

# 6 LAND USE IN SUB-SAHARAN AFRICA<sup>1</sup>

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*J.M. Maitima and D.J. Gumbo*

## Introduction

Sub-Saharan Africa (SSA) has abundant natural resources, which support economies, provide livelihoods for rural people, maintain vital ecological services and processes, and contribute a unique natural heritage to the global community.<sup>2</sup> Yet, over the years the natural resources and ecosystems have been modified through a broad array of land uses. While these vary from settlements, urban sprawls, grazing lands, and infrastructure developments (e.g., roads) none of these is as dominant as agriculture.<sup>3</sup> Agriculture as a land use in SSA varies by agro-ecological potential from the humid areas dominated by crop production to arid areas used for grazing. Land-use change in SSA is defined by the rate and amount of land converted into cultivation, grazing, and/or urban dwellings.<sup>4</sup>

Causes of land-use change are many and vary from place to place but are largely driven by the demand for more land to meet and improve food security, alleviate poverty, and also enhance the human and social welfare at household and community levels. This is not surprising as close to 61% of SSA's population is largely rural, poor and dependent on traditional agricultural

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<sup>2</sup> Ruth *et al.* (2005); Wolman (1993); Doos (2002).

<sup>3</sup> Doos (2002); Foley *et al.* (2005).

<sup>4</sup> Ruth *et al.* (2005); Wolman (1993); Lambin *et al.* (2003).

systems for survival.<sup>5</sup> As a consequence, many countries in the region have developed programmes to modernise agriculture in an effort to reduce poverty, improve food security and increase the capacity to generate foreign exchange earnings through the sale of agricultural products. As these development agendas are implemented, and people gain awareness on the need and the means of how to improve the economic status of their well being, through increased and better utilisation of the limited land resources, pressure on land is increasing more and more.<sup>6</sup>

The potential of the land to meet individual household needs and generate income at national level to keep the national economies growing faces many challenges, such as population growth, declining availability of land, the degradation of land resources and the changes in international trade markets.<sup>7</sup> In SSA, 61% of the population is classified as agriculturalist or people whose major occupation is cultivation of crops and or livestock rearing.<sup>8</sup> The distribution of people varies in habitats ranging from mountains, tropical forests, semi-arid areas, riparian forests, and swamps. The SSA total land area is 2455 million ha, of which 173 million ha are under annual cultivation or permanent crops – about one quarter of the potentially arable area. In the region as a whole, the arid and semi-arid agro-ecological zones encompass about 43% of the land area; the dry sub-humid zone is equivalent to 13% and the moist sub-humid and humid zones jointly account for 38%. In West Africa, 70% of the total population lives in the moist sub-humid and humid zones, whereas in East and Southern Africa only about half of the population lives in these areas.<sup>9</sup>

The nexus between global change and the land-use dynamics in Africa is characterised by the unprecedented population growth in most of African countries. Even with the backdrop of the HIV/AIDS pandemic population growth in Africa still remains high (Tables 6.1 and 6.2). The growth rates are some of the highest in the world and to feed and shelter the increasing population more land is being converted from indigenous

<sup>5</sup> Geist and Lambin (2002); Lambin *et al.* (2003).

<sup>6</sup> Ruth *et al.* (2005); Nathan (1989).

<sup>7</sup> Ibid.

<sup>8</sup> UNEP (2002).

<sup>9</sup> Ibid.

vegetation to croplands and settlements. This increase in cultivation has reduced biodiversity and vegetation cover, and has fragmented habitats to such an extent that some of SSA's unique resources have been lost.<sup>10</sup> The impacts have been greatest in the more arable humid regions where rainfall is more reliable and supports crop production. Reduction in vegetation cover on one hand reduces the potential to absorb carbon dioxide from the atmosphere resulting in higher concentrations of CO<sub>2</sub> in the atmosphere.<sup>11</sup>

*Table 6.1: Tanzania population census totals, 1967-2002*

Census year	Population (millions)	Percentage Intercensal Increase	Population Growth (%)
1967	12.3	42.3	3.3
1978	17.5	32.0	2.8
1988	23.1	49.8	2.9
2002	34.6		

Source: Tanzania Central Census Office (2003)

*Table 6.2: Uganda's population, 1948-2002*

Index	1948	1959	1969	1980	1991	2002
Population (millions)	5.0	6.5	9.5	12.6	16.7	24.7
Population increase (millions)		1.5	3.0	3.1	4.1	8.0
Ave. Annual increase		143,000	300,000	282,000	367,000	685,518
Population density (Persons/km <sup>2</sup> )	--	--	48	64	85	126

Source: Uganda Bureau of Statistics (2004)

<sup>10</sup> Nathan (1989); Lambin *et al* (2003).

<sup>11</sup> Mitchell and Hulme (1999); Schimel *et al.* (1996); Henderson-Sellers, Dickinson and Wilson (1988).

At a global scale, land-use change has been recognised as a major cause of the greenhouse effect.<sup>12</sup> On the other hand, vegetation loss is closely correlated with the high soil erosion rates that are now common descriptors of environment change in SSA. Other impacts of global change that have implications on

land use, particularly in Africa include increases in urbanisation, focus on market and export oriented agricultural production, globalisation of trade, and improvements in communication and levels of literacy among others.

This chapter summarises the status of land use in sub-Saharan Africa by giving highlights on the trends of change in each of the four major parts of the region (eastern, central, southern and western Africa). The chapter also discusses briefly how the changes are affecting livelihoods and national economies.

