifting cultivation by clearing a new plot in the forest every 3-5 years and then in the past allowed a fallow period of 7 up to 20 years. This is the basis of the Chitemene system in Zambia and the Machambas that are used to cultivate crops such as cassava, maize, beans, and potatoes in Niassa Province of Mozambique (Chidumayo, 1987; Landry and Chirwa, 2011). In Mozambique, the fields are usually first planted with cereals or ground nuts followed later by cassava. Cassava is complemented by maize, sorghum, beans and cocoyam.

The rice-tree crop farming system is prevalent in some part of Madagascar. Banana and coffee are major crops grown and are complemented by rice, maize, cassava and legumes. Additionally, root crop farming is also practiced in Southern Madagascar and is also

dominant in some parts of Mozambique; especially with cassava (*Manihot*) in typical homegarden fashion along the Indian Ocean coastline provinces such as Inhambane.

In South Africa, the general agroecosystem is mainly composed of large commercial and smaller holder farming system in semiarid and dry sub-humid zones. This system comprises of scattered smaller holder farms in the former homelands and large commercial farms both with mixed cereal-livestock systems. In addition, maize mixed farming and agro-pastoral millet/sorghum farming systems are practiced in South Africa. Also predominant in the commercial sector is the game farms which typically comprise of private nature reserves which somehow contribute to *in-situ* biodiversity conservation.

3.1 The traditional tree legume-based system (Faidherbia albida parklands)

For centuries farmers have retained a low density of trees in the parkland or two-tiered systems in the tropics, especially in the semi-arid areas in order to improve the yield of understorey crops (Akinnifesi et al., 2008b; Dancette and Poulain, 1969; Phombeya, 1999).

In Southern Africa, traditionally farmers grow crops under scattered trees of albida (*Faidherbia albida*), including coffee/*Faidherbia albida* system in Arusha, Tanzania, and the albida/maize system in southern and central Malawi. *F. Albida* has a unique characteristic of shedding most of its leaves during the wet season and resuming leaf growth during the dry season. This makes it possible to cultivate under its canopy with minimum shading effect on the companion crop. Substantial benefits are realized from these practices as resource-use by trees and associated crop components rarely overlap (Weil and Mughogho, 1993). The

cultivation of crops under canopies of *F. albida* is the most notable of such traditional agroforestry practices in Southern Africa.

The improved crop growth under tree canopies can be explained in terms of a combination of factors, such as i) increased nutrient inputs including biological N fixation, excreta manure and urine from livestock grazing, resting or camping under the tree, and birds that take shelter under or perch in search for food (Kang and Akinnifesi, 2000); ii) increased nutrient availability through enhanced soil biological activity and rates of nutrient turnover, and iii) improved micro-climate and soil physico-chemical properties (Buresh and Tian, 1997). The possibility of root scavenging effect of *F. albida* from neighbouring fields also needs to be further investigated. *F. albida* is also known to have low N₂-fixing rates.

3.2 Ngoro agroecosystem

It is important to note that some agroecosystems developed are designed to reduce the negative impacts of agricultural activities on the environment and the ecosystem. The Ngoro cultivation system practiced on the slopes in Southwest Tanzania is such an example (Malley, 1999). Malley (1999) notes that Ngoro cultivation system is a local name for the pitting practice of the Matengo tribe in South-western highlands of Tanzania. The system of cultivation consists of pits surrounded by ridges with crops grown on ridges around the pits. The ridges consist of a sandwich of undisturbed soil below a layer of dried grasses and raised soil on top. The construction of the system is usually done late in the rainy season around March and April when soils are wet and the rains are about to end. Such a timing of operations reduce labour effort in cultivation as the soil is still wet and easy to till yet with

minimum potential of erosion as a result of pit overflow. Furthermore, the system will have stabilised before the planting of crops in the following cropping season.

