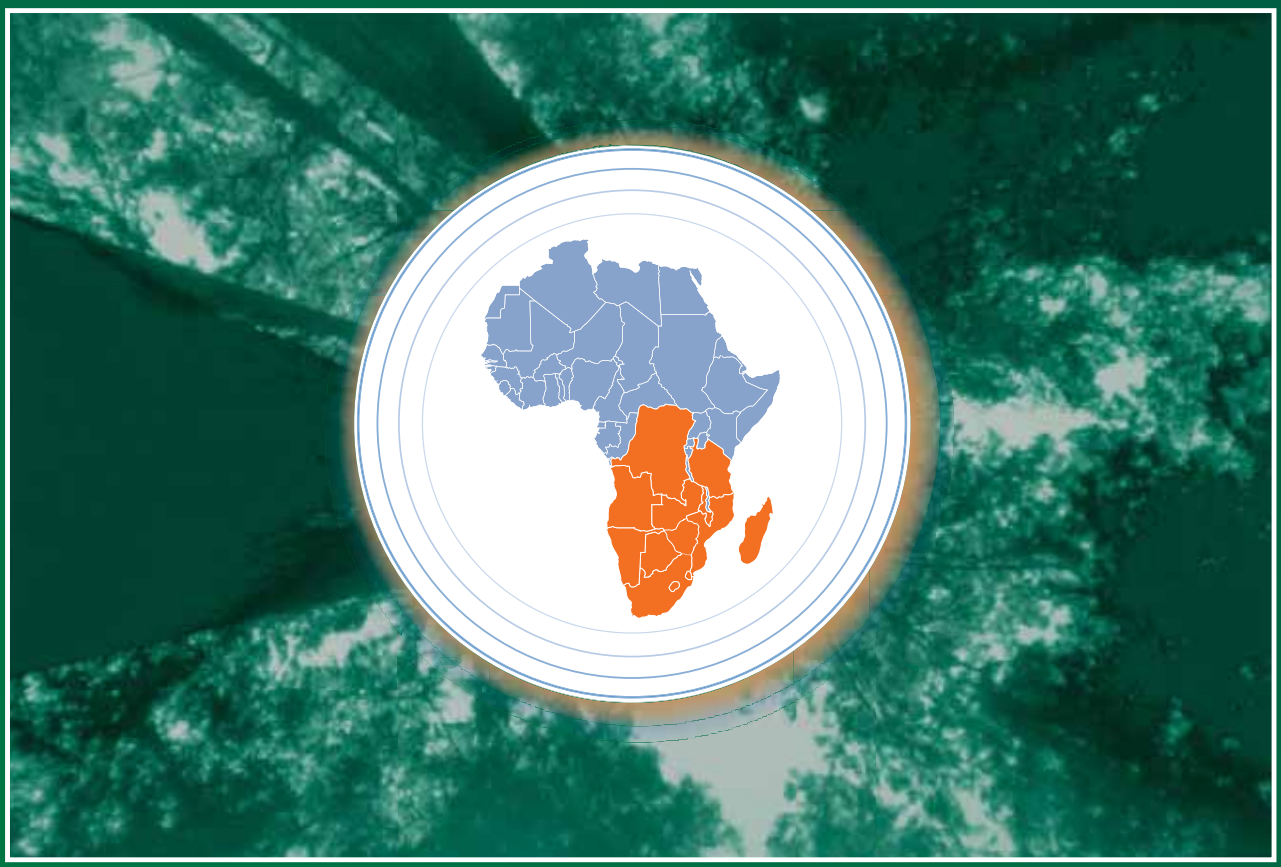
Forests and Climate Change Working Paper 12



Forests, Rangelands and Climate Change in Southern Africa

Forests and Climate Change Working Paper 12

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Foreword

This publication is part of a series by FAO's Forests and Climate Change Programme, the principal objective of which is to strengthen the capacities of countries and facilitate their efforts to mitigate and adapt to climate change through actions consistent with sustainable forest management. The objectives of this report are to provide an overview of the actual and potential impacts of climate change on forest and rangeland resources in southern Africa, review related efforts under way in the countries and the region to respond to climate change, and identify areas of potential cooperation among countries in the region.

People and ecosystems in southern Africa are extremely vulnerable to climate change. Forest and rangeland ecosystems play a vital role in livelihoods by supplying goods and services to rural communities, but they are under threat from climate change and human pressures. While many climate change efforts to date in the forest sector in southern Africa have focused on mitigation (e.g. reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries – REDD+), countries have recognized the urgency of building resilience and facilitating adaptation to climate change in the sector. National actions can be enhanced through collaborative work among countries in southern Africa. The importance of regional cooperation to support countries in climate change adaptation has been recognized by the parties of the United Nations Framework Convention on Climate Change, who collectively have called for intensified cooperation.

Working in partnership, FAO and the Southern African Development Community, with the financial support of the Government of Belgium, convened the Workshop on Forests, Rangelands and Climate Change Adaptation in Southern Africa on 17–19 June 2013 in Johannesburg, South Africa. The aims of the workshop were to exchange information, identify issues of common concern and shared needs, and discuss the development of a programme to facilitate national action and regional collaboration in the area of forests, rangelands and climate change adaptation. This publication was prepared to serve as a point of departure for the discussions at the workshop, and it has since been updated to take into account the outcomes of the workshop.

This report will be of interest to specialists and policy-makers in the forest, rangeland and climate change sectors in southern Africa as well as forest managers, students and members of the general public interested in learning more about forests, rangelands and climate change adaptation in the region.

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Acronyms

AMESD	African Monitoring of the Environment for Sustainable Development
CDM	Clean Development Mechanism
COMACO	Community Markets for Conservation
COMESA	Common Market for Eastern and Southern Africa
COMIFAC	Central African Forest Commission/Commission des Forêts d'Afrique Centrale
COP	Conference of the Parties
DEWFORA	Improved Drought Early Warning and Forecasting to strengthen preparedness and adaptation to droughts in Africa
DfID	Department for International Development (United Kingdom of Great Britain and Northern Ireland)
EAC	East African Community
EU	European Union
FANR	Food, Agriculture and Natural Resources
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FP7	European Commission Seventh Framework Programme
GCM	general circulation model
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GIS	geographic information system
GIZ	German Agency for International Cooperation/Deutsche Gesellschaft für Internationale Zusammenarbeit
GSSA	Grasslands Society of South Africa
GTZ	German Technical Cooperation/Deutsche Gesellschaft für Technische Zusammenarbeit
INC	Initial National Communication
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
LTAS	Long Term Adaptation Scenarios Research Programme
MICOA	Ministry for Coordination of Environmental Affairs
MRV	monitoring, reporting and verification
NAPA	national adaptation programme of action
NTFP	non-timber forest product
REDD+	reducing emissions from deforestation and forest degradation, and the role of conservation of forest carbon stocks, sustainable forest management and the enhancement of forest carbon stocks
REL	reference emission level
SADC	Southern African Development Community

SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Use
SPOT	Satellite for Observation of Earth/ Satellite Pour l'Observation de la Terre
UNDP	United Nations Development Fund
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
ZEMA	Zambia Environmental Management Authority
2NC	Second National Communication

Executive summary

The forests and rangelands resource in southern Africa is of critical importance to sustainable livelihoods and ecosystems. However, this resource is also extremely vulnerable to the projected changes in climate in the region, as well as to other external stressors with which climate may interact, which, in turn, will have serious implications for people and economies. Consequently, adaptation is a central priority in the Southern African Development Community (SADC)'s regional response framework. This paper provides an overview of the status of issues and actions related to the adaptation of forest and rangeland resources to climate change in southern Africa.

A background to the resource is provided which serves to contextualize the extent of the resource, highlight the significance of its economic, social and environmental functions, and outline drivers of deforestation and land degradation. A summary of climate histories and trends in southern Africa indicates a robust pattern of rising temperatures, with some statistically significant changes in rainfall. Climate models project increased average, minimum and maximum temperatures, with increases evident in all seasons. The majority of models for rainfall project decreased rainfall for the June–July–August (winter) season and for the September–October–November (spring) season. In addition, increases in very hot days and in heat waves are projected by all climate change models discussed.

The potential impacts of climate change, climate variability and extreme events are discussed in terms of how projected changes would impact on forest and rangeland resources as well as on sustainable development. The need for adaptation to deliver livelihood benefits beyond climate change is highlighted in a discussion on adaptation needs. It is emphasized that successful adaptation projects should simultaneously achieve synergies with socio-economic benefits, climate change adaptation and biodiversity and ecosystem conservation.

National adaptation priorities, as identified in national adaptation programme of action (NAPAs) and national communications, include sustainable forest management and the sustainable use of resources; afforestation and reforestation programmes; the promotion of agroforestry, non-timber livelihoods, alternative energy sources and climate-resilient tree varieties; and capacity-building and the strengthening of institutional frameworks. There are few ongoing initiatives in the SADC region dealing with adaptation to climate change, especially in forests and rangelands. NAPAs and country reports prepared for an FAO workshop identified barriers that limit the implementation of national adaptation priorities. This provides insight into key challenges that need to be overcome in addressing climate change. While forests and rangelands play key roles in adaptation to climate change, existing policies and national strategies in many SADC countries do not adequately reflect the climate change needs of these resources and the people who depend on them, especially in terms of adaptation. The need to provide assistance to countries to enhance technical capacity and financial capacity is also highlighted.

It is essential to integrate key sectors in the adaptation of forests and rangelands to climate change through the development of holistic programmes that benefit the environment, the communities that depend on the resource, and governments. There are multiple key initiatives in the SADC region on which to build and improve regional and interregional collaboration in climate change adaptation in forests and rangelands. A project spanning the SADC region to help strengthen capacities at all levels and across national borders to enhance resilience to climate change could work in synergy with these.

1. Introduction

Southern Africa is extremely vulnerable to climate variability and climate change, and this vulnerability is compounded by low adaptive capacity and the interaction of social, economic and environmental factors with climate. Forest and rangeland ecosystems in the region are significant in their contributions to livelihood options and national economic activities, and their increased vulnerability to climate change has serious negative implications for the communities and economies that depend on them. However, forests and rangelands[1] also offer unique opportunities for improving the adaptive capacity of societies, and this is especially true for lower-income rural populations.

There is an urgent need for countries in the region to prioritize activities that build resilience and facilitate adaptation to climate change in the forest sector, as well as in other land-based sectors. Regional cooperation in climate change adaptation is recognized and supported by the United Nations Framework Convention on Climate Change (UNFCCC)[2], and national priorities can be supplemented and reinforced through collaborative work among countries in the region.

This paper was prepared as a background document for the Workshop on Forests, Rangelands and Climate Change Adaptation, which was organized by FAO and the Southern African Development Community (SADC) Secretariat and held in June 2013 in Johannesburg, South Africa. The objectives of the workshop were to take stock of the current efforts of countries in this area, identify country priorities and potential areas of cooperative work within the region, and define the scope of a programme for climate change adaption in forests and rangelands.

This paper provides an analysis of the implications of climate change for forests and rangelands in southern Africa. The extent of the resources and their economic and social functions and drivers of change is outlined. The vulnerability of the resources to climate change and adaptation needs and options for the SADC region are highlighted, as well as potential synergies with mitigation options. A summary of current national actions, country needs and potential areas of collaboration among countries in the region is provided to inform existing and future cooperative initiatives related to the adaptation of forests and rangelands to climate change.

[1] In this report, the term “forests and rangelands” encompasses forests, woodlands, savannahs and rangelands.

[2] The UNFCCC, in the 2010 Cancun Agreements, invited Parties to strengthen and/or establish regional centres and networks, in particular in developing countries, with support from developed country Parties and relevant organizations, to facilitate and enhance national and regional adaptation actions.

2. Background

This section provides a background to forest and rangeland resources in the SADC region[3] and their economic, social and environmental significance, and it outlines the drivers of deforestation and land degradation.

The SADC Land Cover Database was generated in 2002 with a combination of remote sensing-derived and ancillary data (Figure 1) (CSIR, 2002). National land cover was mapped at a scale of 1:250 000 from satellite imagery and is available in digital spatial formats; countries for which appropriate data were unavailable at the time were omitted from mapping. Natural forests, plantation forests, woodlands, bushlands, grasslands and shrublands are among the various land-cover classes shown in Figure 1.

2.1. Forests in the SADC region

Forest resources in the SADC region are extensive and diverse and cover an estimated area of 394 million hectares (ha)[4], or 41 percent of the total land area of the 15 SADC member states (Annex 1; FAO, 2010). Figure 2 shows the distribution of forest cover in SADC countries, expressed as a percentage of the total forest cover in the SADC region.

[3] The SADC region comprises more countries than the southern African region, notably the United Republic of Tanzania and the Democratic Republic of the Congo. Established in 1980, SADC now has 15 member states: Angola, Botswana, Democratic Republic of the Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, the United Republic of Tanzania, Zambia and Zimbabwe.

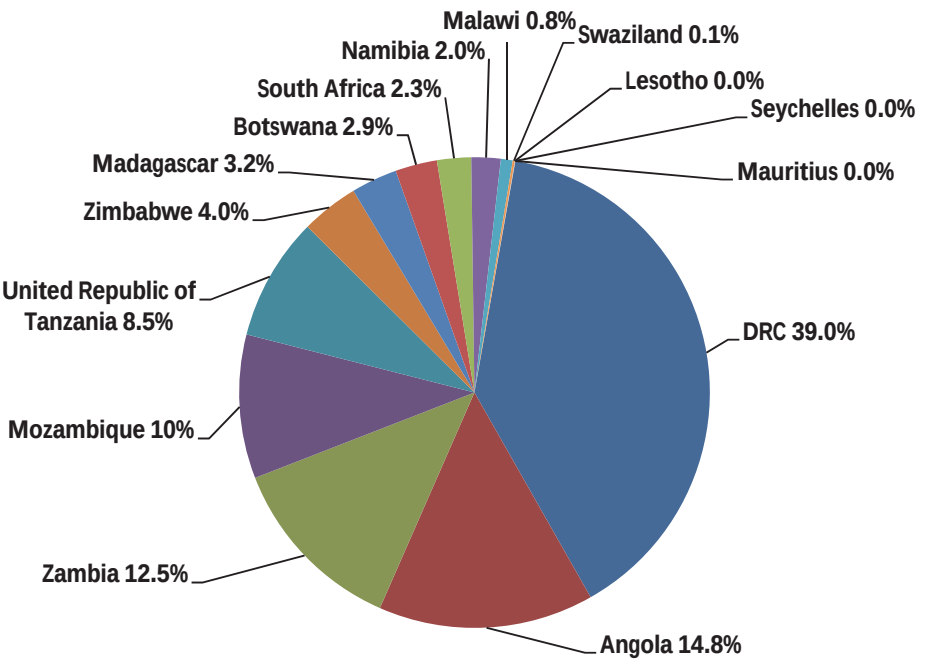
[4] Total forest cover includes natural and planted forests.

FIGURE 1: Land cover in SADC countries, 2002

Source: (CSIR, 2002)

Forest cover is concentrated in a few countries in the SADC region: the Democratic Republic of the Congo, Angola, Zambia and Mozambique have the largest forest areas and account for more than three-quarters of the total forest area in the SADC region. Those four countries are among the five most-forested countries in Africa; together with Sudan, they contain more than 55 percent of the continent's forest estate (FAO, 2011). In contrast, Lesotho, Namibia and South Africa are the least-forested countries in the SADC region (Annex 1).

