The Hemispheres of Earth

Land, sea, sky, and shining city lights—gathered from various satellite missions over decades of remote sensing—form this beautiful image of the Earth that is a fusion between science and art. Created by a team of NASA scientists and graphic artists, these layers of global satellite data depict everything from polar sea ice to the light reflected by the chlorophyll in multi-millions of microscopic photosynthesizing organisms growing in the oceans. The images of Africa in the pages that follow are both a showcase for remote sensing technology and a source of inspiration for appreciating the beauty of our planet and better understanding how land, ocean, atmosphere—and even life itself—interact on Earth.

Source: Earth Observatory/NASA

Maasai, Kenya

Photo: Jacqui Goodwin/Flickr.com

Chapter 3

Tracking Progress Towards Environmental Sustainability

Millennium Development Goal 7:
Ensure Environmental Sustainablilty

United Nations Millennium Development Goals

The Millennium Declaration

In September 2000, 147 heads of State and Government, and 189 nations in total, in the United Nations Millennium Declaration committed themselves to making the right to development a reality for everyone and to freeing the entire human race from want. They acknowledged that progress is based on sustainable economic growth, which must focus on the poor, with human rights at the centre. The objective of the Declaration is to promote "a comprehensive approach and a coordinated strategy, tackling many problems simultaneously across a broad front."

The Declaration calls for halving by the year 2015, the number of people who live on less than one dollar a day. This effort also involves finding solutions to hunger, malnutrition and disease, promoting gender equality and the empowerment of women, guaranteeing a basic education for everyone, and supporting the Agenda 21 principles of sustainable development. Direct support from the richer countries, in the form of aid, trade, debt relief and investment is to be provided to help the developing countries.

Millennium Development Goals (MDGs)	*Effective 15 January 2008*
Goals and Targets (from the Millennium Declaration)	***Indicators for monitoring progress***
Goal 1: Eradicate extreme poverty and hunger	
Target 1.A: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	1.1 Proportion of population below $1 (PPP) per day[a] 1.2 Poverty gap ratio 1.3 Share of poorest quintile in national consumption
Target 1.B: Achieve full and productive employment and decent work for all, including women and young people	1.4 Growth rate of GDP per person employed 1.5 Employment-to-population ration 1.6 Proportion of employed people living below $1 (PPP) per day 1.7 Proportion of own-account and contributing family workers in total employment
Target 1.C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	1.8 Prevalence of underweight children under-five years of age 1.9 Proportion of population below minimum level of dietary energy consumption
Goal 2: Achieve universal primary education	
Target 2.A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	2.1 Net enrolment ratio in primary education 2.2 Proportion of pupils starting grade 1 who reach grade 5 2.3 Literacy rate of 15-24 year-olds
Goal 3: Promote gender equality and empower women	
Target 3.A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015	3.1 Ratios of girls to boys in primary, secondary and tertiary education 3.2 Share of women in wage employment in the non-agricultural sector 3.3 Proportion of seats held by women in national parliament
Goal 4: Reduce child mortality	
Target 4.A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	4.1 Under-five mortality rate 4.2 Infant mortality rate 4.3 Proportion of one year-old children immunised against measles
Goal 5: Improve maternal health	
Target 5.A: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio	5.1 Maternal mortality ratio 5.2 Proportion of births attended by skilled health personnel
Target 5.B: Achieve, by 2015, universal access to reproductive health	5.3 Contraceptive prevalence rate 5.4 Adolescent birth rate 5.5 Antenatal care coverage (at least one visit and at least four visits) 5.6 Unmet need for family planning
Goal 6: Combat HIV/AIDS, malaria and other diseases	
Target 6.A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS	6.1 HIV prevalence among population aged 15-24 years 6.2 Condom use at last high-risk sex 6.3 Proportion of population aged 15-24 years with comprehensive correct knowledge of HIV/AIDS 6.4 Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years
Target 6.B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all who need it	6.5 Proportion of population with advanced HIV infection with access to antiretroviral drugs
Target 6.C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	6.6 Incidence and death rates associated with malaria 6.7 Proportion of children under 5 sleeping under insecticide-treated bednets 6.8 Proportion of children under 5 with fever who are treated with appropriate anti-malarial drugs 6.9 Incidence, prevalence and death rates associated with tuberculosis 6.10 Proportion of tuberculosis cases detected and cured under directly observed treatment short course
Goal 7: Ensure environmental sustainability	
Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	7.1 Proportion of land area covered by forest 7.2 CO_2 emissions, total, per capita and per $1 GDP (PPP) 7.3 Consumption of ozone-depleting substances 7.4 Proportion of fish stocks within safe biological limits 7.5 Proportion of total water resources
Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	7.6 Proportion of terrestrial and marine areas protected 7.7 Proportion of species threatened with extinction
Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	7.8 Proportion of population using an improved water source 7.9 Proportion of population using an improved sanitation facility
Target 7.D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	7.10 Proportion of urban population living in slums[b]
Goal 8: Develop a global partnership for development	
Target 8.A: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system Includes a commitment to good governance, development and poverty reduction—both nationally and internationally	Some of the indicators listed below are monitored separately for the least developed countries (LDCs), Africa, landlocked developing countries and small island developing States. ***Official development assistance (ODA)*** 8.1. Net ODA, total and to the least developed countries, as percentage of OECD/DAC donors' gross national income
Target 8.B: Address the special needs of the least developed countries *Includes:* tariff and quota free access for the least developed countries' exports; enhanced programme of debt relief for heavily indebted poor countries (HIPC) and cancellation of official bilateral debt; and more generous ODA for countries committed to poverty reduction	8.2. Proportion of total bilateral, sector-allocable ODA of OECD/DAC donors to basic social services (basic education, primary health care, nutrition, safe water and sanitation) 8.3 Proportion of bilateral official development assistance of OECD/DAC donors that is untied 8.4 ODA received in landlocked developing countries as a proportion of their gross national incomes 8.5 ODA received in small island developing States as a proportion of their gross national incomes ***Market access***
Target 8.C: Address the special needs of landlocked developing countries and small island developing States (through the Programme of Action for the Sustainable Development of Small Island Developing States and the outcome of the twenty-second special session of the General Assembly)	8.6 Proportion of total developed country imports (by value and excluding arms) from developing countries and least developed countries, admitted free of duty 8.7 Average tariffs imposed by developed countries on agricultural products and textiles and clothing from developing countries 8.8 Agricultural support estimate for OECD countries as a percentage of their gross domestic product 8.9 Proportion of ODA provided to help build trade capacity
Target 8.D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term.	***Debt sustainability*** 8.10 Total number of countries that have reached their HIPC decision points and number that have reached their HIPC completion points (cumulative) 8.11 Debt relief committed under HIPC and MDRI Initiatives 8.12 Debt service as a percentage of exports of goods and services
Target 8.E: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries	8.13 Proportion of population with access to affordable essential drugs on a sustainable basis
Target 8.F: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications	8.14 Telephone lines per 100 population 8.15 Cellular subscribers per 100 population 8.16 Internet users per 100 population

The Millennium Development Goals and targets come from the Millennium Declaration, signed by 189 countries, including 147 heads of State and Government, in September 2000 (http://www.un.org/millennium/declaration/ares552e.htm) and from further agreement by member states at the 2005 World Summit (Resolution adopted by the General Assembly—A/RES/60/1, http://www.un.org/Docs/journal/asp/ws.asp?m=A/RES/60/1). The goals and targets are interrelated and should be seen as a whole. They represent a partnership between the developed countries and the developing countries "to create an environment—at the national and global levels alike—which is conducive to development and the elimination of poverty".

[a] *For monitoring country poverty trends, indicators based on national poverty lines should be used, where available.*

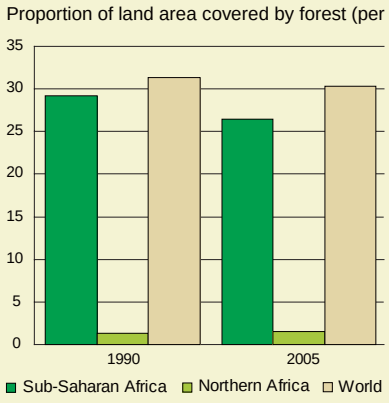
[b] *The actual proportion of people living in slums is measured by a proxy, represented by the urban population living in households with at least one of the four characteristics: (a) lack of access to improved water supply; (b) lack of access to improved sanitation; (c) overcrowding (3 or more person per room); and (d) dwellings made of non-durable material.*

Source: UN 2007b

This vision took the shape of eight Millennium Development Goals, which provide a framework for development planning for countries around the world, and time-bound targets by which progress can be measured. To help track progress on the commitment made in the year 2000 in the United Nations Millennium Declaration, international and national statistical experts selected relevant indicators to be used to assess progress over the period from 1990 to 2015, when targets are expected to be met. Each year, the Secretary-General presents a report to the United Nations General Assembly on progress achieved towards implementing the Declaration, based on data on the 60 selected indicators, for 21 targets aggregated at global and regional levels.

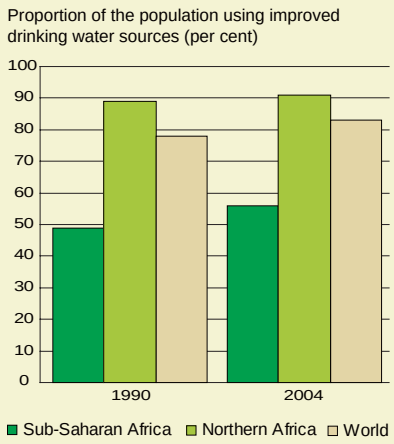
Forested land as percentage of land area:

From 1990 to 2005, the world lost three per cent of its forests, an average decrease of 0.2 per cent a year. Deforestation, primarily due to the conversion of forests to agricultural land in developing countries, continues at an alarming rate—about 13 million hectares a year. The rate of loss has been fastest in some of the world's most biologically diverse regions, including sub-Saharan Africa (UN 2007c). While the proportion of forested land stood at one per cent for both time periods in northern Africa, that of Sub-Saharan Africa dropped by three per cent, from 29 per cent in 1990 to 26 per cent in 2005.



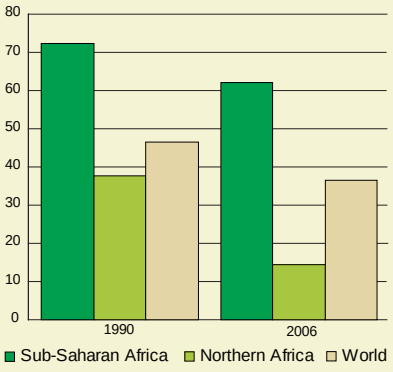
Proportion of population with sustainable access to an improved water source:

In Africa, only 42 per cent of people in rural areas had access to clean water, according to the latest 2004 data, and 63 per cent of the entire population lacked access to basic sanitation facilities—down only barely from 68 per cent in 1990, and far from the target of cutting this proportion in half by 2015 (UN 2007a).



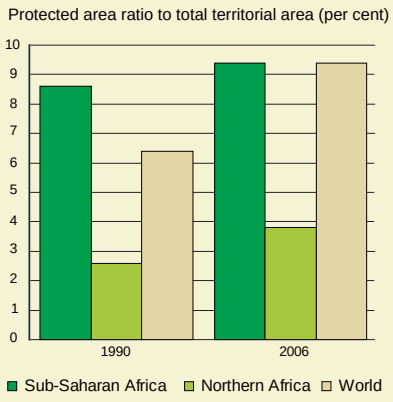
Proportion of households with access to secure tenure:

Already, nearly half the world's population lives in cities and towns. But due to urban migration and rapid population growth, the number of urban dwellers will continue to expand, from 3 200 million people today to nearly 5 000 million by 2030, with most of the growth taking place in Africa and Asia. In 2005, one out of three urban dwellers was living in slum conditions—that is, lacking at least one of the basic conditions of decent housing: adequate sanitation, improved water supply, durable housing or adequate living space. Even if the growth rate of slum dwellers decreases, the rapid expansion of urban areas will make it challenging to improve living conditions quickly enough to meet the target. Sub-Saharan Africa is still one of the regions where lack of adequate shelter among urban populations is most acute. Looking beyond the regional averages, the situation is even more discouraging. In countries including Chad, the Central African Republic and Ethiopia, four out of five urban dwellers live in slums. Northern Africa has the fewest people living in non-durable housing (UN 2007c).



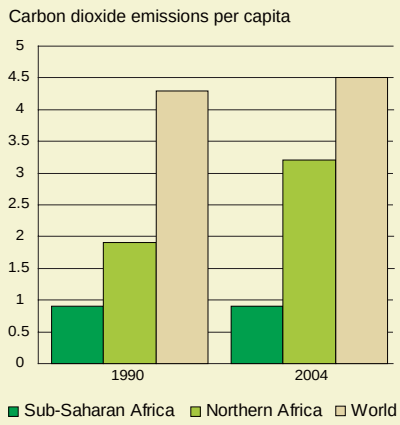
Ratio of area protected to maintain biological diversity to surface area:

The proportion of protected areas globally has steadily increased, and a total of about 20 million km^2 of land and sea were under protection by 2006. However, not all protected areas are effectively managed for conservation. Further clouding the picture is the fact that only a fraction of these areas—about two million km^2—are marine ecosystems, despite their important role in the sustainability of fish stocks and of coastal livelihoods (UN 2007c). In Africa, more protected areas have been set aside than ever before. Between 1990 and 2006, Sub-Saharan Africa increased the proportion of area protected from 8.6 per cent to 9.4 per cent. Likewise, northern Africa increased the proportion from 2.6 per cent to 3.8 per cent.



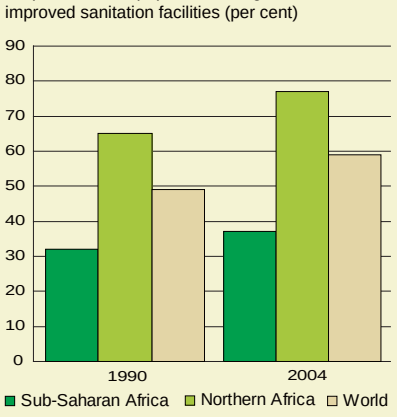
Carbon Dioxide Emissions (per capita) and Consumption of Ozone-Depleting CFCs (ODP tonnes):

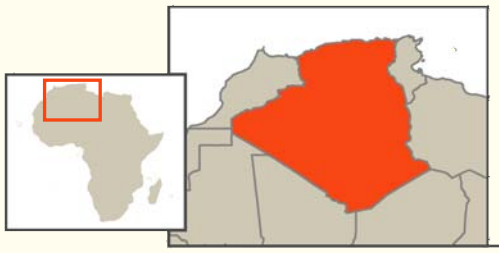
Worldwide, the carbon dioxide emissions reached 2 900 million metric tonnes in 2004 and continue to rise, as evidenced by increasing concentrations of CO_2 in the atmosphere. In northern Africa, emissions more than doubled between 1990 and 2004, increasing from 1.9 to 3.2 metric tonnes of CO_2 per capita. At an average of 0.9 metric tonnes of CO_2 per capita that did not change between 1990 and 2004, an individual in sub-Saharan Africa accounts for less than one tenth of the CO_2 produced by an average person in the developed world (UN 2007c).



Proportion of population with access to improved sanitation:

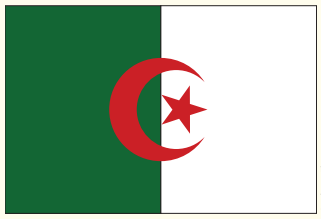
An estimated 1 600 million people will need access to improved sanitation over the period 2005-2015 to meet the MDG target. Yet if trends since 1990 continue, the world is likely to miss the target by almost 600 million people. In the African continent, only northern Africa is on track to halve the proportion of people without basic sanitation by 2015. In sub-Saharan Africa, the absolute number of people without access to sanitation actually increased—from 335 million in 1990 to 440 million people by the end of 2004. This number may increase even further if trends do not improve (UN 2007c).





People's Democratic Republic of Algeria

Total Surface Area: 2 381 741 km²
Estimated Population in 2006: 33 354 000



Algeria is the second largest country in Africa after Sudan. A narrow and mountainous coastal zone constitutes the country's most fertile region, one that enjoys a hospitable Mediterranean climate. As a result, this part of Algeria is densely populated, with approximately 96 per cent of the population occupying less than one-fifth of the country's land (UNCCD 2004). In contrast, 87 per cent of Algeria lies within the bounds of the Sahara Desert. In this region, population density is a mere seven inhabitants per km² (FAO 2005). Average rainfall varies dramatically, ranging from 1 600 mm per year in the coastal mountains to less than 100 mm per year in the Sahara.

Important Environmental Issues

- Desertification
- Water Scarcity
- Pollution

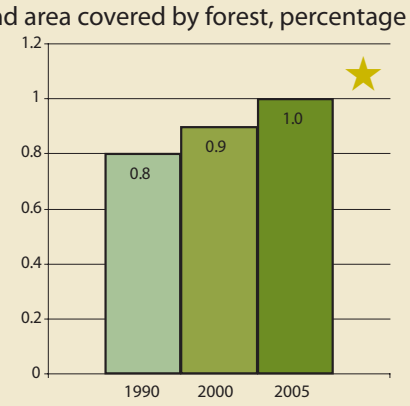
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

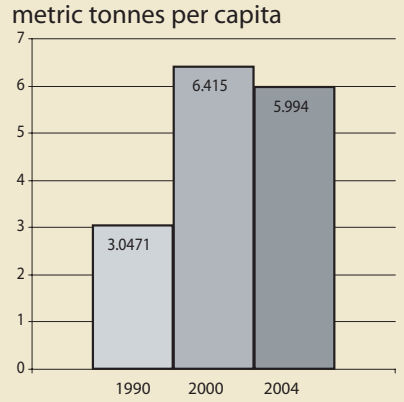
Water shortages, aggravated by regular droughts, are a major problem for Algeria and a limiting factor in the availability of safe drinking water. Encroachment of the desert into the fertile northern section of the country is Algeria's other principal environmental problem. Nevertheless, Algeria has seen an increase in forested area. The country's extent of protected area has remained unchanged for the past 15 years.

★ Indicates progress

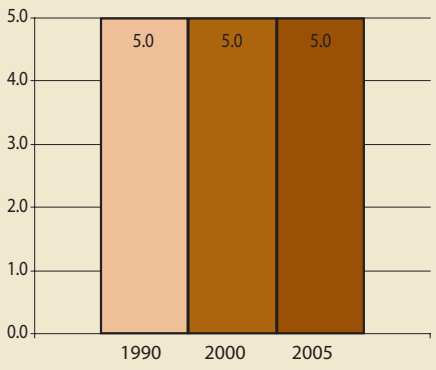
Land area covered by forest, percentage



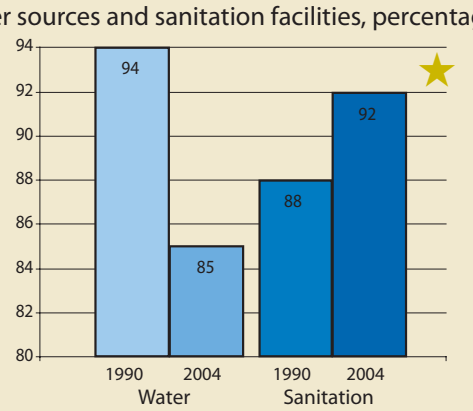
Carbon dioxide (CO_2) emissions, metric tonnes per capita



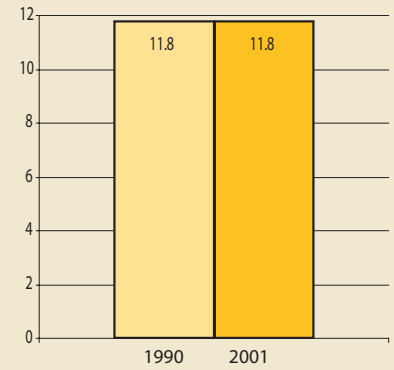
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

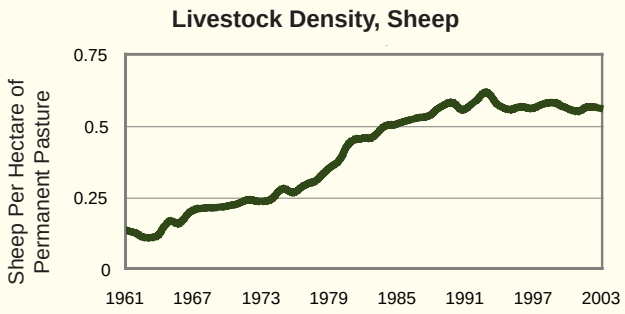


Over 90 per cent of Algerians live along the Mediterranean coast on only 12 per cent of the country's land.