## **Patterns of land-use systems in sub-Saharan Africa**

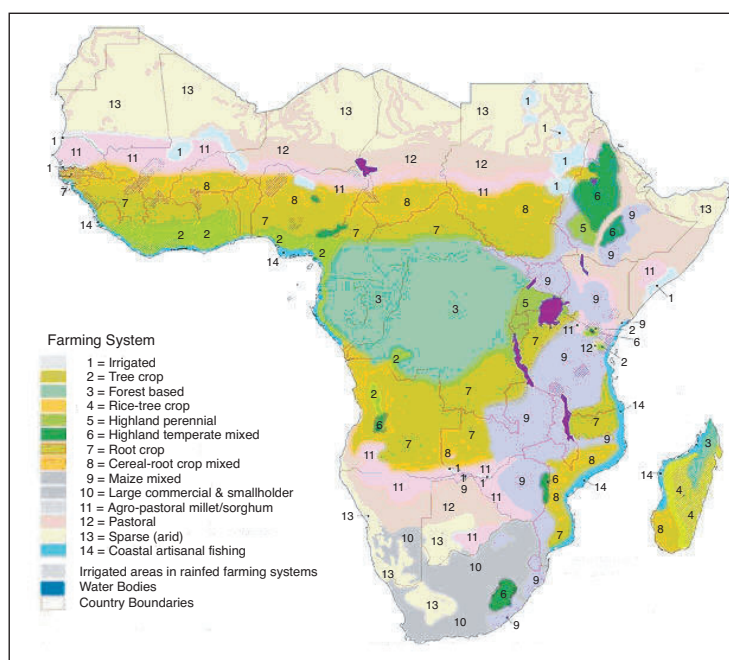
The patterns of land use in SSA vary by agro-ecological potential (Fig 6.1). Generally, there is intensive cultivation in the humid and sub-humid regions, where there is higher rainfall and fertile soils. In the semi-arid areas land use is characterised by livestock grazing systems and wildlife conservation. While cultivation is the dominant land use in humid and sub-humid areas, agro-pastoral land-use systems are on the increase in most of the semi-arid ecological zones due to the integration of cultivation and grazing.<sup>13</sup> These general patterns of production vary from region to region due to factors such as disease prevalence (e.g., trypanosomiasis and malaria) land tenure, infrastructure (e.g., roads), and markets.<sup>14</sup> Semi arid regions closer to major towns tend to be more integrated in livestock and cropping systems probably due to the influence of immigrants on land-use practices and food demands.

<sup>12</sup> Lambin *et al.* (2003).

<sup>13</sup> Nathan (1989); NEMA (2000); Olson *et al.* (2004); Foley *et al.* (2005).

<sup>14</sup> Reid and Swallow (1998); WHO/UNICEF (2000).

Figure 6.1: Major farming systems of sub-Saharan Africa



Adapted from FAOSTAT (2001).

The eastern African sub-region is characterised by two fragile ecosystems, namely: mountainous and hilly areas (predominantly in Burundi, Rwanda, Uganda, Kenya and Ethiopia); and semi-arid or arid (dryland) areas (predominantly in Ethiopia, Kenya and Somalia). The first ecosystem supports most of the sub-region's population (with densities of more than 200 people per km<sup>2</sup>), and are the centres of crop cultivation, for example, the highlands of Ethiopia (above 1,500 m asl) constitute about 45% of the total land area, and are inhabited by 80% of the population and by 75% of the country's livestock.<sup>15</sup> In Burundi, Rwanda, and Uganda, higher and more predictable rainfall facilitates relatively extensive cultivation (42%, 35% and 45% respectively).<sup>16</sup> The

<sup>15</sup> EPA/MEDC (1997).

<sup>16</sup> FAOSTAT (2001); FAO (2000).

dryland ecosystems, however, have low rainfall and are extremely vulnerable to drought and desertification. In these drier regions, the most prominent land use is livestock production that is more preferable and less risky, compared to cultivation.

Southern Africa has a total land area of 6.9 million km<sup>2</sup>, of which almost 33% is covered by forest, 21% is desert, and the remaining natural habitat is largely savannahs and grasslands. Rainfall in the sub-region ranges from 50mm yr<sup>-1</sup> in the arid deserts of Botswana, Namibia and South Africa, to more than 1,000mm yr<sup>-1</sup> in the equatorial forests of Angola, Malawi, Mozambique and northern Zambia.<sup>17</sup> In most areas, rainfall is largely seasonal, falling over a period of just a few months, often in the form of intense thunderstorms or showers. Where vegetation cover is reduced, this can lead to higher rates of soil erosion of up to 50 t ha<sup>-1</sup> yr<sup>-1</sup> in some countries like Malawi.<sup>18</sup> Most of the sub-region experiences high variability in rainfall, and frequent or prolonged periods of flooding and drought. Grazing lands currently cover 49% of the area, predominantly in savannahs and grasslands and, especially, in the drier countries where forest cover is lower.<sup>19</sup> Permanent crops and arable lands cover slightly less than 6% of the land area, and are predominantly rain-fed, except in South Africa, where irrigation potential is relatively well developed.

Central Africa is predominantly covered by forest and savannah.<sup>20</sup> The coastal humid belt, with high and relatively constant rainfall, supports dense tropical forests, whereas the northern parts of Cameroon, Central African Republic, and Chad are drier and experience variable rainfall, and the dominant vegetation is savannah. Land use in some parts of the sub-region is sensitive to climatic and vegetation characteristics, with forestry and commercial plantation agriculture largely found in the humid zones (where rainfall reaches up to 4,000mm yr<sup>-1</sup>), and livestock rearing, with some subsistence cultivation, in the semi-arid zones (where rainfall averages 500mm yr<sup>-1</sup>). The semi-arid zone is highly vulnerable to climatic variations and drought, which limit agricultural expansion. Soils are vulnerable to erosion, because most of the rainfall occurs in intense heavy storms, and because the clay and silt content makes the soils prone

<sup>17</sup> Chenje (2000).

<sup>18</sup> Erskine (1987).

<sup>19</sup> FAOSTAT (2001).