FIGURE 2: Distribution of forest cover among SADC member states as a percentage of the total forest cover in the region (394 million ha)



Source: FAO, 2010

Natural forests in the SADC region

Southern Africa is relatively arid. Natural forest types in the SADC countries range from tropical moist forests in Angola and the Democratic Republic of the Congo to scrubland and desert ecosystems in the Kalahari and Namib deserts in western Botswana and southern Namibia (FAO, 2001). Natural forests comprise six main forest types: the miombo woodlands, the mopane woodlands, the baikiea woodlands, acacia woodlands, montane and tropical moist forests, and mangrove forests (Mubaiwa, 2004).

Miombo woodlands constitute the most extensive vegetation type in the SADC countries. The most extensive dry deciduous forests in the world, miombo woodlands cover a substantial area of Angola, Malawi, Mozambique, Zambia and Zimbabwe, extending north into the United Republic of Tanzania and the Democratic Republic of the Congo (FAO, 2001). The miombo woodlands have high species richness and are an important sink for carbon; consequently, their deforestation would result in a large volume of carbon dioxide emissions (Scholes, 2004).

Mopane woodlands occupy drier areas characterized by low rainfall and high temperatures in Mozambique, northern Namibia, southern Angola and large areas of Zimbabwe and Botswana. The baikiea woodlands (Zambezi teak forests) are found in the Kalahari sands of western Zimbabwe, northern Botswana, northeastern Namibia, eastern Angola and Zambia. Acacia woodlands are common in various parts of the Zambezian phytoregion where the rainfall is low and the soil suitable. Montane and tropical moist forests are found in pockets in high-altitude, high-rainfall areas in Malawi, Mozambique, Zimbabwe and Zambia and in most of Angola and the Democratic Republic of the Congo. Mangroves occur in coastal areas of the tropical regions of Angola, Mauritius, Mozambique, South Africa and the United Republic of Tanzania (FAO, 2001).

Plantation forests in the SADC region

Plantation forests account for about 3.3 million ha of forest cover in the SADC region (Annex 1), approximately half of which is in South Africa. There are relatively small plantation forest sectors in Angola, Madagascar, Malawi, Mozambique, Swaziland, the United Republic of Tanzania and Zimbabwe. Most of the plantation forests in these countries are for industrial purposes such as wood pulp and timber and are privately owned. South Africa's plantation forest area of 1.273 million ha accounts for 1 percent of its national land area (122.3 million ha) (DAFF, 2012). Pine (51 percent of the total area) and eucalypts (40.5 percent) comprise the majority of South Africa's plantation forest area, with the remainder consisting of acacia (wattle) and other species. Commercial plantations in South Africa are certified by the Forest Stewardship Council (and the International Organization for Standardization 14001 certification scheme) as sustainably managed (DAFF, 2009). Swaziland has approximately 140 000 ha of plantation forests, Zimbabwe has 108 000 ha of commercial plantations and Mozambique has a plantation forest area of 62 000 ha (FAO, 2010). Botswana, Lesotho and Namibia do not have commercial plantations, except for some small woodlots that were established for the provision of fuelwood and poles for general farm construction (FAO, 2003). The volumes of industrial roundwood removal (based on five-year averages between 2003 and 2007) per country are shown in Annex 1.

The expansion of plantation forests in SADC countries is limited by the availability of suitable land. Afforestation in South Africa is also limited by water legislation, and most catchments have no further potential for forestry expansion due to this limitation. Mozambique has some of the best conditions for expanding the plantation forest sector in southern Africa (Cuvilas, Jirjis and Lucas, 2010), and there are a number of proposals which might lead to the sector's rapid growth over the next decade. Due to the current complex political situation in Zimbabwe it is possible that the current area of plantation forests might be significantly reduced.

2.2. Rangelands in the SADC region

Rangelands in the SADC region largely comprise the grassland, arid savannah, semi-arid savannah, thicket, nama karoo, succulent karoo, desert and fynbos biomes. It should be noted, for clarity, that in certain countries, biodiversity assessment may use different terminology for such biomes, but the naming conventions of Palmer (2003) are used in this paper.

The grassland biome comprises mainly the high-altitude areas of Lesotho, South Africa and Swaziland. In parts highly adapted to cattle/large stock production, the grassland biome is also highly transformed; in the case of South Africa, it exhibits the highest rate of fragmentation and degradation. Among its interesting features is the prevalence of 'sweet' versus 'sour' veld and the fluctuation of these – with key implications for palatability and, in certain areas, carrying capacity.

Arid savannah occurs mainly in southwestern Africa, where a summer rainfall season tends to encourage woody shrub production, with some interspersed grass (Palmer, 2003). There are semi-arid savannah woodlands in Zimbabwe and northeast parts of South Africa, including mopane and riparian shrubs.

The thicket biome occurs in the subcontinent's southeastern coastal region and largely along drainage lines and ridges towards the interior (Palmer, 2003). It comprises, for example, a key resource for large commercial stock and game production in South Africa's Eastern Cape and karoo midlands. The thicket biome exhibits dense cover, with succulent shrubs, woody shrubs and low trees – including the spekboom shrub (*Portulacaria afra*, Figure 3) – a species currently generating substantial interest for carbon sequestration.

FIGURE 3: The spekboom shrub (*Portulacaria afra*)

Photo: E. Archer Van Garderen

The nama karoo occupies the central and western regions of South Africa and southern Namibia, exhibiting a mix of shrubs, small shrubs and annual and perennial grasses (Archer *et al*., 2011; Palmer, 2003). It is a biome highly suited to small stock production (with some cattle farming occurring on high-altitude areas in the interior, where the biome neighbours the grassland biome). Game production, in different forms, is on the increase in this area (Archer *et al*., 2011).

The succulent karoo is a biome of great ecological significance, falling within the winter rainfall regions of the southern and southwestern portions of South Africa. With high levels of biodiversity and endemism, the succulent karoo has been a site of substantial conservation attention and research for more than a decade (Archer *et al*., 2011).

The desert biome occurs largely within Namibia. The largest desert area on the subcontinent is the Namib, which comprises both rocky and sandy deserts (Palmer, 2003). Many vegetation types (as well as animals and other organisms) exhibit interesting morphological adaptations to aridity.

Finally, the fynbos biome (or Cape floristic kingdom) occurs within South Africa's winter rainfall region, although some relic communities of summer rainfall fynbos exist to the north (for example along the escarpment edge in the area of Mariepskop, Mpumalanga, South Africa). Comprising three main vegetation types (including fynbos heathland, renosterveld shrubland and strandveld shrubland), the fynbos is recognized as a global hotspot for biodiversity and forms the only floristic kingdom in the world completely within the borders of a single country (South African National Parks, 2013).

2.3. Economic, social and environmental functions of forest cover

Forests play a major role in the livelihoods of communities as sources of wood and non-wood products. They are also important for local people in rural areas, who rely to a large extent on forests for shelter, food, energy, construction material, employment and other products for domestic consumption as well as trade (Zaikowski, 2008). Most countries in southern Africa have extensive rural areas with high poverty levels and the economic, social and environmental functions of forests vary greatly among countries.

Fuelwood is probably the most important forest product in many SADC countries, especially among rural communities. The miombo woodlands, for example, are important for livelihoods, with 75 million people inhabiting miombo regions and an additional 25 million urban dwellers relying on miombo wood or charcoal as a source of energy (cited in Dewees *et al*., 2010). In Mozambique's miombo woodlands, timber exports reached around US$65 million in 2005 (4 percent of total exports), despite the low availability of commercial timber species (FAO, 2007) (note: illegal timber extraction was not captured in the total). The estimated annual value of the charcoal industry in the four largest urban areas of Malawi is about US$41.3 million (Kambewa *et al*., 2007); this total was slightly lower than the value of the tea industry and about 0.5 percent of the recorded gross domestic product (GDP) (Dewees *et al*., 2010).

Plantation forestry provides the raw materials for downstream activities such as sawmilling, woodchip exports, timber boards, furniture, mining timber, treated poles, charcoal, pulp and paper manufacture, and non-timber forest products (NTFPs). South Africa produces 70 percent of the SADC region's total roundwood and sawn timber production (FAO, 2010). The forest, timber, pulp and paper sector in South Africa contributes R22 billion per annum to GDP and produces more than 22 million m^3 of roundwood worth an estimated R5.1 billion annually (Mavimbela, 2010).

In a review of ecosystem-based adaptation using forest and trees, Pramova *et al*. (2012) highlighted cases in which trees and forests can support adaptation, including by providing goods to communities, by providing land cover in watersheds to reduce erosion and flood risk and by protecting coastal areas from climate-related threats. NTFPs constitute important safety nets and are used to diversify income as part of adaptive strategies (which are both anticipatory and reactive) by many communities in developing countries faced with increased climatic variability. In the United Republic of Tanzania, up to 68 percent of household income is derived from forests, and livelihood diversification is partly achieved through the collection of fuelwood, fruits, spices, fodder, traditional medicines, meat and the production of timber, charcoal and bricks (Paavola, 2008). Similarly, in South Africa, research in two villages in the Eastern Cape and Limpopo found that up to 70 percent of households used NTFPs to help in coping with shocks, including climatic ones (Paumgarten and Shackleton, 2011).

Agroforestry (combining trees and shrubs with crops or livestock) is recognized as an effective approach for minimizing production risks under climate variability and change. Verchot *et al*. (2007) discussed the mitigation potential of agroforestry in the humid and sub-humid tropics and highlighted the role that agroforestry has in climate change adaptation, particularly for smallholder farmers. Trees are able to explore larger soil depths to access water and nutrients, which will benefit crops in times of drought. In addition, trees contribute to increased soil porosity, reduced runoff and increased soil cover, leading to increased water infiltration and water retention and reduced moisture stress. However, care must be taken to minimize competition between trees and crops in agroforestry systems for soil moisture (particularly in areas of low rainfall) and light (Verchot *et al*., 2007). Agroforestry can mean the difference between modest yields and crop failure during drought. Garrity *et al.* (2010), for example, reported that during a drought season in Malawi, farmers who practised agroforestry obtained modest crop yields, while farmers who did not practise agroforestry experienced crop failure.

Forests influence rainfall interception, evapotranspiration, water infiltration and groundwater recharge and contribute to regulating base flows during dry seasons and peak flows during rainfall events; these are important services in the adaptation of people to climate variability and change (Pramova *et al*., 2012). According to these authors, evidence of the role of watershed regulating services for social adaptation to climate change is scarce. However, literature on the relationship between forests and water can be used to inform ecosystem-based adaptation decisions.

While the socio-economic value of forests is high in terms of livelihoods and increased income, forest area is declining due to increased collection of wood for fuel, clearing for agriculture, and illegal or poorly regulated timber extraction (Zaikowski, 2008). FAO (2010) reported an increase in woodfuel removals between 2000 and 2005 (average values provided in Annex 1). However, considering that informally and illegally removed wood, especially woodfuel, is not usually recorded, the actual amount of wood removals is undoubtedly higher.

2.4. Economic and social functions of rangelands

In the southern Africa region, rangelands are key to many livelihood options. No single land-use type dominates, but, rather, there is a "complex range of economic activities", including conservation and tourism, commercial livestock production and smallholder livestock systems (Thornton *et al*., 2007; Archer *et al*., 2011).

Communal and commercial livestock production is the main activity in many rangeland areas in SADC countries, providing options for both large and small stock. As noted previously, some of the biomes that make up southern Africa's rangelands may be more suitable for large stock production (e.g. the grasslands biome), while others may be more suitable for small stock production (e.g. the succulent karoo). An increasing area of activity in parts of the rangelands, often in partnership with livestock production, is niche or horticultural crops. Examples are rooibos tea in the succulent karoo and fynbos; olives (e.g. in the nama karoo); lavender; and a growing market for organic produce (including niche markets for red meat).

Linked to the above activities, also often in addition to or complementary with livestock production, is the use of wild food and products from rangelands. Key examples are herbs and traditional medicines such as *buchu* in the fynbos biome and wild foods for home consumption or sale such as mopane worms in the semi-arid savannah.

Intensive agriculture is also present (on occasion, controversially) in parts of SADC's rangelands. Intensive cropping in these areas is often dependent on groundwater and on irrigation technology such as the centre pivot. For example, potato production in the sandveld (bordering the succulent karoo and fynbos biomes) is an irrigation-driven production system using mainly groundwater. Other key activities in rangelands (particularly in settlements in these areas) include businesses that support agricultural and game production, such as transport, agricultural commodity processing, and veterinary services.

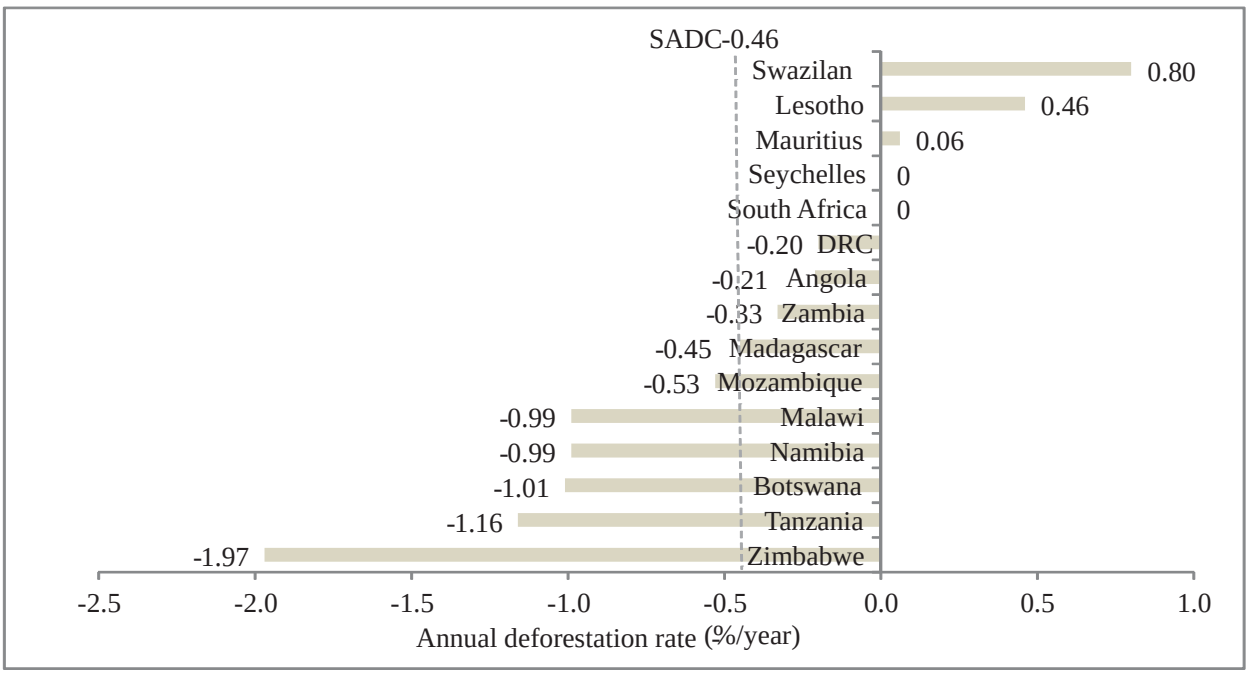
Mining activity is increasingly a feature of rangelands in SADC countries. In the grasslands biome, for example, high levels of fragmentation in South Africa's Mpumalanga Province are significantly driven by mining activity (Archer *et al*., 2011), and this is also the case for the semi-arid and arid savannahs in Botswana and Zimbabwe. Mining is a key livelihood option in these areas, which are generally highly marginalized economically, although the need for unskilled versus skilled labour may fluctuate and greatly affect local settlement dynamics. Some SADC countries have legal demands for ecological restoration for some mining types, but these are difficult to implement and do not apply equally in all countries.