3.3 The traditional agrosilvipastoral complex system in the Kilimanjaro region.

The significance of growing a combination of crops and tree plants as well as the interrelationship among farming, forestry and stock-raising has sometimes been disregarded by researchers (Kegam, 1994). Such agroecosystems increase biodiversity. The Chagga people on the slopes of Mount Kilimanjaro practice intensive land use by intercropping coffee and banana. In addition to this practice, they combine farming, forestry and livestock in their homestead called '*kihamba*', where there is an integration of crops, plants and livestock increasing the number of observed plants - 42 families and 111 species (Kegam, 1994); yet not every farmer grows them all. Hence, the diversity of plant species in the '*kihamba*' is certainly high.

3.4 Dambo land ecosystems (dimba cultivation and pastures)

Smallholder farmers cultivate uplands as well as wetlands (see Banda et al., 1999; Moyo, 2008; 2009). The dambo is cultivated in the dry season intensively utilising both monocropping system as well as mixed cropping patterns also known as intercropping dominated by maize, beans, sugarcane and green vegetables. Apart from such intensive dry-season cultivation, dambo are a source of green grazing pastures when the uplands have dry grass. Such practices of cultivation and grazing result in vegetation degradation (Banda et al., 1999) as invaders such as *Cynodon*, *Urochloa* and *Sporobolus* grass species become dominant.

3.5 Transhumancegrazing systems

Seasonality is considered to be an important factor in the agricultural systems of the Southern African agroecosystems. It revolves around the very distinct wet and dry seasons. The availability of pasture in the late dry season is of particular importance in the management of the agroecosystems (Clarke et al., 1994). In Zambia, transhumance grazing is still practised on the Kafue flats, where livestock graze in woodlands in the wet season and on the low-lying flood plains in the dry season (Sørensen, 1993). Scoones (1990) also reported this pattern of grazing in Zimbabwe.

4.0 Agricultural production and biodiversity

About 90% of the biodiversity resources in the tropics are located in human-dominated working landscapes (Garrity, 2004). Modern agriculture is currently one of the greatest threats to biodiversity, and holds thus the key to the conservation of the remaining biodiversity in agroecosystems (Sileshi et al., 2008). Innovative biodiversity-rich farming systems can potentially be high-yielding and sustainable, and thus support persistence of wild species by limiting the adverse effects of modern mono-cropping agriculture. Adoption of sustainable farming practices that utilize and conserve biodiversity may ultimately improve environmental quality and limit agricultural expansion into natural forests as well as the negative impacts of agriculture on biodiversity. Hence, there is a compelling case for advocating conservation that is in tandem with livelihood needs of the people affected. In this regard, integrated agroforestry systems have been advocated as a suitable pathway for improved livelihoods as it also impinges on biodiversity in working landscapes through incorporation of additional species into agriculture (Atta Krah et al., 2004; Sileshi et al., 2007; 2008).

Cereals and grains are Southern Africa's most important crops, occupying a large area of cultivatable land. Maize is the most common crop and is a dietary staple, a source of livestock feed, and an export crop in some countries. Other crop varieties include sorghum, millet, wheat and rice grown for subsistence use and income generation. A large number of small scale farmers and commercial farmers also producing cassava, peanuts, sunflower seeds, beans, potatoes and soybeans.

Southern Africa is also endowed with a great variety of indigenous/ traditional fruits, nuts, leafy green vegetables and non-domesticated animals. Some of these occur naturally as weeds whilst others are planted such as Bambara nut, (*Vigna subterranea*), *Moringa oleifera* and cowpea (*Vigna unguiculata*) are planted but are not widely recognised. Some occur naturally in the crop fields and home gardens and include *Amaranthus* spp, selected *Solanum* spp, *Cleome* spp, wild okra (*Corchorus olitorius*), while others are widely collected from the wild. For example, the Orchids Genera *Disa* *Hubenaria* and *Satyrium* are collected from the wild to make a popular meatless sausage (locally called chikanda) in Zambia. These are very important foods in Southern Africa and have been said to have high nutritional and medicinal value (Maundu, 1999). Various species in the gourd family (*Curcubita*) are also cultivated as agricultural crops. Leafy vegetables are also common and include various *Brassica* spp. While these crops continue to be maintained by cultural preferences and traditional practices, they remain inadequately characterized and neglected by research and conservation. According to Bioversity International (undated), underutilized crops were once more widely grown but are falling into disuse for a number of reasons. Farmers and consumers are using these crops less because they are in some way not competitive with other improved crop species in the

same agricultural environment. The decline of these crops may erode the genetic base and so preventing the use of distinctive useful traits in crop adaptation and improvement.