<sup>20</sup> Sayer and Campbell (2001).

to crusting when exposed.<sup>21</sup> Approximately 8% of the total area is under cultivation of permanent crops (with Cameroon having the largest share, at 15% of its land area), and 16.5% is used as permanent pasture.<sup>22</sup>

West Africa is a heterogeneous region with a dominantly rural economy centred on agriculture that traditionally is adapted closely to the dynamic biophysical environment. The status of the biophysical environment is, therefore, crucial to the agriculture, the economies and the general development process in West Africa.<sup>23</sup> Soils vary from nutrient-deficient coastal sands, plateau laterites and saline desert soils, through waterlogged coastal swampy soils, dry savannah and desert soils, including potentially rich loess, to fertile alluvium and humic forest soils. More of West Africa's population is concentrated in the rain forest zone, and in the adjoining swampy mangroves and sandy coconut-growing coastal areas, than in any other. This population feature relates to the forest resources, and to the fishing and export-import opportunities offered by the sea, thus making this zone crucially important for protection.<sup>24</sup> The most extensive ecosystem in the region is the Sahel, which extends northwards of the savannah zone on an elevated plain with isolated hills, to the southern fringes of the Sahara Desert. It receives 200-500 mm of highly unimodal rainfall, has hardy stunted trees, notably *Acacia sp.*, and short grasses, which form the basis of the essentially livestock economy. Beyond this zone, in the extreme north, lies the true desert.

Land cover and land use in western Africa are largely determined by climate, and a dramatic variation is seen from north to south in rainfall and vegetation cover. In the north, average annual rainfall is 350-850mm yr<sup>-1</sup> and savannahs are the dominant ecosystems along the southern border of the Sahel (Mali, Mauritania, Niger, and northern Senegal). Here, climate variability is greatest, and droughts are common, and often severe. Cultivation is limited, and the dominant agricultural activity is pastoral livestock rearing. For example, in Mali and Niger, cultivation represents just 4% of the land area.<sup>25</sup> By contrast,

<sup>21</sup> Njinyam (1998).

<sup>22</sup> FAOSTAT (2001).

<sup>23</sup> Gyasi *et al.* (1995).

<sup>24</sup> Ouedraogo and Toulmin (1999).

<sup>25</sup> FAOSTAT (2001).



permanent pasture accounts for 25% of the land area in Mali. In the equatorial and coastal zone, rainfall is higher ranging from 1,000 to 4,000 mm yr<sup>-1</sup>, and with greater inter-annual and intra-annual reliability and periodic flooding.<sup>26</sup> In 2000, forest covered almost 12% of the land area, was highly fragmented, and under increasing threat from charcoal production and collection of wood for fuel, commercial logging, plantation and slash-and-burn agriculture.<sup>27</sup>

Nearly 11% of the total area of western Africa is currently cultivated under rain-fed agriculture mostly occurring in the equatorial belt. Togo and Nigeria have the largest percentage of land under cultivation (42% and 33% respectively), followed by Côte d'Ivoire and Ghana (23% each).<sup>28</sup>

## Land use and land cover changes

Land-use change in SSA is characterised by two major processes: 1) land-use intensification within the highlands or humid areas and 2) expansion of cultivation into the rangelands and forests and woodlands.<sup>29</sup> Within the highlands minimal expansion of cultivation is observed around the mountain forest edges where there is still natural vegetation and conservation measures are not enforced. Land is scarce within the highlands due to high population.

In eastern Africa most of the occupants of the high potential areas are cultivators. One of the biggest problems with the high potential areas is the declining land-parcel size due to subdivision of land to the younger generations.<sup>30</sup> In this situation the only way people have been able to cope with increasing demand for more output from the land is by intensifying agricultural activities. This has resulted in the impoverishment of soils in the highlands, which have become more prone to degradation.<sup>31</sup>

In southern Africa there is a range of forest and woodland types that follow the rainfall distribution pattern of the sub-region. The wetter, more northern parts of the sub-region support more closed canopy forest, whilst drier countries in the

<sup>26</sup> Ibid.

<sup>27</sup> FAO (2001).

<sup>28</sup> FAOSTAT (2001).

<sup>29</sup> Lepers *et al.* (2005); Olson *et al.* (2004); Doos (2002).

<sup>30</sup> Olson *et al.* (2004).

<sup>31</sup> Maitima *et al.* (2004).



south and west have predominantly woodlands and savannahs. The total forest and woodland area of southern Africa amounts to 32.7% of the sub-region's total area, and constitutes 34% of all of Africa's forests.<sup>32</sup> Angola has the highest forest cover with 56% of the land area under forests; Lesotho has the lowest with less than 1%.<sup>33</sup> There are four forest and woodland types, namely deciduous broadleaf forests (temperate forest types), lower montane forest, mangroves, deciduous/semi-deciduous broadleaf forest, and savannahs (tropical forest types).

Southern Africa also has six regions of exceptional plant species diversity, and forest species are abundant in many of these.<sup>34</sup> Among these is the Cape Floral kingdom and the Miombo Ecoregion where 26 areas of biological significance were delineated by WWF.<sup>35</sup> Close to 70% of the population of this sub-region is employed in agriculture. This sector can be divided into two. Firstly, the small-scale farming with land holdings of less than 2 ha/household who may also be engaged in shifting cultivation, but generally practise low input agriculture. Increasing populations and demand for food have led to encroachment on woodlands and losses of up to 1.9% per annum have been experienced in some areas of Zambia.<sup>36</sup> The crops produced are mainly maize, pulses and millets. Lately, this group of farmers has started to move into cash cropping.

The second group of farmers are the commercial farmers that typically cultivate up 2,000 ha per farm under both rain-fed and irrigation. Located in parts of Zambia, Mozambique, South Africa, and to a lesser extent Zimbabwe these farmers grow crops such as maize, wheat, tobacco, tea, cashew nuts, sugar cane, coffee and cotton. In addition, the large-scale commercial farmers may also be involved in livestock rearing in the drier areas and of significance has been the extent to which these farmers have also added wildlife to their commercial ventures as well. Rural communities have also been actively engaged in sustainable wildlife utilisation in the sub-region and such initiatives have addressed some of the food security issues.

<sup>32</sup> FAO (2001).

<sup>33</sup> Ibid.

<sup>34</sup> White (1983).

<sup>35</sup> WWF-SARPO (2003).

<sup>36</sup> WWF-SARPO (2004).

