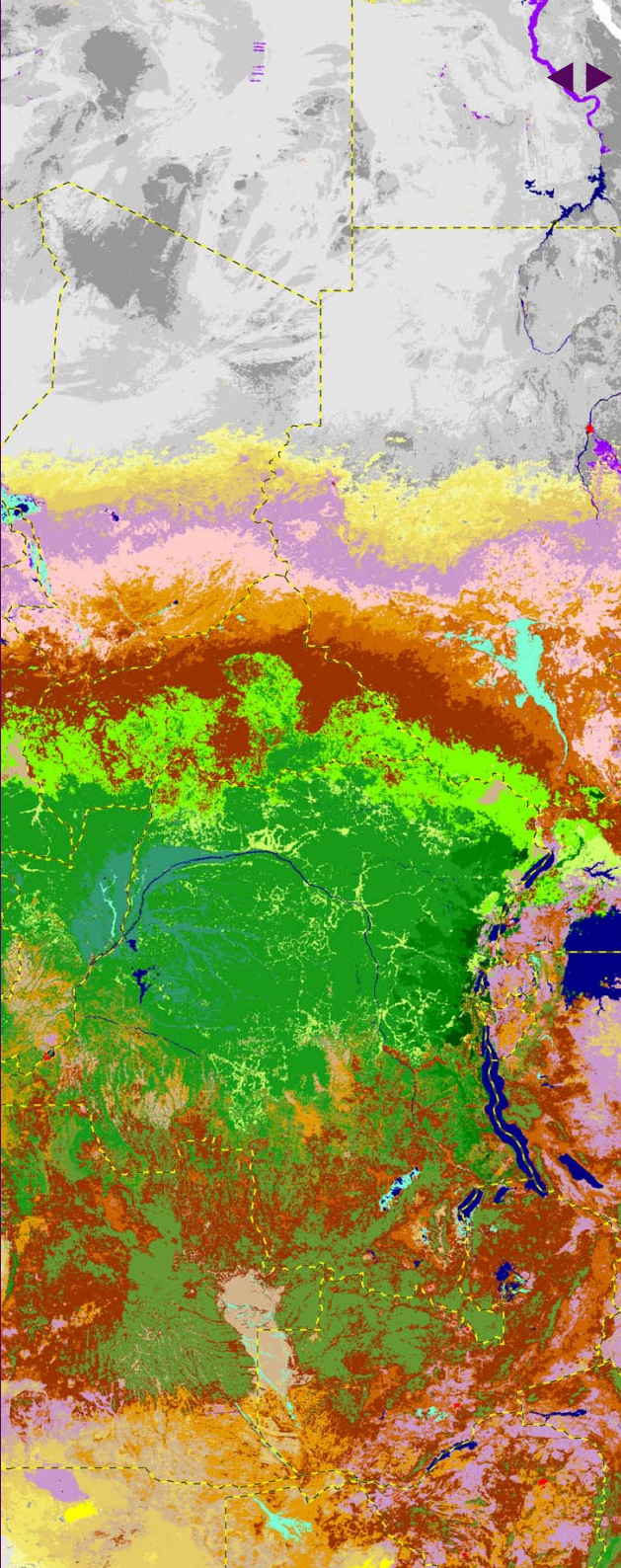


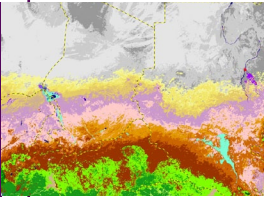


CHAPTER 3: AFRICA'S TROPICAL FOREST CARBON

- The forests of tropical Africa
- The state of tropical Africa's forest carbon
- Causes and drivers of deforestation and degradation

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CHAPTER 3: AFRICA'S TROPICAL FOREST CARBON