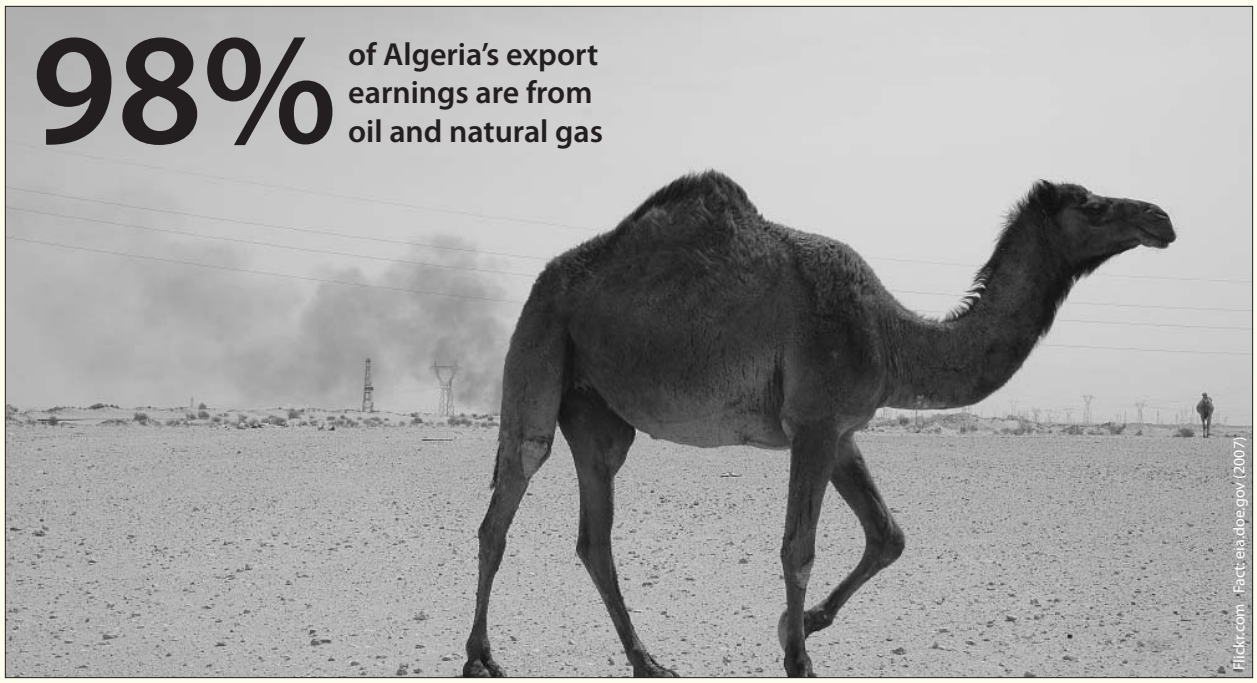
Desertification

Desertification has affected over 130 000 km^2 of land in Algeria over the past decade (Recelma 2006), of which almost four per cent is thought to be unrecoverable (Nedraoui 2001). The government has initiated reforestation and restoration schemes, but irrigation-induced soil salinity, overgrazing, and forest fires (both intentional and accidental) continue to degrade vulnerable lands, especially in the semi-arid plains just north of the Sahara Desert.

Sheep represent roughly 80 per cent of livestock production (FAO 2007a), which is heavily concentrated in the high plateau region that accounts for only one-tenth of Algeria's surface area. It is estimated that sheep stocks are ten times greater than the carrying capacity of the utilized pasture land (FAO 2007a), thereby exposing soils to significant water and wind erosion.

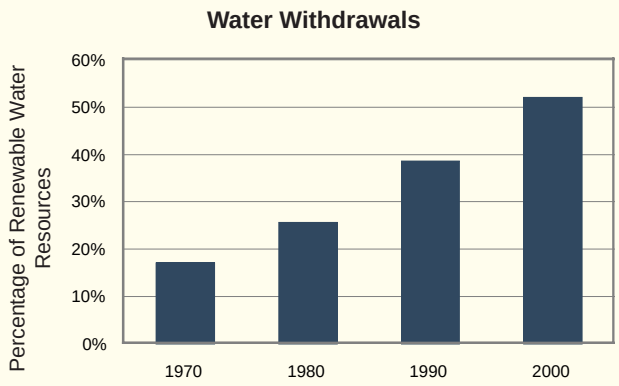


Source: FAOSTAT



Water Scarcity

Algeria is the second most water-scarce country in Africa with only 355 m^3 available per person per year (FAO 2007b), which is far below the international water scarcity threshold of 1 000 m^3. The vast majority of freshwater resources occur in the north, where overexploitation of coastal groundwater has resulted in saltwater intrusion. The Algerian government has embarked on several hydro-infrastructure projects to maximize access to existing water resources, such as constructing new dams, reducing dam silting, and preventing water loss and waste. Additionally, Algeria is one of only a few countries in the world practising desalination of ocean water.

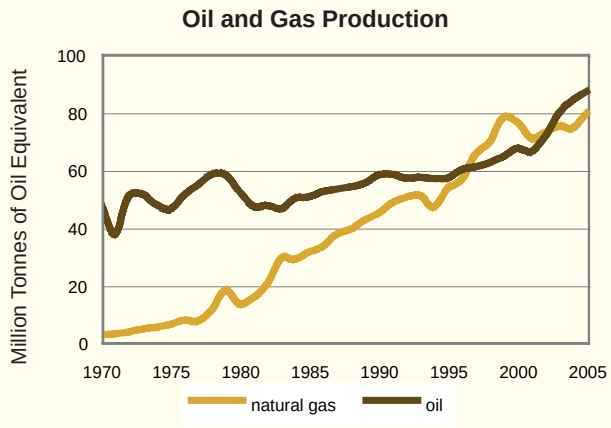


Source: AQUASTAT

Pollution

Pollution of freshwater and marine resources is a significant problem in northern Algeria, where most of the population resides. Agricultural runoff and untreated municipal and industrial wastewater result in significant contamination of surface water. Industries alone are estimated to discharge roughly 200 million cubic metres of effluent per year into the environment (METAP n.d.).

Petroleum refining wastes are a major contributor to the increasingly severe pollution of the Mediterranean Sea. Algeria ranks third and second in Africa for proven reserves of oil and natural gas, respectively (DoE 2007).



Source: BP Statistical Review of World Energy 2007

ALGERIA

Hassi R' Mel

0 7 14 Kilometres

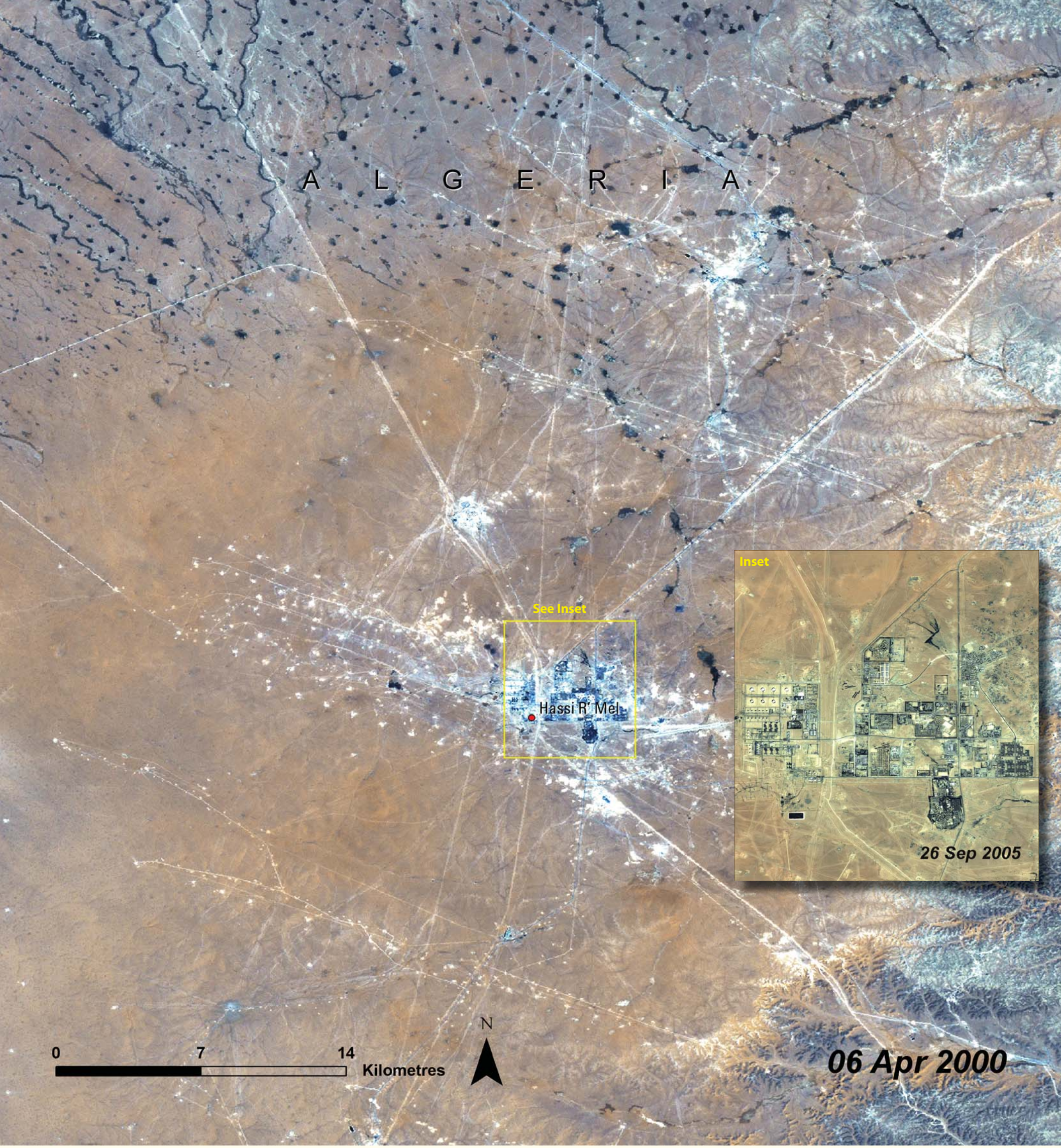
N

13 Nov 1972

Gas Fields Across the Desert: Hassi R' Mel, Algeria

In 2006, oil and natural gas exports made up 98 per cent of Algeria's total exports. A major portion of these fuels came from the Hassi R'Mel gas fields, located about 550 km south of Algiers. The fields were discovered in 1956; initial production started in 1961, and has since become one of the world's largest gas fields.

These two satellite images show the dramatic development of the area in the last three decades. In the 1972 image, changes to the landscape are minor compared to the 2000 image,



which reveals vastly expanded infrastructure, mainly related to the gas fields. The high resolution image from 2005 shows more detail (see inset).

In addition to gas production, Algeria began building a hybrid gas and solar power generating facility at Hassi R'Mel in July 2007. It will produce 150 megawatts of electricity, with 25 megawatts coming from 180 000 m² of parabolic reflectors. The first of its kind, this facility is expected to be operating by 2010. By 2020 Algeria hopes to be exporting 6 000 megawatts of power to Europe—roughly the equivalent of 10 per cent of Germany's current consumption.

N'Goussa

A L G E R I A

Chott Ouni
El Raneb

Chott
Aïn
El Beïda

Ouargla

'Aïn el Beïda

0 3 6 Kilometres

N

16 Jan 1976

Modern Irrigation: Ouargla Oasis, Algeria

Ouargla, located in the sands of the northern Sahara Desert, overlies the North-West Sahara Aquifer (NWSA) which extends underneath Algeria, Tunisia and Libyan Arab Jamahiriya. Use of the superficial water table of the NWSA extends back to ancient times. In the 19th century, bore holes were drilled to access deeper parts of the aquifer. By the1970s there were roughly 2 000 bore holes on the NWSA. These wells now provide water to irrigate approximately 500 000 date palms surrounding Ouargla.

N'Goussa

A L G E R I A

Chott Oum El Raneb

Chott Aïn El Beïda

Ouargla

'Aïn el Beïda

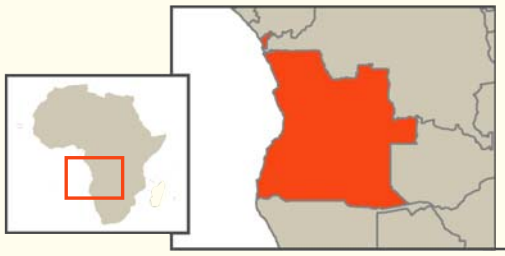
N

0 3 6 Kilometres

08 Mar 2006

The region's traditional irrigation methods used sustainable amounts of water. Modern, more intensive irrigation methods can lead to degraded water quality, decreased water levels, and loss of artesian pressure, as well as salinization of the superficial water table and the soil. Natural drainage conditions and insufficient engineered drainage have already led to accumulation of water near the surface and a concentration of minerals. This salinized water at a depth of 0.5 to 1.5 m below the soil surface is detrimental to palm trees.

The 1976 image shows date palms surrounding Ouargla and Chott Aïn El Beïda, a saline depression that has collected irrigation runoff for generations. The 2006 image shows a proliferation of irrigated land, which, without proper management, will not be sustainable.



Republic of Angola

Total Surface Area: 1 246 700 km²
Estimated Population in 2006: 16 400 000

Angola is the seventh largest country in Africa. The climate is semi-arid in the south and along the narrow coastal plain, which rises abruptly to a vast inland plateau that accounts for two-thirds of the total land area and receives substantial rainfall. The country is endowed with dense tropical rain forests in the north as well as substantial oil and mineral resources. Soils, however, are generally poor and susceptible to erosion. The Zambezi River and several tributaries of the Congo River originate in Angola.

Important Environmental Issues

- Threats to Biodiversity
- Access to Potable Water
- Overfishing and Coastal Degradation

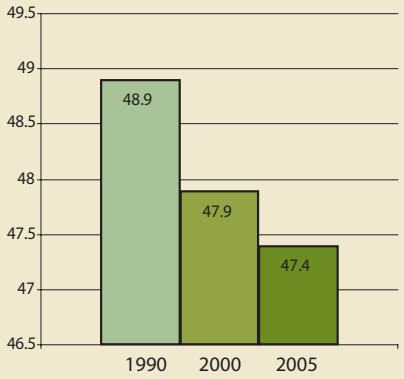
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

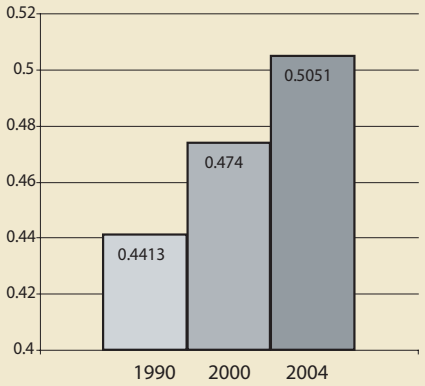
About 47.4 per cent of Angola is classified as forest and woodland. Between 1983 and 1993 Angola's forest and woodland declined at the rate of 3.1 per cent. Since then, decline has slowed, but still continues. Angola's land productivity is continually threatened by drought and soil erosion, which contribute to water pollution and silt deposits in rivers and dams. However, access to safe drinking water and sanitation show signs of improvement.

★ Indicates progress

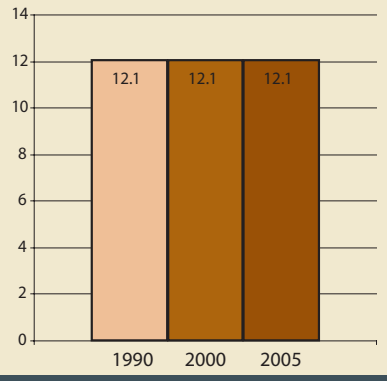
Land area covered by forest, percentage



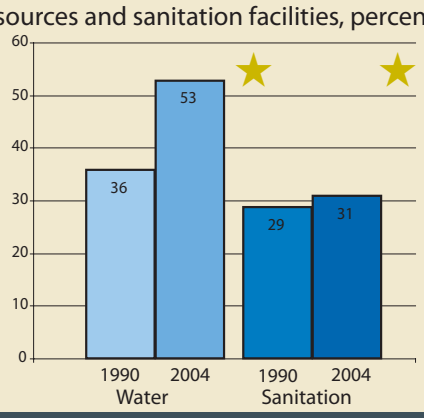
Carbon dioxide (CO_2) emissions, metric tonnes per capita



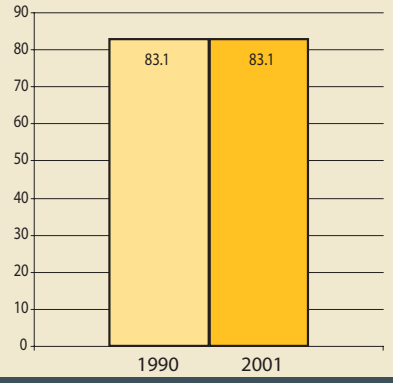
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

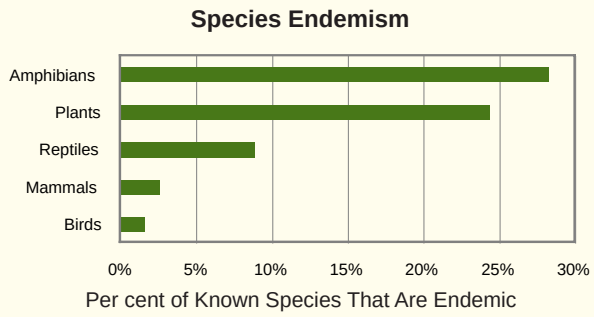


The rainforests of northern Angola are threatened by subsistence agriculture, which provides food for almost 90 per cent of the population.

Threats to Biodiversity

Angola has exceptional and unique biological resources owing to its large size and topographical variation, including 1 260 endemic plant species and 92 per cent of southern Africa's known bird species (CDB 2006). Nearly three decades of civil unrest, however, have hindered meaningful protection, and uncontrolled logging, bush-burning, and poaching threaten numerous species.

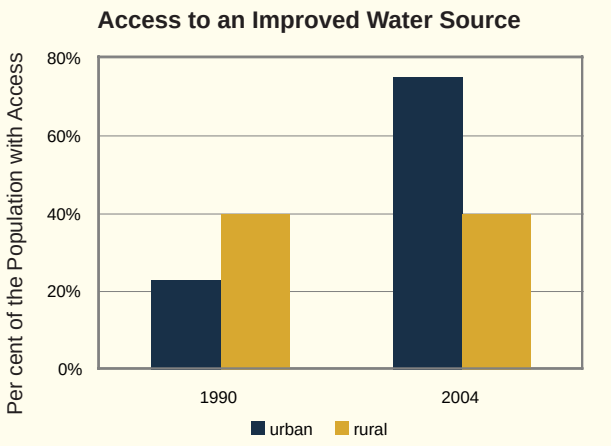
Elephants, for example, have been reduced from over 12 000 individuals in 1981 to approximately 250 today (Thompson 2006). Angola remains the only African country with a significant population of elephants not to ratify CITES, an international treaty that restricts trade in endangered species. As a result, it remains a major conduit for selling ivory obtained illegally from all over the African continent.



Source: IUCN

Access to Potable Water

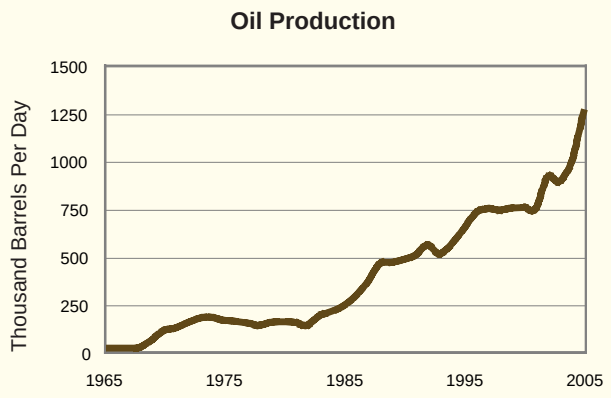
Freshwater resources are relatively abundant in Angola, with over 10 000 m^3 available per person per year (FAO 2007). However, water infrastructure is lacking, and soil erosion from poor land management has resulted in heavy siltation of rivers and dams. Thus, access to potable water is low in the country, particularly in rural areas, where only 40 per cent of the population has access to an improved drinking water source (compared to 75 per cent in urban areas) (UN 2007). As a consequence, Angola has Africa's second highest mortality rate in children younger than five; approximately one out of every four children will die before reaching the age of five, primarily due to water and sanitation related diseases (UNICEF 2006).