Central Africa is home to one of the world's largest rain forests, and serves as one of the world's most important carbon sinks.<sup>37</sup> Deforestation is one of the most pressing environmental problems facing almost all sub-Saharan African nations but in central Africa it is the most common land-use change. The primary cause of deforestation is wood utilisation for domestic and commercial purposes. Many sub-Saharan countries have had over three quarters of their forest cover depleted, and it is estimated that if current trends continue, many areas, especially those in the Sudano-Sahelian belt, will experience a severe shortage of fuel wood by 2025.<sup>38</sup> Deforestation also has negative implications for the local environment (increased erosion and loss of biodiversity). The highest deforestation rates occur in areas with large growing populations such as the Eastern parts of the Democratic Republic of Congo (DRC) and the Sahel. Since 1957, two-thirds of Gabon's forests have been logged.<sup>39</sup> Large blocks of intact natural forest do remain, particularly in DRC, Gabon, and Congo. In DRC, which contains more than half this region's forest cover, many forests remain intact, partly because the nation's poor transportation system cannot easily handle timber and mineral exploitation.

In East Africa, expansion of cultivation has primarily targeted fertile lands where agricultural production can be sustained. These areas are mainly in the highland areas where human settlements have existed for many generations and the only areas remaining uncultivated are the protected areas. It is due to the scarcity of land in the highland areas that cultivations are now extending to the lowland areas that were previously used only by pastoralists and wildlife.<sup>40</sup> Unlike in the highlands, areas suitable for cultivation in the lowlands are scarce. The low rainfall and nutrient poor soils within the lowlands tend to limit cultivators mainly to areas where there is surface water like along rivers, and around swamps and lakes.

The intensification of agriculture and overuse of water for irrigation has increased pressure on already scarce resources resulting in the drying up of many swamps and wetlands.<sup>41</sup>

<sup>37</sup> Gyasi *et al* (1995).

<sup>38</sup> UNEP (2002).

<sup>39</sup> Allen and Barnes (1985); Achard *et al* (2002); Kevin and Schreiber (1994).

<sup>40</sup> Olson *et al* (2004).

<sup>41</sup> Campbell *et al.* (2003).

Pollution has also increased due to deposition of agro-chemicals into the water reservoirs accompanied by high biodiversity loss of indigenous plant and animal species.<sup>42</sup> Land-use change in these areas is a centre of controversy and source of conflict between cultivators and herders over the access to water and pastures.

## Drivers of land-use change

In many parts of Africa, population increase is the major driving force for land-use change.<sup>43</sup> The increase in population apparently translates into expansion of cultivation and settlement areas. Increased focus on commercial agricultural production is another driver of agricultural expansion. As people change from subsistence farming to the production of commodities for local and external markets, the need for larger farms increases in order to produce enough to sell for higher income.<sup>44</sup> Production of some commercial crops, for example cotton, requires cultivation of vast tracts of land in order to cover the costs of production and generate profits. Availability of new food crops that have better markets makes farmers cultivate more land to capture the new opportunities. Human local migrations from one agro-ecological zone to another contribute to the introduction of new crops and new farming techniques that in many cases cause expansion of cultivations.<sup>45</sup>

In many areas, land degradation has reduced productivity of the land leading to poor yields. In turn people cultivate more land in order to produce enough. Similarly, declining quality of pastures as a result of land degradation makes livestock and wildlife to graze on wider orbits thus demanding more land for grazing. This situation is experienced more within the rangelands where both cultivators and herders compete for land.<sup>46</sup> Income diversification at household level contributes to expansion of cultivation. Farmers have developed this strategy as a means of coping with climate variability and changes in market opportunities. In a number of studies, it has been observed that farmers who have diversified their crop types and

<sup>42</sup> Githaiga (2004); Maitima *et al* (2004); Maitima *et al* (2004).

<sup>43</sup> Allen and Barnes (1985); Lambin *et al* (2003).

<sup>44</sup> Oyejide (1993).

<sup>45</sup> Olson *et al* (2004); Maitima *et al* (2004).

<sup>46</sup> Maitima *et al* (2004).

have integrated livestock with cropping are richer and more food secure than those who have not.<sup>47</sup>

Charcoal making has become a major issue of concern and is certainly a driver of land-use change. It changes the vegetation structure of a given woodland area and in some cases will lead to woodland and biodiversity loss. Such an activity, if coupled with high population densities, will transform woodlands into a wasteland. It has been estimated that a minimum of 80% of the population of Africa uses fuel derived from biomass.<sup>48</sup>

Urbanisation is another cause for land-use change. Expanding urban and municipal centres have created markets for food commodities produced in the rural areas and thus the increase in demand in towns result into an increase in demand for supplies of food produced in the rural areas. It is estimated that by 2015 about 51% of human population will be urban (Table 6.3). There is, therefore, an urgent need for countries in SSA to develop measures to reduce dependence on charcoal as a source of energy especially with the urban centres.

*Table 6.3: Population and urbanisation trends in Kenya, Tanzania, and Uganda*

Country	1975		2002		2015	
	Population (millions)	% Urban	Population (millions)	% Urban	Population (millions)	% Urban
Kenya	13.6	12.9	31.5	38.2	40.0	51.8
Tanzania	16.2	10.1	36.3	34.4	45.9	46.8
Uganda	10.8	8.3	25.0	12.2	39.3	14.2

Source: The Human Development Report 2002 (UNDP 2002)