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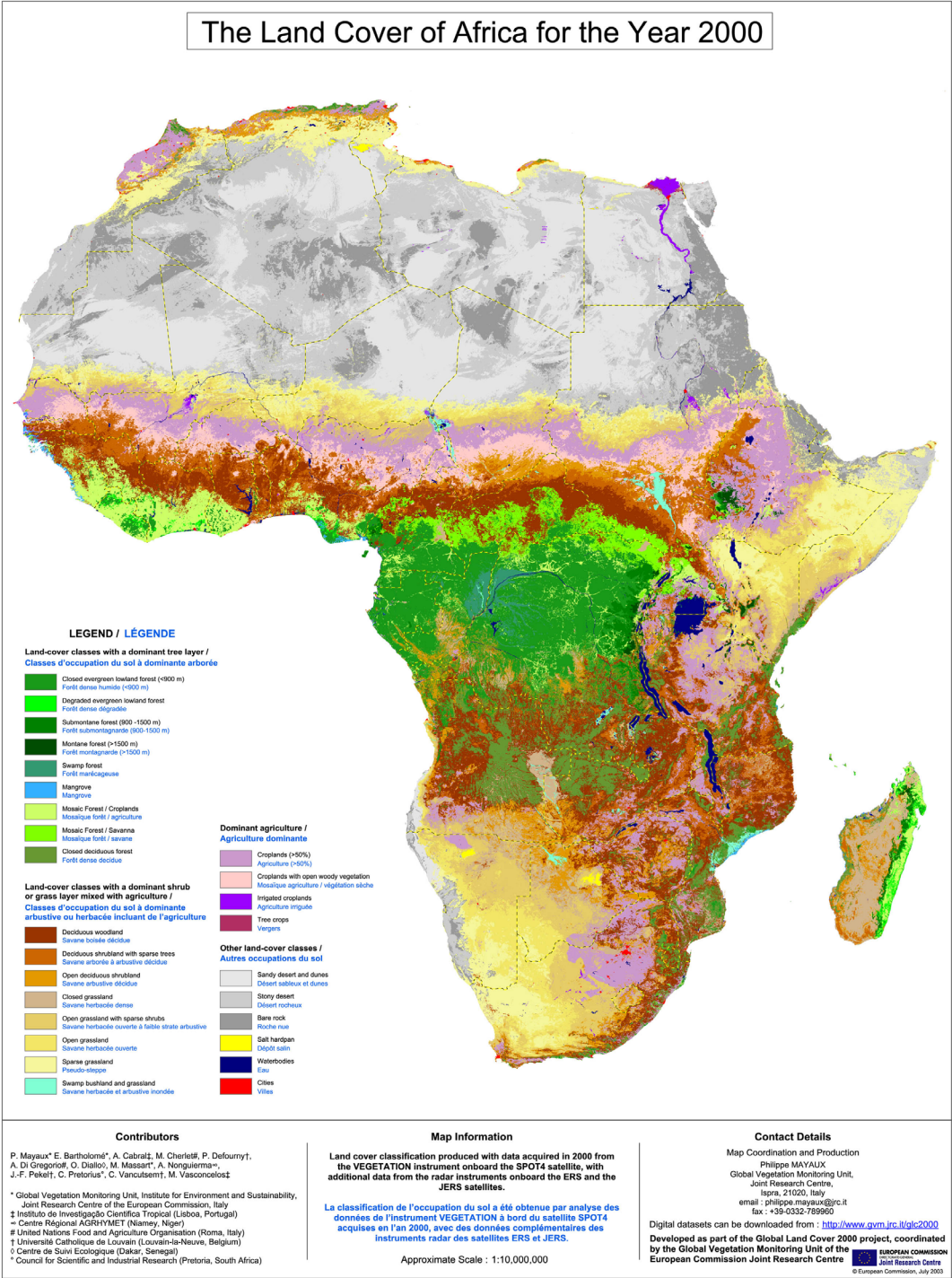
Chapter summary

This chapter introduces readers to the state of Africa's tropical forests: their extent and composition; how much carbon they store and how fast they are disappearing; and finally a brief overview of the causes and drivers of deforestation, which the report explores in depth over the next five chapters.



Figure 1: Land cover in tropical Africa

(see Figure 1 – [click here](#))



Courtesy of MAYAUX, P., BARTHOLOMÉ, E., FRITZ, S., and BELWARD, A., 2004, A new land-cover map of Africa for the year 2000, *Journal of Biogeography* 31 (6), 861–877



1. Introduction – the forests of tropical Africa

The forests of tropical Africa span the continent, covering more than half a billion hectares. Africa's tropical forests change in shape and composition as one moves over the continent, reflecting the huge variety of climatic conditions (see Figure 1). At the heart of Africa lies the Congo Basin, which contains the second largest tropical rainforest in the world. Tropical rainforests also stretch out from the Congo along the West African coast all the way to Guinea.

On the other side of the continent, the East African Coastal Forests line the coast from Somalia down to Mozambique. Further inland, the more seasonal and drier climates give way to the more open types of forest: the acacia, mopane and miombo woodlands fill out East and Southern Africa, spreading in a broad arc that runs from Angola on the south-west coast, around the Congo Basin and up through Tanzania and Kenya to Ethiopia. Mountain forests dot the East African landscape, like islands of exceptional biodiversity in a sea of open woodland and savannah.

Africa's forests are invaluable natural resources. They are very rich in biodiversity – there are three internationally recognised biodiversity hotspots in forests across the continent.¹ They are also vital sources of water for drinking and agriculture. The Congo Basin generates rainfall across the continent, and perhaps beyond,² while the mountain forests in East Africa fill Lake Victoria, the source of the Nile, and provide water to major cities like Dar es Salaam, Nairobi and Kampala. Africa's forests also provide millions of people with timber, energy, food, and a source of livelihoods.

1.1 Forest history

Humans have been living in Africa's tropical forests for millennia. Forests can be very harsh environments, and over time humans have developed innovative ways of utilising and altering the forest to make it more habitable. They are a source of food, medicines, fibre

and tools, and places of religious significance. They are also vital to traditional 'slash and burn' agriculture, a form of subsistence farming in which patches of forest are cleared and burnt to create a fertile soil for crops, and then left fallow to regenerate, with farmers moving on to clear a new patch. Deforestation and forest degradation have gone on within Africa's forests throughout.^{3,4}

Since the days of the Arab and then European slave trade, timber and other forest products have been extracted, often for export. In the 19th century, the 'scramble for Africa' by the European powers intensified the utilisation of forests.^{5,6} By the late 19th century, prospecting European geologists began to explore the rich mineral deposits underneath tropical African forests. The start of the petroleum age in the early 20th century accelerated extraction activities. The 19th century also saw the conversion of forests to cocoa, tea and coffee plantations, driven by European demand, a process that accelerated in the 20th century. At the beginning of the 21st century, growing demand from emerging economies in Asia and South America, and from oil-rich states in the Middle East, has also begun to influence the future of Africa's tropical forests.

The start of the conservation era in the early decades of the 20th century was initially driven by the need to ensure game for hunting by Europeans. Many protected areas in the region are still called 'hunting reserves'. There are parallels here with Europe in the early medieval period, for example, the setting aside of the New Forest in England as a hunting preserve by William the Conqueror. Since 1945, as on other continents, the emphasis has shifted toward the conservation of forests as national heritage assets, and for biodiversity conservation and tourism. Many of Africa's national parks were created in the years leading up to independence.