Source: MDG Indicators

Overfishing and Coastal Degradation

Strong coastal upwelling and the presence of several estuaries support productive and diverse marine life along the 1 650 kilometre-long Angolan coast. However, overfishing by both local and foreign fishing fleets has significantly reduced fish stocks, threatening some species with extinction. In addition, increasing poverty and growth among coastal communities have contributed to the destruction of coastal mangrove forests for fuelwood. Finally, pollution from offshore oil production (Angola is the second-largest oil producer in sub-Saharan Africa (BP 2007)) presents yet another risk to the marine environment.



Source: BP Statistical Review of World Energy 2007

Catoca Diamond Mine: Angola

The Catoca kimberlite pipe (diamond-rich geological formations) in the Lunda Sul province of Angola is the world's fourth largest in terms of surface area, with diamond reserves of at least 40 million carats. The Catoca Mine was constructed between 1994 and 1997. In 2003, the mine produced 2.5 million carats worth US$ 189 million.

Mining, by its very nature, significantly alters the landscape. Satellite images from 1990 and 2006 show the extent of change at Catoca over that 16-year period. Diamond mining is a

large-scale earth-moving operation—for each carat recovered, more than a tonne of material is moved. Diamond mining is also extremely water intensive, since water is used to wash the final gravels and separate the diamonds.

The Catoca Mine was built to minimize its environmental footprint. Its current extraction methods produce little toxic waste. The next stage of the project, however, will use dense media separation (DMS) for diamond recovery, a chemical process that exerts a far greater environmental impact.

Ekunha

A N G O L A

Huambo

Caála

Kalenga

Lepi

Gunga

Coquengo

Sandombe

0 7.5 15 Kilometres

N

29 Aug 1973

Land Degradation: Huambo Province , Angola

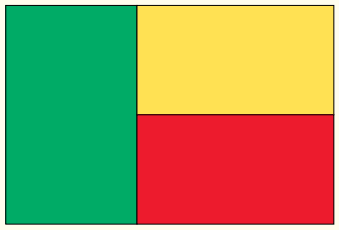
While Huambo province has been referred to as the “breadbasket of Angola,” its soils in reality are not ideal for agriculture. Many years of intensive cash crop agriculture on these marginal soils dating back to the 1920/1930s further diminished their agricultural capacity. During Angola’s civil war (1976-2002) many people who could not leave the region moved to the safer zones along the Benguela Railways corridor between Huambo and Caála. In the 2006 image this human activity shows as the lighter colours and loss of green throughout the centre of the

image, particularly surrounding the two cities and the rail line between them. This concentration of settlement and agriculture with minimal inputs further degraded soils in these areas.

Deforestation has also been found to be an important cause of land degradation and relocation in Huambo province. The loss of several forested areas, including some forest plantations, can be seen between the 1973 and 2006 images, where patches of dense green have been replaced by more reflective farmland and dense settlement (yellow arrows). At the end of the war, many of those returning to Huambo province found their land would no longer support them and were again displaced. In addition, returning refugees found that destruction of infrastructure, limited availability of inputs, and limited seed stock further reduced their prospects.

Republic of Benin

Total Surface Area: 112 622 km²
Estimated Population in 2006: 8 703 000



Benin's climate reflects a strong north-south gradient, with an equatorial coastline transitioning northward and inland to an increasingly arid continental zone. More than half of the population is concentrated in the south on only one-tenth of the country's land (CBD 2002). This region is characterised by coastal lagoons, marshes, and an area of fertile inland lowlands. The Niger River, one of the largest in Africa, forms a 120-kilometre-long border between northeast Benin and Niger.

Important Environmental Issues

- Deforestation
- Desertification
- Threats to Biodiversity

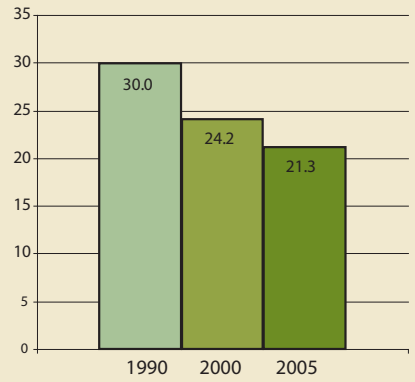
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

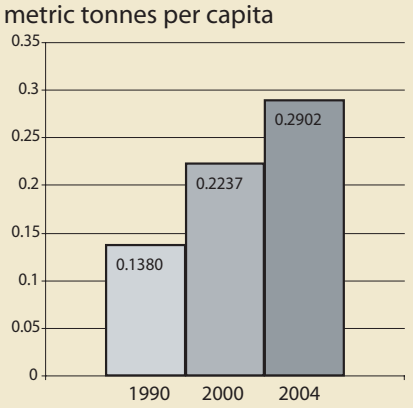
Gradual decrease in forested areas bears testament to the fact that Benin has little natural forest remaining. An estimated 59 per cent of Benin's forest loss is due to uncontrolled agricultural practices and fires. A recent study of three cities in Benin found that in two of them, the vast majority of the population lacked running water and basic sanitation, although the MDG graph shows small improvements in this area.

★ Indicates progress

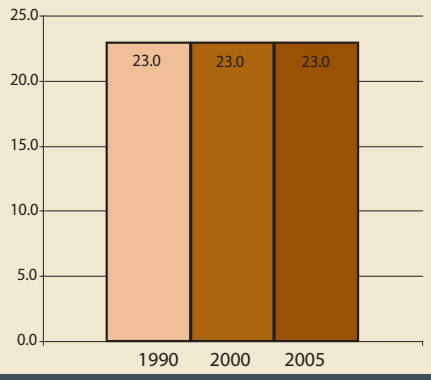
Land area covered by forest, percentage



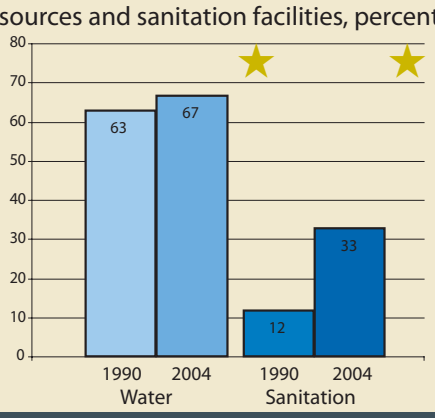
Carbon dioxide (CO_2) emissions, metric tonnes per capita



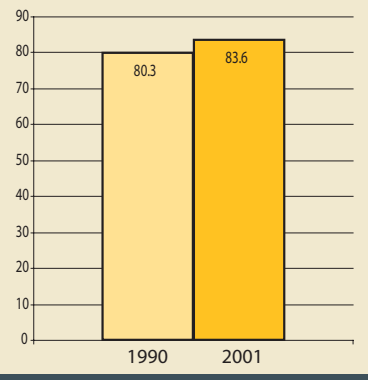
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

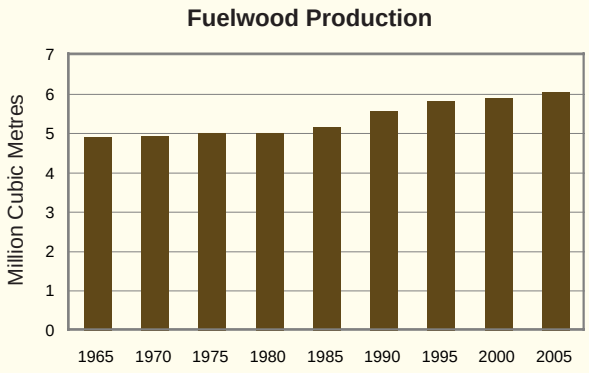


With more than 17 per cent of its surface area harvested for cotton production, Benin is the seventh largest producer of cotton in Africa.

faostat.fao.org (2008)

Deforestation

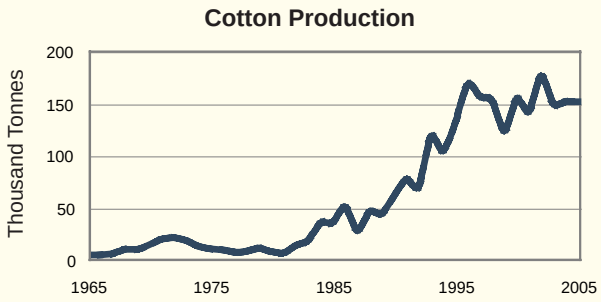
A dense tropical rain forest once covered much of the area north of the coast, but slash-and-burn agriculture and heavy dependence on fuelwood by 95 per cent of the population (WHO 2006) have driven rapid deforestation. Mangrove forests, on the other hand, are threatened most by fishing and salt production. Overall, Benin has lost nearly one-third of its forest cover since 1990, and the rate of forest loss between 2000 and 2005 was high at 2.4 per cent per year (UN 2007). Slash-and-burn agriculture is estimated to affect 160 000 hectares of forest per year.



Source: FAOSTAT database

Desertification

Benin's semi-arid northern territories are vulnerable to desertification, with an estimated 50 per cent of lands already affected. Although periodic drought is a natural driver of this trend, agriculture is the primary human cause due to its role in deforestation, soil erosion, and pollution. In particular, the relative profitability of cotton, which accounts for 80 per cent of all export revenues in Benin (Brottem 2005), has resulted in increasingly intensive farming practices. In the north, cotton production is directly linked to widespread deforestation, chemical pollution by pesticides and fertilizers, and reduced soil fertility.

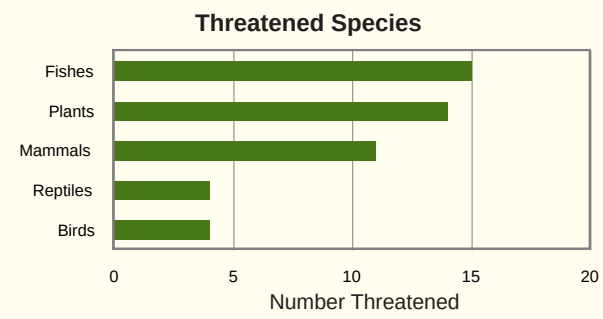


Source: FAOSTAT database

Threats to Biodiversity

Benin's diverse biological resources face a number of human threats, including agricultural expansion, uncontrolled use of bush fires for land clearing, and an increase in commercial poaching using automatic weapons. In the south, wetlands have been severely degraded and in the north, many large mammal species are endangered.

The "W" Biosphere Reserve, named after a double bend in the Niger River, is the first transboundary biosphere reserve in Africa, spanning Benin, Burkina Faso, and Niger. Covering more than one million hectares, the reserve is a buffer against advancing desertification from the north and hosts one of the largest populations of ungulates in West Africa. Endangered large mammal species in the reserve include cheetah, leopard, and spotted hyena.



Source: IUCN Red List

Dangbo

B E N I N

Ouémé

Porto Novo

Porto Novo Lagoon

Lake Nokoué

Akraké

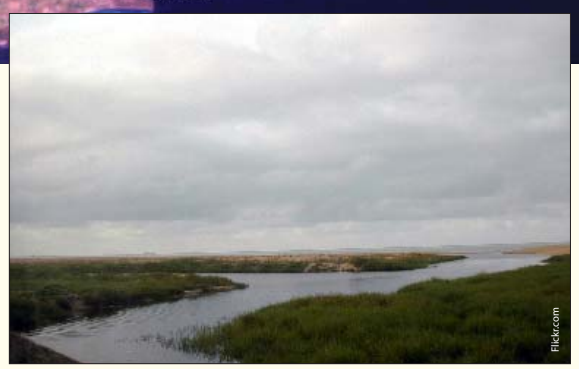
0 4 8 Kilometres

N

22 Jan 1986

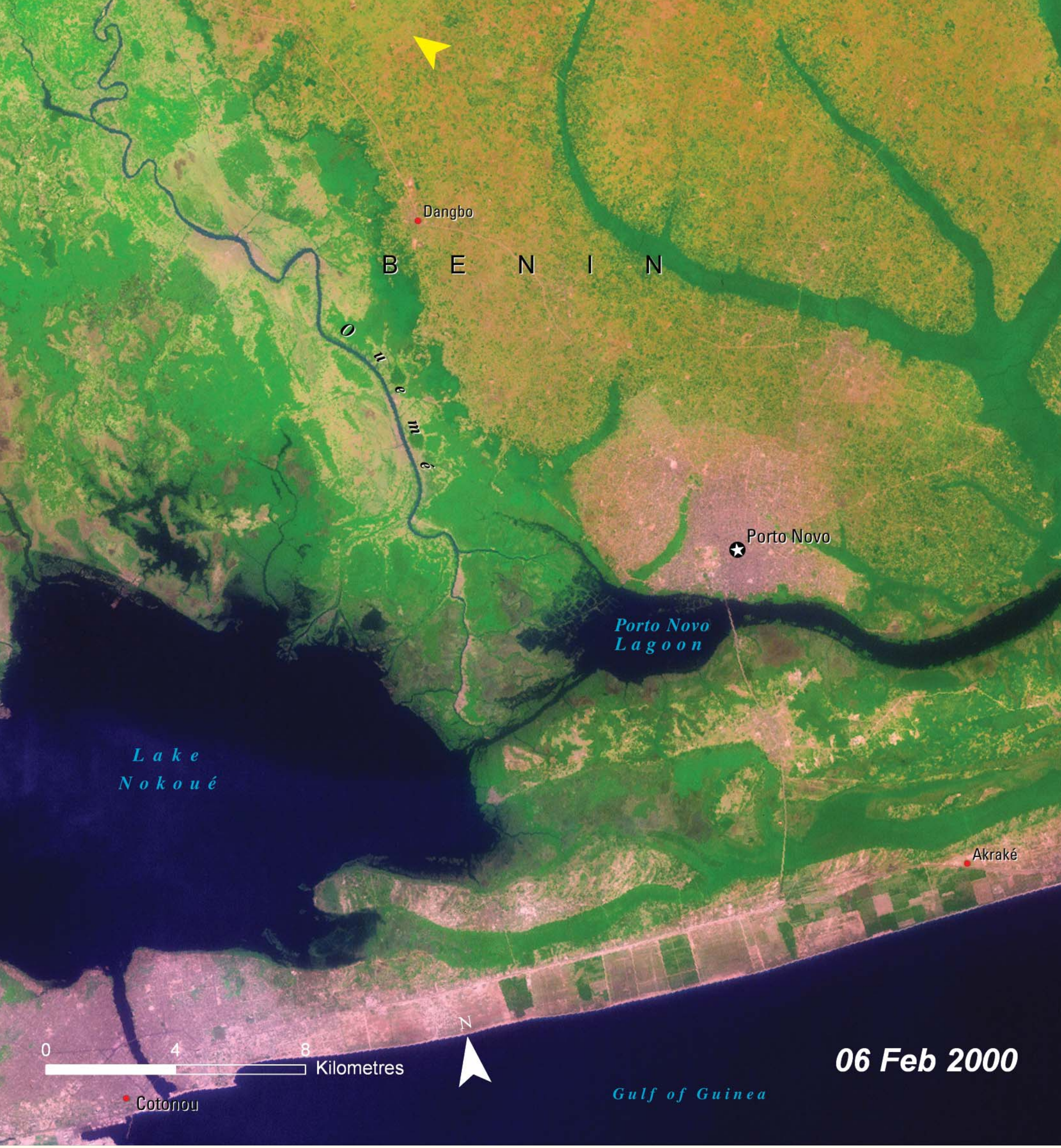
Gulf of Guinea

Cotonou

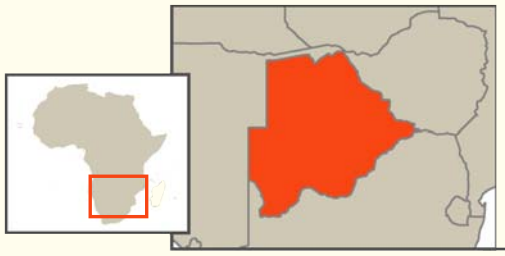


Deforestation: Ouemé Floodplain, Benin

Benin's capital city, Porto Novo, and its largest city, Cotonou, lie within the floodplain and watershed of the Ouemé River. They share this important water system with Lake Nokoué and Porto Novo lagoon. The Ouemé River is home to over 120 species of fish; the greatest concentration of the occurring in the lower reaches of the river basin. Almost all of them are used for human consumption. The wetlands in the system serve as important nursery and feeding grounds for many of these species. They are also important habitat for many of the 233 bird species found in Benin.



In addition to its biodiversity, the coastal zone plays a key role in the economy of Benin. Fishing, agriculture, and other economic activities within the coastal zone provide 70 per cent of the country's total GDP and livelihoods for much of Benin's population. Population pressure and the drive to boost the gross production from the coastal zone without proper environmental management threaten the integrity of the productive resource base and biodiversity resources. Illegal logging is a serious problem throughout the whole catchment. Between 1986 and 2000, dense forest in this area was reduced by more that 40 per cent. The 1986 image shows forested areas at the north-western edge of Lake Nokoué and north-eastern sections of the wetland system of Porto Novo lagoon. By 2000, some of the northern reserves had been decimated (yellow arrow).



Republic of Botswana

Total Surface Area: 581 730 km²
Estimated Population in 2006: 1 760 000

Botswana is a flat, landlocked country situated on the central plateau of southern Africa. The climate is generally semi-arid with variable rainfall and frequent droughts, particularly in the Kalahari (Kgalagadi) Desert in the western and central regions. Ninety-five per cent of Botswana's surface water resources are concentrated in the northwest corner of the country (FAO 2005) near the Okavango Delta, although the majority of the population lives in the east.

Important Environmental Issues

- Overgrazing and Desertification
- Water Scarcity and Urbanisation
- Wildlife of the Okavango Delta

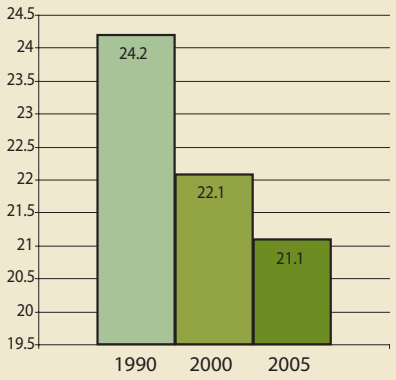
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

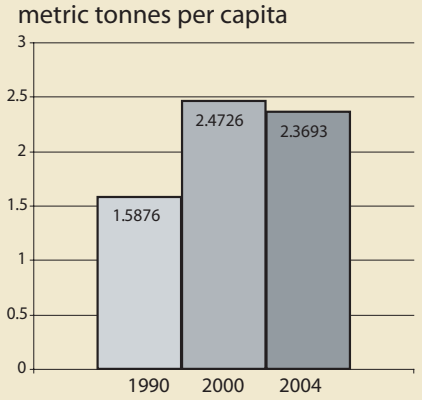
Nearly 68 per cent of the country is part of the Kalahari (Kgalagadi) Desert and periodic droughts exacerbate the water supply problem. About 90 per cent of Botswana is covered by some kind of savannah; however, overgrazing due to the rapid expansion of the cattle population is a continuing threat to vegetation and wildlife. While the country has a very limited water supply, Botswana shows a slight improvement in access to safe drinking water.