## Trends in Land-use Change

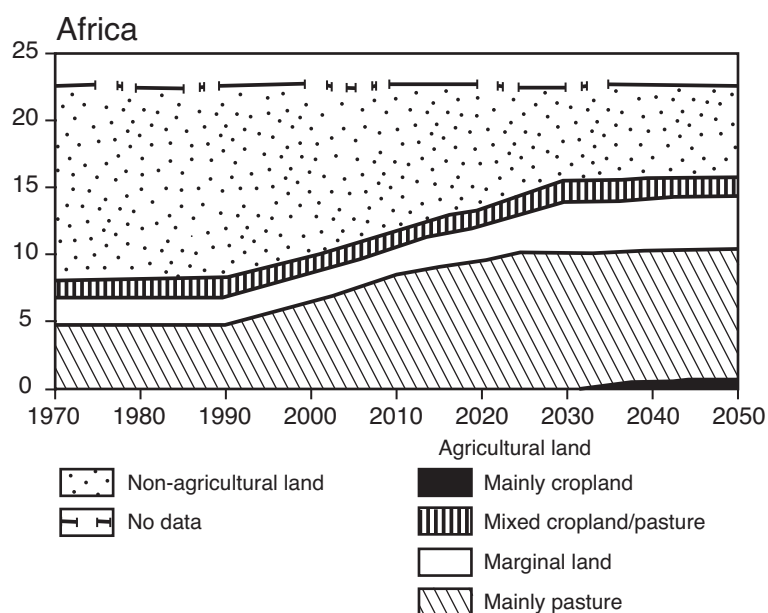
From 1990, agriculture in Africa has been expanding steadily with pastures and mixed cropland and pasture taking the highest proportion of land mainly within the marginal lands (Fig 6.2). Comparatively Africa has the highest rate of expansion and it is projected that the same rates will persist up to year 2030 and

<sup>47</sup> Olson *et al.* (2004).

<sup>48</sup> Kituyi (2002).

there after normalise. The rates of expansion, however, have not been uniform in all areas; areas affected by tsetse flies for example have either been left uncultivated due to constraints of trypanosomiasis on humans and livestock. These areas are, however, rapidly occupied and converted into agricultural lands as soon as the trypanosomiasis challenge is reduced. Figure 6.3 illustrates the rate of land-use change following tsetse flies control in Ethiopia.<sup>49</sup>

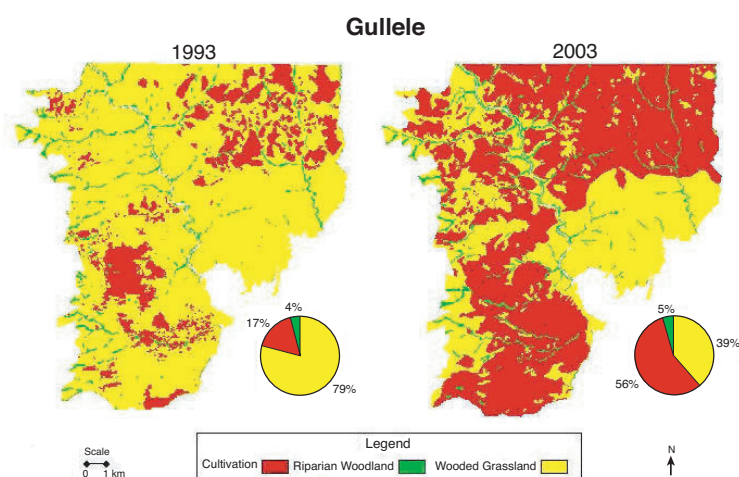
*Figure 6.2: Comparison of relative changes in agricultural expansion in Africa*



Source: UNEP (1997)

<sup>49</sup> Wilson (2004).

Figure 6.3: Land use change in Gullele Ethiopia from 1993 to 2003



Source: Wilson (2003).

On trends in land cover change, analysis of vegetation change across sub-Saharan Africa between the years 2000 and 2002 reveals an overall change of 8% of the total annual integrated vegetation index of the continent each year reflecting a change in photosynthetic activity each year.<sup>50</sup> Large portions of southern and eastern Africa experienced various forms of change within the three years, while typically lower in extent and magnitude areas of change were notable across much of the Sahel as well. These are associated with changes in seasonality in the timing and lengths of growing seasons.

The changes were largely distributed among savannah, forest transition, and semi arid regions with higher vegetation potential. The spatial distribution of changes across sub-Saharan Africa indicates more sustained increase in vegetation cover in eastern Africa and a more sustained decrease in southern Africa. Most changes in western and central Africa were ephemeral. More detailed trends of land-use change in each of the four sub-regions of SSA are discussed below.

<sup>50</sup> Linderman *et al.* (2005); Zhang *et al.* (2005).

## Eastern Africa

Land-use change analysis across East Africa has been done in great detail by the Land-use Change Impacts and Dynamics (LUCID) project team.<sup>51</sup> Results of this analysis indicate similar land-use patterns in many sites, characterised by increasing intensification. However, this pattern has occurred at different rates across the region. Conversion of areas with natural vegetation to farmlands is by far the most prominent as summarised below:

1. Expansion of cultivation into grazing areas, particularly in the semi-arid to sub-humid areas;
2. Increase in rain-fed and irrigated agriculture in wetlands or along streams especially in semi-arid areas;
3. Reduction in vegetation cover on land that is not protected; and,
4. Intensification of land use in areas already under crops in the more humid areas.

Based on research conducted in Kajiado District in Kenya, the largest change of land use was the conversion of grazing lands to rain-fed agriculture especially in sub-humid and semi-arid areas. Between 1887 and 1950, semi-arid and sub-humid areas were predominantly pastoral with substantial amounts of vegetation cover, scattered settlements and cultivation. From the 1950s to the present there has been much conversion of grazing land to croplands. This trend is seen in many areas with similar ecological settings across East Africa.<sup>52</sup> However, the rate of expansion appears to be slowing in many areas due to scarcity of land.

The establishment of group ranches in Kenya in the 1970s/1980s led to the emergence of private commercial ranch systems. Today however, the group ranches are being subdivided into individual units, with wider implications for land-use change, land tenure and household resource allocations.<sup>53</sup> These subdivisions are likely to affect many social institutions including the traditional Maasai pastoral system and the wildlife, that depend on availability of large grazing areas that allow both livestock and wildlife to access resources that are widely distributed in both time and space.<sup>54</sup>

<sup>51</sup> See [www.lucideastafrica.org](http://www.lucideastafrica.org), accessed November 2006; Olson *et al* (2004).

<sup>52</sup> Campbell *et al* (2003); Olson *et al* (2004).

<sup>53</sup> Lusenaka (1996); Olson *et al* (2004).