4.1 Agroforestry systems and biodiversity

Traditional agroforestry systems are complex systems that have been developed to mimic natural systems where farmers and forest dwellers have tended to either integrate many tree species in various productive niches on their farms or by managing biodiverse forest resources (Sileshi et al., 2007). The cultivation of crops in homegardens, agroforests and under tree canopies in parklands is the most notable of traditional agroforestry practices in Southern Africa (Hemp 2006; Sileshi et al., 2007). A typical example of this is the agroforestry system of the Chaggahomegardens in Tanzania (Hemp 2006). The homegardens maintain not only a high biodiversity but are also an old and very sustainable way of land use that meets several different demands. These practices benefit biodiversity through *in-situ* conservation of tree species on farms, reduction of pressure on remaining forests, and the provision of suitable habitat for plant and animal species on farmland (McNeely and Schroth, 2006). It has also been argued that many traditional systems also maintain valued biological interactions and biodiversity at higher levels than some of the 'new' agroforestry technologies (Leakey and Simons, 1998). Agroforest systems provide for a high diversity of both the flora and fauna species. For example a small scale farmer may produce a variety of crops such as cassava, peanuts, sunflower seeds, beans, potatoes and soybeans in association with trees. The high abundance of fauna and flora species in a field play an important role in the adaptation to changing environment. As such diversity management can constitute a central part of the livelihood management strategies of farmers (particularly pastoralists) and communities in different agroecosystems throughout Africa

(Rege et al., 2003). The higher abundance of difference species or varieties present in a field or in an agroforestry system the greater the probability that at least some of them can cope with changing environment (Syampungani et al., 2010). Species diversity also reduces the probability of pests and diseases by diluting the availability of their hosts (Chapin et al., 2000). Furthermore, it diversifies the sources of income for a small scale farmer. Additionally, through indigenous knowledge, farmers in many regions occasionally set aside from production portions of their land and also leave some species on their farmlands which contribute towards the management and maintenance of biodiversity.

The increased consideration of traditional, tree-based land use practices and the widening of the focus from the field to the landscape scale in agroforestry science have made links between agroforestry and the conservation of biodiversity more relevant and more obvious (McNeely and Schroth, 2006). The Parkland systems, where woody perennials are deliberately preserved in association with crops and/or animals in a spatially dispersed arrangement have both ecological and economic interaction between the trees and other components of the systems (Bonkougou et al., 1994). Traditionally, the rural population in Southern Africa has for long practiced parkland systems (Akinnifesi et al., 2008b). Tree species are retained on farmlands for various reasons which include fodder, fruits, shade, medicines and soil fertility enhancement and income.

Traditional agroforestry systems are a major source of medicinal plants. There is also increasing interest in natural medicines in the developed world, creating new or expanded markets for these products. In South Africa, the economic exploitation of medicinal plant has meant more than 20000 tons of material from 770 medicinal plant species are collected

from the wild each year, providing employment to more than 66000 harvesters and traders; while up to 50 tons of medicinal plants are cultivated in a year resulting in highly prized indigenous plants such as African wild ginger and the pepper bark tree being harvested to the brink of extinction and the rise in price of popular plants (Chirwa et al., 2008). This puts further extraction pressure on the forests resulting in the loss of some preferred species and the erosion of the gene pools.

The positive impact of agroforestry on the biodiversity conservation of nature reserves has mostly been attributed to the reduced pressure on the natural forest due to the ability of agroforestry to sustain their daily livelihood (Murniati et al., 2001). On the other hand, Sileshi et al., (2007), have argued that the biodiversity in the miombo eco-region is under threat as species-rich miombo woodlands have been converted to farmlands and plantations that are relatively species poor. This is also associated with the effect of fire and human-created gaps inside forest-reserve that offer opportunities for colonization by invasive species, which are a threat to biodiversity (Sileshi et al., 2007). Notwithstanding, other studies have reported rapid development of miombo regrowth with increased species richness in abandoned cleared plots in many parts of the miombo ecoregion (Geldenhuys, 2005; Syampungani, 2008).