These different phases of utilisation or protection of forests have successively added activities, rather than one land use replacing another. The result is that forestry, agriculture, mining, oil and gas extraction, and conservation can be found side by side, both outside and within many forests.

Africa's human population grew rapidly during the latter part of the 20th century, and is set to grow significantly greater in the period to 2050. The impacts of that growth can be seen in many parts of the region, especially woodfuel removals for fuelwood and charcoal, often destined for use in Africa's rapidly expanding cities. Demographic trends and occupation of forests have also been influenced by wars and civil instability across much of the region over the last half century, in the DRC, for example, during the Mobutu years, and since.⁷

In parallel with their political and economic history, western notions of development and sustainability began to impact on forests in the post-1945 era, initially through financing from international institutions that expanded the scale and scope of the forestry and agriculture sectors in the 1960s and 1970s (including, for example, Unilever's rubber plantations in the DRC). Since then many multilateral and bilateral donors have focused on improving the rights and livelihoods of forest communities, often by supporting initiatives to stimulate small-scale forest enterprises rather than larger-scale commercial logging.

Since 2000, concerns over the deterioration of ecosystems (driven by the landmark *Millennium Ecosystem Assessment*⁸ and other studies) have added a new dimension to forest protection in tropical Africa, over and above biodiversity and carbon conservation. One consequence has been the development of attempts to regulate demands on forests through *sustainable* practices – from Forest Stewardship Council (FSC) certification of Sustainable Forest Management practices, to conservation agriculture and agroforestry.

More recently, ecosystem protection has also focused on 'ecosystem services' and the need to protect them, such as the provision of freshwater.

In terms of the near future, the new threats to Africa's forests are a function of the rise in global demand for agricultural commodities and biofuels, threats that have already had a devastating impact in parts of the Amazon and South-East Asia.⁹

1.2 West Africa

West Africa's vegetation changes gradually from rainforests along the coast, to desert in the interior. The Guinean rainforests once formed a thick, continuous band of forest that ran from Guinea to Cameroon, but have now been fragmented by logging, agriculture and urbanisation. Roughly 40 per cent of the rest is found in just one country, Liberia.¹⁰ These rainforests are together recognised internationally as a biodiversity hotspot.¹ Despite covering a relatively small area of tropical Africa, the Guinean forests are home to a quarter of the entire continent's mammal species, including 20 species of primate.¹ Moving north and inland, the climate becomes drier and the forests are more open, until they merge into the scrub of the Sahel, and finally the Sahara desert.¹⁰

Only 15 per cent of the Guinean rainforests remain, with less than 20 per cent of them within strict protected areas.¹ Europeans colonised West Africa early, and the long-term exploitation of resources such as timber and minerals has taken its toll. Cash crops have also replaced vast areas of forest. Ivory Coast and Ghana are the first and second biggest producers of cocoa in the world. Cocoa farms cover between 5 and 6 million hectares of land in West Africa, much of which was forested.^{10, 11} In an attempt to reduce the impact of cocoa farming on forests, some organisations have encouraged farmers to grow 'shade grown' cocoa, which means leaving the canopy-bearing trees intact and growing cocoa beneath them.¹¹



The West African coast also contains one of the largest mangrove forests in the world, in Nigeria. These forests share the region with high levels of population, and heavy development driven by the oil industry has caused widespread damage. Forty per cent of Nigeria's mangroves are thought to have been lost before 1980.¹⁰

West Africa's forests could provide vital environmental services, by encouraging rainfall, cooling local air temperatures and halting the growth of the Sahara desert from the north. The loss of these services could have serious economic consequences for these countries. Some research in Ghana suggests that if that country were to lose all of its forests, the knock-on effect of rising temperatures – up to 6°C on the coast – could have a serious impact on agricultural productivity in the rest of the country.¹²

1.3 Central Africa

Central Africa is dominated by the immense rainforest of the Congo Basin. Around the perimeter of the Congo, the forest merges into woodlands and savannah. Over 40 million hectares of forest across the six Central African countries – Cameroon, Central African Republic, Democratic Republic of Congo, Equatorial Guinea, Gabon, and Republic of Congo – have been officially allocated to timber companies. A further 90 million could potentially be allocated to them in the future. Mining concessions also cover vast areas of land.¹³

Protected areas are extensive, covering over 30 million hectares of forest. Regional cooperation has led to very large cross-border conservation areas being established, which link up protected areas between Cameroon, CAR, Gabon, and Republic of Congo. Commercial agriculture is perhaps a less important cause of deforestation here than in West and East Africa, although slash and burn farming is very prominent.

The giant Democratic Republic of Congo contains most of the Congo Basin rainforests, and about half of Africa's tropical rainforest in total.

It is the largest reservoir of forest carbon in Africa, and the second largest in the tropics, behind Brazil.¹⁴ Protected areas covered over 10 per cent of the DRC's territory in 2007;¹⁵ this may seem small, but it amounts to almost 25 million hectares – roughly the size of the UK, or the US state of Wyoming. The DRC is extraordinarily rich in mineral resources; between 500,000 and 2 million people work as artisanal miners in the DRC, digging in the soil with rudimentary equipment, by far the greatest number for any country in Africa.¹⁶

1.4 East Africa

East Africa's forests are dominated by miombo and acacia woodlands, which form a mosaic landscape with savannah. Miombo and acacia woodlands are much more open than the dense rainforests of the Congo Basin and coastal West Africa. The Coastal Forests that stretch from Mozambique to Somalia are very high in biodiversity, but much of them have been lost. The forests that cover the mountain ranges on either side of the East African Rift Valley, which runs from Ethiopia through Kenya, Uganda and Tanzania to Mozambique, are also biodiversity hotspots.¹ These mountain forests also provide freshwater, feeding rivers that flow to major cities, like Dar es Salaam and Nairobi, and vast water catchments like Lake Victoria, which is the source of the White Nile.