<sup>54</sup> Ntiati (2002).



In Uganda, studies around Lake Mburo, show that an elaborate pattern of development is associated with expansion of cultivated areas, settlements, woodlots, and declining land for fallow, grazing, forestry and wetland following a land restructuring policy and the government resettlement scheme.<sup>55</sup> In the recent years the amount of land under irrigation has grown rapidly within the sub-humid and semi-arid areas. In the Kilimanjaro region of Kenya, for example, irrigated land expanded from 245 to 4768 hectares between 1973 and 2000, and in the Kilimanjaro region of Tanzania from 336 to 4078 hectares during the same period.<sup>56</sup> The source of the water is usually rivers or swamps rather than being pumped from aquifers. Rice, flowers and vegetables are the main crops and there are destined for both national and export markets.<sup>57</sup>

Many woodlands and forests without enforced protected area status have been reduced in size and/or their vegetative cover has diminished. They have either been converted to pasture for grazing, to fields for rain-fed agriculture, or their woody plants have been extensively cut for charcoal production.<sup>58</sup>

In areas that were already cultivated in the 1950s, land-use changes have been less dramatic. They have been primarily an infiltration of cultivation into valleys, hills and other pieces of land that had not yet been cropped, changes in types of crops, fragmentation and shrinkage of farm sizes, and an increase in planted trees in densely populated areas. These changes are mainly associated with intensification of the existing farming system, reflecting an increase in the application of labour and, in most places, capital inputs on the land.

## Southern Africa

In Southern Africa, up to 70% of the population resides in the rural areas sustaining their food requirements through low-input subsistence agriculture. The extensive Miombo woodlands found in this sub-region is home to the region's biodiversity. These woodlands are a basis for livelihoods and provide everything from food resources to materials for use in the rural

<sup>55</sup> Tukarhirwa (2004).

<sup>56</sup> Campbell, Misana and Olson (2004).

<sup>57</sup> Campbell *et al* (2003); Campbell, Misana and Olson (2004).

<sup>58</sup> Mbonile, Misana S. and Sokoni (2003); Olson *et al.* (2004).

home. The woodlands are also habitats to a wide variety of large herbivores, e.g., the elephant, which in some cases have been placed in protected areas and to date most of the countries in the sub-region have close to 10% of national land under protection. These dominant woodlands are under pressure from land uses that extract resources, agricultural encroachment, fire, grazing, and other natural resources mismanagement approaches.<sup>59</sup>

Changes in land use and land cover in Miombo potentially affect a wide range of socio-economic and environmental processes. Land use in the Miombo woodlands include cultivation, extraction of fuel wood, harvesting of construction material, and non-timber forest products, which are diminishing the area available for communal grazing. Communal grazing has led to degradation in close to 50% of the sub-region's grazing areas.<sup>60</sup> Traditionally the moist savannahs of Southern Africa have been used for agriculture. The soils under Miombo woodlands are inherently infertile with limited productivity and as such, the slash and burn (*chitemene*) still dominates the central African Miombo. Where extensively practised, slash and burn can result in fires, rapid vegetation loss, and excessive siltation of the river systems and lakes. In addition, the practice of burning hardwoods for charcoal has reduced much of the productive and densely settled central Africa plateau of southern Africa to open secondary grassland. For example, charcoal burning is contributing to the sub-region's 0.5% yr<sup>-1</sup> of woodland and biodiversity loss.<sup>61</sup>

Conversion to permanently cropped land, in the absence of intensive soil management leads to reductions in soil organic matter, nutrient depletion, and soil erosion. As land is still available in many areas especially within the Miombo, shifting cultivation is often practiced especially in the early stages of agricultural development. Human activities are central to the current dynamics of Miombo ecosystems. The extensive and intensive use of the soils and vegetation by agrarian communities has undoubtedly shaped, and continues to shape, much of the present Miombo landscape.<sup>62</sup>

<sup>59</sup> Gumbo (2002).

<sup>60</sup> UNEP (1999).

<sup>61</sup> World Bank (2002).

<sup>62</sup> Much of the information on Miombo woodlands of Southern Africa can be obtained from the Miombo project report on <http://miombo.gecp.virginia.edu>.

The arid savannahs of southern Africa have supported pastoral communities for many years without excessive overgrazing until recently. High densities of grazers, mainly cattle, have largely replaced the mixed herbivore populations comprising browsers. The effect of overgrazing and under browsing, has led directly or indirectly to the transformation of several millions of hectares of formerly productive natural pastures to closed thickets. The process of bush encroachment has led to the pastoral industry changing from a major exporter to an importer of dairy products. The cost of bush clearing using selective herbicides in Namibia is currently higher than the land's market value.

## Western Africa

In West Africa the trends in land-use change are dominated by intensification of agriculture in the areas already settled. Population pressures are among the factors that have and will continue to contribute to substantial resource degradation in the coastal zones of Western Africa. Traditionally, opportunities for agriculture and employment in the more humid coastal areas have encouraged steady migrations from the Sudano-Sahelian area towards the coast. Much of the coastal rain forest has been cleared to make way for agricultural plantations and urban development and what remains is decreasing at an annual rate of between 2 and 5 %.<sup>63</sup> Fragile coastal ecosystems, such as the stretch of coast between Accra (Ghana) and the Niger Delta (Nigeria), are under further stress because of increasing demand for resources compounded by industrial and urban development and their associated pollution loads.

A major part of the problem of biodiversity conservation is located outside of the protected areas, in managed agro-ecosystems where population growth, commercialisation, land degradation and deforestation put severe pressures on sustainability. Farmers have managed these lands for long periods of time and traditional farming systems have frequently been able to respond successfully to the changing conditions, applying indigenously developed techniques and knowledge. This knowledge is, however, ignored more often than not by modern science and agricultural research.<sup>64</sup>

<sup>63</sup> World Bank (1996).

<sup>64</sup> Uitto (1995).