★ Indicates progress

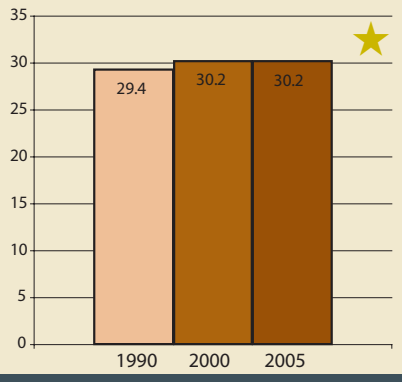
Land area covered by forest, percentage



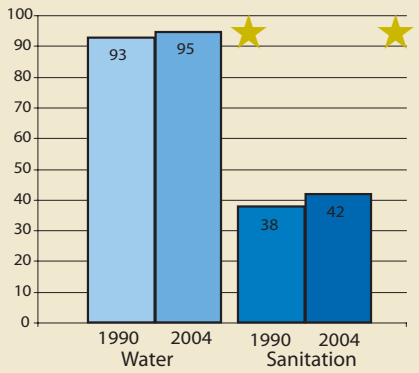
Carbon dioxide (CO_2) emissions, metric tonnes per capita



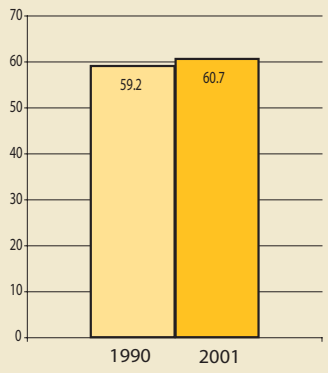
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

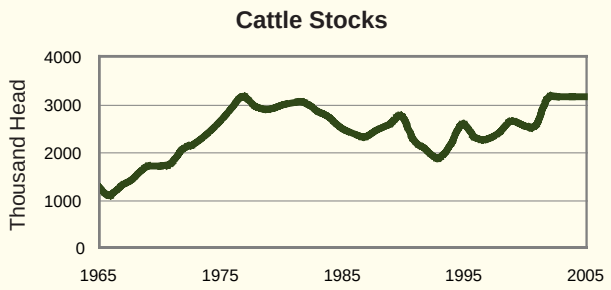


Botswana has the largest African elephant population in the world—estimated at over 133 829 in 2006. For every 14 people in Botswana, there is an elephant.

IUCN.org (n.d.); UN (2007)

Overgrazing and Desertification

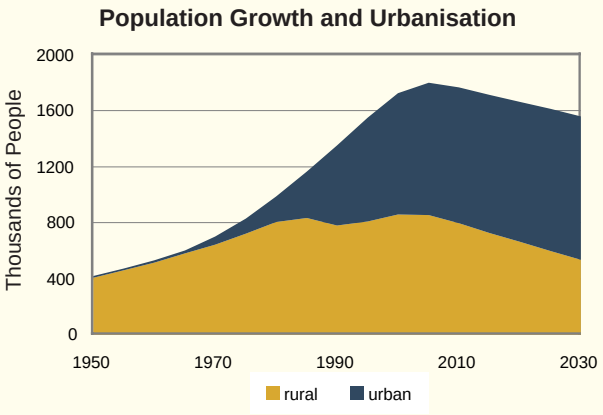
Due to naturally arid conditions and frequent droughts, Botswana is one of the countries in the Kalahari (Kgalagadi) region of southern Africa most at risk from desertification. Between 2000 and 2003, an estimated ten per cent of lands were already affected (UNCCD 2004). The major drivers of desertification are overgrazing and the creation of boreholes in semi-arid areas. Where water for livestock is limited, large numbers of cattle concentrate around boreholes, leading to localised overgrazing. In addition, significant growth in cattle stocks has forced pastoralists to expand westward into the Kalahari (Kgalagadi), leading to vegetation loss and erosion of marginal lands.



Source: FAOSTAT

Water Scarcity and Urbanisation

Botswana is poorly endowed with water resources and subject to frequent, severe drought, yet demand for water is increasing in all sectors. Groundwater accounts for two-thirds of all water consumption, but some underground aquifers are affected by natural salinity and others are threatened by pollution from livestock and human waste (FAO 2005). Water scarcity played a role in the decline of the agricultural sector from nearly 40 per cent of GDP in the 1960s to only 2.6 per cent in 2004 (FAO 2005). It is also a factor driving Botswana's rapid urbanisation. The proportion of people living in urban areas is expected to increase from 57 per cent in 2005 to over 70 per cent in 2030 (UNESA 2006).

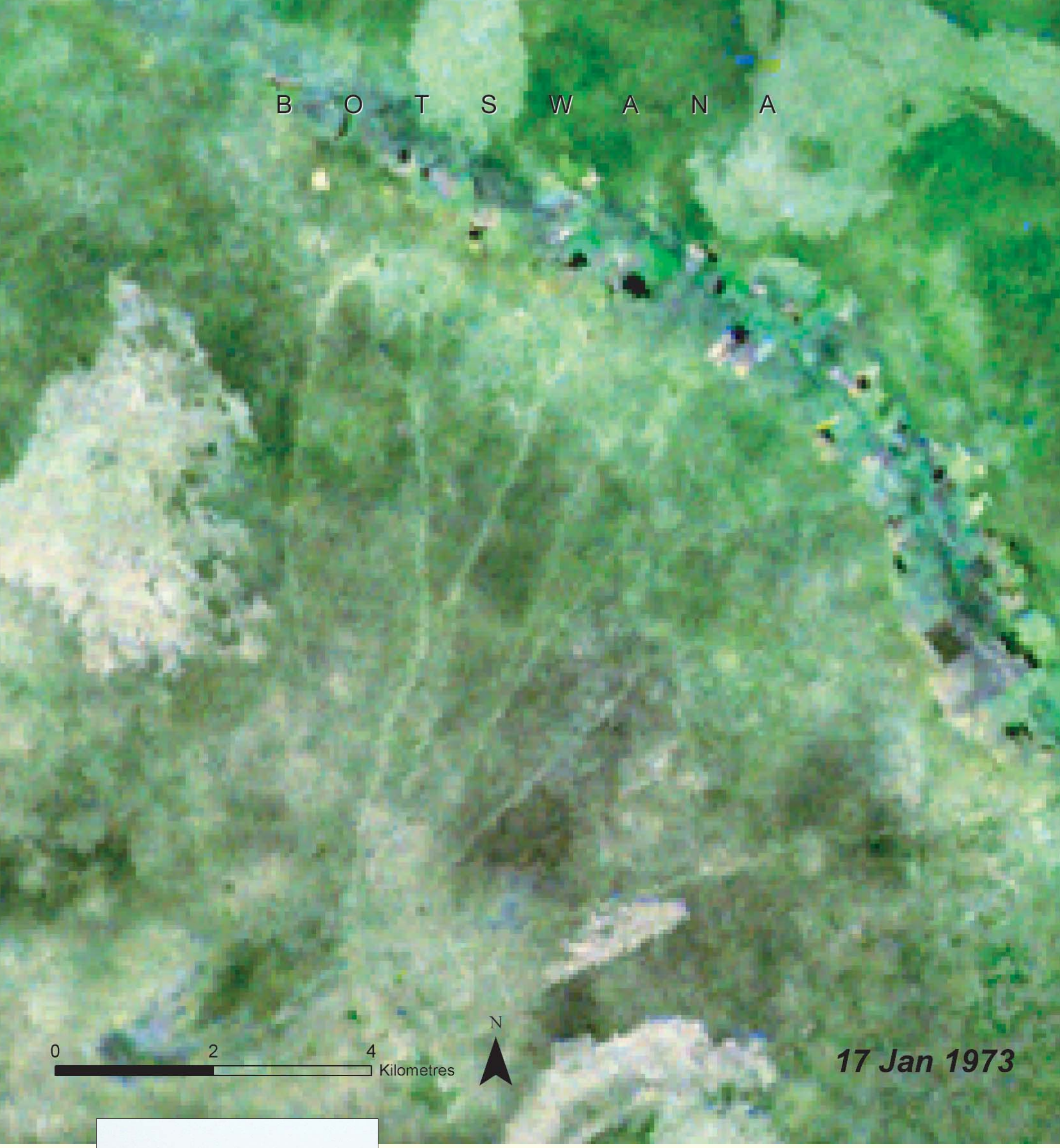


Source: UN Population Division, World Urbanization Prospects 2005 revision

Wildlife of the Okavango Delta

The Okavango Delta in northwest Botswana is one of the largest remaining inland wetland ecosystems in the world. It sustains over 2 000 plant species, 450 bird species, and 65 fish species associated with its 13-18 000 km² of permanent and seasonally inundated swampland (FAO 2005).

Land use conflict between wildlife and agriculture is a problem around the Delta and elsewhere in Botswana. Elephants, for example, now exceed 130 000 individuals and have surpassed the carrying capacity of their northern territory, especially along the Okavango Delta. This has resulted in the destruction of cropland and the depletion and degradation of resources that are important to rural livelihoods.



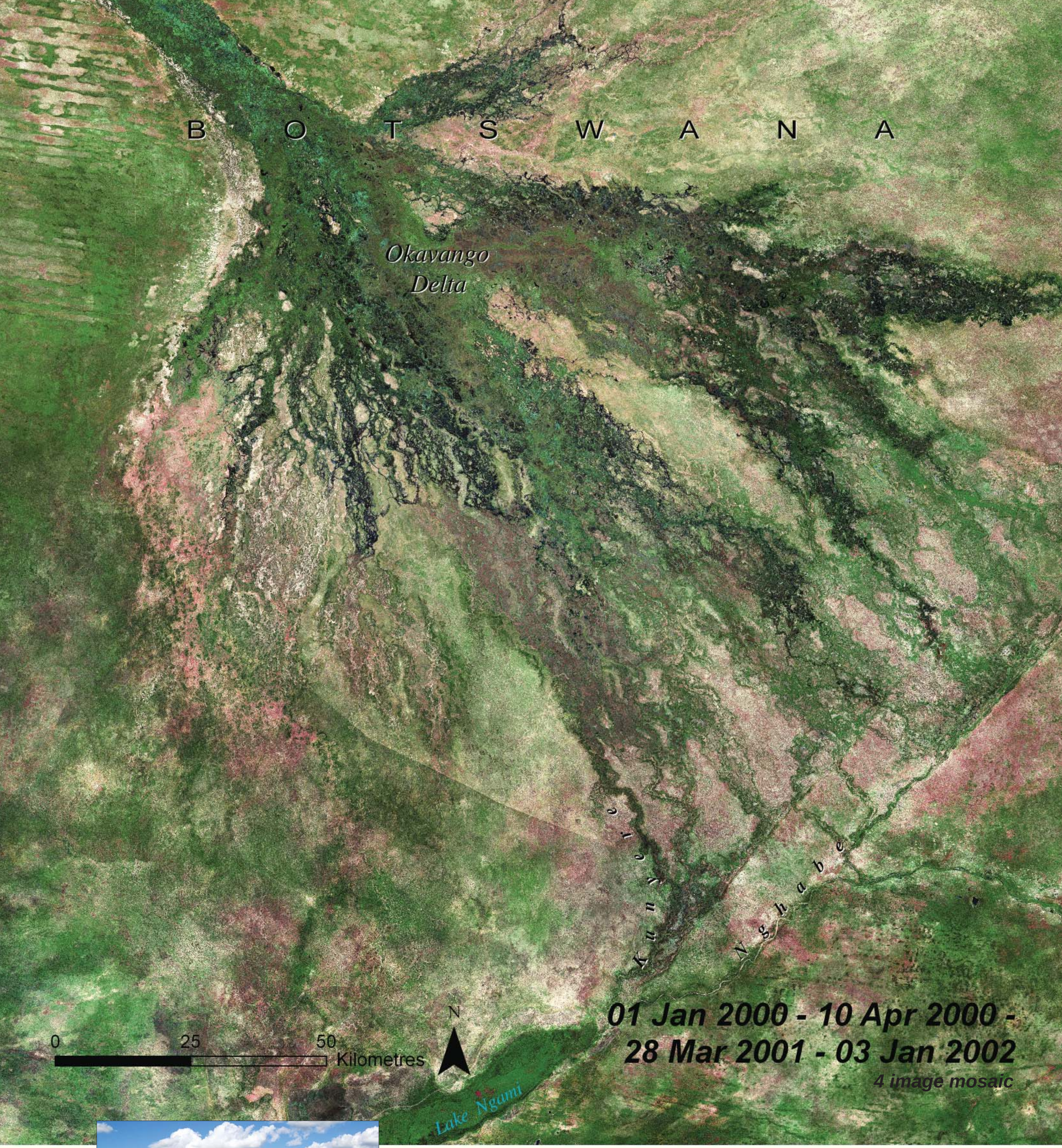
Jwaneng Diamond Mine: Botswana

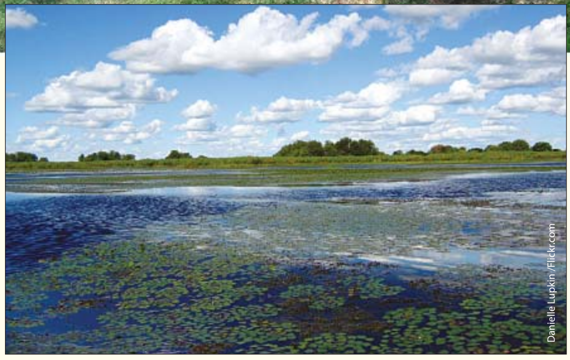
Botswana is the world's leading producer of gem-quality diamonds. The diamond industry accounts for 70 per cent of export earnings within the country. Diamond production in Botswana is dominated by Debswana, a joint venture company owned by De Beers Investments (50 per cent) and the Government of Botswana (50 per cent). The Jwaneng Diamond Mine is located in south-central Botswana about 170 km west of the city of Gaborone, in the Naledi River valley of the Kalahari (Kgalagedi).

Jwaneng is an open pit mine, dug over three kimberlite pipes (diamond-rich geological

formations) which converge near the surface, covering 520 000 m² at ground level. The mine annually produces 9.3 million metric tonnes of ore and an additional 37 million metric tonnes of waste rock. The high rate of diamond extraction, combined with high quality diamonds fetching top prices, make the Jwaneng Diamond Mine the richest diamond mine in the world by value of recovered diamonds.

Debswana has maintained a 5-star National Occupational Safety Association (NOSA) rating since 1986 and owns and operates a local hospital and airport. With over 2 100 employees, the Jwaneng mine is also the first Botswana company to receive International Standards Organization (ISO) 14001 certification in 2000, for environmental compliance. The 1973 image shows no signs of mining activity. The 2006 image shows the dramatic growth of the mine.

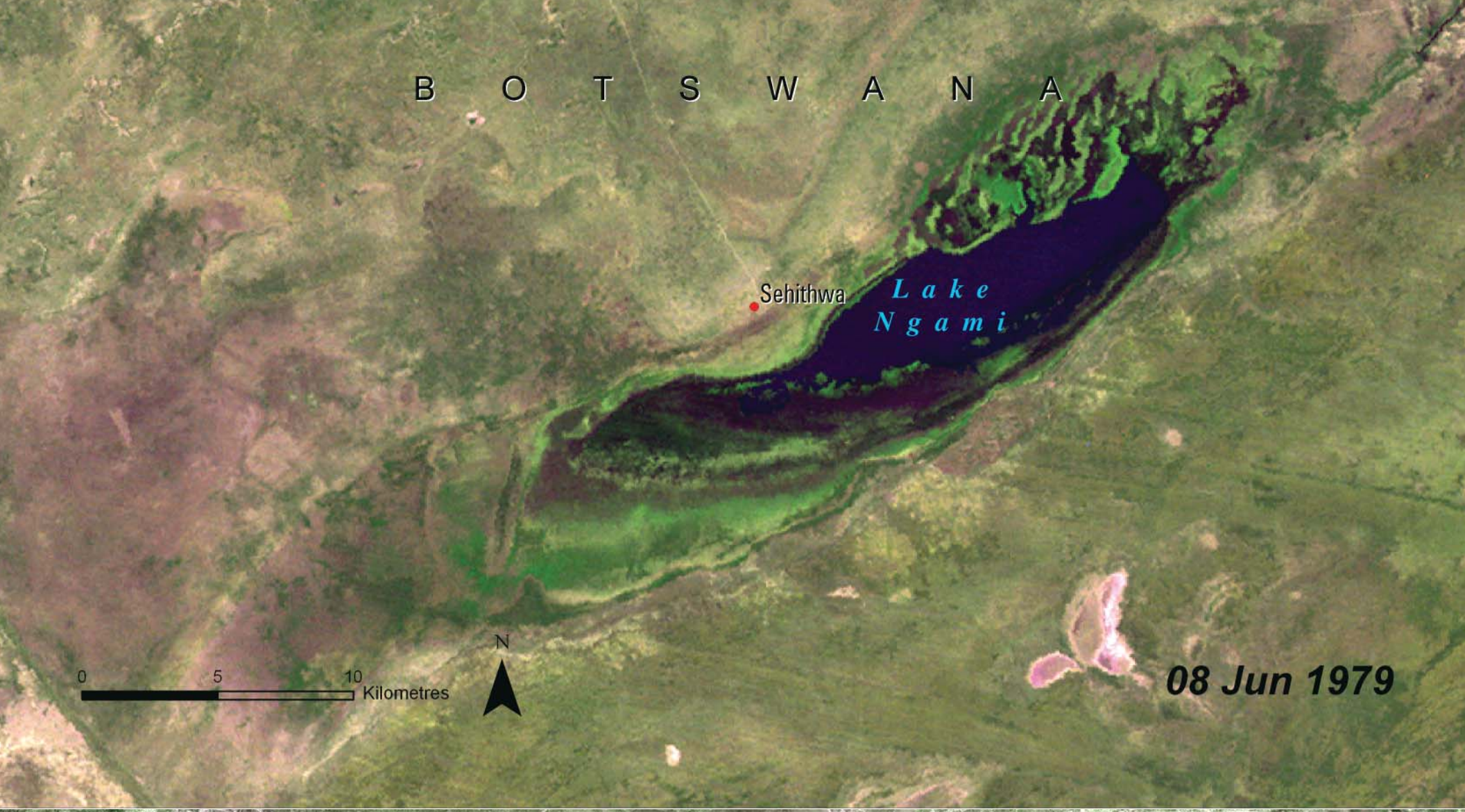


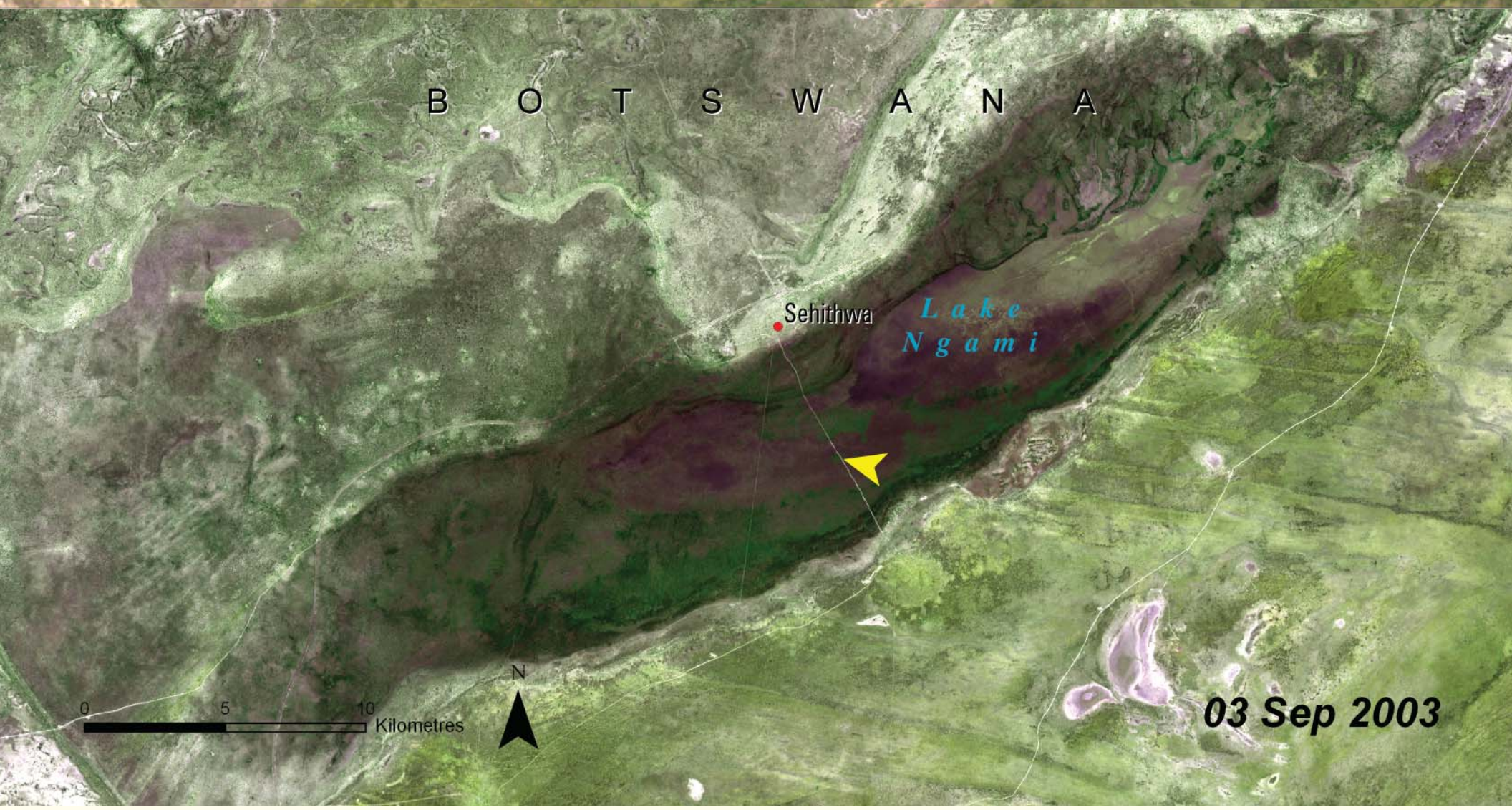


Threatened Waters: Okavango Delta, Botswana

The vast stretches of grassland, wetland, and open water of the Okavango Delta are home to a variety of wildlife and vegetation as well as several native tribes. Although the Okavango ecosystem is considered one of the wonders of the world and attracts tourists from all over the globe, it faces several significant threats.