Wildlife tourism is a big industry and a major foreign exchange earner for some of these countries. Protected areas supporting tourism – national parks and game reserves – appear to be in relatively good condition, but many are comprised more of savannah than forest, though this landscape can still be a significant store of carbon. Commercial agriculture is well established in some places.



The mountain forests of East Africa, such as those on Mount Rwenzori in western Uganda, are incredibly rich in endemic species.

©iStockphoto/Guenter Guni



Only 6 per cent of Kenya is covered in forest, much of it concentrated in the mountains in the south-east corner. Kenya's population is also concentrated in this part of the country, and thus the forests are under pressure from woodfuel harvesting, logging and agriculture. Kenya is Africa's biggest exporter of black tea, which grows well in mountain areas.¹⁰ The success of tea in Kenya has therefore come at the cost of some montane forests, although some companies, such as Unilever, are trying to improve sustainability standards.¹⁷ Of particular concern to Kenyans is the clearing of montane forests in water catchments by settlers.¹⁸

Over 90 per cent of forest in Tanzania is miombo woodland. It has little economic value from the perspective of government, and as such it has not been managed. The government is trying to change this, with large support from NGOs and international donors, by scaling up community forestry across the country's entire forest estate. As such, Tanzania has the most developed community forestry legislation in Africa.¹⁹ About 4.1 million hectares of Tanzania's forests (the size of Switzerland) are under some form of village ownership or management.²⁰

Uganda is a small country (relatively speaking – it is almost as big as the UK, but a quarter of Tanzania, and a tenth of the DRC) with a high population density that is rapidly growing.²¹ Almost all Ugandans rely on woodfuels as their primary source of energy.¹⁰ These pressures place considerable strain on the land and forests. Eighty per cent of soil is considered to be severely degraded by inefficient agricultural practices and overgrazing, and Uganda loses 2.2 per cent of its forests every year, one of the highest rates of decline in Africa.^{10, 22}

1.5 Southern tropical Africa

Forests in Southern tropical Africa face a different mix of threats, though there are some similar themes. The land between the Congo Basin and the Tropic of Capricorn is dominated by dry, open woodlands of miombo and mopane, and savannah grasslands. The carbon intensity of these forests is much lower than those to the north, and the reduced rainfall means they grow more slowly, and

take longer to regenerate from being cleared for agriculture, or cut for woodfuels – both of which are serious threats. Protected areas are extensive in some countries: they cover 30 per cent of Botswana, 41 per cent of Zambia and 15 per cent of Zimbabwe. But many cover savannah rather than forest.¹⁰

Deforestation rates in Southern Africa are some of the highest in the tropical region: Zambia, Zimbabwe, Angola, and Botswana, respectively, are in the top 10 countries with the most annual forest loss between 2000 and 2005.²² Overgrazing and uncontrolled logging are significant causes of deforestation. Agriculture is dominated by subsistence practices, though there are some instances of significant commercial farming: tobacco is a major crop in the region, and one study found that tobacco farming, which involves consuming large volumes of fuelwood to cure tobacco leaves, is a cause of 20 per cent of deforestation in Malawi.²³

Zambia is losing its forests faster than almost anywhere else in Africa. The FAO estimates suggest that Zambia lost an estimated 445,000 hectares of forest every year between 2000 and 2005, second only to Sudan in FAO statistics (589,000 hectares a year).²² More recent estimates from the UN-REDD programme put the figure at 250,000–300,000 hectares a year.²⁴ This is despite 41 per cent of the country being classified as within protected areas.¹⁰

Angola has the second largest land carbon stocks in Africa, but it usually seems to get overlooked in tropical forest conservation strategies. One obvious reason for this is that the country is still recovering from a civil war that only ended in 2003. The conflict deterred foreign investors and NGOs alike, but as the recovery continues, conditions are improving for both groups to re-enter the country. Foreign governments and companies have expressed interest in helping return Angola to its former status as a net food exporter, and potentially a major biofuels producer.^{25, 26} NGOs are needed on the ground to ensure this does not come at the cost of losing large areas of forest.



The climate in Eastern and Southern Africa is more seasonal and drier than that of the Congo Basin, and more open and slower growing woodlands, such as this miombo woodland in Eastern Tanzania, dominate the landscape.

*Courtesy of Anne-Marie Gregory/
Mpingo Conservation and
Development Initiative (MCDI)*



2. The state of tropical Africa's forest carbon

Africa's tropical forests are an important store of carbon, as we demonstrated in **Chapter 1**. The amount of carbon stored in Africa's tropical forests is second only to South America. Africa's forests are being lost at around three times the world average.²² Poor protection, good conditions for agriculture, and growing demand for woodfuels, timber and minerals mean that much of Africa's tropical forest carbon faces a high risk of being emitted.

At the regional and national levels, we seem to know a fair amount about the state of Africa's tropical forest carbon. Estimates for the amount of forest carbon stored in tropical African countries, annual rates of deforestation across the continent, and carbon emissions from deforestation are all available in the literature, as we elaborate below.

The state of knowledge on what is happening to forest carbon at the ground level appears to be very poor, especially for Africa. At the beginning of this research project, FPAN encountered a dearth of carbon data in a number of essential areas, including:

- the amount of carbon stored per hectare in different forest types in Africa;
- the impact of particular activities (eg, selective logging) on forest carbon; and
- the impact of certain interventions (eg, community forestry) on forest carbon.