Game production and tourism in various forms are increasingly important activities in rangeland areas. It is essential to note that no single model of these activities applies throughout the region. Tourism takes very different forms, ranging from large-scale ecotourism initiatives in northern Namibia and Botswana, to small guesthouse initiatives on farms in central South Africa, and many models of game production also apply. Some farmers may continue to combine game production with, for example, large and small stock farming. Some game areas may be entirely under private control, some may be part of a public, private or parastatal consortium, and others may be part of a provincial, local or national government-controlled conservation entity. All will have different revenue streams (generated by, for example, visitors, accommodation, trophy hunting and photo safaris) and different ownership arrangements, as well as differing needs for local labour of various types.

2.5. Deforestation and forest degradation

Deforestation and forest degradation comprise a large proportion (approximately one-fifth) of global anthropogenic greenhouse gas (GHG) emissions. Deforestation in the SADC region is a major concern and has been identified as one of the priority areas for regional action due to its contribution to increased concentrations of carbon dioxide in the atmosphere and to land degradation and its negative impact on biodiversity and the balance of associated ecosystems (Lesolle, 2012). Annual net forest loss in the SADC region was approximately 0.46 percent, or 1.8 million ha, in the period 2005–2010 (FAO, 2010) (Annex, 1; Figure 4). Zimbabwe, the United Republic of Tanzania, Botswana, Namibia and Malawi had the highest rates of deforestation among SADC countries (FAO, 2011).

FIGURE 4: Annual rate of deforestation, SADC countries, 2005–2010



Source: FAO, 2010

Of the SADC countries, Angola, Madagascar, Mozambique and Zambia have the highest timber production capacities from natural forests (FAO, 2001). The loss of natural forests of high timber potential in countries such as Malawi and Zimbabwe was the result of clearing for agriculture and infrastructure development; fuelwood and pole collection; and overstocking with domestic animals. The ecological conditions in Botswana, Lesotho, Namibia, Swaziland and South Africa do not favour timber-producing natural forests. Mauritius reported low annual rates of deforestation (0.06 percent), while South Africa and Seychelles reported zero deforestation in 2005–2010 (Figure 4). Swaziland and Lesotho reported a positive net gain in forest cover in that period.

The extent of forest-cover change and the drivers of deforestation vary among countries. The main causes of deforestation, often acting in combination, are agricultural expansion, woodfuel use, hardwood timber extraction and conversion to plantations (Geist and Lambin, 2002; Wertz-Kanounnikoff and Wallenöffer, 2011). In addition, the rate of deforestation is affected by the combined effect of factors such as development and conservation policies, reigning ecological conditions and the fragility of ecosystems and social environments (FAO, 2001).

2.6. Land degradation in rangelands

Land degradation constitutes one of the most significant challenges facing rangelands in southern Africa, threatening both the resilience of the rangelands themselves and the livelihoods of those who live in them (Seymour and Desmet, 2009; Archer *et al*., 2011). Land degradation can be defined as the reduction or loss of biological or economic productivity arising from inappropriate land-use practices (Hahn *et al*., 2005). Rangelands are under pressure from various drivers of change and there are considerable difficulties in assessing these changes and what they may mean for human use of rangelands (Thornton *et al*., 2009).

Assessments of degradation and desertification in southern Africa vary, and there is a need for the use of comparable approaches. For example, in the first national review of desertification in South Africa, Hoffman and Ashwell (2001) suggested, as did Reynolds *et al*. (2007), that degradation is influenced by historical,

biophysical and social factors. They used a qualitative assessment of degradation and suggested that, in general, the communal areas of South Africa were perceived as being most degraded and that degradation was related to rural population density and poverty as well as the biophysical environment (Hoffman and Todd, 2000). Several recent attempts have been made to provide a more quantitative estimate of land degradation in southern Africa (e.g. Bai and Dent, 2007; Wessels *et al*., 2007; Thompson *et al*., 2009; Mambo, 2012). Most of these studies used satellite data and assessed changes in the Normalized Difference Vegetation Index, as well as other vegetation indices, over time.

Understanding linkages between rainfall, land use and degradation is critical, since climate change can modify both the magnitude of and frequency with which the thresholds of desertification processes are exceeded (Archer and Tadross, 2009). For example, a higher frequency of drier spells or a lower critical-rainfall season can affect vegetation cover, with implications for both erosion processes and extensive livestock production. In an area under pressure from overgrazing or inappropriate water use, climate change can act as an additional pressure or stressor that can amplify desertification (Archer and Tadross, 2009). Meadows and Hoffman (2003) suggested that the degradation of rangelands is likely to accelerate in subsistence and communal farming areas under climate change scenarios. In addition, if small-scale farmers are re-settled on farms without support and extension advice, there is a risk that high, uncontrolled stocking rates will impact negatively on the long-term productivity of such areas (Wessels *et al*., 2011).

A key to combating land degradation is monitoring and measurement. In the SADC region, initiatives are under way to use SPOT-derived dry matter productivity images to generate both a baseline carrying capacity map for SADC and carrying capacity forecasting over the seasonal and longer time scales. Funds for this initiative are derived, at present, from African Monitoring of the Environment for Sustainable Development (AMESD) and Improved Drought Early Warning and Forecasting to strengthen preparedness and adaptation to droughts in Africa (DEWFORA), a project of the European Commission Seventh Framework Programme (FP7).

3. Impacts of climate change and adaptation options

FIGURE 5: Meteorological station, Dobbelaarskop Farm, Suid Bokkeveld, South Africa

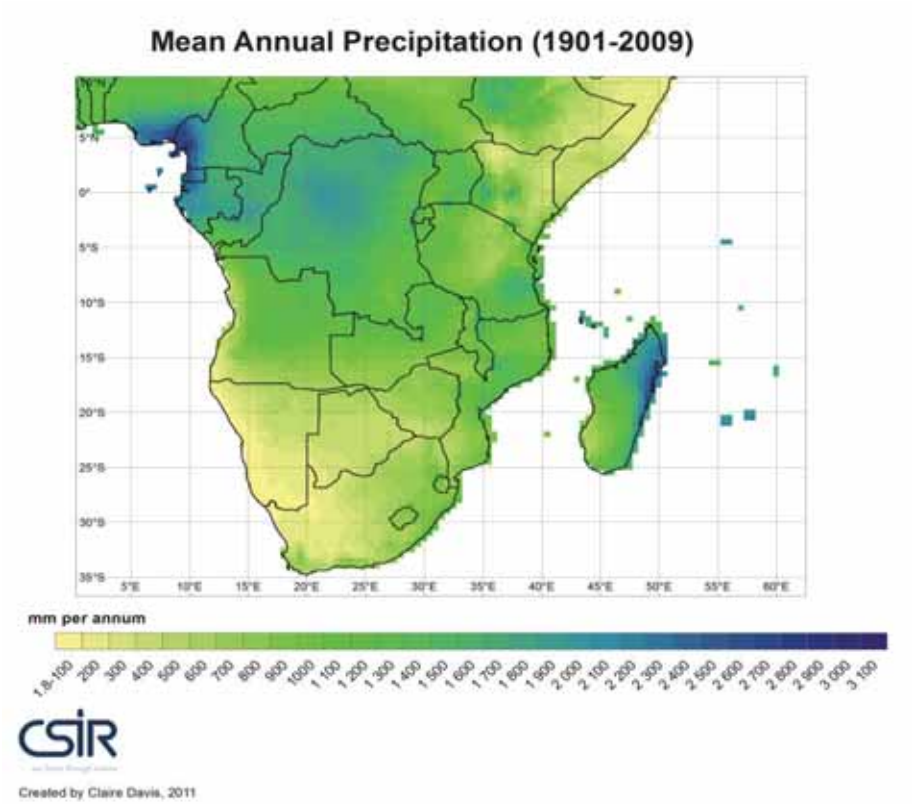
Photo: E. Archer Van Garderen

3.1. Evidence of climate change and future scenarios of climate change in the region

Evidence of climate change in the SADC region has been accumulating for some time, including from region-wide assessments, assessments in smaller areas and point assessments. At the regional scale, Davis and Joubert (2011) characterized the current climate of the SADC region as a largely semi-arid region, with high inter- and intra-seasonal variability in precipitation. Extreme hydroclimatic events are frequent features of the southern African climate and are often a focus of the region's evolving early-warning systems (see, for example, INGC, 2009).

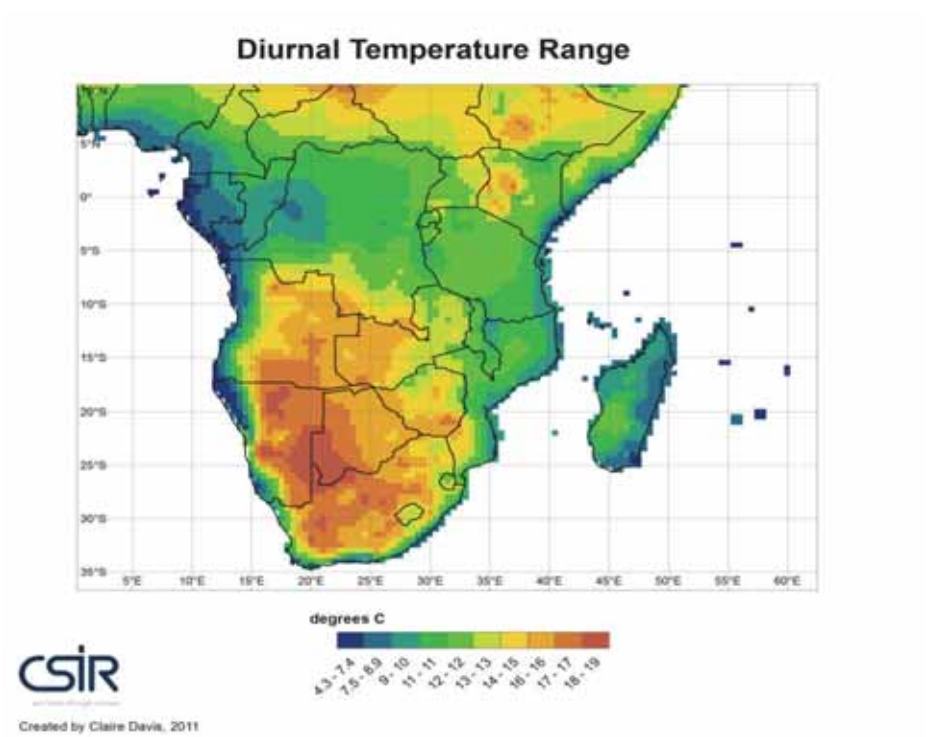
Southern African rainfall shows clear seasonal characteristics, with the largest part of the subcontinent experiencing a summer rainfall season, usually commencing around October/November and tapering off in February/March (Davis and Joubert, 2011). Certain studies show distinct differences in season onset, cessation and dry spell frequency, both spatially and temporally. Forecast skill in season onset and cessation is a clear priority in the subregion (e.g. Tadross, Hewitson and Usman, 2003; Tadross, Jack and Hewitson, 2005; Usman *et al*., 2005; Tadross *et al*., 2009; Crespo, Hachigonta and Tadross, 2011; Landman *et al*., 2011). Figure 6 shows mean annual rainfall in southern Africa, calculated from a 1901–2009 mean derived from the high-resolution gridded dataset of the Climatic Research Unit of the University of East Anglia (Mitchell and Jones, 2005).

FIGURE 6: Mean annual rainfall over southern Africa (calculated from 1901–2009 mean)



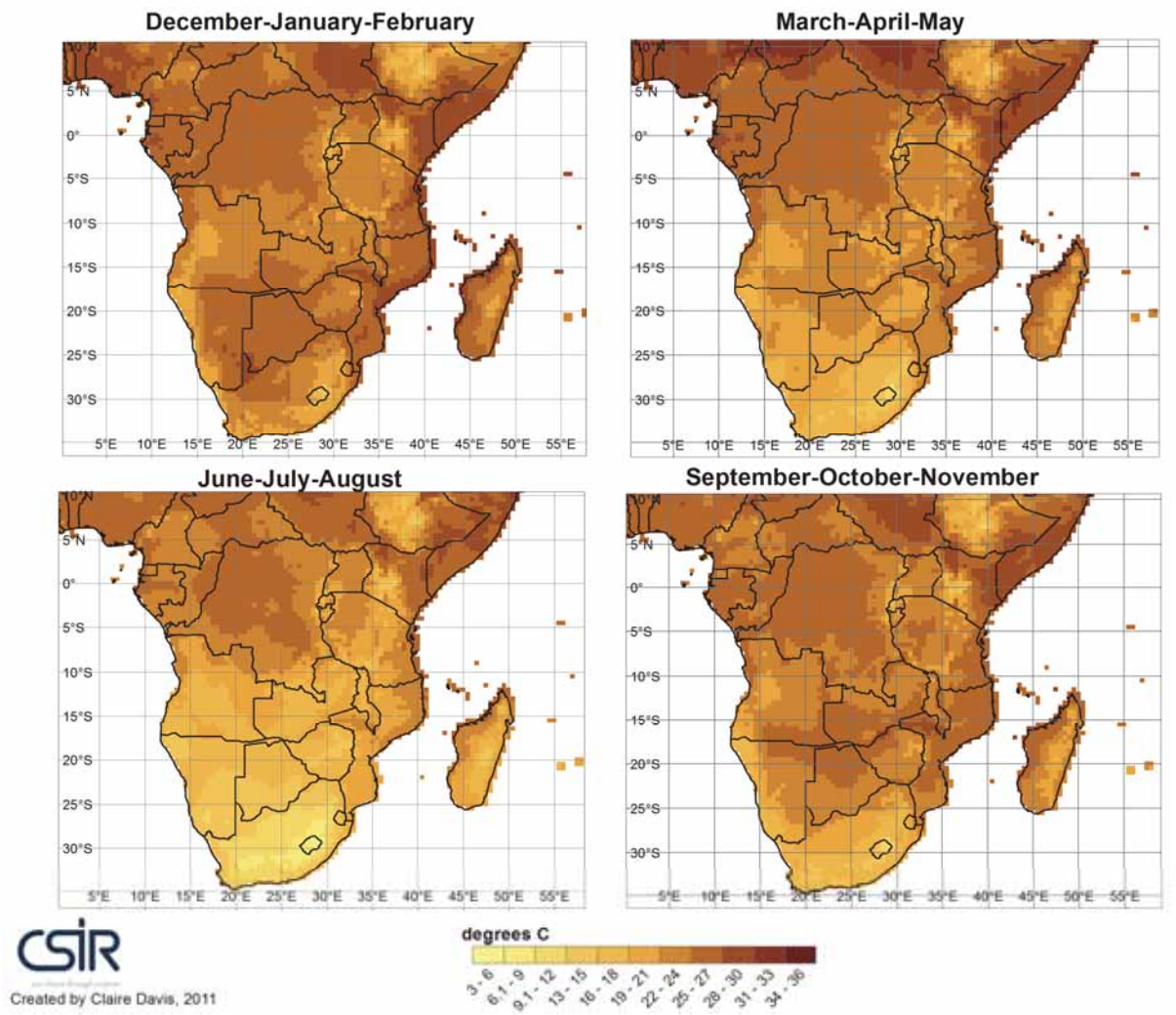
Source: Reproduced from Davis and Joubert, 2011

FIGURE 7: Diurnal temperature range (°C) over southern Africa (calculated from 1901–2009 mean)



Source: Reproduced from Davis and Joubert, 2011

FIGURE 8: Seasonal average temperature over southern Africa (calculated from 1901–2009 mean)