Proposed upstream water projects are among these threats. The Okavango River originates in the highlands of east-central Angola and brings the flood waters and sediment necessary to maintain the dynamic flooding of the delta. Upstream dams could trap much of this





sediment, causing the river's channels to erode. These deeper channels would likely become established as the few permanent channels, thereby depriving vast areas of life-sustaining floods. Nevertheless, there is increasing pressure to divert water from the river for agriculture in Namibia and Angola.

At the southernmost tip of the Okavango Delta lies Lake Ngami, a significant breeding ground for birds. Historical records and recent satellite data suggest the lake has declined significantly over the past 150 years. For roughly the last century the lake has been fed primarily by flood waters that make it through the wetland into the Kunyere and Nghabe Rivers. Should flooding decrease or cease in the delta, the lake would likely dry up entirely. Decreasing water levels have already led to a paved road across a part of the lake which has been dry for several years (yellow arrow).

Burkina Faso

Total Surface Area: 274 000 km²
Estimated Population in 2006: 13 634 000

Burkina Faso is a landlocked country within the arid savannah belt of the Sahel, just south of the Sahara Desert. The tropical dry climate becomes increasingly arid to the north, with rainfall arriving during one wet season. Year to year, precipitation is highly variable, resulting in frequent droughts since the 1970s. Population density is relatively low, with the exception of the central plateau area, which is also the most agriculturally productive region.

Important Environmental Issues

- Water Scarcity
- Land Degradation and Desertification
- Deforestation

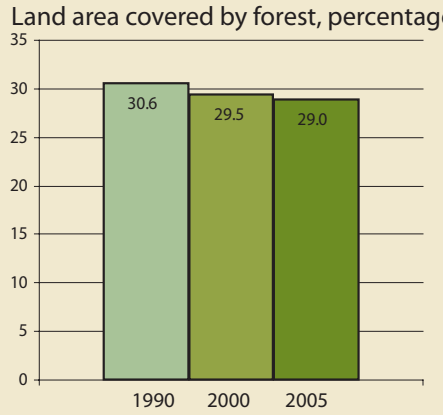
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

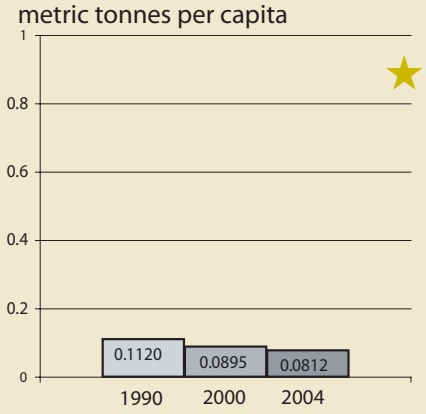
Major environmental problems facing Burkina Faso are recurrent drought, which contributes to the nation's water supply problems, and the advance of the northern desert into the savannah as a result of overgrazing of pasture, slash-and-burn agriculture, and overcutting of wood for fuel. Apart from a 1.6 per cent decrease in forested area between 1990 and 2005, all other environmental indicators of Burkina Faso show signs of improvement.

★ Indicates progress

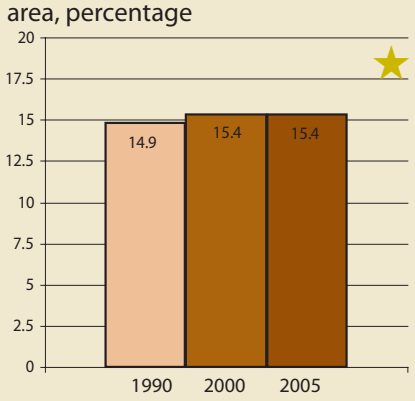
Land area covered by forest, percentage



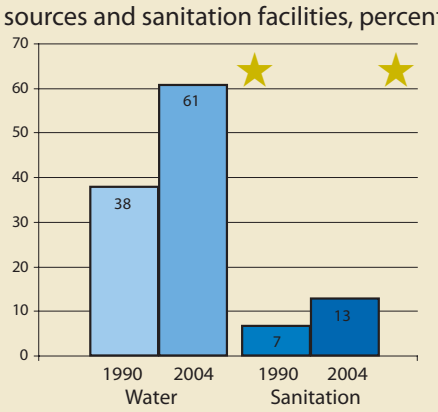
Carbon dioxide (CO_2) emissions, metric tonnes per capita



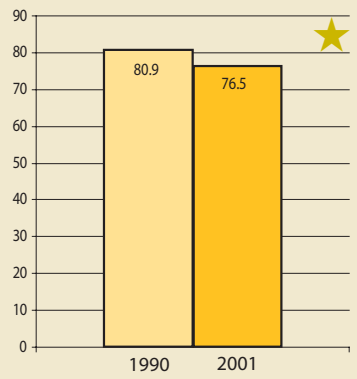
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

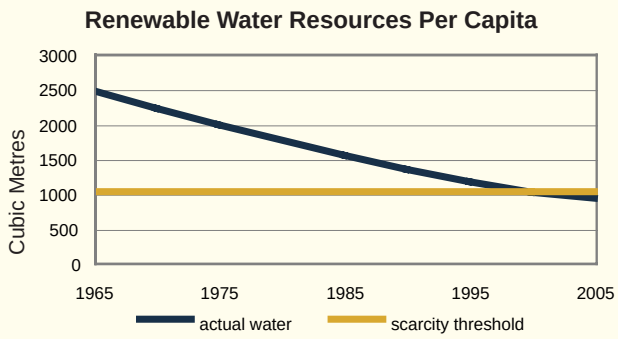


Burkina Faso's parks protect the largest elephant population in West Africa.

Water Scarcity

Burkina Faso is a water scarce country with only 906 m^3 of freshwater available per person per year (FAO 2007). Seasonal variation in water availability is large and droughts frequently devastate rural areas. In 2003, the water supply in the capital city of Ouagadougou could only meet about 70 per cent of demand (UN 2003), yet the urban population continues to grow at five per cent per year.

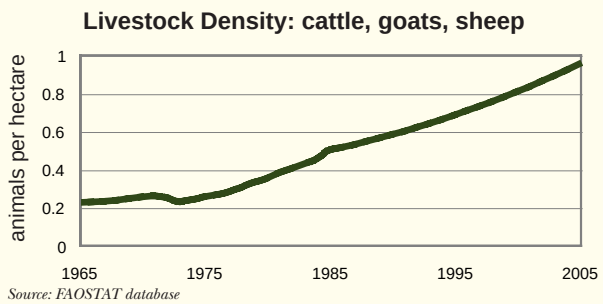
To manage its scarce water resources, Burkina Faso has a network of roughly 2 100 dams (International Small Hydro-Atlas n.d.) built mostly in rural areas to harvest rain water runoff. These dams provide important local protection against drought, extend the crop season, and create a year-round domestic water source. The Ziga Dam outside of Ougadougou, which was scheduled for completion in 2007, is expected to relieve some of the city's current water deficit (ADB 2006).



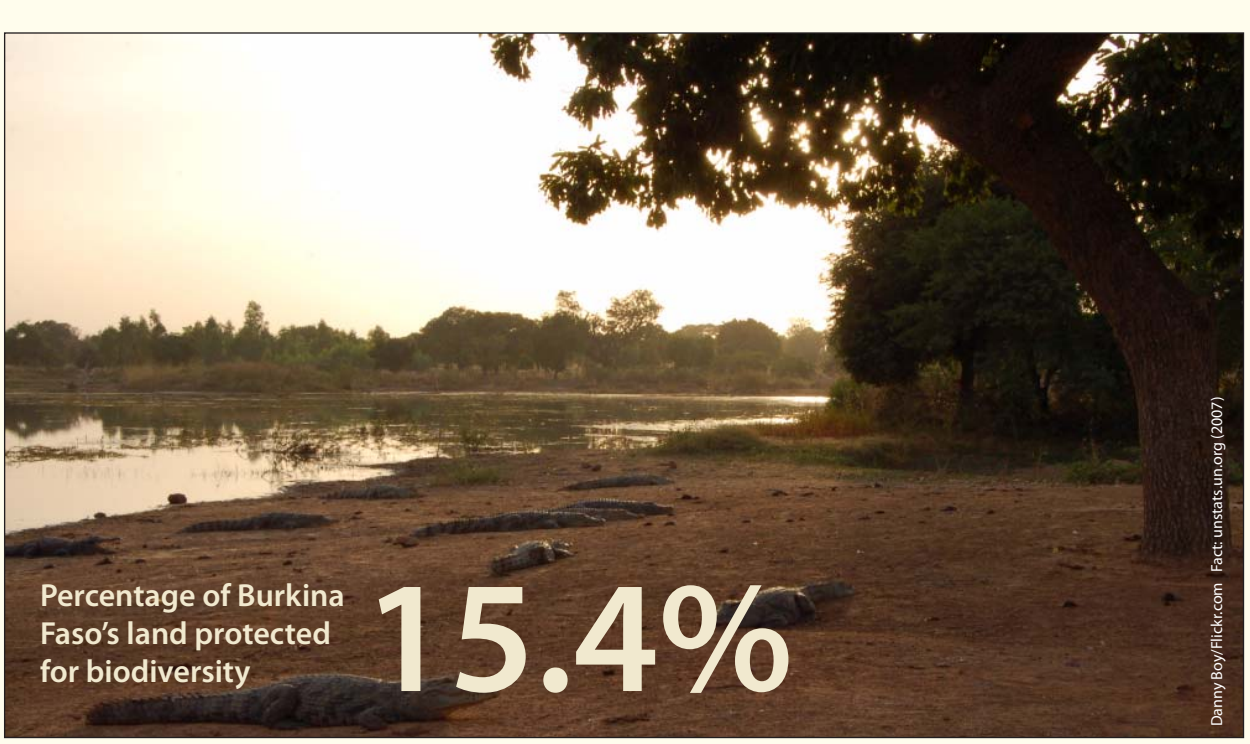
Source: AQUASTAT

Land Degradation and Desertification

Intensive cultivation and overgrazing in Burkina Faso threatens some of the country's most agriculturally productive regions with desertification; almost 90 per cent of lands are at risk (FAO AGL 2003). Agriculture accounts for 92 per cent of employment, which is the highest proportion in Africa, and approximately one-third of GDP (FAO 2005). Due to population growth, the cultivated area has more than doubled since 1961 at the expense of fallow, marginal, and previously unutilized areas, putting pressure on already fragile soils and limited water resources. Other drivers of desertification in Burkina Faso include bush fires, which ravage thousands of hectares of land each year, and recurrent drought.

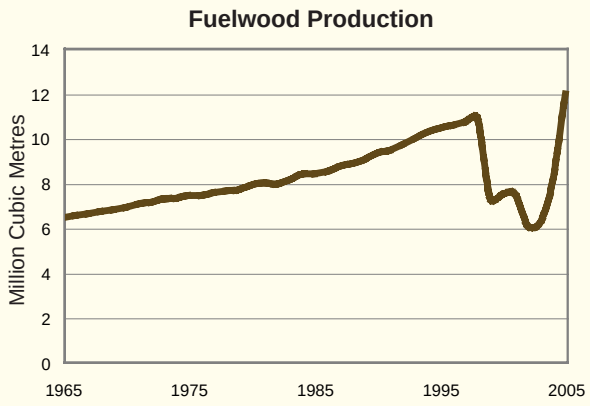


Source: FAOSTAT database



Deforestation

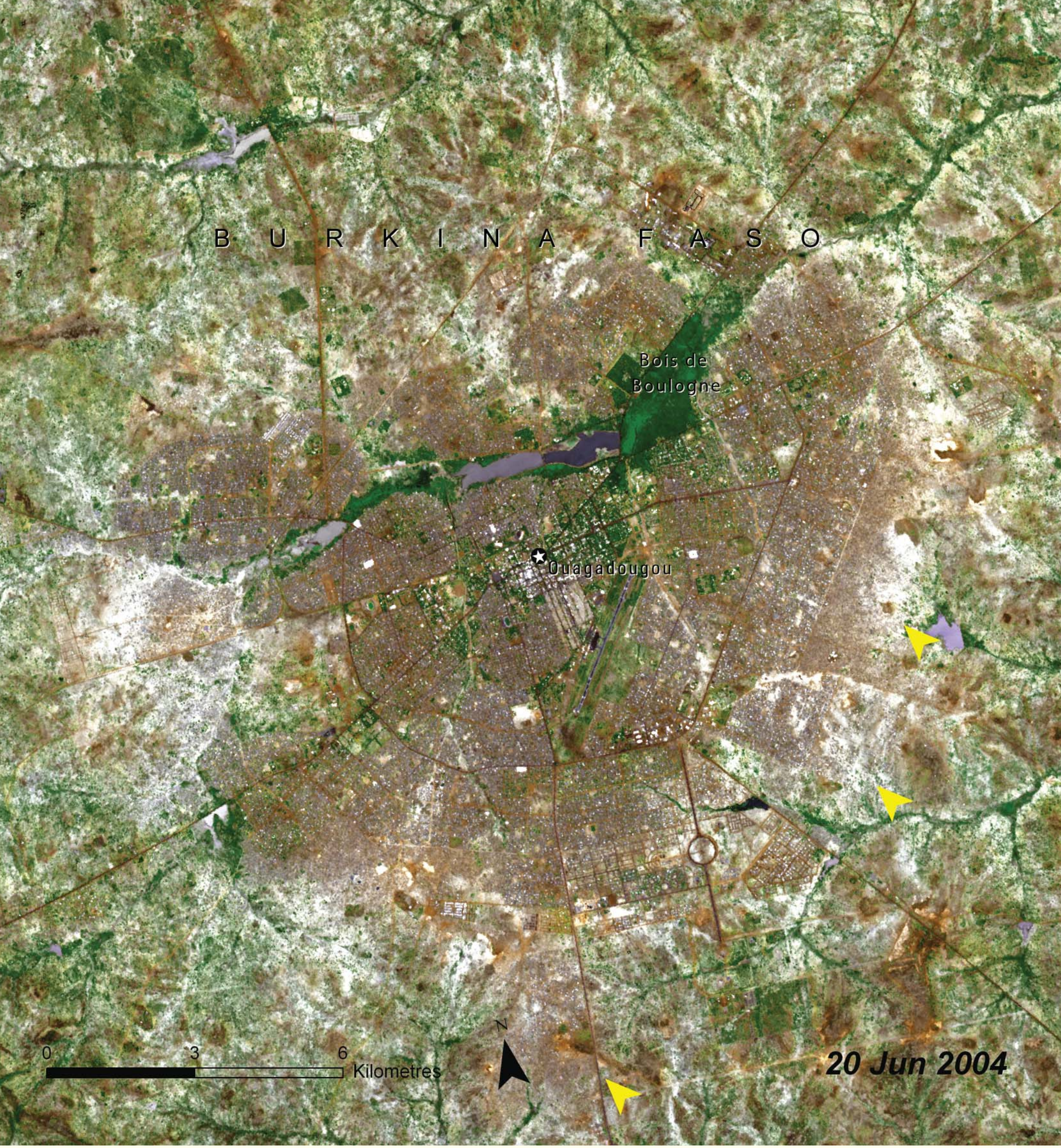
Forests cover nearly one-third of Burkina Faso's surface area and satisfy approximately 90 per cent of domestic energy needs (UNCCD 2000). Due to population growth, fuelwood harvesting has increased by almost 30 per cent since 1990 (FAO 2007), resulting in depletion of forest resources near population centres. In the capital city of Ougadougou, for example, fuelwood is now harvested from 150 km away (FAO 2003). However, overall forest cover has remained relatively stable, declining by less than two per cent between 1990 and 2005 (UN 2007). This is largely thanks to ambitious reforestation initiatives and the introduction of efficient fuelwood stoves.



Source: FAOSTAT database

Unplanned Settlements: Ouagadougou, Burkina Faso

Urban population in Burkina Faso grew 200 per cent between 1975 and 2000 and is projected to continue expanding at a similar pace over the next quarter century. The capital, Ouagadougou, is home to approximately 40 per cent of Burkina Faso's rapidly growing urban population, with 1.2 million residents in 2003. In the 1980s, much of Ouagadougou's growth was the result of rural to urban migration of young people; however, by the mid-1990s natural growth had become the main factor.



In spite of government attempts to manage it, much of the residential growth in Ouagadougou has occurred in unplanned settlements at the periphery of the city. Because of the sprawling nature of these settlements, the city occupied 14 times more area in 1993 than it had only 33 years earlier. By the early 1980s, 60 per cent of the urban area was occupied by unplanned settlement. Much of this growth was concentrated in the south to southwest perimeter, a trend already apparent in the 1986 image (yellow arrows). The 2004 image shows more recent growth has been concentrated in the south and east (yellow arrows).

Unplanned settlements limit future possibilities for planned development and further complicate delivery of basic services. The problem of an insufficient water supply is already being heavily felt. In addition, space used for these settlements is lost to other uses, including agriculture and wildlife habitat.

BURKINA FASO

Ouamou Hunting Concession

Pagou- Tanuougou Hunting Concession

Singou Reserve

Singou

Arly Reserve

Pama Partial Reserve

Arly Partial Reserve

Madjori Reserve

Pendjari National Park

Pendjari

Ouaie

BENIN

0 10 20 Kilometres

N

10 Nov 1972 - 06 Oct 1973

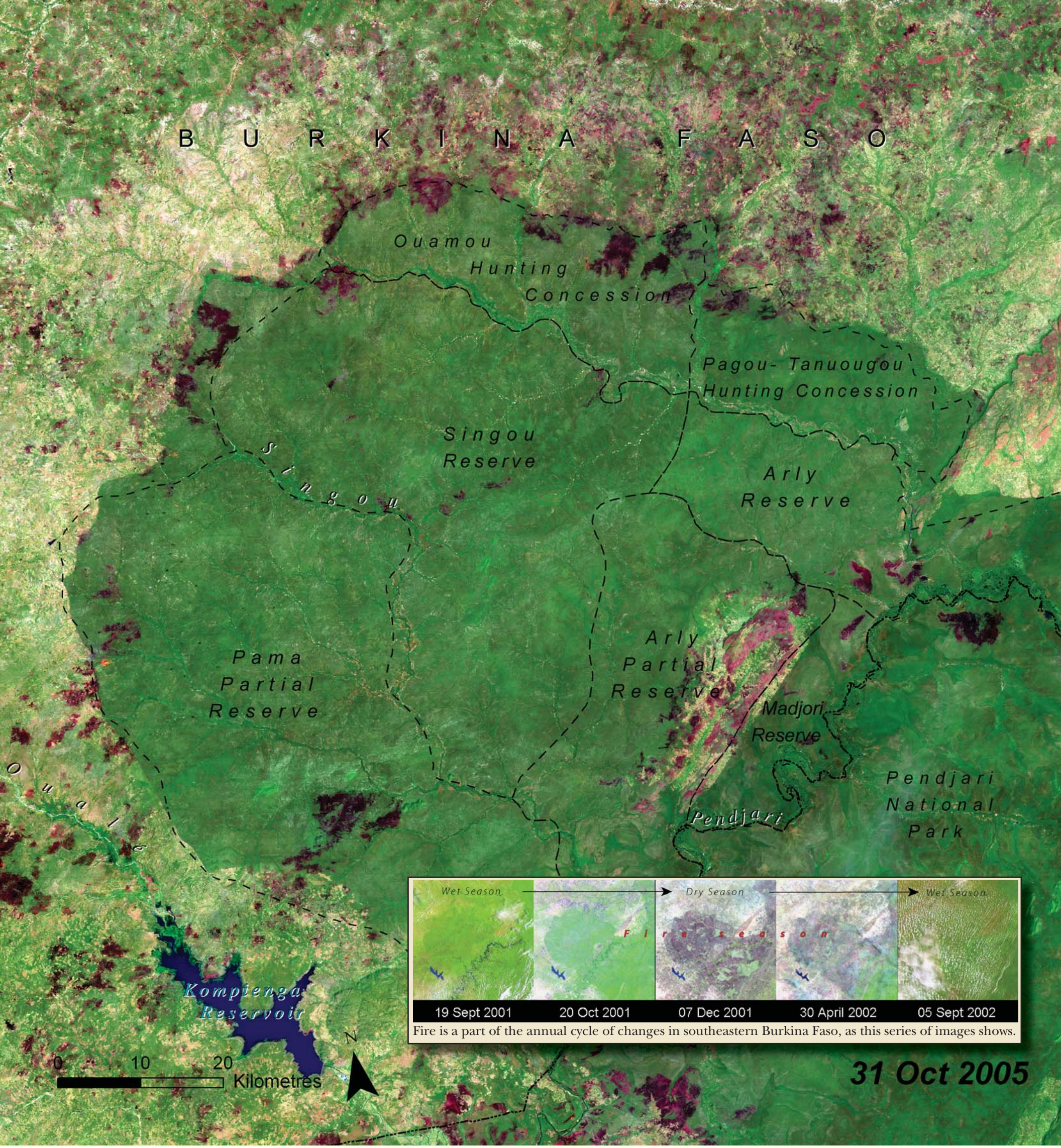
2 image mosaic

Permission Pending/Photoshare

Protection of W National Park: Burkina Faso

"W" National Park in Burkina Faso is part of the W-Arly-Pendjari Complex, a transboundary network of protected areas, which, taken together, are the largest and most important continuum of ecosystems in the West African savannah. The complex's varied habitat is home to approximately 544 different plant species, 360 bird species, and more than 50 species of mammals including elephants and hippopotamuses.