5.0 Loss of agricultural biodiversity

Agricultural biodiversity is declining at an accelerated rate in Southern Africa owing to increased demands from a rapidly growing population and increased competition for natural resources. The principal underlying causes for biodiversity loss include the rapid expansion

of industrial and Green Revolution agriculture, biofuels production, intensive livestock production, industrial fisheries and aquaculture, growing use of genetically modified varieties and breeds and the practice of monoculture. According to the Food and Agricultural Organization (FAO, 2010), the replacement of local crop varieties by improved or exotic varieties and species has been reported by almost all countries as the main cause of the genetic erosion of crops and other forms of agrobiodiversity. With crops, genetic erosion occurs as old crop varieties in farmers' fields are replaced by newer crops. The number of crop varieties in smallholder farms is reduced when commercial crop varieties are introduced into traditional farming systems (see also FAO, 2010).

Furthermore, biodiversity may be lowered as a result of invasive alien species which are plants and microbes introduced to new regions mainly through human activities (see Witt undated; Monier et al., 2004). Invasive plants have a range of impacts including interference with crop and pasture production for light, water and nutrients; displacement of crops and pasture species through production of toxins that inhibit growth (allelopathy) of other plants.

6.0 Conservation of agricultural biodiversity

Traditional agroecosystems are now known to conserve, manage and maintain genetic resources. Chiwona (2002) demonstrates that crop landraces are a common form of genetic resources conserved under such traditional farming systems. Gondwe et al., (1999) show the extent of rural poultry biodiversity in Malawi as a result of farming practices adopted by local farmers over millennia. Farmers retain diversity in livestock for example through exchange

of genetic resources among farmers through stock acquisition and sharing systems a practice also observed in crop land races conservation by local farmers in Lower Shire in Malawi (Chiwona, 2002). Furthermore, conservationist and plant breeders have benefitted from traditional agroecosystems by collecting samples from farmers' fields and storing them '*ex-situ*' (off-site) in gene banks. However, in recent years there has been increasing recognition of the need to retain this '*in-situ*' (on-site) conservation for the successful genetic resource conservation that allows for the genetic resources to continually and continuously adapt to the environment (Chiwona, 2002).

It is easy to distinguish between two forms of *in-situ* conservation: 'genetic reserve conservation'; and 'on-farm conservation' and expand on these concepts (Maxted et al., 1997b). 'On-farm conservation' is considered to be the sustainable management of genetic diversity of locally developed traditional crop varieties with associated wild and weedy species or forms by farmers within traditional agricultural, horticultural or agri-silvicultural cultivation systems. The key feature of on-farm conservation is the traditional knowledge and practical skills of the farmers; thus it is sometimes referred to as on-farm management (Engels and Wood, 1999).

Realising the importance of maintenance and conservation of genetic resources, initially 13 countries of the Southern African Development Community (SADC) have pooled resources and established the SADC Plant Genetic Resources Centre (SPGRC), which is based in Lusaka, Zambia, and is working with other national centres, in co-ordinating the conservation activities of the whole region, and stores a collection of local plant genetic resources. To date, 37 000 accessions of different crops have been collected and registered,

and over a third of these have been deposited in the base collection at SPGRC. However, germ-plasm collection is not the only way in which SPGRC aims to conserve and guarantee the safe preservation of crop and wild plant genetic resources. The centre is also documenting the efficient and sustainable use of the plant genetic resources of the region, and is providing a forum for the exchange of scientific, cultural, traditional and indigenous knowledge (Kapange, 2007).

The importance of combining *ex-situ* and *in-situ* conservation of genetic resources is shown by the centre and other institutions in utilising both methods in a complementary manner. - SPGRC has been following as different strategies the selection of relevant species and identifying interested farmers or communities that are then involved in the collection, multiplication and redistribution of seeds within communities; the identification of volunteer farmers willing to grow or multiply seed; the promotion and identification of marketing possibilities (e.g. seed fairs, restaurants, etc.); and the documentation of indigenous knowledge related to the species collected.