In many settlement areas farmers express repercussions of increased land degradation, which has led to reduced productivity of their farms. This has resulted into increased weeding, resulting from the invasion of savannah grasses (*Panicum maximum* and *Digitaria ciliaris*) and pan-tropical weeds (particularly *Chromolaena odorata*); declining yields; failure of particular crops, such as yams and plantain as a result of changing environmental conditions and unreliable rainfall. As a result of declining productivity, farmers also tend to match crop production with soil. When yields become marginal, long fallows are introduced, leaving the land to rest for some time. Soil analysis has revealed that most soils were in the range of 50% of their optimum pre-cultivation level.<sup>65</sup>

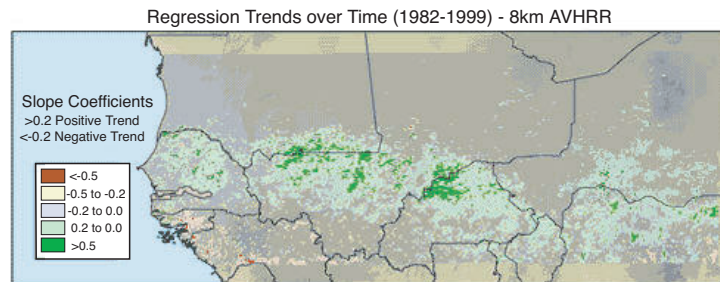
Highly detailed analysis of land cover changes on Land Sat and SPOT 5 images from some parts of the Sahel (Senegal, Mali and Burkina Faso) show an encouraging positive trend possibly indicating an increase in overall productivity in recent years (Fig 6.4). This observation is based on studies by USGS international programme at the national centre for EROS.<sup>66</sup> One of the more striking general observations was an area in northeast Burkina Faso where deposition of sand has formed 'fingers' of productive soils running parallel along an east-west tract. However, between these sandy depositions, lie bands of unproductive clay soils that allow very little vegetation growth. It is likely that changes in seasonality enabled the soils to retain more moisture, triggering a process of greening up depending on the type of soils. Patterns in vegetation green-up at small scales are largely associated with soil properties and vegetation types.<sup>67</sup>

<sup>65</sup> Amanor (1994); Tuffuor (1992).

<sup>66</sup> See <http://edcintl.cr.usgs.gov/landcover.html>.

<sup>67</sup> FAO (1995); Zhang *et al.* (2005).

Figure 6.4: Trends of increased productivity



Source: <http://edcintl.cr.usgs.gov/landcover.html> (accessed on 29 November 2006).

## Central Africa

Despite the favourable climatic conditions in central Africa, large-scale agricultural development is limited due to failures in markets and political instability in most of the region. Shifting cultivation (or slash-and-burn agriculture) has been traditional means of coping with rainfall variability, but this practice is no longer sustainable, because of much larger populations.<sup>68</sup> The priority issues in central Africa are, therefore: improving food security through enhanced production and distribution of resources; and, reducing the pressures that shifting cultivation has on forests and woodlands.<sup>69</sup>

Central Africa's biological resources are the backbone of the sub-region's economy and support millions of livelihoods. Timber extraction is growing rapidly and deforestation is a major concern for Central Africa. The tropical forest of Africa is 18% of the world total and covers over 20 million km<sup>2</sup> of land in West and Central Africa. This region has been facing deforestation with various degrees of intensity throughout this century. The actual pace of deforestation varies from one country to another and accurate data do not yet exist. Recent estimates indicate that the annual rate of deforestation in the region can vary from

<sup>68</sup> Ruth *et al.* (2005); UNEP (1997 and 1999).

<sup>69</sup> Southgate (1990).

15,000 hectares in Gabon to 290,000 ha in Cote d'Ivoire.<sup>70</sup> The damage caused to remaining forest areas by timber extraction is an additional concern for the sub-region.<sup>71</sup>

Irrigated agriculture is limited, partly because the fertile soils and the high reliable rainfall in the humid zone are conducive to rain-fed agriculture, and partly because the infrastructure development required for establishing irrigated cultivation in the semi-arid zone has so far been prohibitively expensive. One of the most important environmental impacts of uncontrolled urbanisation in Central Africa is its spread into fragile ecosystems, including delicate or highly erodible slopes, natural drainage waterways or valleys, and areas that are subject to flooding.<sup>72</sup> Due to the intense competition for space in urban areas, green spaces are rapidly disappearing and areas usually deemed unsuitable for housing are the only refuges available for the urban poor, who are then vulnerable to flooding, landslides, and outbreaks of pests and diseases. Although planning regulations are in place, they are poorly monitored and enforced.

### **Impact of land-use changes on land degradation, biodiversity loss and sustainable resource management**

All across SSA increasing population pressures have led to increases in cultivation and grazing intensity. This has led to massive deforestation and conversion of natural habitats to farmlands and settlements with implications on biodiversity and land degradation.<sup>73</sup> Deforestation is a pressing environmental problem faced by many sub-Saharan African nations, with many of these countries having over three quarters of their forest cover depleted.. The highest deforestation rates occur around large growing populations such as the East African Highlands and the Sahel.<sup>74</sup> Deforestation also leads to increased soil erosion and loss of biodiversity.

<sup>70</sup> FAO (1988).

<sup>71</sup> Tomberline and Buongiorno (2001).

<sup>72</sup> UNEP (2002).

<sup>73</sup> Olson *et al.* (2004); Maitima *et al.* (2004).

<sup>74</sup> Allen and Barnes (1985); FAO (2001); Tomberline and Buongiorno (2001); Achard *et al.* (2002); Geist and Lambin (2002).

Land productivity is reduced in intensively cultivated areas due to declining soil fertility.<sup>75</sup> Extension of cultivation into the areas where land is still available is a response by farmers to replace the loss in production brought about by impoverished soils under continuous cultivation. The outcome of this adaptive response especially among the small-scale farmers is the increasing land subdivision trend, slowly reducing available land from extensive to intensively managed land-use systems.