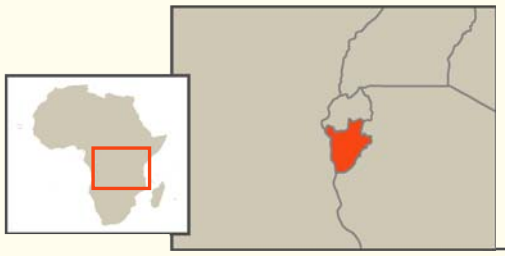
Partial eradication of the black and tsetse flies (carriers of river blindness and sleeping sickness), an influx of transhumant pastoralists due to Sahelian droughts, and government



Fire is a part of the annual cycle of changes in southeastern Burkina Faso, as this series of images shows.

promotion of cotton growing, led to a regional population explosion in the late 1970s. Nevertheless, human population in and around the Park remains relatively low, which, along with its protected status, has kept it the most pristine of Burkina Faso's protected areas.

In the early 1970s image, the boundary of the Park and surrounding protected areas is indistinguishable from adjacent lands. By 2005, areas of contrasting land use are easily visible, as is the Kompienga Reservoir. Built in 1989, the dam is a source of water for irrigated agriculture as well as a fishery. Also visible in the 2005 image are scattered burn scars (dark reddish purple patches) as the dry season begins. Burning across most of the area is an annual occurrence.



Republic of Burundi

Total Surface Area: 27 834 km²
Estimated Population in 2006: 7 834 000

Burundi is one of Africa's smallest countries and has the second-highest population density on the continent. Its landscape is hilly and mountainous; differences in elevation lead to wide variations in rainfall and climate. The country is divided between the Nile and Congo Basins, which feed the Nile and Congo Rivers—the two longest rivers in Africa. Burundi has substantial surface water resources in the form of many rivers, lakes, and wetlands.

Important Environmental Issues

- Land Availability and Degradation
- Deforestation
- Lake Tanganyika Ecosystems and Fisheries

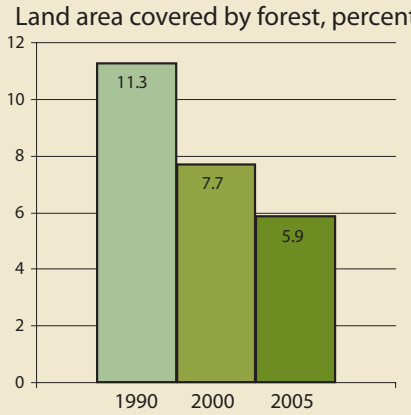
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

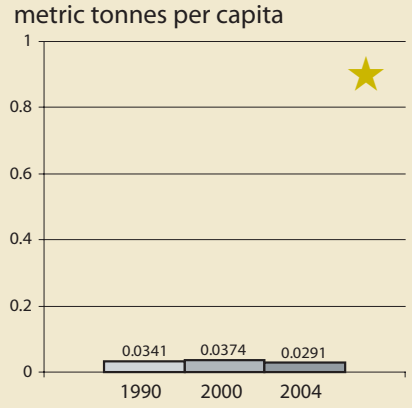
Burundi experienced an almost 50 per cent decrease in forested area from 1990-2005, which could have been the result of uncontrolled cutting of forests for fuel, despite legislation requiring permits. Burundi also has difficulty maintaining the purity of its water supply, a problem that contributes to deteriorating sanitation.

★ Indicates progress

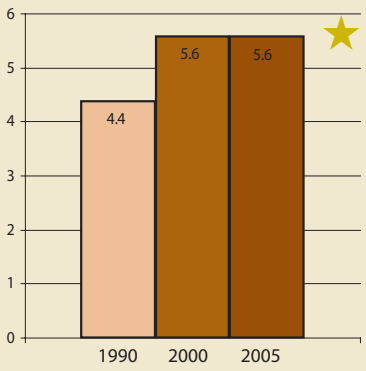
Land area covered by forest, percentage



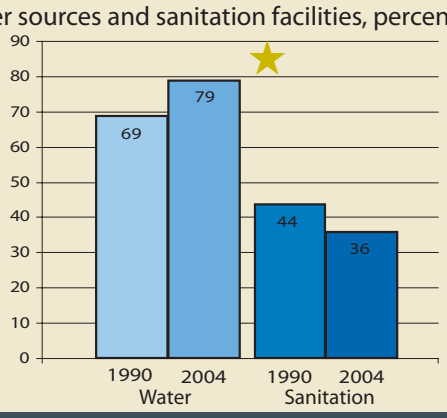
Carbon dioxide (CO_2) emissions, metric tonnes per capita



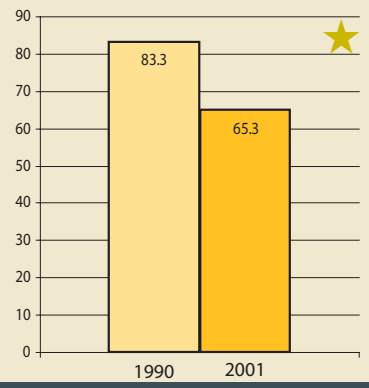
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban



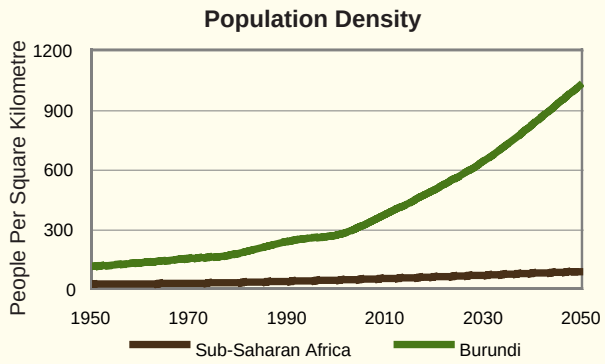
Lake Tanganyika, a remarkable 676 km long, is also the second deepest lake (after Lake Baikal) in the world at 1 471 m deep.

nps.gov (n.d)

Land Availability and Degradation

Burundi is densely populated with approximately 317 people per square kilometre, and the population continues to grow rapidly at three per cent per year (UNESA 2005). Over 90 per cent of the population resides in rural areas, making Burundi the least urbanised African country (UNESA 2006).

Despite low availability of arable land relative to other African countries, agriculture accounts for 90 per cent of the labour force (FAO 2006a) and 51 per cent of GDP (World Bank 2007). Roughly 91 per cent of the total land area is already being utilized for crops or livestock (FAO 2006b), and intensive cultivation has led to severe soil erosion on Burundi's naturally steep terrain. Seventy-six per cent of land is considered to be severely degraded (FAO AGL 2003).

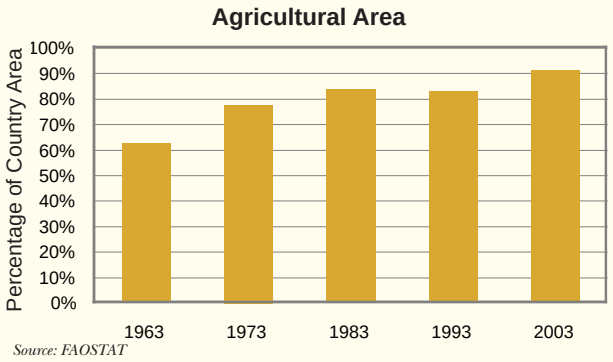


Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat

Deforestation

Burundi has the highest rate of deforestation in Africa, having lost 5.2 per cent of its forest cover annually between 2000 and 2005 (FAO 2005). Only six per cent of the country is now forested (UN 2007) a result of land conversion for crops and grazing and heavy reliance on wood for fuel; approximately 95 per cent of the population harvest fuelwood for their primary energy source (FAO AGL 2003).

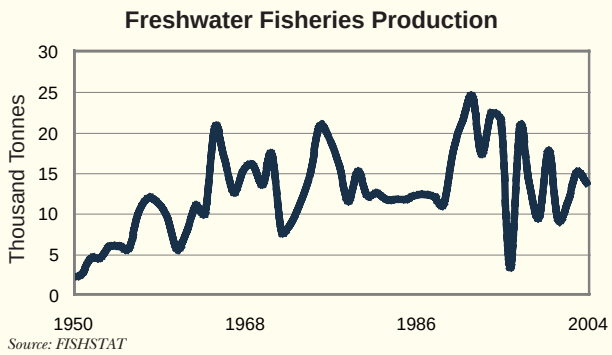
Deforestation has impacted Burundi's diverse biological resources and ecosystems, and has contributed to the extirpation of both gorillas and elephants. Soil erosion from deforestation has caused siltation of rivers, lakes, and wetlands, threatening both aquatic ecosystems and freshwater supplies.



Source: FAOSTAT

Lake Tanganyika Ecosystems and Fisheries

Burundi shares all three of its major lakes with neighboring countries. One of these is Lake Tanganyika, one of the oldest lakes in Africa's Rift Valley (Jorgensen and others 2005). Of 308 identified native fish species in the lake, 238 are endemic (FAO n.d.).



Source: FISHSTAT

Lake Tanganyika is also the heart of Burundi's fishing industry, providing a vital source of income and protein for many people. However, fishing has intensified in recent decades, leading to a dramatic expansion of human settlements around the lake as well as concerns of over-fishing. Furthermore, deforestation in the region has accelerated siltation of lake waters, and waste discharge from the capital city of Bujumbura is a significant source of pollution.

DEMOCRATIC

REPUBLIC

OF THE

CONGO

B U R U N D I

Ruzizi

Gatumba

Bujumbura

Lake Tanganyika

0 5 10 Kilometres

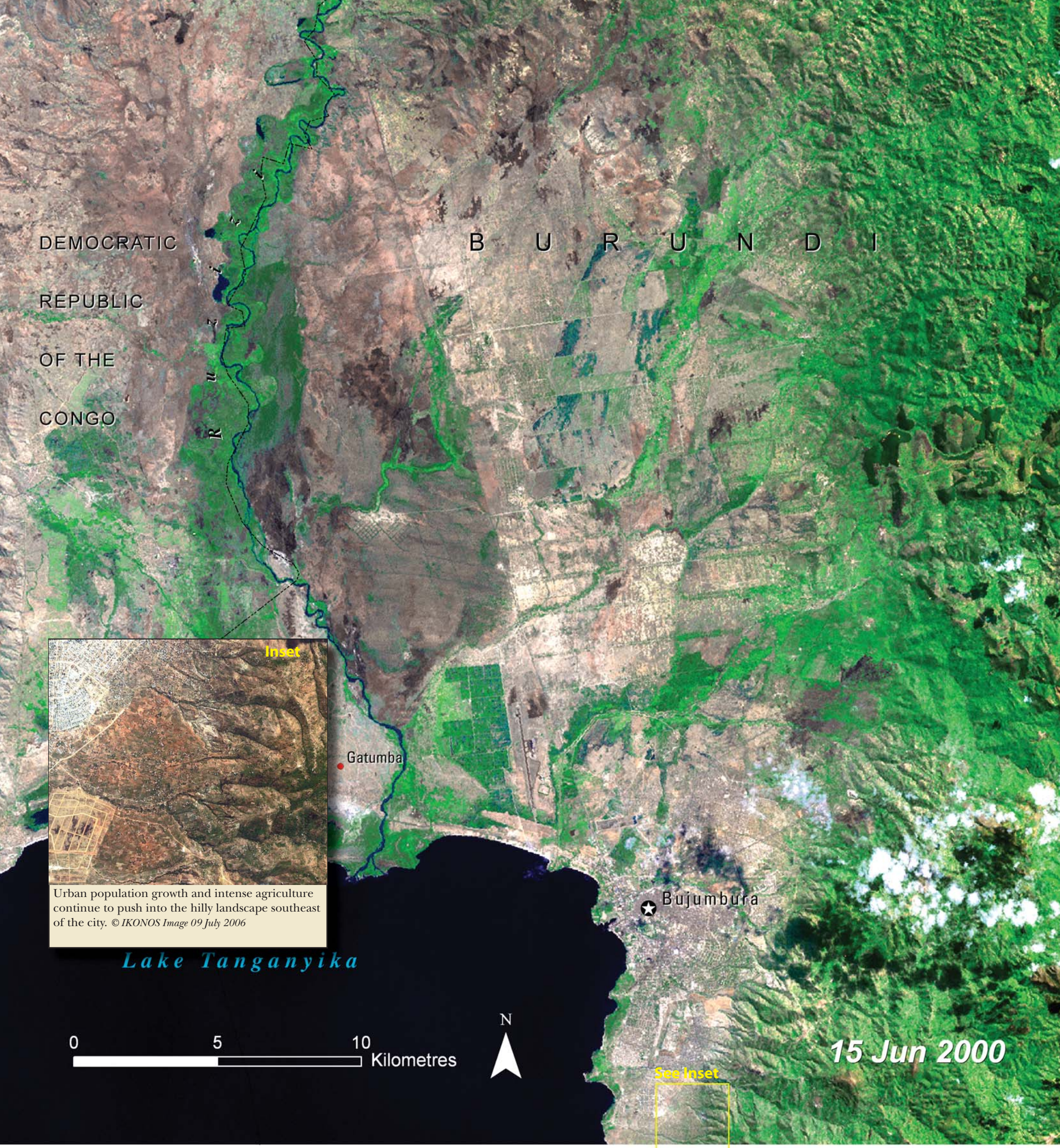
N

06 Jun 1979

Agriculture and Urban Expansion: Bujumbura, Burundi

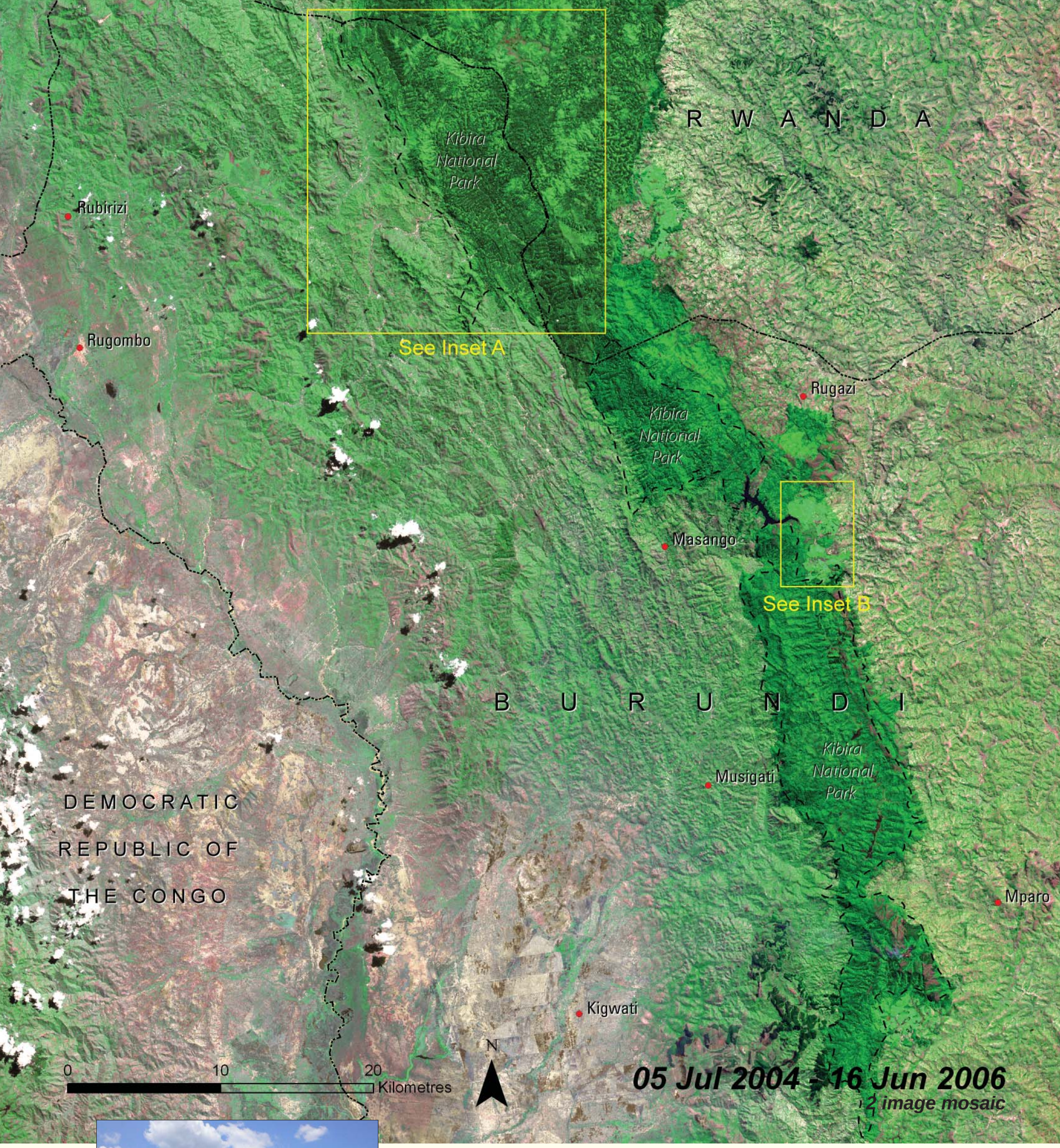
With 91 per cent of its people living in rural areas, Burundi is one of the most rural nations in Africa. It is also the second most densely populated. Approximately 90 per cent of the work force relies on agriculture, the vast majority being subsistence farmers. Some of the most intense agriculture in Burundi surrounds the growing capital of Bujumbura.

A comparison of 1979 and 2000 satellite images shows the expansion of agriculture around the capital. The high-resolution satellite image (inset) shows the interface between the southeast edge of the city and surrounding farms.