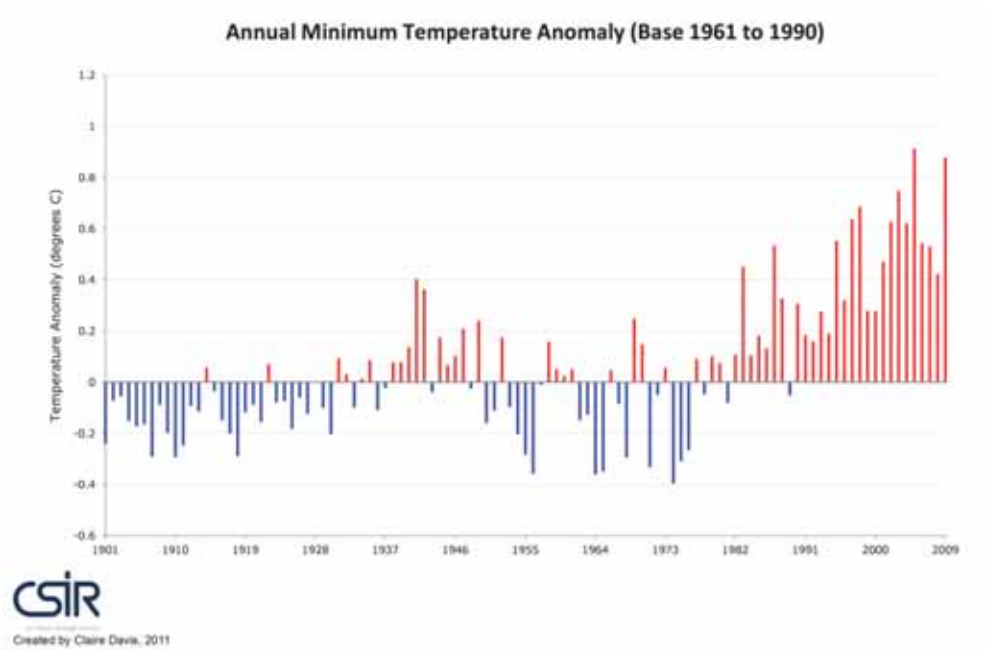


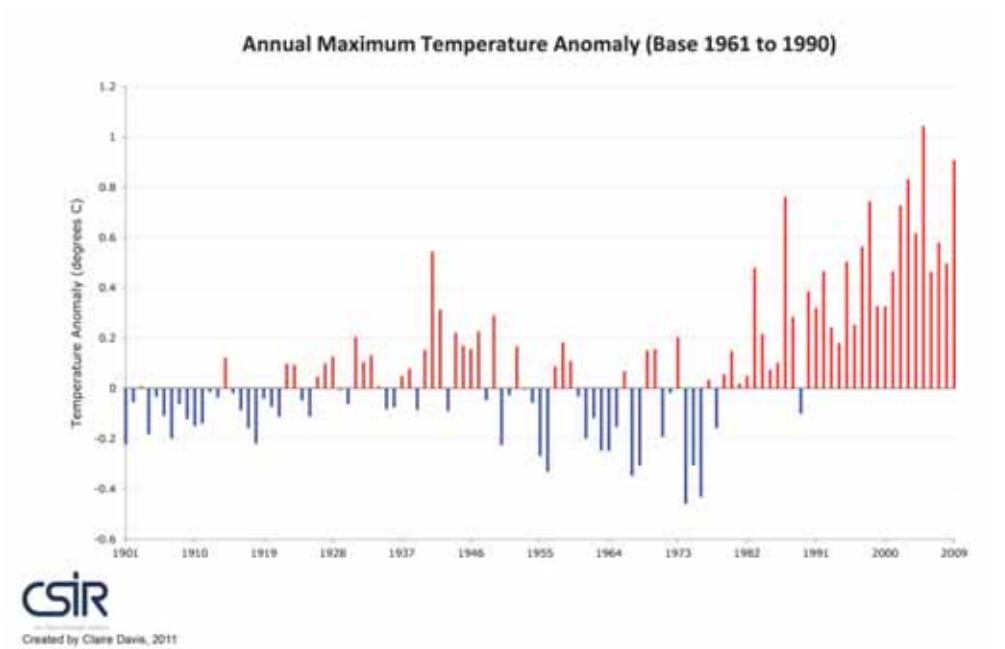
Source: Reproduced from Davis and Joubert, 2011

The SADC region exhibits a largely warm climate, with the annual average temperature mostly above 17 °C, with exceptions in high-altitude and coastal areas (Davis and Joubert, 2011). Mean annual minimum temperature ranges from about 3 °C to 25 °C, while mean annual maximum temperature range from about 15 °C to 36 °C (Davis and Joubert, 2011). Figure 7 shows the diurnal temperature range in southern Africa and Figure 8 shows the seasonal average temperature.

As mentioned earlier, evidence is mounting that changes are occurring in many of the climatic characteristics of the southern African climate. Davis and Joubert (2011) and other studies found clear evidence of rising temperatures in a range of areas, often at the local level – see, for example, Kruger and Shongwe (2004); Archer *et al*. (2009); Lotter and le Maitre (2012) and Kusangaya *et al*. (2013, under review). Figure 9 presents results from Davis and Joubert (2011) showing annual minimum and maximum temperature anomalies in southern Africa.

FIGURE 9: Annual minimum (top) and maximum (bottom) temperature anomalies, southern Africa (1901–2009). Red shading indicates positive anomalies and blue indicates negative anomalies compared with long-term climatology (1961–1990 mean).





Source: Davis and Joubert, 2011

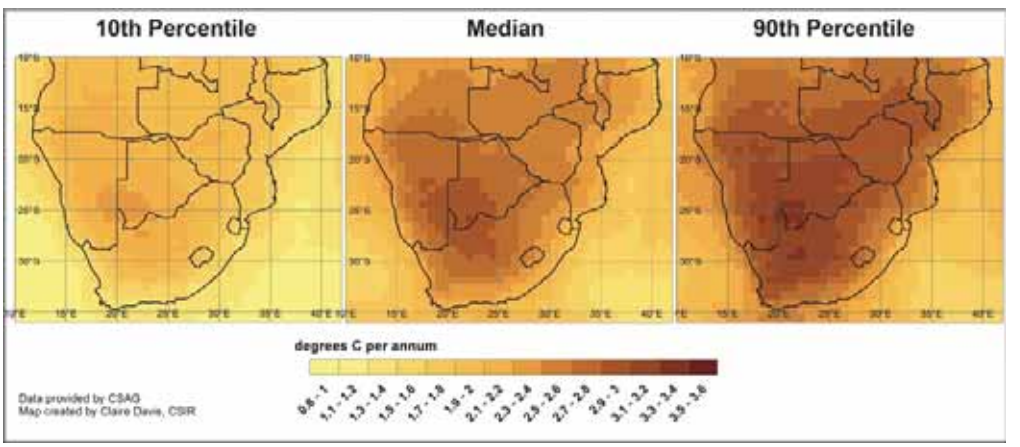
Kusangaya *et al.* (2013, under review) provide a comprehensive overview of studies in the SADC region analyzing long-term changes in rainfall and temperature at both the regional and local levels, showing a mix of results.

The field of climate change projections for the SADC region is evolving at an increasingly rapid rate. Here we present the most up-to-date and forthcoming results of these projections.

Davis *et al*. (2013, under revision) present key working messages derived from the latest sets of climate change projections for southern Africa and the areas of agreement to provide an indication of long-term projections for the regional climate. Using general circulation models (GCMs), statistical downscalings and dynamical downscalings, areas of agreement and disagreement are identified and discussed. Tadross *et al*. (2011) provided details of the GCMs used in each scenario as well as a useful discussion of the strengths and weaknesses of different approaches and the technical details of downscaling approaches.

All projections show a temperature increase of between 1 °C and 3 °C over the larger part of the region by 2060 (Davis *et al.,* 2013, under revision). The most significant increases occur in the arid southwest, with the most significant increases in winter (June–July–August) and spring (September–October–November). Figure 10 shows projected changes in maximum temperature by 2036–2065 relative to the 1961–2000 period, using ten statistically downscaled GCMs (Davis *et al*., 2013, under revision; Tadross *et al*., 2011). The change in temperature is expressed as the 10th, 50th (median) and 90th percentiles to provide an envelope of change (i.e. the full range of future possibilities). The 10th percentile provides an indication of the lower limit of change (best-case scenario) and the 90th percentile provides the upper limit of change (worst-case scenario). The 50th percentile provides a value of the change that is most likely to occur and an indication of the extent of agreement between the downscaled models.

FIGURE 10: Projected changes in maximum temperature (°C) by 2036–2065 relative to 1961–2000 based on the 10th percentile, median, and 90th percentile of the ten statistically downscaled GCMs



Source: Tadross et al., 2011

In terms of rainfall, areas of agreement include annual rainfall increases in southeast South Africa, a decrease in rainfall in southern Zambia and Zimbabwe during summer (December–January–February), and a possible projected decrease in rainfall in central Zambia in spring (September–October–November).

Box 1 provides an "at-a-glance" indication of areas of agreement and disagreement in climate change projections, including findings for extreme weather events.

BOX 1

Summary and comparison of climate change projections from the GCMs and the two downscaling techniques

	GCM	Statistical downscalings	Dynamical downscalings
Time scale	1960–2000 2030–2060	1961–2000 2036–2065	1961–2000 2036–2065
Rainfall	Decreases over central and western southern Africa during summer (December–January–February) and autumn (March–April–May) Increases further north over eastern Africa Decreases over most of southern Africa during September–October–November and southwestern Africa during winter (June–July–August)	Increases over Angola, northern Mozambique and southeastern South Africa during summer (December–January–February) and autumn (March–April–May) Decreases over Zimbabwe, Zambia, western Mozambique and parts of the southwestern coastline during summer (December–January–February) and spring (September–October–November)	Increases over eastern Africa and southeastern South Africa during summer (December–January–February) Decrease in western southern Africa in winter (June–July–August)
Temperature	Increase in mean, minimum and maximum temperature (increases in range indicated)		
	1–3˚C	0.8–3.6˚C	0.4–3.2 ˚C
Extreme weather events	Increases in very hot days and heat waves	Increases in very hot days and heat waves	More extreme rainfall events in eastern southern Africa Increase in very hot days – above 35˚C

Source: Tadross et al., 2011 and Davis et al., 2013, under revision

Before moving on to the implications of such projections for forests and forest communities in the SADC region, it is essential to observe that, as indicated earlier, work on climate modelling for the SADC region (and, indeed, for Africa) is a highly dynamic and fast-moving field. A key area of work is South Africa's Long Term Adaptation Scenarios (LTAS) process, in which the Climate Scenarios Task Team is working to develop a set of "consensus climate change scenarios" for an area that includes the SADC region – with further support from programmes such as the Applied Centre for Climate and Earth Systems Science. As a first step, the LTAS process will generate consensus messages on short-term, medium-term and long-term time scales, with a basic interpretation of each model and model set. Further work in the second half of 2013, including impacts modelling for the forest sector, will make use of these analyses.

To conclude, climate histories and trends in southern Africa to date indicate a robust pattern of rising temperatures, with some statistically significant changes in rainfall (Kusangaya *et al.*, 2013, under review). All models to date show projected increased average, minimum and maximum temperatures. For many of the models, the increase is more pronounced as we move towards 2100. Increased temperatures are evident in all

seasons and are particularly pronounced towards the interior of the continent, as we would expect given the role of oceans in maintaining largely temperate climates in coastal areas. In projected rainfall areas of agreement, a majority of models indicate decreased rainfall in June–July–August (winter) and September–October–November (spring). All models show increases in very hot days and heat waves, and we expect this message to persist in forthcoming updated model results. There is an ongoing effort to improve confidence in climate change projections and, as such, models are continuously updated as new technical capacities and capabilities become available. Updated climate change projections for southern Africa are expected in 2013 as part of the LTAS process and the Coordinated Regional Climate Downscaling Experiment.

3.2. Vulnerability of forests and forest communities to climate change

Forests in southern Africa are critically important for sustainable livelihoods and ecosystems, as detailed, for example, in the SADC Protocol of Forestry (2002), which is intended to promote the "development, conservation, sustainable management and utilization of all types of forests and trees" (SADC, 2002). The forests are vulnerable, however, to the projected changes in climate described earlier, as well as to other external stressors, with which climate may interact in particular ways. A range of critical trends, some of which are described earlier, may make forests in the region more vulnerable to climate change. Table 1 outlines the key vulnerabilities identified in national adaptation programmes of action (NAPAs).

The aforementioned trends in deforestation, degradation and damage to ecosystem services in forests and rangelands in the SADC region make not only those ecosystems more vulnerable to climate change but also the communities that rely on them. Zambia's initial communication stated that deforestation is occurring at annual rates of 250 000–300 000 ha and is attributable to harvesting for charcoal and woodfuel, timber production and unsustainable agricultural methods and other land-use practices. In the case of the Okongo Community Forest, the degradation of the forest base was seen as both the result of and the driver of livelihood vulnerability (Mouton, 2008). In the cases of Community Markets for Conservation (COMACO) in Zambia and the Mdumu North Conservancy in Namibia, poaching was both (partly) a result of restricted income options and a longer-term driver of them as the resource base erodes (Midgley *et al*., 2012).

In a number of SADC countries, communities that are most vulnerable in forest and rangeland areas are those for whom natural resources comprise a significant part of their food and livelihood security. Mambo (2012), for example, showed how particular households in the semi-arid rangelands of Bushbuckridge Municipality in the Lowveld are made vulnerable to food and livelihood security and the role of natural resource dependence in this vulnerability (albeit that relationships and feedbacks are complex). Of particular interest in studies such as that of Mambo (2012) and Mouton (2008) and those reviewed by Archer *et al*. (2011) is that the most vulnerable communities and entities in forest and rangeland areas are typically those that are economically, socially and/or politically marginalized. These include (but are not limited to) immigrants (Mambo, 2012), who may not have the economic and social safety nets afforded to neighbouring communities, land reform/restitution recipients, who may lack appropriate post-resettlement support (Archer van Garderen, 2013), and politically marginalized ethnic groups, such as the San in Namibia (Mouton, 2008).

Gender relationships and how they are affected by climate change in terms of access to and use of forest resources and forest sustainability is also important. Women may be significantly impacted by climate change and are active actors in the protection and management of forest resources. It is through the sharing of skills and local experiences on natural resource management and acquired valuable knowledge that women will be better able to contribute positively to identifying appropriate adaptation and mitigation measures (Osman-Elasha, Chidumayo and Donfack, 2011). The participation of women in forest development policies, strategies and capacity-building initiatives needs to be promoted.