7.0 Conservation of agroforestry species in the landscape and /farmland

The different conservation approaches such as *in-situ*, *ex-situ* and *circa situ* have all their own advantages and disadvantages and it has been suggested that the options should rather be practiced as complementary approaches to conservation (Atta-Krah et al., 2004). Agroforestry research and development in Southern Africa has employed both *circa situ* and *in-situ conservation* approaches in the process of domestication of multipurpose tree species (Akinnifesi et al., 2008a; Akinnifesi et al., 2008c; Leakey and Akinnifesi, 2008).

While some of the species used in agroforestry are exotic, many are native, natural stands of native species are under threat due to agricultural expansion, overgrazing and exploitation for other uses, calling for urgent conservation and management of remnant populations. To adequately conserve and use a species, a detailed knowledge of genetic variation within and among populations is required. In order to determine the genetic diversity between and within different populations of the trees, ethnobotanical surveys, screening of accessions of tree species, multi-locational provenance trials, clonal and cultivars selection and testing for indigenous fruit tree species have been conducted (Akinnifesiet al., 2004; 2006). Random amplified polymorphic DNA (RAPD) analysis has also shown that there is a high differentiation among populations in some species even for geographically proximate sites (Jamnadass et al., 2005; Kadu et al., 2006). This has significant implications for conservation and cultivation of the species in Southern Africa.

8.0 Climate change and agricultural production systems in Southern Africa

Climate change has been observed to have negative consequences on the agricultural sector which is the largest single economic activity for the region. It has been associated with death of livestock and reduction in crop production in the region (Kandji et al., 2006). Such events tend to lead to water logging of soils, leaching of nutrients and the high proliferation of agricultural pests and diseases (Syampungani et al., 2010). Earlier suggestions from the analysis of maize production in the tropics indicated that there would be a decline of 10% on average as result of climate change (Verchot et al., 2007). Harsch (1992) reported a decline in Southern African region of cereal production in the 1991/92 season which put at an estimated 30 million people on the brink of starvation; while Kandji et al., (2006) observed a

deficit of regional requirement of 7.6 million tonnes. In 2001/02 farming season, 1.2 million tonnes of cereal deficit was reported across the SADC region (SADC, 2002).

A number of improved farming practices have been suggested as having potential to increase the sustainability of farming systems and contribute to reducing farmers' vulnerability to climate variability while sequestering carbon from the atmosphere. Examples of promising improved agricultural practices that can address climate change include those that enhance carbon sequestration such as better management of trees in mosaic landscape including: improved fallow techniques, use of fertilizer trees and reduced use of inorganic nitrogen fertilizers (Akinnifesi et al., 2010; Symapungani et al., 2010; Verchot et al., 2007). Specifically, of all the land uses analysed in the Land-Use, Land-Use Change and Forestry report of the IPCC (2000), agroforestry offered the highest potential for carbon sequestration in non-Annex I countries (Verchot et al., 2007). This is especially important in the Southern African Agroecosystems where most traditional farming systems involve mixed cropping and trees in the land scape as highlighted earlier.

9.0 Concluding summary

About 90% of the biodiversity resources in the tropics and indeed Southern Africa are located in human-dominated working landscapes and yet agriculture is the main land use system taking most of the land surface: and therefore directly impacting on the vast diversity of life, ranging from pests and associated organisms in cultivated lands through to natural vegetation containing rare and endemic species that need protection.

Agriculture is currently one of the greatest threats to biodiversity, and holds thus the key to the conservation of the remaining biodiversity in agroecosystems in Southern Africa. The main cause of the genetic erosion of crops and other forms of agrobiodiversity is the replacement of local varieties by improved or exotic varieties and species. Hence, the adoption of sustainable farming practices that utilize and conserve biodiversity may ultimately improve environmental quality and limit agricultural expansion into natural forests.