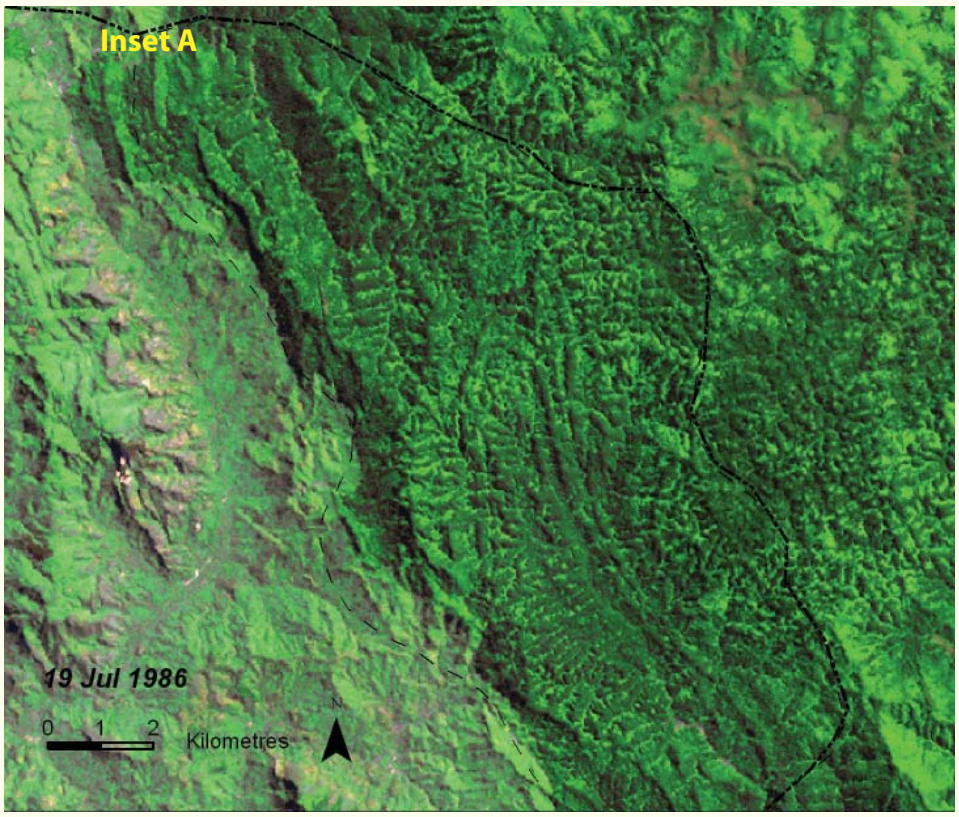
Urban population growth and intense agriculture continue to push into the hilly landscape southeast of the city. *© IKONOS Image 09 July 2006*

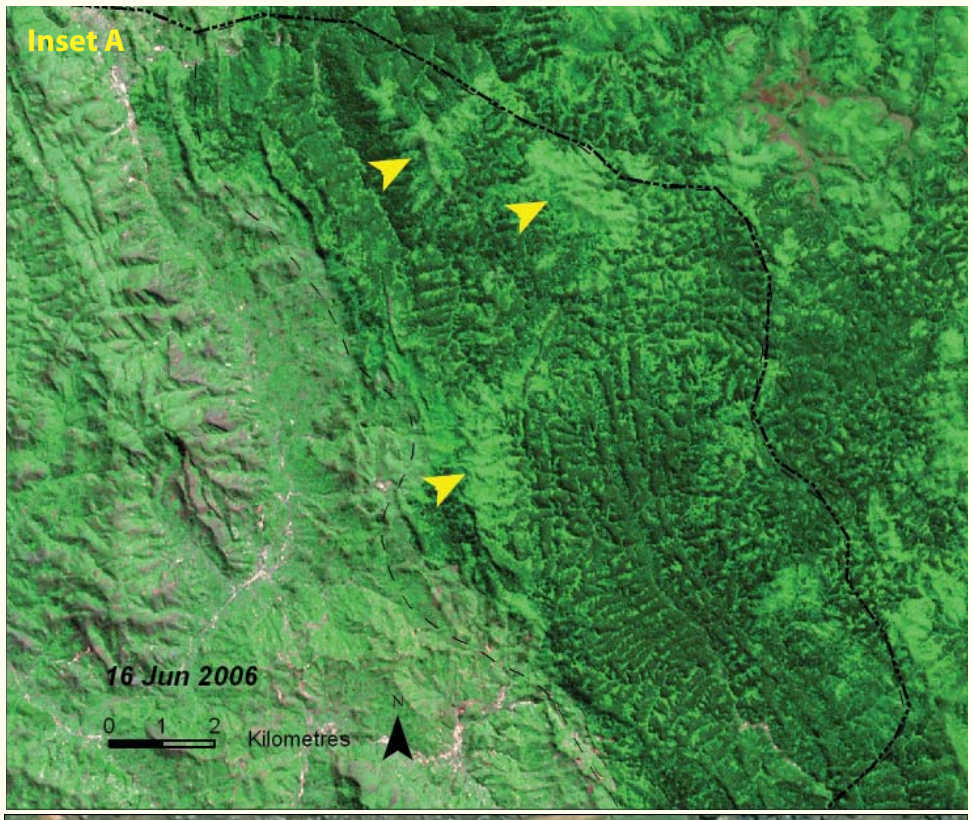
Adequate rainfall and good soils have historically made Burundi self-sufficient in food production. However, many areas in Burundi are considered unfit for cultivation. Scarcity of land will continue to put pressure on farmers to cultivate unsuitable lands. Burundi's domesticated land use has been measured at 86 per cent; a country is generally considered to be "land scarce" when 70 per cent or more of its land is used. Better agricultural practices could improve productivity and might relieve some of the pressure to convert additional unsuitable land to agriculture.

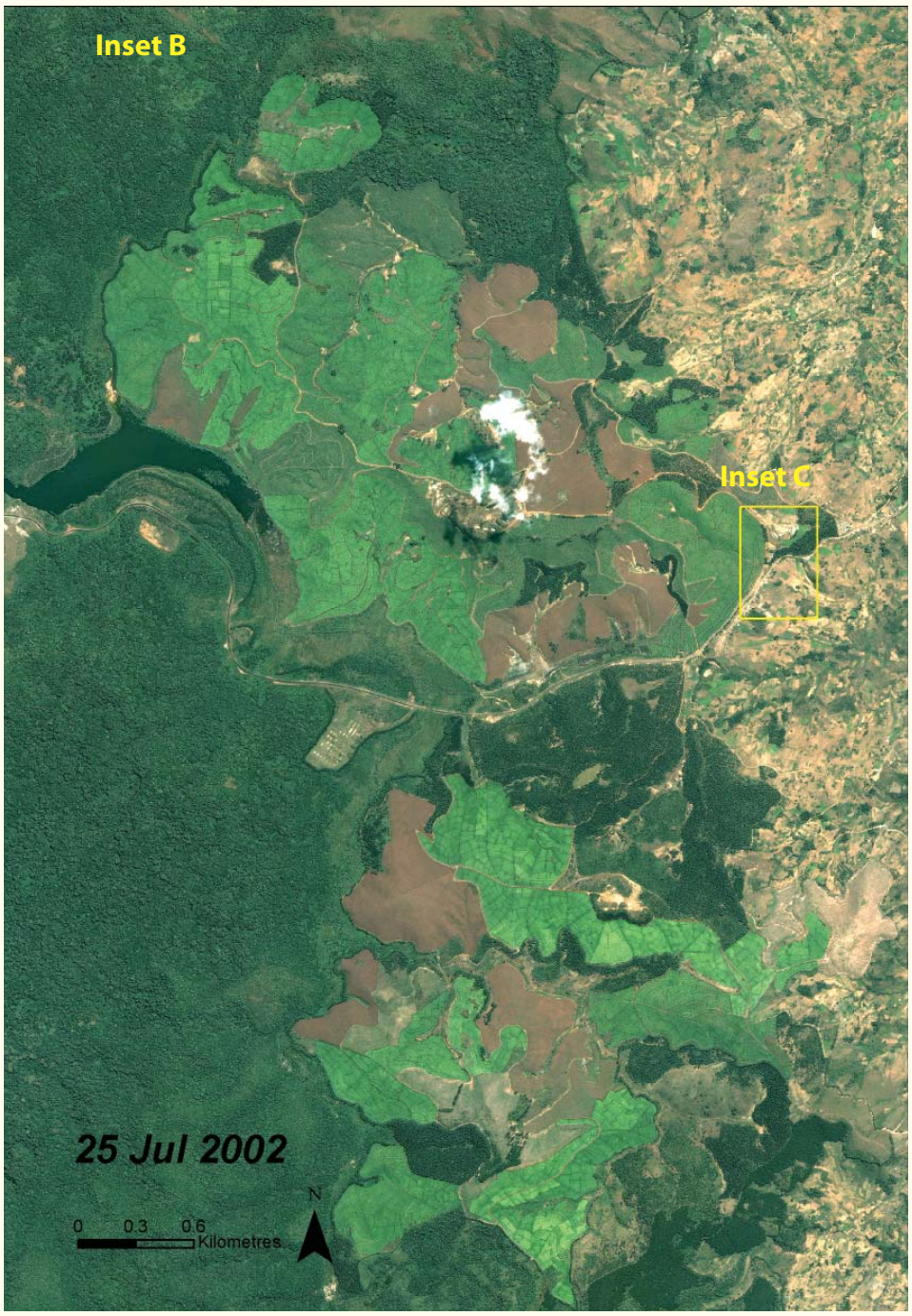


An Island of Biodiversity: Kibira Forest, Burundi

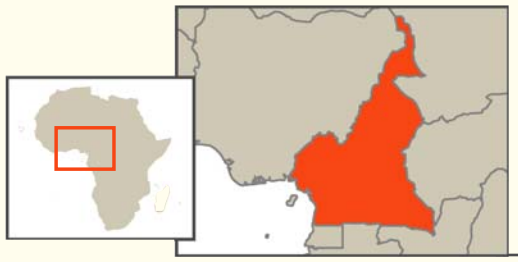
Uncontrolled cutting of trees for fuelwood coupled with land clearing for agriculture and grazing in Burundi has resulted in profound deforestation—as much as 47 per cent of the country's forest cover has disappeared since 1990. Along the mountains dividing the Congo and Nile River Basins is Kibira Forest, Burundi's only montane rain forest. This 40 000-hectare forest and national park is home to 644 plant species including the threatened African mahogany species, *Entandrophragma excelsum*, as well as 98 mammal and roughly 200 bird species. Kibira is also the source for 75 per cent of the water driving the country's largest hydroelectric dam.







The 2004/2006 image at left shows Kibira Forest as an island of green in a largely deforested landscape. The high-resolution images (lower right) show how agriculture—large and small—is closing in on the forest boundaries. While the forest is a national park, it faces continued pressure from legal and illegal cutting of trees, cutting of bamboo, fire, poaching, grazing, and agriculture. Light green patches in the enlarged 2006 image (top right, yellow arrows) show evidence of disturbance where the mature forest has most likely been lost to fire or tree-cutting. Limited legal forestry is allowed in the park; however inadequate capacity to enforce policy has led to considerable illegal logging and clearing for farms.



Republic of Cameroon

Total Surface Area: 475 442 km²
Estimated Population in 2006: 16 601 000

Cameroon is a medium-sized country whose nearly 17 million inhabitants are split fairly evenly between urban and rural areas. Its Atlantic coast is dominated by a wet, densely forested coastal plain, behind which is a large inland plateau of tropical rain forest. Further north are drier, less populated savannah plains extending to the northern border with Lake Chad. Cameroon is particularly well-endowed with timber resources, as well as petroleum, iron ore, and bauxite.

Important Environmental Issues

- Land Degradation and Deforestation
- Over-harvesting of Biological Resources
- Degradation of Coastal and Marine Ecosystems

Progress Towards Environmental Sustainability

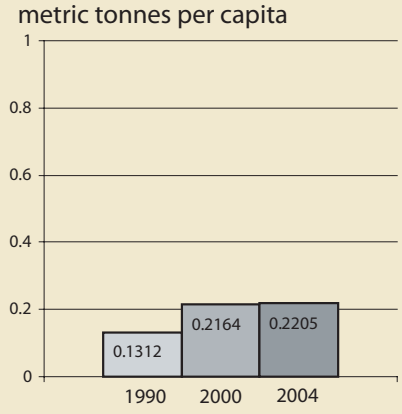
As defined by the United Nations Millennium Development Goal 7 Indicators

Fires and commercial exploitation of Cameroon's forests result in the clearing of 200 000 hectares per year. Currently, the forested area of 23.9 million hectares occupies almost 50 per cent of the land area. While forests are being destroyed even within reserved lands, Cameroon saw a gradual increase in the percentage of protected areas between 1990 and 2005.

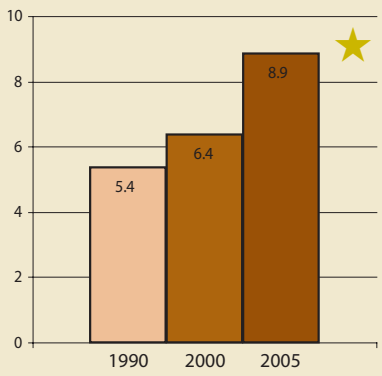
★ Indicates progress

Land area covered by forest, percentage

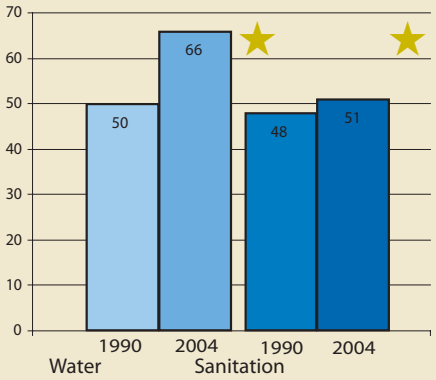
Carbon dioxide (CO_2) emissions, metric tonnes per capita



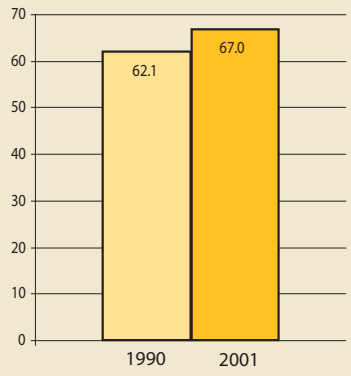
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

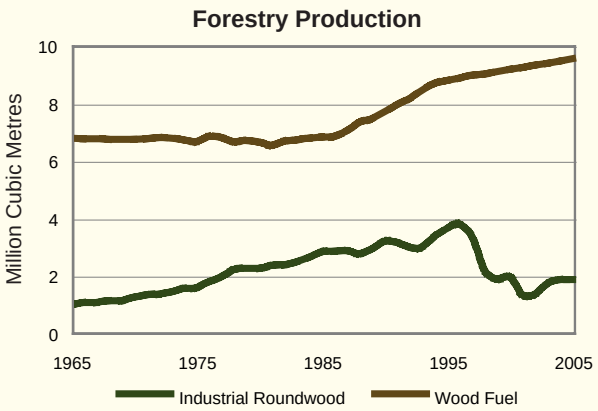


With 63 snake species, Mount Nlonako in Cameroon is the richest single locality in the world for snake species.

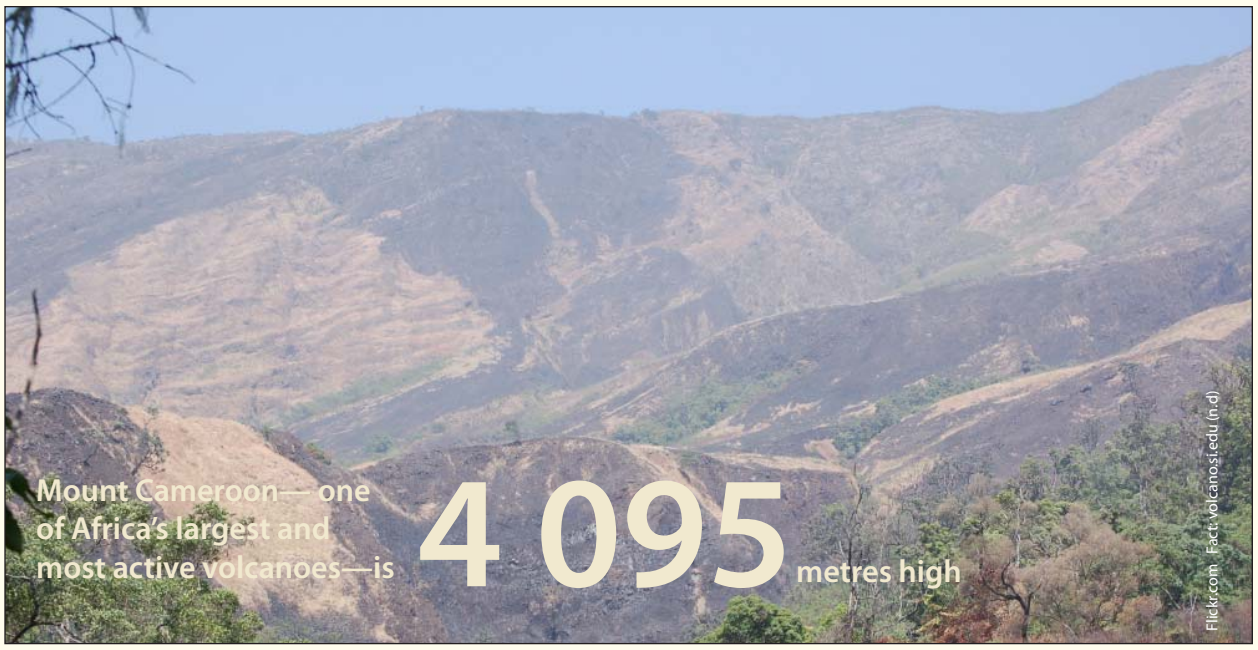
Land Degradation and Deforestation

Land degradation has long affected the drier regions of northern Cameroon, but it has also begun to affect the forested lands of the centre and south. Severely degraded land now covers 37 per cent of the country (FAO AGL 2003), driven by deforestation, intensive agriculture, and overgrazing, among other factors. The cattle population in Cameroon grew approximately 26 per cent between 1990 and 2004, reaching more than 5.9 million head (FAO 2007).

Forests cover nearly half of Cameroon, but they are being lost at an average rate of one per cent per year (UN 2007). This translates to over one million hectares of forest felled between 2000 and 2005, which is the second highest total in central Africa (FAO 2005). Commercial logging (both legal and illegal), demand for fuelwood, and agriculture are the principal drivers. A 1999 ban on raw timber exports designed to stimulate the domestic wood processing industry led to an initial drop in industrial roundwood production, but it is predicted that the industry will rebound as processing capacity grows (FAO 2003).



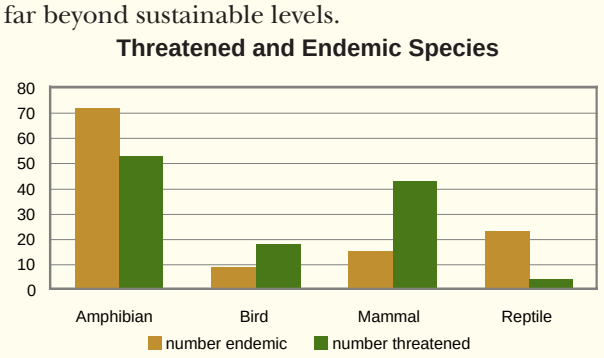
Source: FAOSTAT database



Over-harvesting of Biological Resources

Cameroon represents all of the major ecosystems on the African continent and ranks fifth among African countries for its level of biodiversity. Nearly 2 000 different animal species and 9 000 plant species, 156 of which are endemic, have been recorded (CBD 2007). This natural bounty is threatened by a combination of habitat loss and over-harvesting of biological resources.

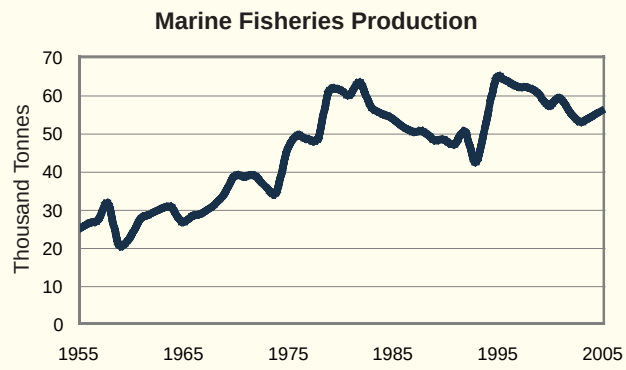
Among the rural poor in particular, biological resources such as medicinal plants and wildlife make up a significant portion of income and diet. One village-level study estimated that non-wood forest products contribute nearly half of household incomes (FAO 2003). Commercialised bush meat production is of particular concern for biodiversity, as increased demand has driven hunters to harvest far beyond sustainable levels.