In response, FPAN commissioned **ProForest**, a UK-based company specialising in natural resource management and practical approaches to sustainability, to conduct a review of primary data on forest carbon in tropical Africa cited in peer-reviewed journals. The findings of this research are startling, as outlined below (see the full report, *Terrestrial carbon: emissions, sequestration and storage in tropical Africa: a Review of the scientific literature and existing carbon projects* in **Annex 1**).

2.1 Ground-level forest carbon data

ProForest found that primary data on the amount of carbon stored per hectare in forests, grasslands, other ecosystems and agricultural land in tropical Africa is very scarce. **ProForest's** literature review recovered only 32 data points (values) for total land carbon stored per hectare across all categories of land cover surveyed.ⁱ **This is less than 1 data point per country.** For forests, a total of only 14 data points were found, from just 5 publications, for total carbon in intact rainforest; only 5 were found for intact dry forests (like miombo or acacia woodlands).ⁱⁱ For comparison, in the UK, national estimates of woodland cover and condition (which are used for carbon stock calculations) are based on over 15,000 1-hectare plots of woodland across England, Scotland and Wales, and on a vegetation classification scheme that itself is built on over 35,000 vegetation samples.

The picture is much the same for data on carbon sequestration – how much carbon a hectare of forest (or other terrestrial ecosystem) draws out of the atmosphere in a year. The literature review found only 96 data points for rates of carbon sequestration across all land cover types surveyed. About half were for agricultural land, and a third for plantations; only 5 were for natural forests, **less than 1 study for every 6 countries.** Empirical data on how much carbon is being sequestered by Africa's tropical forests every year rests upon as few as 5 values.

Given the central place that forests are granted in global climate change mitigation strategies, and the large sums of money that governments, multilateral institutions and forest carbon businesses are prepared to put on the table to protect them (see **Chapter 1**), the existence of such fundamental holes in our knowledge is a serious concern.

ⁱ Data points for 'total land carbon' include carbon stored both belowground (soil) and aboveground (vegetation). Much research counts only one or the other, rather than both.

ⁱⁱ Other categories of land cover include 'degraded dry forest' (2 data points), 'degraded rainforest' (only 1 data point), 'wet plantation' (in a rainforest area – 0 data points), and 'drylands, grasslands and shrubland' (2 data points). See the **ProForest Annex** for more.



2.2 Macro-level forest carbon data

Data on forest carbon dynamics at the national and regional levels appears to be much more available, if subject to large error margins. Here we provide a summary of the major points.

2.2.1 Forest cover

The total forest area in the countries that we include within the scope of 'tropical Africa' in this report is estimated at **575 million hectares** by the FAO (see Table 1).ⁱⁱⁱ This is a third larger than the combined land area of the 27 members of the EU. At the regional level, Central Africa contains the most forest, with 223 million hectares (40 per cent of the total). Almost 25 per cent of Africa's

tropical forest is within just one country – the Democratic Republic of Congo. However, the other 4 countries that make up the top 5 tropical African countries in terms of total forest area are in fact outside of the Congo Basin: Sudan, Angola, Zambia and Tanzania, respectively. This highlights the importance of considering forests beyond the Congo Basin, which often receives the lion's share of attention in regional REDD strategies.

ⁱⁱⁱ Readers may notice a discrepancy between the figure for forest cover cited here (575 million hectares) and a figure cited elsewhere in this report from the FAO (504.1 million hectares). This discrepancy exists because the two figures refer to different countries: the FAO figure is for 'sub-Saharan Africa', and therefore includes some Southern African countries that we exclude from our definition of tropical Africa – Lesotho, Namibia, South Africa and Swaziland – and excludes some countries along the Sahel zone that we include – Burkina Faso, Ethiopia, Eritrea and Sudan.

Table 1: Key statistics for tropical African countries

Country	Region of tropical Africa*	Population (1,000)	Forest area, 2005 (1,000 ha)	Annual forest loss, 2000–2005 (1,000 ha)	Total volatile carbon stored in forests (GtC)
Democratic Republic of Congo	Central	66,020	133,610	-319	39.2
Angola	Southern	18,498	59,104	-125	12.3
Central African Republic	Central	4,422	22,755	-30	8.3
Zambia	Southern	12,935	42,452	-445	7.1
Cameroon	Central	19,522	21,245	-220	6.8
Republic of Congo	Central	3,683	22,471	-17	6.0
Mozambique	East	20,226	19,262	-50	5.6
Gabon	Central	1,475	21,775	-10	5.3
Tanzania	East	43,739	35,257	-412	4.0
Nigeria	West	154,729	11,089	-410	3.3
Sudan	East	39,154	67,546	-589	3.0
Madagascar	East	19,625	12,838	-37	2.1
Ivory Coast	West	21,075	10,405	15	2.0



Table 1: Key statistics for tropical African countries

Country	Region of tropical Africa*	Population (1,000)	Forest area, 2005 (1,000 ha)	Annual forest loss, 2000–2005 (1,000 ha)	Total volatile carbon stored in forests (GtC)
Guinea	West	10,069	6,724	-36	1.7
Ghana	West	23,837	5,517	-115	1.3
Zimbabwe	Southern	12,523	17,540	-313	1.3
Uganda	East	32,710	3,627	-86	1.1
Liberia	West	3,476	3,154	-60	0.9
Ethiopia	East	79,221	13,000	-141	0.7
Kenya	East	39,802	3,522	-12	0.7
Benin	West	8,935	2,351	-65	0.6
Equatorial Guinea	Central	676	1,632	-15	0.5
Guinea-Bissau	West	1,611	2,072	-10	0.4
Malawi	Southern	15,263	3,402	-33	0.4
Togo	West	6,619	386	-20	0.4
Sierra Leone	West	5,696	2,754	-19	0.3
Botswana	Southern	1,950	11,943	-118	0.2
Senegal	West	12,534	8,673	-45	0.2
Burkina Faso	West	15,757	6,794	-24	0.1
Burundi	East	8,303	152	-9	0.1
Rwanda	East	9,998	480	27	0.0
Eritrea	East	5,073	1,554	-4	no data
Total		719,157	575,086	-3,747	116