TABLE 1: Vulnerably of forests to climate change, as identified in NAPAs

Country	Vulnerability of forests to climate change
Angola	Soil erosion, land degradation and desertification. This is due to a number of factors, including inappropriate land-cultivation practices, deforestation (for energy and commercial timber, including in rainforests), and climate-induced erosion (severe rainfall)
Democratic Republic of the Congo	High dependency on woodfuels; heavy rainfall; coastal erosion; inundations; scorching; and seasonal drought
Lesotho	Rural communities depend on biomass fuels as a major energy source for both cooking and heating. The resilience and regenerative capacity of forest resources are negatively affected by extreme climatic conditions. Livestock production is deteriorating due to the degradation of rangelands. Extreme weather conditions are conducive to the incidence of diseases and pests
Madagascar	Deforestation (slash and burn); decrease of biodiversity; and soil degradation
Malawi	The major climatic hazards that threaten the forest sector are extended droughts, which lead to land degradation, a loss of soil fertility, and forest fires
Mozambique	The most hazardous extreme events are droughts, floods and tropical cyclones. Other environmental problems that affect the country are epidemics, plagues, slash-and-burn practices, industrial accidents and erosion
United Republic of Tanzania	Deforestation and desertification; frequent forest fires; changes in forest types, species composition and distribution; and the disappearance of medicinal plants. Vulnerable species are those that have limited geographical ranges, drought/heat intolerance, low germination rates, low survival rate of seedlings, and limited seed dispersal/migration capabilities. Unsustainable supply of forest, products and services. Decrease in employment and foreign exchange earnings through forest-based industries and trade; loss of coastal and marine habitats (e.g. mangroves)
Zambia	Negative impacts on the regeneration of forest resources by drought and climatic changes that affect the resilience of forest vegetation types could grossly affect the income and welfare of the communities

3.3. Potential impacts of climate change, climate variability and extreme events on forests and rangelands and implications for sustainable development

Climate change and variability are likely to impact forests and rangelands in a variety of ways, with critical implications for local livelihoods as well as for areas and communities further afield who may be dependent on them. Lesolle (2012) indicated that increases in temperature (as projected by all scenarios described above for the SADC region) are likely to result in changes to tree lines and phenology for certain species. In addition, the implications of, for example, increased temperatures for pests and pathogens affecting key species in both natural and plantation forests are a key area of concern. In their comprehensive overview of drought- and heat-induced tree mortality, and the extent to which this may indicate emerging climate change risks for forests, Allen *et al.* (2010) observed that certain of the globe's forest ecosystems may already be impacted by climate change and that "forests may become increasingly vulnerable to higher background tree mortality rates and die-off in response to future warming and drought, even in environments that are not normally considered water-limited" (p. 660). Given that the vast majority of the SADC region is already water-limited, the possibility of increased tree mortality is of major concern. Examples of studies showing impacts of climate change on particular species significant in the SADC region follow.

Foden (2007) indicated trends in *Aloe dichotoma* that could be the result of temperature increases and latitudinal and altitudinal shifting. More recently, discussions have focused on the extent to which such trends might also be the result of other external stressors, but the study remains a robust example of a key focus on an indicator species of concern. Van der Merwe (2013) focused on *Colophospermum mopane*, showing possible spatial shifts in response to climate change (albeit with interactions with other factors, such as soil type).

Germishuizen and Mzinyane (2013) reviewed the projected impacts of climate change on species critical for plantation forests in the SADC region (especially *Eucalyptus grandis* and *Pinus patula*), with critical impacts indicated particularly for *P. patula*, including an increased frequency of pests and diseases and an increase in the frequency and intensity of fire. Such impacts have already been observed in some plantation forests and are likely to become more severe (Germishuizen and Mzinyane, 2013). This is particularly concerning given plans to expand plantation forestry in parts of the SADC region (including Mozambique and South Africa's Eastern Cape Province).

Other identified impacts are bush encroachment in both rangeland and forest areas, as well as changes in tree–grass interactions, which are relevant throughout most of the SADC region. Studies have shown that increased concentrations of carbon dioxide in the atmosphere are associated with increased woody plant cover, through the following two mechanisms (Archer *et al*., 2011).

First, plant transpiration rates are reduced under elevated atmospheric concentrations of carbon dioxide, increasing soil water availability and the competitive dominance and productivity of deep-rooted plants, such as shrubs (Bond and Midgley, 2000). Second, Bond, Midgley and Woodward (2003) indicated that increased atmospheric concentrations of carbon dioxide favours the post-fire regrowth of woody plants, which may increase woody-plant cover at the expense of grassland.

Climate change is thus likely to change grass–tree interactions (not simply through increased carbon dioxide), thus altering the balance between forests and rangelands, albeit building on an already dynamic base. Moderating effects occur, however, linked to an altered fire regime. A reduction in fire intensity may favour tree production, while an increase is likely to favour grass production. In focusing on encroachment by *Acacia mellifera*, Joubert and Smit (2009) proposed that fire may act as the critical mediator of transitions from open savannah to thicket (Archer *et al*., 2011).

3.4. Adaptation needs in the region (forest and rangeland resources, forest communities and related infrastructure)

Given such projected (and, in some cases, already-experienced) impacts, response is a clear priority. Options for adaptation in southern Africa and Africa in general are still being developed, with best-practice and learning still being collated (Wise *et al*. under review). Nevertheless, some learning is available from studies and collated material to date.

One of the most important priorities for adaptation in forests is the need for measures to deliver benefits beyond adaptation to climate change (e.g. Midgley *et al*., 2012; GIZ, 2010; Lesolle, 2012; Clarke, Shackleton and Powell, 2012). Midgley *et al*. (2012) collated learning from a series of studies focused on improved adaptation in Africa and emphasized that many of the most successful projects deliver additional livelihood benefits (e.g. job creation, poverty alleviation and green economy outcomes). This can be considered a critical adaptation need in forests in the SADC region, partly in light of the finding above that restricted livelihood options may both make communities more vulnerable to external stressors such as climate change and act as a driver of forest-cover loss and fragmentation.

Drawing on work in community-based adaptation and community-based natural resource management, Midgley *et al*. (2012) argued that adaptation must simultaneously achieve synergies with socio-economic benefits, climate change adaptation, and biodiversity and ecosystem conservation – an observation also made in other studies (e.g. Archer *et al*., 2008; Archer *et al*., 2009; Clarke, Shackleton and Powell, 2012; Mouton, 2008; Oettle *et al*., 2004; Oettle, 2012). For example, a project focusing on the restoration of coastal ecosystems in the United Republic of Tanzania has strong economic diversification benefits, with a focus on mariculture linked to coastal ecosystem restoration. COMACO, in Zambia, in partnership with the

community resource boards of Luangwa Valley, producer group cooperatives, district council authorities and key government institutions (including the Zambia Wildlife Authority and the ministries of Tourism and Environment and Natural Resources), are using commercial food-processing enterprises to economically incentivize improve land management practices and resistance to poaching (partly by enabling the marketing of organic produce at high market prices) (Midgley *et al*., 2012).

In the Mdumu North Complex, Namibia (in Caprivi), stakeholders in a broad management area (comprising three conservancies, three community forests and three protected areas) have agreed on guidelines to restore ecosystems in the area, with a clear focus on livelihoods and deriving economic benefits from ecosystem services (Midgley *et al*., 2012). Incomes from the conservancies, including from concession fees from trophy hunting and joint-venture agreements for profit-sharing from tourism (an increasingly common model in southern Africa, as elsewhere on the continent), have risen in the last ten years compared with agriculture, so the focus of livelihood generation has shifted towards the conservancies and away from agriculture and poaching (Midgley *et al*., 2012).

In northern Namibia, the Okongo Community Forest Project was commissioned in 1998 for a period of eight years, with a community handover in 2006. An ex-post evaluation conducted in 2008 indicated that elements of the project have been highly successful, with key learning that could benefit the management of community forest assets elsewhere in the SADC region (Mouton, 2008). Again, a critical emphasis is on the achievement of synergies between different objectives, with a clear focus on local livelihoods and the economic incentivization of restoration and improved management of the forest resource base. Challenges remain, however, as discussed in the next section.

3.5. Forest and rangeland management options that would promote resilience, reduce vulnerability and enhance adaptation of forests and forest-dependent people

Adaptation strategies

The life cycle of a forest ranges from decades to centuries. In the past, forest-related decisions were made on the assumption that the climate would remain relatively stable throughout the life of a forest, but this assumption is being challenged by predicted changes in the climate. Adaptation requires planned responses that are implemented well in advance of the impacts of climate change (Spittlehouse and Stewart, 2003). When developing and implementing forest-related climate change adaptation actions, policies and processes it is essential to have a good understanding of local vulnerabilities to climate change in their ecological and social contexts (Klein, Buck and Eastaugh, 2010).

A framework for planning adaptive actions/measures, described in Spittlehouse and Stewart (2003), consists of four steps: (1) defining the issue; (2) assessing the vulnerability of the forest, forest communities and society to change; (3) developing adaptive actions to be taken now (current actions); and (4) developing adaptive actions that may be required in the future as change occurs. Climate change adaptation strategies can be viewed as a risk management component of sustainable forest management plans (Spittlehouse and Stewart, 2003). Forest managers should select adaptive practices that are locally appropriate, and they should work with stakeholders and communities to improve these practices. Examples of climate change adaptation measures are listed in Table 2. The specific adaptation priorities and needs of SADC countries are discussed in detail in Chapter 5.

TABLE 2. Examples of climate change adaptation measures

Topic	Adaptation measures
Gene management	Reassess the location of conservation areas and seed banks; breed pest-resistant genotypes; determine the adaptability of genotypes and their responses to climate change
Forest protection	Manage forest fire and pests to reduce disturbance; restore destroyed forest; protect trees from disease
Forest regeneration	Use drought-tolerant genotypes; use artificial regeneration; control invasive species
Silvicultural management	Selectively remove poorly adapted trees; adjust rotation periods; manage forest density; adjust species composition and forest structure
Non-wood resources	Minimize habitat fragmentation; conserve wildlife; maintain primary forests and the diversity of functional groups
Park and wilderness area management	Conserve biodiversity; maintain connectivity between protected areas; employ adaptive management

Source: Kleine, Buck and Eastaugh, 2010, adapted from Spittlehouse and Stewart, 2003 and Kalame *et al*., 2009

Best practice for adaptation interventions

Midgley *et al*. (2012) summarized a set of key learnings on best practice for adaptation interventions in the SADC region, including forest and rangeland areas, that may be used as guidelines for interventions. In presenting a range of "success stories", and analyzing them in a standard manner, the authors observed that the success stories "illustrate how some of Africa's sustainable development challenges can be effectively addressed through an integrated approach that responds to the triple challenge of socio-economic deprivation, ecosystem degradation and adverse climate change impacts" (Midgley *et al*., 2012).

The best-practice guidelines proposed on the basis of the key learnings of Midgley *et al*. (2012) comprise the following:

1. Involve relevant stakeholders in integrated and adaptive planning and implementation.[5]
2. Locate adaptation approaches in the context of the broader landscape.[6]
3. Develop adaptation responses that are locally contextualized.
4. Develop linkages with national and subnational enabling frameworks.[7]
5. Safeguard communities against risks and costs.
6. Carefully consider project financial sustainability from the start.
7. Develop a robust monitoring and evaluation system.
8. Track cost-effectiveness and resilience outcomes.
9. Establish learning networks and communities of practice.

It is clear from reviews of interventions such as the Okongo Community Forest that, in particular, the last five elements of these guidelines are often challenging for adaptation interventions in forests and rangelands. For example, Mouton (2008) observed that certain risks remain for some elements of the community in the Okongo Community Forest Project (for example, the San people continue to be marginalized from aspects of

[5] This is an area in which the Okongo Community Forest received some praise, but the ex-post evaluation indicated there were still deficiencies (Mouton, 2008). The work of the Heiveld Cooperative in South Africa's Suid Bokkeveld provides a robust example of participatory adaptation planning.

[6] For example, in the current re-declaration of the Kathu Forest in South Africa's Northern Cape, a wider buffer area has been proposed in response to development encroachment in the wider landscape.

[7] The COMACO activities are an excellent example of this.

the project, with critical implications). Many interventions throughout the SADC region also tend to lack a robust monitoring and evaluation system and a solid plan for financial sustainability after external funding terminates (in this case, the COMACO programme in Zambia is a laudable success, with opportunities for learning elsewhere). Tracking cost-effectiveness and the real outcomes for resilience is essential and will help in moving programmes beyond reliance on external funding. Finally, establishing learning networks and communities of practice is critical – as well-documented by Oettle *et al*. (2004) in their experience with community exchange and training in the Suid Bokkeveld (focused on rooibos production and marketing, and on ecotourism).

3.6. Possible negative consequences for forests and rangelands of adaptation measures taken outside the sector

It is critical to observe that adaptation measures taken outside the sectors reliant on forests and rangelands may, under certain circumstances, have negative consequences, or generate disincentives. This possibility lies behind several of the best-practice guidelines for adaptation interventions made in section 3.5, including the development of linkages with national and subnational enabling frameworks (Midgley *et al*., 2012).

For example, in some SADC countries, adaptation planning in the water sector at the national level may include the development of large-scale dams, or changes in inundation levels (in Malawi, for example, a dialogue in 2002 on responses to external stressors such as climate change included large-scale dam development as an option). Such large-scale planning may have major implications for communities living in forest areas adjacent to or downstream of dams. Planning in the health sector on a response to, for example, a changing risk of malaria, may have consequences in terms of exposure to chemicals (a focus of current research at the University of Cape Town). In the plantation forest sector, changes to the spatial planning of plantations in response to climate change projections may impact community areas and livelihoods.

In rangeland areas, the agricultural sector may respond to an increasing incidence of heat stress by increasing irrigation. Depending on the source and scheduling, however, irrigation may not be the best option in arid and semi-arid rangeland areas (for example, in areas where irrigation relies on groundwater). Agricultural and water sectors in these areas may also adapt, by, for example, increasing water storage facilities (e.g. by raising a dam wall). As shown earlier, such approaches may have negative effects outside the sector and, on occasion and in the longer term, within the sector itself. Finally, in forest and rangeland areas, an increased incidence of pests and diseases associated with higher temperatures is likely, and responses to these need to be managed carefully with an eye to knock-on effects on other sectors and local communities (including, for example, those caused by the increased use of pesticides, which is a focus of the FP7-funded Vegitrade programme).

Effectively, national and district-level planning for climate change adaption should be done with clear knowledge of, and management for, the consequences for forest and rangeland communities.

4. Links with mitigation actions

Adaptation is a central priority in SADC's regional response framework. Mitigation activities, while still being implemented in the region, have generally been considered less of a priority and have been seen as the domains of countries that are large carbon emitters. While most SADC countries have not been major contributors to emissions to date, current patterns of development may be considered, in some areas, to be unsustainable and may add to future ecological degradation (SADC Council of Non-governmental Organisations and FES, 2011). Mitigation actions are aimed at reducing GHG emissions and thereby contributing to reducing the extent of global warming. Forests contribute to mitigation through their capacity to remove carbon from the atmosphere and store it. Approximately 20 percent of global GHG emissions are the result of deforestation and forest degradation.

Thirty-seven Annex I (i.e developed) countries have committed themselves, under the Kyoto Protocol, to reducing their emissions to a level below those of 1990. "Joint Implementation" projects with other Annex I countries and investment in Clean Development Mechanism (CDM) projects in developing countries (non-Annex I countries) are options to give developed countries flexibility in meeting their GHG emissions reduction targets. Afforestation and reforestation are the only forms of forestry projects eligible under the CDM. CDM forestry projects involve tree-planting and the production of "credits" for the carbon that is sequestrated by these trees; they also include a commitment to replace any carbon credits that have been lost before the end of the stipulated commitment period (i.e. 30–60 years). An example of an active CDM project in southern Africa is a large-scale afforestation project in the Democratic Republic of the Congo, the "Ibi Batéké degraded savannah afforestation project for fuelwood production"; further information on this can be found at CDM (2013). A literature review by FAO (2012) on forest management and climate change provided an overview of the CDM (and limitations of this mechanism in forestry) and other carbon mechanisms, such as reducing emissions from deforestation and forest degradation, and the role of conservation of forest carbon stocks, sustainable forest management and the enhancement of forest carbon stocks (REDD+).