The agroecosystems of Southern Africa are complex and mimic natural systems and therefore tend to either integrate many tree species and agricultural crops in various productive niches and so managing biodiverse agricultural and forest resources. These practices inadvertently benefit biodiversity through in-situ conservation of agricultural crop varieties and tree species on farms, and also reduce pressure on remaining biodiversity in the forests, while at the same time provide suitable habitat for plant and animal species on farmland. In addition, these traditional farming practices are intimately linked with underutilised species which play an important role in the breeding programs of major crops. The poor conservation status of underutilized and neglected species severely hinders their successful improvement and promotion. Efforts, therefore, need to be directed towards the better maintenance of their resource base, both through *ex-situ* and *in-situ* conservation methods, to ensure their development and their sustainable use by present and future generations. Hence, the need to encourage the maintenance of the SADC Plant Genetic Resources Centre.

It can be concluded that the agroecosystems found in Southern Africa benefit from conservation, management and maintenance of biodiversity. Unfortunately, in producing food, non-food products and other environmental services, modern cropping systems tend to reduce biodiversity while traditional agroecosystems have potential to address climate change and are also able to utilise variability in genetic resources to sustain production and other ecosystem services necessary for attaining farmers' livelihoods thereby signifying the important role of indigenous knowledge in biodiversity conservation.

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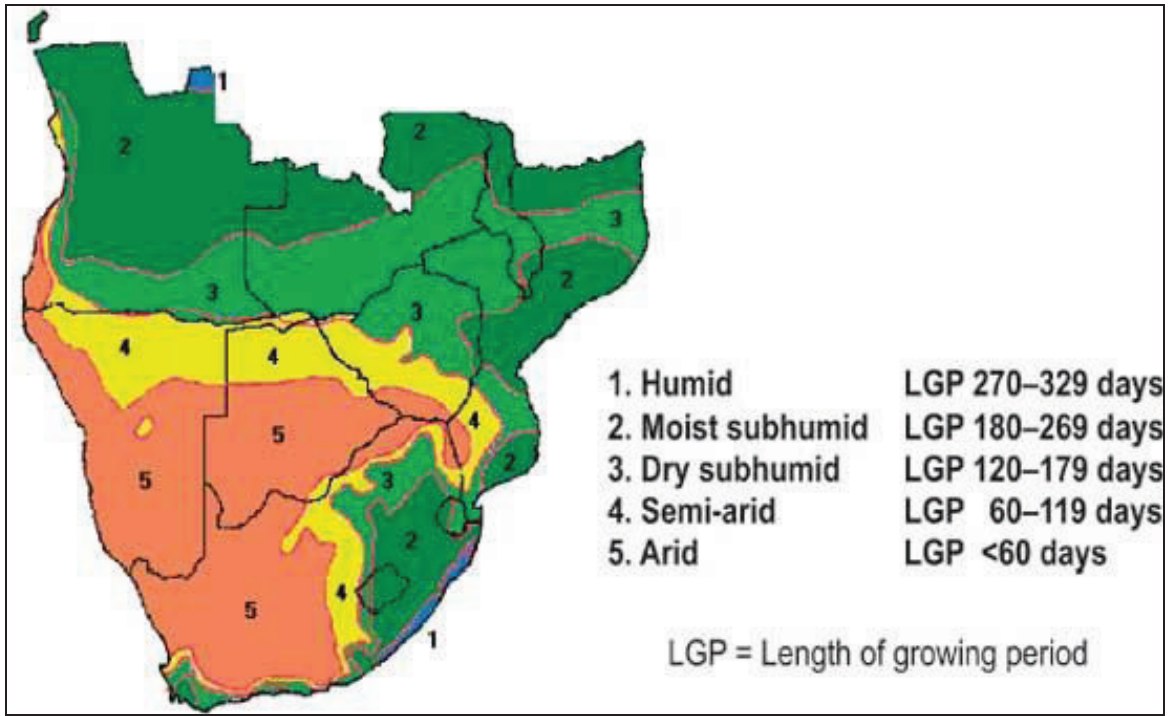


Figure 1: Agroecological zones of Southern Africa (IIASA and FAO, 2000)