Sources: Strassburg, B., A. Creed, and R. Ashton, *Policy Briefs 1: Distribution of Terrestrial Carbon Across Developing Countries*.¹⁴ FAO, *Forest Resources Assessment 2005*.²² UN Department of Economic and Social Affairs Population Division, *World Population Prospects*, Table A.1. 2009.²⁷

* For purposes of statistical breakdown.



2.2.2 Forest carbon

These forests contain an estimated **116 gigatonnes** of 'volatile' carbon between them.^{iv} The distribution of forest carbon across tropical Africa closely traces the distribution of forests, however it is weighted slightly more towards Central Africa – 57 per cent of all tropical forest carbon. This is due to the very high carbon intensity of the Congo Basin rainforests.

Terrestrial Carbon Group (TCG) estimate that 58.2 gigatonnes of Africa's tropical forest carbon is at risk of being lost in the future.²⁸ Once emitted into the atmosphere this transforms into **213GtCO₂**, which is equal to over **5 years** of global greenhouse gas emissions at 2005 levels.²⁹

2.2.3 Deforestation rates

Between 2000 and 2005, tropical Africa lost an estimated **3.7 million hectares** of forest every year – twice the size of Wales (see Table 1). The top 10 countries with the most forest loss were, in order, Sudan, Zambia, Tanzania, Nigeria, the DRC, Zimbabwe, Cameroon, Ethiopia, Angola and Botswana. These countries account for 83 per cent of deforestation in tropical Africa for this period. This list may contain some surprises – countries like Sudan, Zambia, Angola and Botswana probably do not come to mind as hotspots of deforestation for many readers.

In fact, at the regional level, tropical deforestation in Africa for this period was concentrated outside of the Congo Basin countries: an estimated two thirds of deforestation in tropical Africa occurred in East and Southern African countries. These are countries dominated by drier, more open woodlands, rather than dense rainforest. A fifth of deforestation (21 per cent) occurred in West Africa, and only 16 per cent in Central Africa.

^{iv} Volatile carbon refers to the carbon that would be emitted in the event of deforestation. This is assumed to be 100 per cent of aboveground carbon, and 25 per cent of belowground carbon, in this table. TCG note that some research has found that up to 40 per cent of belowground carbon could be lost during deforestation.²⁸



Eric Gaba (user Sting) and user Bobarino for Wikimedia Commons, under Creative Commons license CC-BY-SA 2.5 and earlier.



3. Causes and drivers of deforestation and degradation

The causes of deforestation in tropical African countries are many. Our analysis follows much of the literature in drawing a distinction between proximate causes – the tangible activities that cause forests to be cleared – and underlying drivers, the social, political and economic conditions that influence these activities. Within this framework we organise the commentary around the four themes that are then explored in much more detail in **Chapters 4-7**: forestry, agriculture, woodfuels, and mining and energy extraction. We then go on to look at the underlying drivers.

3.1 Proximate causes

3.1.1 Forestry

Logging is often at the frontline of deforestation in tropical Africa. Loggers are often the first to move into a remote forest, removing the largest and most valuable timber species. In Central and West Africa, timber companies, mostly foreign-owned, are granted access to vast areas of forest to extract high value hardwood timber species. In East and Southern Africa, the formal logging sector seems to be dominated instead by small-scale loggers, who are the first to move into a forest area and take the largest trees, disrupting the canopy and fundamentally altering the structure of the forest.

The area of forest in the Congo Basin which has been formally designated for potential exploitation by loggers is 133 million hectares – roughly equivalent to the land areas of France, Germany and the UK combined.¹³ Timber companies operating in Africa are widely understood to practice more selective logging than in other tropical forest regions, such as South-East Asia, removing 13 trees per hectare, rather than 10–15. Although the term ‘selective’ suggests a highly precise process, in practice selective logging can inflict substantial collateral damage to surrounding trees. Research in selective logging operations

has found that for every tree that is felled many others can be killed or damaged in the process.^{30, 31}

However, perhaps the greatest impact of industrial logging on forests is indirect. Logging roads help expose previously remote areas of forest to new activities, such as hunting, charcoal making, and slash and burn farming.

3.1.2 Agriculture

Agriculture is the greatest proximate cause of deforestation in tropical Africa. Some estimates attribute agriculture as a cause in over 80 per cent of cases of deforestation.³² Forests are converted to agricultural land for many reasons. Subsistence farmers clear and burn forests as the most affordable and most effective way of increasing soil fertility. Commercial farmers replace forests with cash crops because it is highly profitable. Between them they clear millions of hectares of tropical forests in Africa every year.

Agricultural expansion is intimately related to other proximate causes. It can be preceded by some activities, but it also brings other activities with it. For example, the expansion of the agricultural frontier often follows the loggers and charcoal makers, who help thin out areas of forest and make them easier for farmers to clear. At the same time, agricultural activity can often increase woodfuel harvest: many subsistence farmers make charcoal in the dry season, and processing for some crops, such as tobacco, can utilise huge quantities of woodfuels.