REDD+ is a mechanism to create an incentive for developing countries to undertake forestry and related activities at the national (and in some cases subnational) level that, together, would contribute to climate change mitigation. The incentive is provided through the creation of financial value for the carbon stored in trees. The REDD+ concept was included in the Bali Action Plan, which was agreed by the 13th Conference of the Parties (COP) to the UNFCCC. The COP 16 decision on this concept states that REDD is not only about reducing emissions but also halting and reversing forest loss and enhancing forest carbon stocks. At COP 16, parties agreed on the scope of REDD+ actions, which includes reducing emissions from deforestation and forest degradation, conserving forest carbon stocks, sustainably managing forests (to maintain constant forest carbon stocks over time) and enhancing forest carbon stocks. COP 16 also agreed on the key elements of countries' REDD+ programmes, including the development of a national REDD+ strategy; the establishment of national reference emission levels (RELs); the development of a robust and transparent national forest monitoring, reporting and verification (MRV) system; and the development of a system for providing information on how social and environmental safeguards are to be observed.

REDD+ can play an important role in reducing emissions and increasing GHG removals from the atmosphere. By incentivizing improved forest and land management, REDD+ can also contribute to sustainable socio-economic development. However, a key issue for the forest sector is ensuring that there is appropriate community engagement as well as equity in the share of proceeds from forest trade, forest-generated finance, and the benefits generated by REDD+ (Lesolle, 2012).

The concept of REDD+ and the distribution of its benefits are currently being considered at the national level, but there is potential for synergies at a regional level. SADC member states decided to develop a regional REDD+ programme in 2009 aimed at addressing common problems of deforestation and degradation in the region and formulating climate change mitigation measures in the forest sector (SADC, 2013). This REDD+ programme sought to improve the capacity of the SADC member states and the benefits they receive from their national REDD+ programmes through regional cooperation. Wertz-Kanounnikoff and Wallenöffer (2011) provided an assessment of the comparative advantages of a regional versus national approach to REDD+ in the SADC region.

4.1. REDD+ under way in the subregion

The SADC REDD+ programme aims to improve the capacity of member states to manage and benefit from their national REDD+ programmes through regional cooperation and also increase the influence of SADC as a region (SADC, 2013). The development of MRV systems is the focus of the SADC REDD+ MRV project, currently under way and jointly implemented by the Food, Agriculture and Natural Resources (FANR) Directorate of SADC and the German Agency for International Cooperation (GIZ) on behalf of the German Federal Ministry of the Environment. Four pilot countries, Botswana, Mozambique, Malawi and Zambia, each with a different ecosystem representative of the SADC region, have been selected for developing test sites (GIZ, 2012). This project is further described in Chapter 6.

The World Bank Forest Carbon Partnership Facility (FCPF) is a programme to assist developing countries in their REDD+ activities by providing value to standing forests (FCPF, 2013). The Democratic Republic of the Congo, Madagascar, Mozambique and the United Republic of Tanzania are among the 36 developing countries that have been selected to join the FCPF and have signed participation agreements. The FCPF has two separate but complementary funding mechanisms – the Readiness Fund and the Carbon Fund – to achieve its strategic objectives.

The UN-REDD Programme is a partnership between FAO, the United Nations Development Programme (UNDP) and the United Nations Environment Programme that supports nationally led REDD+ processes and promotes the involvement of stakeholders in national and international REDD+ implementation. The Democratic Republic of the Congo, the United Republic of Tanzania and Zambia are among 16 countries with UN-REDD national programmes, the aim of which is to prepare countries for future REDD+ implementation (UN-REDD Programme, 2013).

The REDD countries database provides a summary of key information across a broad range of areas, including policies, plans, laws, statistics, activities and financing for REDD+ countries, including the United Republic of Tanzania and Zambia (The REDD Desk, 2011a). In addition, a country needs assessment on REDD+ was commissioned by the UN-REDD Programme in conjunction with the FCPF (Kojwang and Ulloa, 2012). The purpose of the study was to enable the UN-REDD Programme to review its policies and align the Programme's support with the priority needs of countries. Annex 2 contains a summary for the Democratic Republic of the Congo, the United Republic of Tanzania and Zambia, derived from the country needs assessment, of the top five achievements and needs or gaps in terms of REDD+ readiness; additional detail on the UN-REDD Programme in those three countries is outlined below.

The Democratic Republic of the Congo has progressed from the planning stage – the initial Democratic Republic of the Congo UN-REDD National Programme – which helped launch and structure the national REDD+ strategy, to the implementation stage, which is the full national programme (readiness plan) approved by the UN-REDD Programme Policy Board (UN-REDD Programme, 2013). Under the full national programme, REDD+ activities have moved from strategic planning to results, the completion of key studies, the testing of REDD+ pilot projects and the training of personnel. Regional sharing has also taken place, with the Democratic Republic of the Congo sharing its learning experiences on setting up national satellite forest monitoring systems with the United Republic of Tanzania (UN-REDD Programme, 2013).

The United Republic of Tanzania has a number of plans, policies and laws that support REDD+ activities, such as the Environmental Management Act, 2004, the National Forest Policy, 1998, and the Forest Act, 2002, which provides incentives and a legal framework for participatory forest management. REDD+ planning began in 2009 through the development of a National REDD+ Strategy and Action Plan (United Republic of Tanzania, 2012; The REDD Desk, 2013). Nine pilot projects linked to capacity-building and technical support for developing a national MRV system and the piloting of a National Trust Fund are among the United Republic of Tanzania's activities (United Republic of Tanzania, 2012). A national carbon monitoring centre has also been established and was launched in March 2013; it will play a crucial role in REDD+ MRV in the country. The United Republic of Tanzania is also part of the FCPF, but it does not currently receive funding from it since the country's readiness phase is being funded by other programmes (the Government of Norway and the UN-REDD Programme) (United Republic of Tanzania, 2012). However, FCPF membership provides an opportunity for the country to stay current in terms of international REDD+ policy and to learn from other partnership members.

Zambia has been identified, at a global level, as one of the top ten GHG-emitting countries as a result of deforestation and degradation (EIA, 2008), and REDD+ is viewed as an important mitigation option

(Estrada, Trines and Emmer, 2012). It is important to note, however, that the estimated rates of deforestation vary depending on the methods of measurements used. REDD+ has evolved in Zambia in the context of a national development agenda that aims to achieve sustained economic growth that is compatible with both environmental and social sustainability (The REDD Desk, 2011a). Reducing dependence on woodfuel for energy to reduce deforestation and degradation is a key priority in the country's national plans. Zambia was selected as a pilot country for the UN-REDD Programme in 2010. Also in 2010, planning for REDD+ commenced and a national joint programme was established between the Forestry Department in the Ministry of Lands, Natural Resources and Environmental Protection and the implementing bodies of the UN-REDD Programme (The REDD Desk, 2011b). A national REDD+ strategy is expected to be completed in the second quarter of 2013.

4.2. REDD+ capacity-building

REDD+ capacity-building is critically important in achieving REDD+ readiness. However, data are needed on the type of capacity-building and the number of people that are reached in countries implementing REDD+ capacity-building initiatives to inform planning on where investments on additional capacity-building are required. A report by Conservation International, the Organization for International Studies and The Center for People and Forests presented results from a study of REDD+ capacity-building initiatives implemented in Africa and the Asia-Pacific region between September 2010 and June 2012; the Democratic Republic of the Congo and Madagascar were among the six countries surveyed (RECOFTC, 2013). The study highlighted that training needs to spread beyond major cities and upscaled beyond the REDD+ demonstration sites.

4.3. Synergies and trade-offs between forest mitigation and forest adaptation projects

Forest mitigation projects such as REDD+ and CDM projects have the potential to facilitate the adaptation of forests to climate change by reducing anthropogenic pressures on forests, enhancing connectivity between forest areas and the conservation of biodiversity hotspots, and increasing the value and resilience of forests (Locatelli, 2011). However, explicit references to adaptation or the development of adaptive capacity are rarely included in these mitigation activities (FAO, 2012).

Adaptation practices could be included synergistically in most mitigation projects in the forest sector (Nabuurs *et al*., 2007). The integration of mitigation and adaptation activities in forest projects can contribute to the sustainability of their outcomes by increasing their local legitimacy (by emphasizing local needs through adaptation) while achieving global benefits (through carbon funding and capacity-building for mitigation activities). However, the inclusion of additional forest adaptation activities in mitigation projects, while reducing the effect of climate change on those forests, may adversely affect the permanence of carbon storage (Locatelli, 2011), such as by incorporating forest management practices such as sanitation harvests or increased thinning to reduce the occurrence of pests and diseases.

Adaptation and mitigation linkages, and the vulnerability of mitigation options to climate change, are summarized in an adaptation and mitigation matrix in Table 3, which presents four types of mitigation action.

TABLE 3: Adaptation and mitigation matrix

Mitigation option	Vulnerability of the mitigation option to climate change	Adaptation options	Implications for GHG emissions due to adaptation
A. Increasing or maintaining the forest area			
Reduction deforestation and forest degradation	Vulnerable to changes in rainfall, higher temperatures (native forest dieback, pest attack, fire, and drought)	Fire and pest management Protected area management Linking corridors of protected areas	No or marginal implications for GHG emissions, positive if the effect of perturbations induced by climate change can be reduced
Afforestataton/reforestation	Vulnerable to changes in rainfall, and higher temperatures (increase of forest fires, pests, dieback due to drought)	Species mix at different scales Fire and pest management Increase biodiversity in plantations by multi-species plantations Introduction of irrigation and fertilization Soil conservation	No or marginal implications for GHG emissions, positive if the effect of perturbations induced by climate change can be reduced May lead to increase in emissions from soils or use of machinery and fertilizers
B. Changing forest management: increasing carbon density at plot and landscape level			
Forest management in plantations	Vulnerable to changes in rainfall, and higher temperatures (i.e. managed forest dieback due to pests or drought)	Pest and forest fire management Adjust rotation periods Species mix at different scales	Marginal implications for GHGs May lead to increase in emissions from soils or use of machinery and fertilizers
Forest management in native forests	Vulnerable to changes in rainfall, and higher temperatures (i.e. managed forest dieback due to pests, or drought)	Pest and fire management Species mix at different scales	No or marginal
C. Substitution of energy-intensive materials			
Increasing substitution of fossil energy intensive products by wood products	Stocks in products not vulnerable to climate change		No implications for GHG emissions
D. Bioenergy			
Bioenergy production from forestry	An intensively managed plantation from where biomass feedstock comes is vulnerable to pests, drought and fire occurence, but the activity of substitution is not	Suitable selection of species to cope with changing climate Pest and fire management	No implications for GHG emissions, except from fertilizer or machinery use

Source: Nabuurs *et al.*, 2007

5. Climate change strategies, and policy and institutional frameworks

5.1. National adaptation priorities

Adaptation priorities were identified in NAPAs for each of the least developed countries in southern Africa (UNFCCC, 2013), as shown in Table 4. Annex 3 provides examples of climate change adaptation projects and activities that have been implemented or are planned for implementation in the forest sector in a number of the SADC countries, and Annex 4 gives examples of forest-related partnerships in which some SADC countries have engaged. Country reports presented at a workshop held by FAO on forests, rangelands and climate change adaptation in southern Africa in June 2013 (FAO, 2013) highlighted the following responses to vulnerabilities:

- intensifying and sustaining afforestation and reforestation programmes;
- promoting agroforestry as a way of meeting both food/subsistence and fuelwood needs;
- promoting alternative/non-timber livelihood systems such as beekeeping to take pressure off forest resources;
- sustainably using and managing forest resources;
- promoting the sustainable harvesting of caterpillars as well as research into the domestication of caterpillars and mushrooms;
- conducting research into, and the promotion of, alternative energy sources, energy conservation initiatives, and efficient charcoal production and use technologies to reduce biomass (wood) fuel consumption;
- conducting research on climate change-resilient tree varieties;
- involving forest-dependent rural communities in forest management through an institutional framework that recognizes and defines their role, while making full use of REDD+ mechanisms;
- improving forest management practices to enhance the resilience of forests and forest products;
- establishing a forest resources database and training and supporting foresters and extension officers;
- enhancing support for disease and pest surveillance and control;
- building and strengthening institutional frameworks for the sustainable management of forest resources;
- improving fire management;
- building the capacity of national experts;
- developing awareness-raising programmes on climate change and the value of forest and rangeland resources;
- developing a work plan for national climate change education and training.

TABLE 4: Adaptation priorities relevant to the forest sector, as identified in NAPAs

Country	Main adaptation priorities and needs
Angola	Monitoring the region's climate, taking into account the late arrival of the rains and their intensity Campaigns for environmental education and awareness Introduction of alternative and sustainable income sources for rural people in marginal zones Reducing pressure on forests through the use of alternative energy sources Ensuring increased soil cover
Democratic Republic of the Congo	Anti-erosion and inundation control Sustainable forest management Protection of coastal areas
Lesotho	Capacity-building and policy reform to integrate climate change in sectoral development plans Management and reclamation of degraded and eroded land in flood-prone areas (pilot project for western lowlands) Conservation and rehabilitation of degraded wetlands in the mountain areas of Lesotho Strengthening and stabilizing ecotourism-based rural livelihoods Stabilizing community livelihoods that are adversely affected by climate change through the improvement of small-scale industries
Madagascar	Adoption of the fight against erosion with soil restoration techniques and the stabilization of sand dunes Coastal management with reforestation, including mangrove plantations Reforestation with adapted species Promoting the transfer of forest management to local communities
Malawi	Sustaining the livelihoods of the most vulnerable communities Increasing the resilience of food production systems to erratic rains by promoting sustainable *dimba* production of maize and vegetables in *dambos*, wetlands and along river valleys Targeting afforestation and reforestation programmes to control siltation and the provision of woodfuel, and for their benefits, for example as sources of alternative cash income Improving energy access and security in rural areas (e.g. through extension of the rural electrification programme, improved stoves and the development of ethanol-based stoves) Developing community-based wildlife ranching and a breeding programme for *nyala* Developing and implementing strategies for drought preparedness, flood zoning and mitigation measures Developing technologies to mitigate climate change Managing forest fires in collaboration with communities
Mozambique	Strengthening an early warning system Strengthening capacities of agricultural producers to cope with climate change Reducing climate change impacts in coastal zones Management of water resources under climate change
Tanzania	Afforestation programmes in degraded lands using more adaptive and fast-growing tree species Developing community forest fire prevention plans and programmes Strengthening community-based forest management practices Promoting alternative sources of energy for both domestic and industrial use Promoting appropriate and efficient technologies to reduce the use of wood Controlling habitat destruction and fragmentation along coasts Enhancing the development of buffer zones and wildlife migratory routes Restoring degraded habitats (e.g. beach nourishment, vertiva grass planting, mangrove replanting)
Zambia	Improving fire management in game reserves Community-based ranching to protect vulnerable species Improving extension services to ensure sustainable land and forest management Promoting community forest management Forest fire management at the community level Targeting afforestation and reforestation programmes to control the siltation of streams and rivers as well as to provide fuelwood to minimize forest encroachment Promoting community woodlots for the provision of fuelwood and as sources of alternative cash income Improving energy access and security, especially in rural areas (e.g. through the Rural Electrification Agency and promoting energy-efficient stoves)

All national communications by SADC countries mention forestry to some extent, usually (although not always) with regard to both adaptation and mitigation, although priorities vary, as shown in the following examples.

Angola

In Angola's Initial National Communication (INC), agriculture, forestry, livestock, fishing and food security are described in a single section, along with the environmental sector, with a clear indication of the need to improve forestry and wildlife protection, conservation and management and with a key emphasis on ecologically sensitive areas (arid, semi-arid and sub-humid zones). A further priority acknowledged upfront in the INC is the critical need for full local communication, social organization and citizen participation. The INC includes a case study describing the contribution of Angola's charcoal industry to deforestation, erosion and sedimentation. The INC clearly acknowledges emissions from land-use change and the forest sector, and technology transfer needs are stated to include improved environmental observation and remote sensing, including forestry monitoring. Due to the difficulty in obtaining data in these areas, the INC does not calculate emissions derived from deforestation and the abandonment of deforested areas.