The LUCID project in east Africa made important findings based on a regional study to identify the linkages between land-use change and land degradation.<sup>76</sup> One of the important findings was the effect which expanding farming, grazing and settlements had on biodiversity. The expansion of these areas has been to the expense of native vegetation and thus indigenous plant and animal biodiversity. Generally large mammals are lost as cultivation expands, but it was found that in some cases there are more species of birds, small mammals and plants in places where people used land in a moderate fashion. Moderate farming in less forested areas is found to increase tree cover thus increasing the diversity of bird species. Land under pastoral production system maintains native plant and animal species more effectively than land under crop cultivation. Furthermore, the study indicates that farmers growing many crops conserve native plant species better than those who grow only one crop. Increasing crop diversity is also one way farmers are coping with land degradation. Expanding croplands leads to decreased soil fertility, decreased soil moisture and increased soil erosion.

Farmers are responding to declining land productivity by the use of livestock manures and the application of crop vegetative residues. Other effects of expanding cultivation in East Africa are water availability and land fragmentation. As farming and settlement expands into water catchment areas, less water is available for people, livestock and wildlife as more water is diverted to irrigation for crops. Land in East Africa is heavily fragmented into small parcels in the highlands, while dry extensive rangelands are now in the process of being fragmented.

<sup>75</sup> Southgate (1990).

<sup>76</sup> Maitima *et al.* (2004).



## Impacts of land use on agricultural production and livelihoods

Agricultural production has been practiced in sub Saharan Africa for many generations.<sup>77</sup> The most common mode of agricultural production is subsistence farming, but due to several advances in strategic focus among many countries there are rapid changes towards a market-based agricultural economy among the small and large-scale farming production systems. However, availability of land is critical for the successful commercialisation of agriculture in SSA. Changes in land use have resulted in land fragmentation, over-cultivation, and reduced fallow periods leading to decline in land productivity and ultimately in intensification of agriculture requiring more farm inputs. The extent and quality of grazing lands have also been reduced, thus intensifying conflict between the cultivators and the herders and even overgrazing by herders and agro-pastoralists due to continuous grazing without rest from grazing or rotation grazing plan. In Kenya, for example, over 50% of grazing lands are badly eroded due to overgrazing in rangelands. In Somalia extensive additional areas have become desert or semi-desert within the past century.<sup>78</sup> Somalia, except for some river valleys and the moist southern-most region, is likely to be transformed into desert-like condition within a few decades unless there are radical changes in land-use practices within a few decades.

In southern Africa, the carrying capacity in grazing lands is diminishing due to deterioration of grazing lands.<sup>79</sup> A study of grassland conditions in 9 countries of southern Africa reports that cattle numbers exceed carrying capacity in each country by 50-100%. Invasion by woody plants from over-grazing has rendered 30,000 km<sup>2</sup> useless for cattle. An additional 140,000 km<sup>2</sup> of savannah is rapidly losing its ability to support livestock as scrubby brush spreads across the land.<sup>80</sup> In Central Africa, Rwanda's 3 million cattle have badly eroded hillsides and have accelerated the damage to soil productivity threatening the national economy, which is almost entirely based on agriculture and livestock.

<sup>77</sup> Bourn *et al.* (2005).

<sup>78</sup> UNEP (2002).

<sup>79</sup> UNEP (2000).

<sup>80</sup> UNEP (2002).

Despite the land-use changes reported in this chapter, and which reflect coping strategies by people in SSA, improvements on livelihoods have been minimal. Poverty has been on the increase in many sub-Saharan countries, and availability of food has been declining. During the past 30 years the number of undernourished people in the region has increased substantially, to an estimated 180 million people. The region has a higher proportion of people living in poverty today than any other region of the world. Across the whole region, rural poverty still accounts for 90% of total poverty and approximately 80% of the poor still depend on agriculture or farm labour for their livelihood.<sup>81</sup>

## Conclusion

Environmental conservation is both an international and national concern. Every effort must be made at both levels to safeguard the natural resources upon which life depends. Human activities must operate within a framework of sustainable development. National and regional policies to foster sustainable land management must be put in place and be enforced to guide agricultural and urban developments. Adequate and informative tools and frameworks must be developed to monitor changes in land cover, biodiversity and land use in order to assess and inform decisions at policy and management levels. There is a need to create awareness among the local populations on the individual and collective benefits associated with environmental conservation as well as build capacity within the countries in the region on how to embrace sustainable land management practices that lead to the conservation of natural resources for economic development.

In SSA, abundance of natural resources provides the basis for pro-poor agricultural development approaches provided the appropriate incentives are created by adjusting the national development frameworks, national policies, and reorientation of public and private institutions for effective and efficient service delivery mechanism. Household strategies for escape poverty, in order of importance, include diversification; intensification; increase in farm size; exit from agriculture; and, increase in off-farm income.

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<sup>81</sup> Ibid.

In order to halve hunger and poverty by the year 2015, massive efforts are required to stimulate such pro-poor growth targets, which ultimately depend on the initiative and effort of individual farm families within each farming system. Although it is impossible to prescribe specific national land-use change actions, the overall challenge is to ensure that land-use change contributes positively in the fight against hunger and poverty by responding to five strategic, inter-linked, initiatives namely: sustainable resource management; improved access to agricultural resources; building of capacity of small-scale farmers to increase competitiveness; and, reduction of household vulnerability by enhancing land productivity.

In most of Sub-Saharan Africa the scope for further expansion of cropland has drastically narrowed. On average, per capita arable land actually cultivated declined from 0.5 ha person<sup>-1</sup> in 1965 to slightly less than 0.3 ha person<sup>-1</sup> in 1990.<sup>82</sup> Slow technological innovation because of ineffective agricultural research and extension systems is only part of the reason; the poor transport infrastructure throughout most of SSA; inappropriate agricultural marketing and pricing as well as dismal and exchange rate policies; and poorly conceived and implemented agricultural projects, have contributed to the persistence of rural poverty.

Without these considerations the relationships between environment and land productivity will remain that of a spiralling task and worsening conditions as endless efforts are made to eradicate poverty in Sub-Saharan Africa.

<sup>82</sup> FAOSTAT (2001).