Subsistence agriculture is the greater proximate cause. Millions of farmers practice slash and burn as the most affordable and most effective means of cultivating crops in the harsh environment of the tropical forest. Farmers have developed slash and burn over millennia, but with populations rapidly growing, the impact on



forests is growing more severe. Commercial agriculture, meanwhile, is less important in Africa than in other tropical regions. Plantations of cocoa, coffee, sugarcane, tea and tobacco have replaced forests all over Africa, but not on the same scale as palm oil in South-East Asia, or soy in Latin America.³³⁻³⁶ This may change in the future. Foreign governments and investors have shown growing interest in making Africa a major 'food bowl' and biofuels 'powerhouse' for the world,³⁷⁻⁴⁰ and agriculture has recently returned to the head of the development agenda for Africa after years of neglect.⁴¹⁻⁴⁴

3.1.3 Woodfuels

Wood is the most important source of energy in tropical Africa. Modern energy services are unreliable and unaffordable for most people, especially in rural areas. National electricity grids fail often, and supplies of liquid petroleum gas (LPG) beyond urban centres are poor. Woodfuels provide over two thirds of primary energy supply in sub-Saharan Africa.⁴⁵ The pressure of woodfuels consumption on Africa's forests is undeniable: over 80 per cent of all the wood that is harvested from sub-Saharan Africa's forests is used as fuel.²²

The impact of the woodfuel harvest is not uniform across the continent. In some cases, levels of production may be low enough that it is offset by forest re-growth. In other cases, especially in areas with high population density and active rural industries reliant on wood for energy, forests have been devastated by woodfuels. Slow growing forest types, like the miombo and mopane woodlands of Southern and East Africa, are particularly vulnerable. The booming charcoal industry, driven by demand from Africa's rapidly growing cities, poses a considerable challenge to forest conservation in the future. Traditional methods of making charcoal are highly inefficient, requiring on average 10 tonnes of wood to produce 1 tonne of charcoal. The implications of a shift from fuelwood to charcoal for Africa's forests, as Africa becomes an urban continent, are huge.⁴⁶

3.1.4 Mining and energy extraction

The extractive industries are highly important economic sectors in Africa. Africa holds a significant proportion of known reserves for many valuable minerals, including 85 per cent of platinum, 60 per cent of cobalt, 75 per cent of diamonds and nearly 40 per cent of gold.⁴⁷ Most tropical African countries have exploitable reserves of minerals or fossil fuels, and mineral and oil exports are major revenue earners for many countries: 76 per cent of export earnings for Gabon, 98 per cent for Nigeria, and 61 per cent for Cameroon.⁴⁸ The value of Africa's minerals and oil may become even greater in the future as global economic growth fuels demand for primary resources.

This does not bode well for Africa's tropical forests. The extractive industries have wrought much damage on Africa's tropical forests. Large-scale operations and artisanal miners have already cleared hundreds of thousands of hectares of forest across the region. Mining and energy extraction can affect forests far beyond the extraction site itself. The discovery of new mineral reserves can attract thousands of people to a new area of forest, and lead to an increase in settlements, logging, woodfuels production, hunting and farming, which can affect a forest far beyond the perimeter of the mining site.

3.2 Underlying drivers of deforestation and degradation

3.2.1 Demographics: population growth and urbanisation

The role of population growth in deforestation may seem intuitively obvious – as population rises, so does the demand for timber, woodfuels and food, so deforestation must also rise. In reality, the role of population growth is poorly understood and some research finds it to be only a minor cause of deforestation.^{32, 49} However, some clear observations can be drawn from the literature. First, the impact of woodfuels consumption is most severe in areas with high levels of population, such as refugee camps and urban centres.



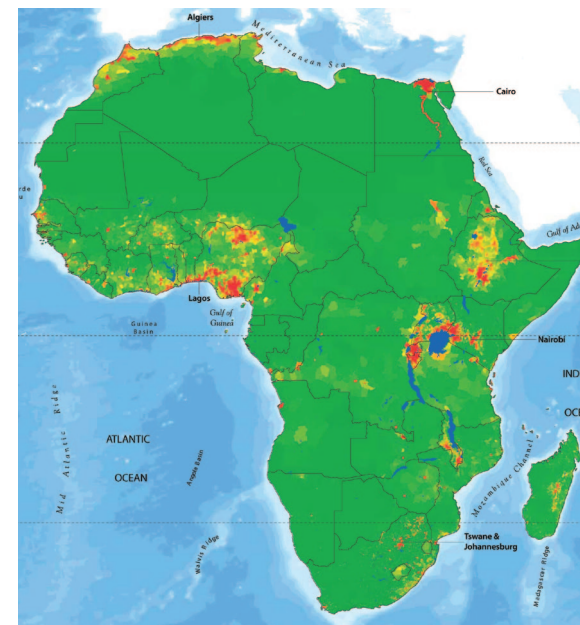
Second, in relation to agriculture, a close relationship between population growth and agricultural expansion may pertain in cases where farmers are largely reliant on extensification (bringing more land under agriculture) to grow more food:^{36, 50} as populations grow, croplands expand, often at the expense of forests.