Botswana

In Botswana's 2nd National Communication (2NC), there is upfront acknowledgement that rangelands and forestry are key economic sectors critical for livelihoods, which are vulnerable to and impacted upon by climate change. Botswana's 2NC includes a much larger section on livestock and pastoral resources than almost any other country in the SADC region, with the possible exception of South Africa. There is clear acknowledgement of emissions from land use and forestry, and of the differential vulnerability of livestock farmers in rangeland areas, which is critical. In terms of forestry, an evaluation of vulnerability in this sector in Botswana is presented, including further considerations of underlying community vulnerability and the importance of their perceptions of the dynamics of forest resources. Some valuable results are presented on the external assessment of forest resources versus community and stakeholder perceptions. Further presentation of results of forest products, broken down by gender, is also provided. A useful presentation is made of assessed coping strategies in response to changes in forest resource availability (including construction timber, fuelwood, fruits, thatching grass and livestock forage).

Malawi

Forests play a prominent role in Malawi's 2NC, with a section characterizing forest resources, including acknowledgement of the substantial variations from one agro-ecological zone to another. Many of the common issues around assessing carrying capacity, rotations, species selection and burning also apply here. The importance of forest resources in meeting socio-economic needs is highlighted, and there is a discussion of forest resources, including the nature and extent of the dominant miombo woodlands. The 2NC also discusses, in depth, the vulnerability of forest resources in the light of external stressors and declining forest reserves.

Mozambique

According to Mozambique's INC, forests will be affected by changing temperatures and rainfall and the altered availability of nutrients. Modelling future forest production of four main species showed that tropical rainforests can be maintained, with top biomass and height increasing by 12–13 percent for most species. Other tree species, however, may show declines. Approximately 6–10 million ha of forest are burnt yearly in Mozambique (INGC, 2009). A key climate change strategy in the region therefore focuses on the reduction of uncontrolled forest fire. Other adaptation measures outlined in the INC are intensive and extensive reforestation projects through the introduction of new forest species that are compatible with the projected climate. As in the case of Zambia, such approaches provide a critical opportunity to achieve complementarity between them and REDD+ objectives.

A United States Agency for International Development (USAID) user needs assessment and training workshop conducted in Mozambique found that Mozambique is a hub of climate change-related activity. The Ministry for Coordination of Environmental Affairs (MICOA) is the designated national authority for climate change and is responsible for overseeing Mozambique's involvement in the UNFCCC. MICOA also leads the process of developing a national climate change strategy. A number of donor-driven programmes are in operation under the auspices of MICOA, including the UNDP's Africa Adaptation Programme. The Ministry for Planning and Development is also taking increasing interest in climate change and, in conjunction with

MICOA, is host to the World Bank's Pilot Program for Climate Resilience. The Ministry for Planning and Development has also been involved in the European Union (EU) Global Climate Change Alliance programme to mainstream climate change in planning policies in the country.

FIGURE 11: Zona Verde, Mozambique

Photo: E. Archer Van Garderen

Namibia

According to the documents reviewed, forestry in Namibia plays an important role in climate change mitigation. The country is currently a net carbon sink, and strategies are focused on conserving and enhancing these sinks. Stakeholders that took part in USAID user needs assessment and training workshops highlighted that there are a number of benefits in reducing emissions through programmes such as REDD+, and more emphasis needs to be placed on understanding these, as well as on finding alignment and synergies between adaptation and REDD+ interventions.

Seychelles

In the 2NC of the Seychelles, the chapter on land use, land-use change and forestry is lengthy and detailed. Forests in the Seychelles are considered tropical and largely comprise mixed fast-growing hardwood species. Estimates of emissions from land use, land-use change and forestry for the year 2000 are provided, but with acknowledgements of significant data gaps, including timber assessments from the responsible ministry. In considering mitigation in the land-use sector, forestry is also given prominence, with details provided on Seychelles' forestry policies and approaches to management (including trends and projections of forest cover). The 2NC also emphasizes the vulnerability and critical importance of coastal vegetation, including mangrove ecosystems – their vulnerability to multiple stressors (including climate change and sea-level rise) and their utility in ecosystem-based adaptation.

Zambia

From the USAID user needs assessment conducted in Zambia, it is clear that the country has made rapid recent progress in national climate change policy formulation, inter-ministerial policy harmonization and strategic planning. The Climate Change Facilitation Unit has been established in the Ministry of Lands, Natural Resources and Environmental Protection, supported by UNDP and the Government of Norway, and has spearheaded the development of the National Climate Change Response Strategy and the National Climate Change Communications and Advocacy Strategy, which are currently at zero draft stage. Support for climate change policy in Zambia has further been provided by the World Bank Pilot Program for Climate

Resilience. This multi-year programme aims to integrate resilience into development planning (the 6th National Development Plan) and accelerate low-carbon growth. In the first phase of the programme, sectoral risks and opportunities were analysed, and in the second phase the integration of resilience into the sectoral plans is planned, including at the subnational level. In addition, a revised forest bill and policy are before cabinet (but according to Zambia's country report in FAO, 2013, had not been passed or accepted by mid-2013). There is scope for complementarity between these initiatives and the UN-REDD Programme in Zambia, which aims to complete a national strategy to reduce deforestation by 2013.

5.2. Key challenges in addressing climate change

For Botswana, Lesotho, Swaziland and Zimbabwe, the most important gaps in addressing climate change was the lack of national climate change policies and associated strategies and action plans to guide climate change adaptation and mitigation activities.

Country reports prepared for FAO's workshop in 2013 (FAO, 2013) identified several barriers that limit the implementation of national adaptation priorities. In addition to limited technical expertise and capacity to fund adaptation activities (see section 5.3), constraints included:

- inadequate institutional frameworks to support the coordination and implementation of national policies;
- limited information-sharing between institutions;
- insufficient cross-sectoral coordination within and between the government and non-governmental sectors;
- weak implementation and enforcement of policies and legislation;
- poor infrastructure;
- poverty and illiteracy;
- limited credit opportunities for rural communities;
- weak communication and information dissemination systems on the importance of forests;
- limited awareness of climate change adaptation;
- a lack of spatial data on climate change;
- limited research or monitoring to support adaptive management;
- inadequate protection of forests;
- inadequate polices on land tenure.

Key gaps identified in climate change mitigation included:

- establishing national GHG inventories;
- determining the GHG emissions projections and mitigation potential of various measures;
- the corresponding MRV requirements.

5.3. Assistance required by the countries to address climate change in forest and rangeland management

In FAO (2013), many countries highlighted the need to enhance technical and financial capacity in order to address climate change. In terms of technical capacity, the majority of countries stated that remote sensing and geographic information system (GIS) expertise is required by countries for forest inventory studies. Expertise in sector-specific climate change impacts is also required.

Many of the strategies for coping with the impacts of climate change in forestry are dependent on climate finance mechanisms. The Green Climate Fund (US$100 billion) tabled in Copenhagen through the Copenhagen Accord and operationalized at COP 17 in Durban is one finance mechanism through which developing countries can obtain support for projects, programmes, policies and other activities related to REDD+, adaptation, capacity-building and technology transfer. However, the USAID user needs assessment and training workshops held in Mozambique, Namibia, Zambia and Zimbabwe showed that the mechanisms through which countries can obtain finance need to be understood more clearly, and that national frameworks

are needed to ensure that the finance is managed and distributed effectively. During its FAO country workshop (FAO, 2013), Malawi also highlighted the need for assistance in implementing REDD+ activities and projects.

5.4. Current and potential subregional and regional initiatives and collaboration

Key initiatives related to forests and rangelands and climate change under way in southern Africa or the SADC region

The Convergence Plan of the Central African Forestry Commission (COMIFAC) provides a framework for harmonized forest policies and programmes in the Central African subregion (Koyo and Foteu, 2006). The Democratic Republic of the Congo is a particularly significant member of COMIFAC, given its vast Congo Basin forests. Stated needs for improvement in the subregion include (Koyo and Foteu, 2006):

- the involvement of rural people and other stakeholders in the planning and management of forest resources and their use;
- links between forest development programmes and programmes for socio-economic development in general and rural development in particular;
- the promotion and industrialization of forest products;
- the promotion of networks and fora for technical and scientific exchange;
- sustainable financial mechanisms for forestry development;
- national forest inventories and the collection of forest data;
- forestry education and research.

The SADC Forestry Protocol was initiated by the SADC Forestry Sector Technical Coordination Unit with IUCN support. Draft elements of a protocol were introduced in 1998, and there were country consultations to clarify the process and its elements. A draft protocol was produced in 2000, followed by further country consultations. A SADC regional workshop was held in September 2001 in Pretoria, and a final draft was agreed by all countries and submitted to the legal process. Heads of state signed the protocol in Luanda in October 2002. The Protocol is intended to support regional forestry cooperation among SADC countries, with the intention of supporting sustainable forest management and trade in forest products in the region (Mubaiwa, 2004). Implementation responsibility lies at both the regional and national levels.

The Programme on Climate Change Adaptation and Mitigation in Eastern and Southern Africa is under way, funded mainly by Norway, the United Kingdom of Great Britain and Northern Ireland's Department for International Development (DfID), the EU, the Rockefeller Foundation and USAID (COMESA, 2012). With a budget of about €90 million, this programme is designed to work through the Common Market for Eastern and Southern Africa (COMESA) and regional infrastructure (including the SADC Climate Change Unit, currently being established), focusing on addressing both the mitigation of and adaptation to climate change in COMESA/East African Community (EAC)/SADC member states. The programme, hereafter referred to as the COMESA programme, has particular emphasis on climate-smart agriculture (including conservation farming), capacity-building, understanding adaptation and mitigation in forestry and agriculture, renewable energy, and improving carbon sequestration in forestry and agriculture. Options for engagement are significant, with the caveat that country needs (and the extent to which this programme addresses those needs) should be re-assessed with a focus on ensuring complementarity and non-duplication. The proposed programme in the SADC region may add value to current initiatives and build regional cooperation in forest and rangeland climate change adaptation and mitigation. A key opportunity here is the aligned development of the SADC Climate Change Strategy, funded by GIZ under the auspices of the SADC Climate Change Unit, partly supported by the COMESA programme. Further details on this are provided below.

GIZ funds the SADC Transboundary Water Management Programme that is currently due to run to the end of 2015 (GIZ, 2013). Working at the regional and river-basin level, this programme is intended to improve basin and regional water management (e.g. for the Limpopo and Zambezi basins), including through capacity-building and the development of integrated planning. Sustainable basin and land-use planning is a key component.

Significantly, GIZ also funds an element of the development of integrated MRV systems for REDD+ in the

SADC region, with REDD+ MRV systems being piloted in three areas: Botswana is developing a pilot site for baikea woodlands; Mozambique is developing a pilot site for mopane woodlands; and Malawi and Zambia are establishing a cross-border pilot site for miombo woodlands. Critical to this work are detailed assessments of forest cover and forest inventories (including the use of remote sensing to assess density). Inventories would then be translated into estimates of carbon storage per forest area (independently assessed). This programme is also set to run to the end of 2015, with funding of €3.365 million (GIZ, 2013).

The Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) is a joint initiative of Angola, Botswana, Namibia, South Africa, Zambia and Germany. It responds to the challenges of global change, specifically in the areas of adaptation to climate change and sustainable land management. Forestry is a thematic area in the SASSCAL programme, along with biodiversity, water, climate, agriculture and capacity development (SASSCAL, 2013). The main products generated in the forestry thematic area are an improved digital forest inventory and information for the SASSCAL region based on remote sensing supported by dedicated ground truthing; silvicultural baseline information on forest dynamics; standing timber volumes and the productivity of main forest types in the region; and tools for forest managers and scientists to better understand and control the drivers of forest destruction and degradation.

For some years, the SADC FANR Directorate has been engaged in various initiatives to develop a SADC climate change strategy. A draft paper on climate change in the SADC region was commissioned in 2012 (Lesolle 2012), and presentations were made at a SADC Climate Change Think Tank in Gaborone in April 2012 (Archer van Garderen, 2013; Lesolle, 2012). David Lesolle and Emma Archer van Garderen subsequently worked with GIZ to provide various options for programme design and an institutional framework for addressing climate change in the SADC region. As of mid-2013, the Technical Committee on Environment had endorsed the draft SADC Climate Change Programme, and the SADC Climate Change Working Group had endorsed the process of developing a strategy and action plan. The SADC Climate Change Unit is proceeding with engaging the two lead authors to start strategy design, with GIZ support. The COMESA programme will likely be launched later in 2013, signalling the formal start of the design of elements of the SADC Climate Change Strategy.

Opportunities for enhanced regional and intraregional collaboration on climate change issues

National actions can be enhanced through collaboration among countries in southern Africa and by support for regional cooperation. The importance of regional cooperation to support countries in climate change adaptation and mitigation has been recognized by the parties to the UNFCCC, who have called for intensified regional cooperation (UNFCCC, 2010). Chishakwe (2010) undertook a stocktaking and gap analysis of programmes and initiatives focused on climate change activities in southern Africa; the critical need to place priority on adaptation programmes was reflected in the composition of adaptation programmes that currently exist at both the subregional and national programme levels. Regional cooperation in southern Africa is limited and the region currently lacks focused adaptation strategies for forests.

In FAO (2013), countries identified a number of opportunities for enhanced regional collaboration among the SADC countries. Such opportunities, some of which have already been discussed in this report, include:

- achieving multiple benefits and synergies between climate change adaptation measures (the SADC Climate Change Strategy development process could contribute significantly to this);
- carbon-smart land use (the COMESA programme explicitly proposes activities in this area for its work areas);
- biodiversity conservation and reduction of deforestation/forest degradation (again, the COMESA programme, among others, provides an opportunity in this area);
- the improvement of livelihood options in and around forests and rangelands (both the COMESA programme and the SASSCAL forestry programme may be options for countries here);
- strengthening institutional capacity and knowledge transfer (almost all countries indicated that this was a key need, and it is included as a priority in many of the programmes that may support regional cooperation. Realistic and comprehensive implementation will be key);
- forestry research, including monitoring, understanding impacts and basic research and development (a range of options exist in terms of forestry research, including the SASSCAL forestry programme and initiatives under, in support of and complementary to REDD+);

- as far as possible, inclusion of such regional needs in multilateral institutions linked to forests;
- linked to the forest research item above, the further development of forest inventories and the use of remote sensing and GIS (links to the SASSCAL forestry programme and REDD+ are key);
- propagation of rare endemic species with recalcitrant seeds;
- control of invasive alien species.

To summarize, there are many key initiatives on which to build to improve regional collaboration on climate change in forests and rangelands. Initial options include incorporating forest and rangeland foci in the SADC Climate Change Strategy and the COMESA programme. Such interventions should be used to further the objectives of COMIFAC and the SADC Forestry Protocol, with a particular focus on ensuring that the SADC Climate Change Strategy and programmes on climate change are aligned in the area of forestry, with such strategies designed to encourage regional cooperation. All such regional cooperation should be guided by the needs identified in the FAO workshop process (FAO, 2013).

The abovementioned COMESA programme, with its explicit focus on climate-smart agriculture, and on improving adaptation/mitigation options in forestry, agriculture and rangelands, provides a further potential opportunity to support such a process, as does the SASSCAL forest programme and (sister themes). A key priority will be to ensure the achievement of multiple benefits and synergies between climate change adaptation, carbon-smart land use, biodiversity conservation and the reduction of deforestation/degradation, and the improvement of livelihoods options in and around forests and rangelands in the SADC region.