The influence of urbanisation is also ambiguous. Some authors argue that urbanisation could reduce the pressure on forests as people move from the countryside to cities, abandoning farms and allowing forests to spill out of their restricted domains and reclaim the land.⁵¹ This is disputed by other research that suggests that urbanisation entails changes to people's lives that can have major implications for forests: urbanisation in African countries is increasing charcoal demand,^{46, 52-54} which, as noted above, can greatly increase the pressure of woodfuels on forests; and as populations become increasingly urbanised, small-scale farms focused on subsistence production may simply get replaced by larger farms established to feed urban populations.⁵⁵

3.2.2 Poverty and wealth

Poverty is often cited as the primary cause of deforestation in Africa. In some senses this is true. The vast majority of households cannot afford electricity or liquid petroleum gas (LPG), so many use woodfuels instead; most farmers cannot afford fertiliser, irrigation or other inputs, so they remain reliant on slash and burn; and for many people living in rural areas, livelihoods that impact the forest and are often illegal, such as hunting, logging, charcoal making and artisanal mining, are the best ways of making a living.

Taken to its end, the implication of this assessment is that if African countries were wealthy then deforestation would be reduced, but wealth can also drive deforestation.^{32, 56} Some of the proximate causes identified above, such as industrial logging, large-scale mining, and commercial agriculture are also made possible by wealth.



These maps show the enormous rate of population growth and urbanisation in tropical Africa in the second half of the 20th century, especially in West Africa, the Lake Victoria basin in East Africa, and the Ethiopian highlands. Demographic trends are a huge influence on forest resources across the region.

Courtesy of UNEP

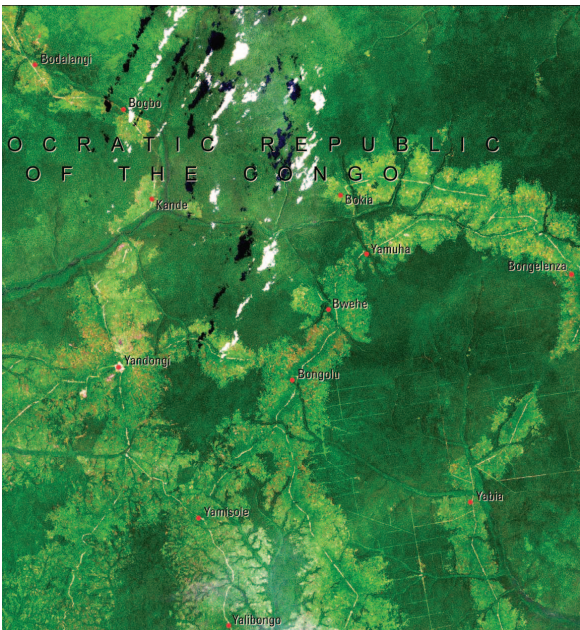


This highlights the fact that while reducing poverty may help alleviate some of the proximate causes of deforestation (woodfuels, for example), it will not help alleviate all of them, and could even exacerbate some causes. Reducing emissions from deforestation and degradation cannot therefore be reduced purely to a development issue. Donors and funders should not assume that forests will be conserved as a by-product of development.

3.2.3 Infrastructure: transport, communication and energy

The influence of infrastructure, such as transport, communication, and energy services, is intimately related to that of poverty and wealth. Poor infrastructure is the other side of the coin of household poverty: abysmal roads, railways and ports prevent farmers from getting their produce to market so they can actually earn an income so they can invest in their land; and poor government and private investment in energy infrastructure has made electricity and LPG supplies unreliable, and largely limited to major towns and cities.

As with poverty and wealth, however, infrastructure development, particularly roads, can be a major driver of deforestation. Many forests in Africa are indirectly protected by high transport costs. As noted above, in relation to logging and mining, roads can open up previously remote areas of forest to settlement, charcoal making and other activities. Reducing transport costs can make commercial activities such as agriculture or logging, which were once too expensive, much more feasible. The selective nature of industrial logging in Africa is partly a function of high transport costs – only the most valuable timber trees are worth extracting. It is possible that reducing transport costs in Congo Basin countries could increase the volume of timber harvested.



The growth of towns and development of rural road networks over the 30-year period between these two satellite images shows the impact of roads on forests in the DRC. The forests have retreated as roads have become busier and charcoal making, logging and agricultural activity has increased.

Courtesy of UNEP



This does not mean that the development of transport, communication and energy infrastructure in tropical African countries should be stifled, in the interests of protecting their forests. Poor infrastructure helps keep hundreds of millions of people in poverty. As noted above in relation to poverty and wealth, these observations point up the fact that the relationship between economic development and forest protection in Africa is not as simple as often portrayed.

3.2.4 Land ownership

Government policy can also have a large bearing on how people value and use land, with consequences for forests. In Africa, 90 per cent of all land is formally claimed as state land. In some countries like Tanzania, a large proportion of the land is also classified as 'general' land, with no formal legal owner.^{20, 57} Individual or communal ownership of land and forests is often only customary rather than codified in law. Land ownership (known as land tenure in the literature) is therefore highly insecure for most people.⁵⁸

Many experts argue that these conditions create incentives that exacerbate deforestation. Farmers have no incentive to invest in the long-term fertility of their land, because it could be acquired by the government or a foreign company without compensation. Loggers have no incentive to keep harvest rates within sustainable limits, and charcoal makers have no incentive to reduce wastage in charcoal kilns, because they have 'open access' to vast areas of forest with no legal owner and no enforced management plan.

Improving the security of land tenure is therefore widely understood as essential to reducing emissions from deforestation and degradation.^{42, 58-61} The support that community forestry receives from NGOs, governments and donor bodies alike, as a strategy to reduce deforestation, is partly based on this belief. It appears to have been effective, in some cases (see **Chapter 4**). However, there appear to be certain conditions when improving land tenure security can increase deforestation, such as under regimes where farmers can clear forests to obtain property rights^{49, 62} or in communities in which the ability to implement management plans is undermined by poor organisation or corruption.



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