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Annex 1. Forest context in SADC

Country	Land area	Forest characteristics				Annual change rate				Forest carbon			Removal of wood products	
		Forest cover, 2010		Planted forests, 2010		Reduction in forest cover (annual deforestation), 2005-2010		Reduction in planted forests, 2005–2010[b]		Carbon stock, 2010	Carbon density, 2010	Carbon change, 2005–2010	Industrial roundwood, 2005[c]	Woodfuel 2005[c]
	(1 000 ha)	(1 000 ha)	(% of land)	(1 000 ha)	(% of forest cover)	(1 000 ha/year)	(%/year)[a]	(1 000 ha/year)	(%/year)	(million tC)	(tC/ha)	(MtC)	(1000 m^3 overbark)	(1000 m^3 overbark)
Angola	124 670	58 480	47	128	0	-125	-0.21	-1	-0.46	4 385	75	-9.38	1 260	4 108
Botswana	56 673	11 351	20	0	0	-118	-1.01	0	0.00	646	57	-6.73	-	759
Democratic Republic of the Congo	226 705	154 135	68	59	0	-311	-0.20	n.s.	0.55	19 639	127	-39.50	205	81 580
Lesotho	3 035	44	1	10	23	n.s.	0.46	n.s.	2.26	2	53	n.s.	n.s.	2 362
Madagascar	58 154	12 553	22	415	3	-57	-0.45	25	7.43	1 626	130	-7.41	238	12 812
Malawi	9 408	3 237	34	365	11	-33	-0.99	16	5.07	144	44	-1.45	598	5 919
Mauritius	203	35	17	15	43	n.s.	0.06	n.s.	0.27	2	65	n.s.	10	7
Mozambique	78 638	39 022	50	62	0	-211	-0.53	8	20.9	1 692	43	-9.07	1 507	19 233
Namibia	82 329	7 920	10		n.s.	-74	-0.99	n.s.	34.76	210	29	-2.15	-	-
Seychelles	46	41	89	5	12	0	0.00	0	0.00	4	88	0.00	10	3
South Africa	121 447	9 241	8	1 763	19	0	0.00	3	0.15	807	87	0.00	21 077	13 800
Swaziland	1 720	563	33	140	25	4	0.80	-1	-0.70	22	39	0.16	379	848
United Republic of Tanzania	88 580	33 428	38	240	1	-403	-1.16	2	0.85	2 019	60	-24.18	2 661	24 970
Zambia	74 339	49 468	67	62	0	-167	-0.33	n.s.	0.66	2 416	49	-8.18	1 179	10 002
Zimbabwe	38 685	15 624	40	108	1	-327	-1.97	0	0	492	31	-10.14	1 001	9 473
Total SADC	964 632	395 142	41	3 372		-1 822	-0.46			34 106		-101.92		

a Rate of gain or loss in percent of the remaining forest area each year within the given period; b Amounts reported for reduction in plantation forest area (annual change rate) are also included in the total amounts for annual deforestation; c Five year averages for 2003-2007

Source: FAO, 2010

Annex 2. Summary of achievements and gaps in the Democratic Republic of the Congo, the United Republic of Tanzania and Zambia in terms of REDD+ readiness

Source: Kojwang and Ulloa (2012)	Democratic Republic of the Congo	United Republic of Tanzania	Zambia
Top five achievements	Functional National REDD+ Steering Committee and Coordination Office with high-level political support In the process of drafting a REDD+ strategy supported by 16 technical working groups Has developed a national MRV framework and expects to set RELs by 2013 Has secured funding from FCPF, UN-REDD Programme and Forest Investment Program and prepared six projects that will implemented in Phase II Has initiated pilot projects in the provinces to provide learning and inform REDD+ strategy	National inventory system: the presence of permanent sample plots that are currently being used to conduct a national forest inventory being done in conjunction with FAO and the National Forest Resources Monitoring and Assessment project REDD+ strategy: a draft strategy in place REDD+ pilots: a total of nine REDD+ relevant pilot projects in place and providing lessons A carbon monitoring and accounting unit centre is being set up at Sokoine University	High-level government support and leadership A bottom-up approach to raising awareness in the country Awareness and capacity development in MRV at all levels, supporting the setting up of GISs in all ten provinces Initiated key studies on drivers of deforestation, stakeholder assessment and engagement plan, forest practices with potential for REDD+, development of REL legal preparedness for REDD+
Top five needs or gaps	Decentralization of REDD+ in the provinces Capacity-building at both the national and provincial levels	Carbon production and benefit-sharing: need for capacity-building and a transparent and equitable system Legal framework: a strengthened legal framework that is enforceable both at the national and regional levels to stem illegal trade in forest products – carbon "leakage" Sustainable financing mechanisms for REDD+ in Phase II	Setting up demonstration projects to support the national REDD+ strategy Strengthen capacities at provincial and district levels – knowledge, skills and equipment Setting up demonstration projects to support REDD+ strategy, to test and provide lessons Safeguards for REDD+ in Zambia need to be explored Civil-society capacity development in forest governance, forest resource monitoring and REDD+ communication

Source: Adapted from Kojwang and Ulloa, 2012

Annex 3. Examples of forest-related adaptation activities and projects

Country	Project/activity
Botswana	Forest policy
	Parliamentary Portfolio Committee on Wildlife, Tourism, Natural Resources and Climate Change
	Promulgation of or review of policies
	National Biodiversity Strategy and Action Plan
	National Environmental Fund
	Tree-planting
	Management of wildland fires
	Establishment of tree nurseries
	Rehabilitation of degraded land
	Community-based natural resource management
Lesotho	Skills-development activities for inmates and correctional services staff. For example, recycling paper into bricks for use with fuel-efficient stoves
	Integrated watershed management programme
	Sustainable land management programme
	"Reducing Vulnerability from Climate Change in the Foothills, Lowlands and the lower Senqu River Basin" Project
Madagascar	Project of forestation of the cashew trees (CDM)
	Project of forestation with *Paulownia* (CDM)
	Project for the extension of protected areas in Madagascar to 6 million ha after the Durban International Conference in 2003
	Elaboration of a readiness preparation proposal (REDD+)
	Elaboration of National Action Plan on Climate Change
Malawi	Tree Planting for Carbon Sequestration and Other Ecosystem Services Project (2007–2012)
	Malawi REDD project – Forest Conservation in Nyika National Park and Mkuwazi Forest Reserve
	Japan Supported Forest Preservation Programme

	Lake Chilwa Basin Climate Change Adaptation Programme upscaling activities
	Department of Forestry REDD+ strategy development with support from USAID
	USAID Kulera Biodiversity Programme by Total Land Care
	Trees of Hope (Clinton Development Initiative)
	Bio Energy Resources Limited Jatropha Project
	Majete REDD+ Project
	Dzalanyama Forest Conservation Project
	Climate Change Programme
	Malawi Africa Adaptation Programme (Japan-supported and implemented under the Climate Change Programme)
	Lake Chilwa Basin Climate Change Adaptation Programme
	Adaptation to Climate Change on Access and Use of Water and Forestry Resources in the Liwonde–Mangochi Protected Area Complex in Malawi to Enhance Food Security
	Sustainable Land Management in the Shire River Basin Project (GEF/UNDP)
	SADC Support Programme on Reducing Emissions from Deforestation and Forest Degradation (REDD)
Mauritius	Ongoing activities
	Maintaining/increasing the forest area through reduction of deforestation and degradation and through afforestation/reforestation
	Maintaining/increasing the stand-level carbon density (tonnes of carbon per ha) through planting, tree improvement or other appropriate silvicultural techniques
	Forest protection against fires, diseases and cyclones
	National tree-planting campaign
	Projects
	The Capacity Building for Sustainable Land Management for the Republic of Mauritius (SLM) Project (2006–2013) supported by UNDP/GEF/FAO
	Protected Area Network Project (2010–2015) funded by UNDP/GEF
	The National Action Programme will be aligned with the 10-year strategic plan of the United Nations Convention to Combat Climate Change
	Regional Capacity Building for Sustainable National Greenhouse Gas Inventory Management Systems in Eastern and Southern Africa Project (2010-2013) by the UNFCCC

	Low-carbon development strategy and is preparing its nationally appropriate mitigation actions
Mozambique	Forestry area Presidential directive on “one leader one forest, one student one plant” The national strategy of reforestation elaborated and in implementation Under REDD+, Mozambique is developing a national strategy and improving national capacity on MRV for REDD+ In the country, ten companies operating in the area of reforestation distributed by Niassa, Zambezia, Nampula and Manica provinces. These companies have an area of 534 000 ha 46 278 ha were reforested in the provinces of Sofala, Manica, Zambezia between 2005 to 2010 Rangeland management Training of technicians in different options to minimize the effects of drought on livestock productivity Research to identify alternative sources of supply for livestock during the dry season Veterinary assistance to farmers Water collection and storage of various purposes Promotion of cattle breeds that are robust and adapted to local conditions Sensitization of communities on best management practices for pastures
Swaziland	Piloting of fuel-efficient technologies and alternative energy sources (fuel-efficient stoves, bioenergy, wind energy, gas) Promotion of: afforestation/reforestation programmes agroforestry

	programme to clear alien invasive plant species
	drought-tolerant fodder species
	water-harvesting techniques for the irrigation of rangelands
	fodder conservation by fencing baling sites to make hay
	Developing an integrated national fire policy, legislation, strategy and action plan (FAO)
	Strengthening the national protected areas system of Swaziland (GEF)
United Republic of Tanzania	Addressing core capacity on adaptation to climate change in productive coastal zones of Pangani, Bagamoyo, Rufiji and Zanzibar
	Mainstreaming environment and climate change adaptation in the implementation of national policies and development plans
	Enhancing climate change adaptation and mitigation capacities of vulnerable communities to eco-villages of different ecosystems of Uluguru Mountains
	Resilient landscapes for resilient communities in Pemba Island
	Empowering vulnerable communities to adapt and mitigate the impacts of climate change in central Tanzania
	Supporting integrated and comprehensive approaches to climate change adaptation in Africa: Africa Adaptation Programme
	Implementation of the national forest resources monitoring and assessment
	Climate change, impacts, adaptation and mitigation in Tanzania programme
Zambia	National tree-planting programme
	Government and other stakeholders with the approach of developing management plans as the major tool towards sustainable forest management
	Rural electrification programme
	An analytical framework has been developed prioritizing the practices with high potential for REDD+ implementation
Zimbabwe	Existing projects
	Afforestation and reforestation and rehabilitation of degraded areas
	Woodland management and the eradication of invasive alien species
	Community-based natural resources management
	Fire management programmes
	Biodiversity and ecosystem Conservation (REDD+, GEF funding)

	Planned projects
	REDD+ projects
	Forest and range resources inventories
	Wood energy-serving domestic cooking stoves (Phase II)
	Climate change mitigation and adaptation projects
	Species screening, species/site matching projects
	Re-defining of silvicultural/agro-ecological zoning

Source: Summarized from country reports in FAO, 2013

Annex 4. Examples of forest-related partnerships in which countries have engaged

Country	Partnership
Botswana	Forest Conservation Botswana Mainstreaming Sustainable Land Management (SLM) in Rangeland Areas of Ngamiland District Productive Landscapes for Improved livelihoods SADC MRV REDD+ SADC AMESD Project Collaboration with New South Wales Rural Fire Services (Australia)
Lesotho	Technical cooperation with GIZ/German Development Service UNDP/GEF support to the Sustainable Land Management Project Cooperation with the Chinese Bamboo Research Centre Maluti-Drakensberg Transfrontier Programme
Madagascar	The Government of Switzerland, through Association Inter Madagascar cooperation brought its collaboration while contributing in the implementation of the Pilot Project REDD – Foreca with the GIZ in the various areas The World Bank through the project “Track II: Systematic Integration of the Reduction of the Catastrophes for the Reduction of the Poverty” financed by the Fund For Diminution of Catastrophe Risks Adaptation Funds related to UNFCCC support the project on resilience of rice cultivation around the Alaotra Lake Least Development Countries Funds related to the UNFCCC also brings its financial support for the project on the management of the coastal zones
Malawi	USAID Japan Government Norway Government Clinton Development Foundation Africa Parks GEF/UNDP small grants UNDP, World Bank, DfID The Royal Norwegian Embassy

Mauritius	UNDP GEF FAO Durell Wildlife Conservation Trust Peregrine Fund World Wide Fund for Nature Kew Gardens Flora and Fauna International and Island Council for Bird Preservation
Mozambique	The investment volume of private sector for reforestation programmes Japan International Cooperation Agency United Nations Joint Program (FAO, UNDP, UN-Habitat, United Nations Environment Programme, United Nations Industrial Development Organization, World Food Programme) FCPF Norway Government Belgium Government
Swaziland	FAO: Non-legally Binding Instrument on All Types of Forests, Policy & Legal framework development (Fire), global forest resources assessment GIZ: REDD+ and MRV, transfrontier conservation areas UNDP: Policy development, Environmental issues GEF: Sustainable Land Management, Strengthening National Protected Areas, CA, Agroforestry, Clearing of invasive alien plants COMESA: National Climate Change Policy and Comprehensive Strategy and Action Plan, CC Policy, Climate Smart Agriculture EU: Sustainable Agriculture (Agroforestry & CA) United Nations Environment Programme: State of the environment, biodiversity conservation African Development Bank: Revamping of the forestry industry sector (pending) Japan International Cooperation Agency cooperation: Capacity building (SFM, participatory forest management)
United Republic of Tanzania	The Government of United Republic of Tanzania and United Nations Environment Programme GIZ USAID

	UNDP
	Norwegian Agency for Development Cooperation
	Danish International Development Agency
	DfID
	Finland Government
Zambia	The Interim Environment Fund – Zambia Environmental Management Authority
	Global Environmental Facility (GEF)
	USAID – Forest Climate Change Programme
	UNDP
	FAO
	United Nations Environmental Programme
	World Bank
	African Development Bank
Zimbabwe	FAO
	Fire management/national forest programme/management of IAS
	Human and wildlife conflict
	GIZ
	National Vegetation Information System (VegRIS)
	Wood energy-saving cooking stoves, phase I
	UNDP/GEF Small Grants Support Programme
	Ecosystem conservation (Hwange-Sanyati Biological Corridor)
	Coping with drought (cultivation of small grain crops and cassava)

Summarized from the country reports in FAO, 2013

Forests and rangelands are vital for rural communities in southern Africa but they are under threat from climate change and other pressures. While many climate change efforts under way in the forest sector in southern Africa are focusing on mitigation, countries recognize the urgent need to also build resilience and facilitate adaptation in the sector.

Forests, rangelands and climate change in southern Africa investigates the implications of climate change for forests and rangelands in southern Africa, including their vulnerabilities and adaptation needs and options. Combined with an analysis of the economic and social roles of forests and rangelands and the drivers of change, this publication lays the foundation for stronger collaboration in this area among countries in southern Africa.

This publication is part of an initiative by FAO, with cooperation of the Southern African Development Community, on forests, rangelands and climate change adaptation in southern Africa. The initiative was launched at a workshop in Johannesburg, South Africa, in June 2013 to take stock of countries' current efforts in this area, identify country priorities and potential areas of cooperative work, and define the scope of a programme for climate change adaption in the region's forest and rangeland sectors.

This report, which was prepared for the workshop, will be a valuable resource for specialists, policy-makers, forest managers, students and members of the public who want to know more about the crucial task of adapting forests and rangelands to climate change in southern Africa.

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