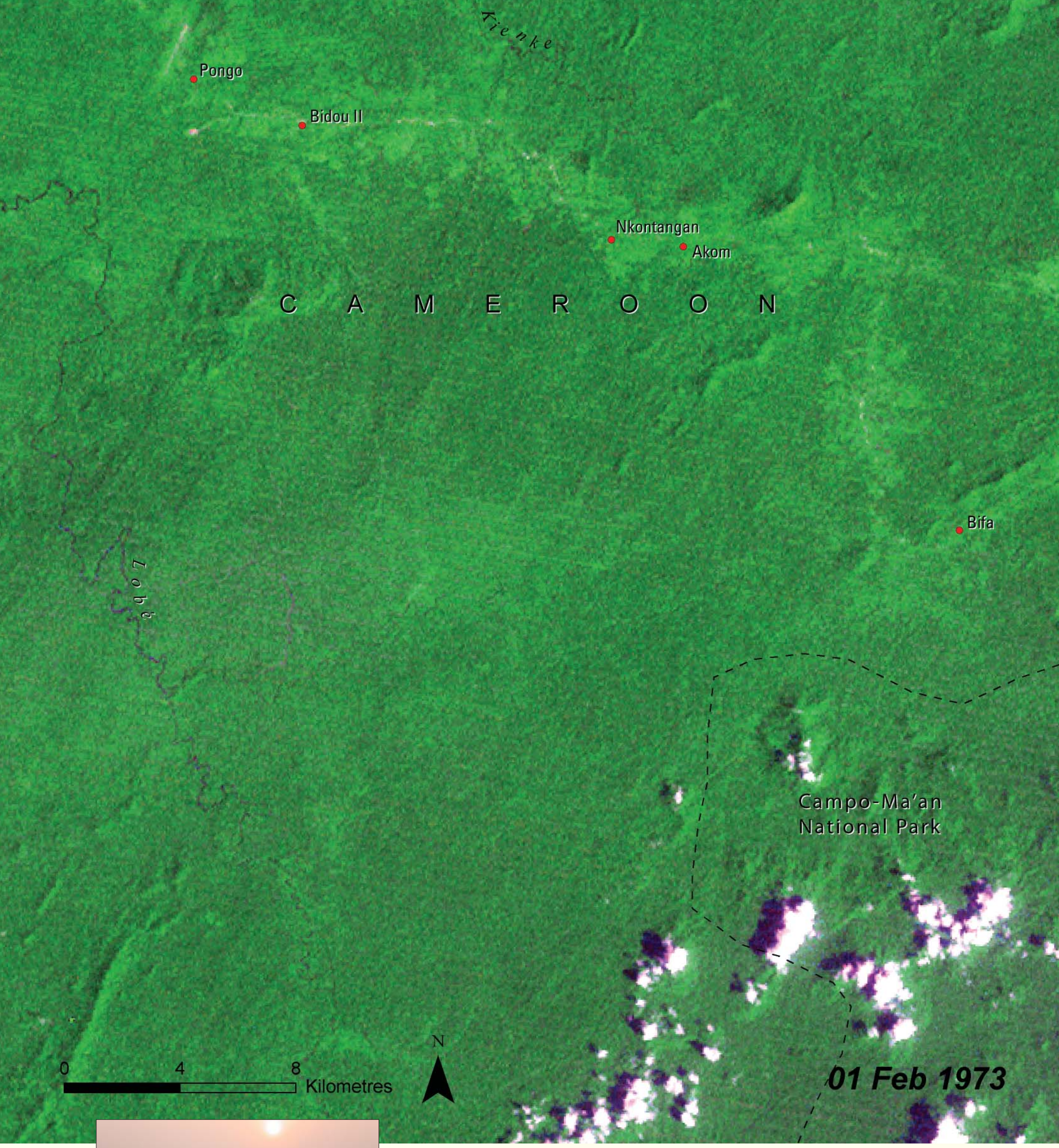
Source: IUCN

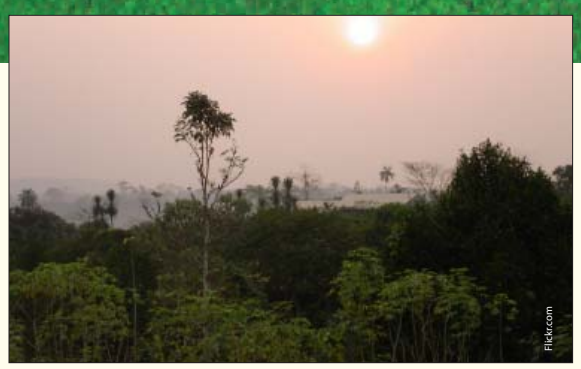
Degradation of Coastal and Marine Ecosystems

Cameroon has rich marine biodiversity, including 21 per cent of all African fish species and over 2 000 km² of coastal mangrove forest (CBD 1999). However, threats to these marine ecosystems are numerous. Approximately 70 per cent of industry is located near coastal ecosystems, contributing to substantial pollution (CBD 1999). Furthermore, overfishing and the use of small-mesh nets that capture young fish has reduced fish stocks and resulted in lower yields. Finally, demand for fuel and construction materials has driven rapid mangrove deforestation.



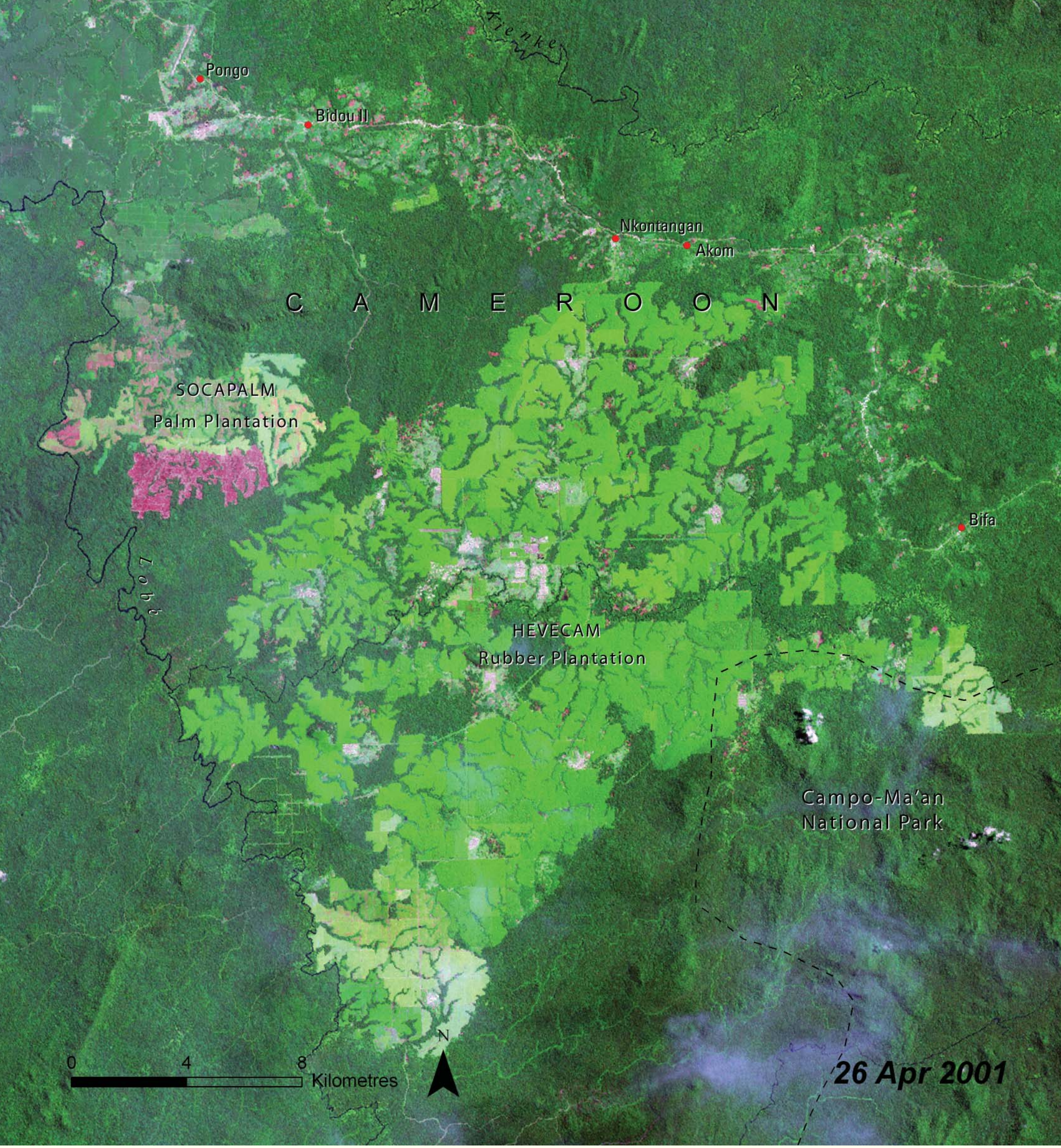
Source: FISHSTAT database





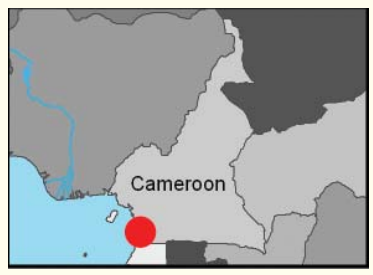
Plantations in Campo-Ma'an: Cameroon

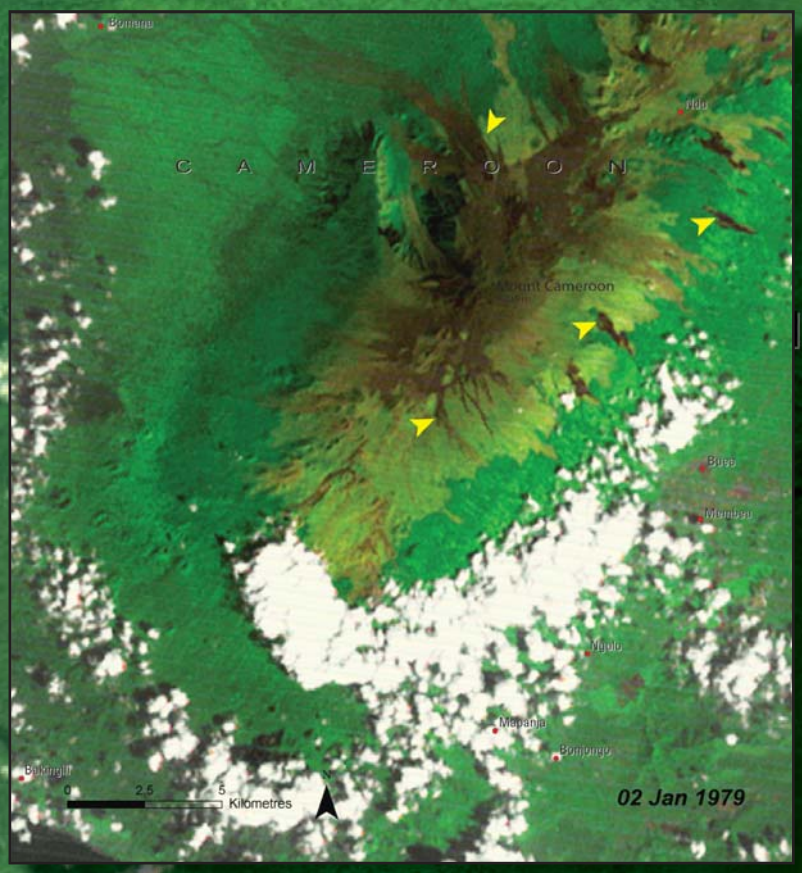
The Campo-Ma'an rain forest in southern Cameroon covers approximately 770 000 hectares of the Guineo-Congolian Regional Centre of Endemism—a species-rich area of rain forest with many species found nowhere else in the world. While the human population density is quite low, the area supports a host of economic activities, many of which threaten the area's ecosystems, including logging, shifting agriculture, and commercial agro-forestry. These forces contribute to the deforestation rate in southern Cameroon, which is among the highest in central Africa.



In the 1973 image the forest appears as largely intact. However, the impact of the agro-forestry industry, which is dominated by rubber and palm plantations, can be seen clearly in the centre of the 2001 image. Plantations, roads and cultivated areas dominate the landscape. These large-scale agro-industrial operations have replaced approximately 7.5 per cent of the area's forest cover.

Campo-Ma'an is an important focus of conservation efforts in Cameroon, and in 2000 the Campo-Ma'an National Park was created to protect its diverse flora and fauna. The park covers 26 400 hectares of diverse forests stretching from the coast to roughly 100 km inland.





C A M E R O O N

Ndu

Mt. Cameroon
4095 m

Buea

1982 lava flow

Membea

Ngolo

Mapanja

Bonjongo

Bakingili

0 2.5 5
Kilometres

N

12 Dec 1986

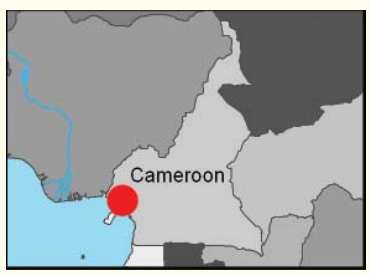
Recent Eruptions: Mount Cameroon, Cameroon

Mount Cameroon, in the country's southwest corner, is among the most active volcanoes in Africa. Rising 4 095 metres above the nearby Atlantic coast, it has erupted seven times in the last century, most recently in 1999 and 2000. The mountain is home to many rare birds and plants. In addition, there are several small communities near the volcano that are at risk from direct and indirect impact of volcanic activity.

In the 1979 satellite image, the tracks of several old lava flows (yellow arrows) can be seen although the volcano had not erupted since 23 January 1959. In the 1986 image, a lava flow is

visible on the southwest flank of the mountain (yellow arrow), the result of a 1982 eruption. The image from 2000 shows large lava flows left by the 1999 and 2000 eruptions (yellow arrows).

The principal vent of the 1999 eruption was at about 1 400 m elevation. It sent a voluminous lava flow estimated at about two kilometres wide and 30 m thick in a south-southwest direction. The flow eventually extended roughly seven kilometres, burning through dense rain forest, industrial palm plantations, and small subsistence farms, and flowing across the important Limbe-Idenau road. The village of Bakingili was evacuated over concerns that the hot lava entering the sea might pose a health threat. In 2000, Mount Cameroon erupted again, with two main lava flows moving down the volcano's southern flank.



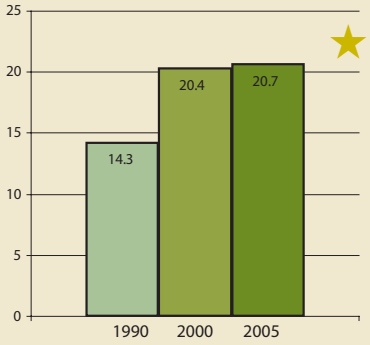
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goals 7 Indicators

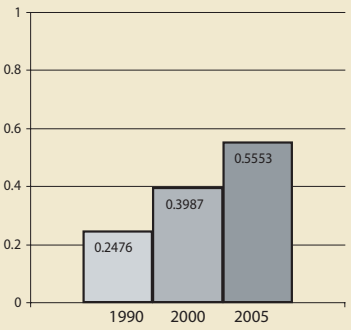
Demand for fuelwood in Cape Verde has resulted in deforestation and has led to the virtual elimination of native vegetation. The most widespread agricultural activity on the islands is raising crops such as corn, cassava, sweet potatoes, and bananas for domestic consumption.

★ Indicates progress

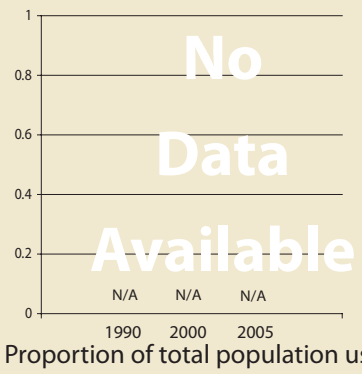
Land area covered by forest, percentage



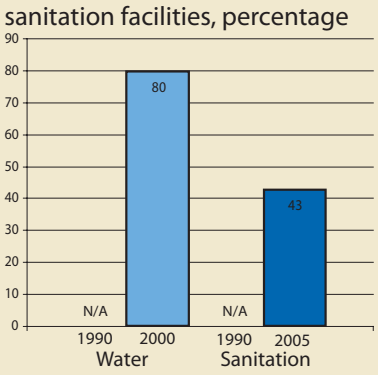
Carbon dioxide (CO_2) emissions, metric tonnes per capita



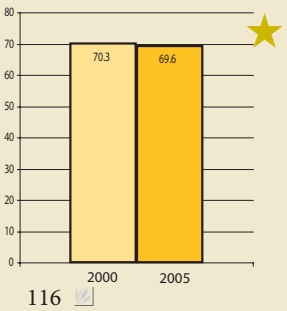
Protected area to total surface area, percentage



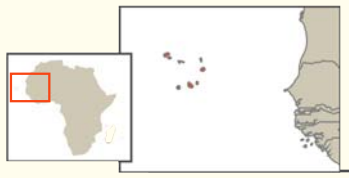
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



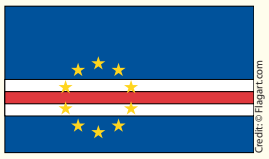
Slum population as percentage of urban



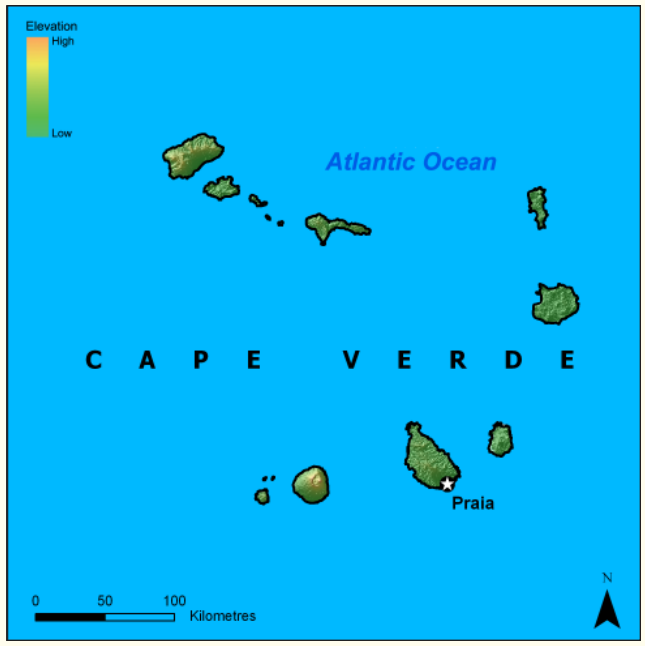
Republic of Cape Verde



Total Surface Area: 4 033 km²
Estimated Population in 2006: 519 000



Located approximately 500 km from the West African coast, the Cape Verde archipelago consists of ten islands and eight islets. The climate is classified as tropical dry and rainfall is extremely erratic and insufficient, with an average of less than 300 mm per year (FAO 2005). In recent decades, the islands have experienced rapid urban migration and today nearly 60 per cent of the population resides in urban areas (UNESA 2006).



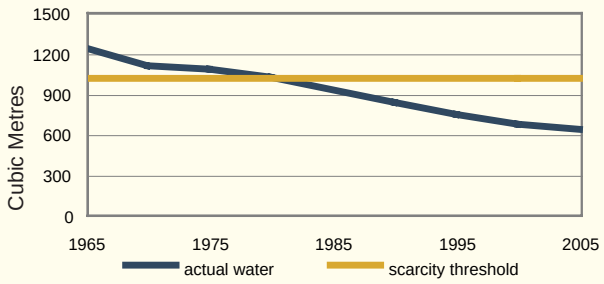
Important Environmental Issues

- Soil Erosion and Land Degradation
- Threats to Biodiversity

Soil Erosion and Land Degradation

Cape Verde is characterized by steep topography, infrequent but torrential rains, and underdeveloped volcanic soils, which make the country highly vulnerable to erosion. Since human settlement of the island, overgrazing, farming, and fuelwood collection have removed much of the natural vegetation, particularly at high altitudes. When combined with the impacts of occasional, severe droughts, these factors have contributed to widespread soil erosion and land degradation. Near the coast, overexploitation of groundwater aquifers has resulted in soil salinisation and saltwater intrusion of wells (FAO 2005).

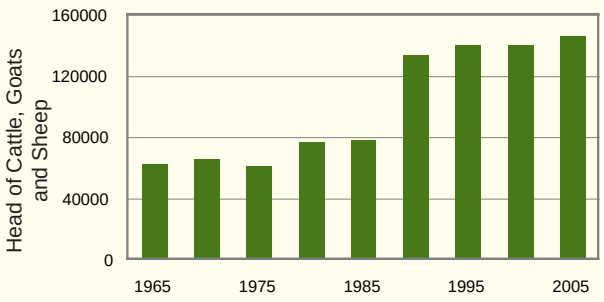
Renewable Water Resources Per Capita



Source: AQUASTAT

Threats to Biodiversity

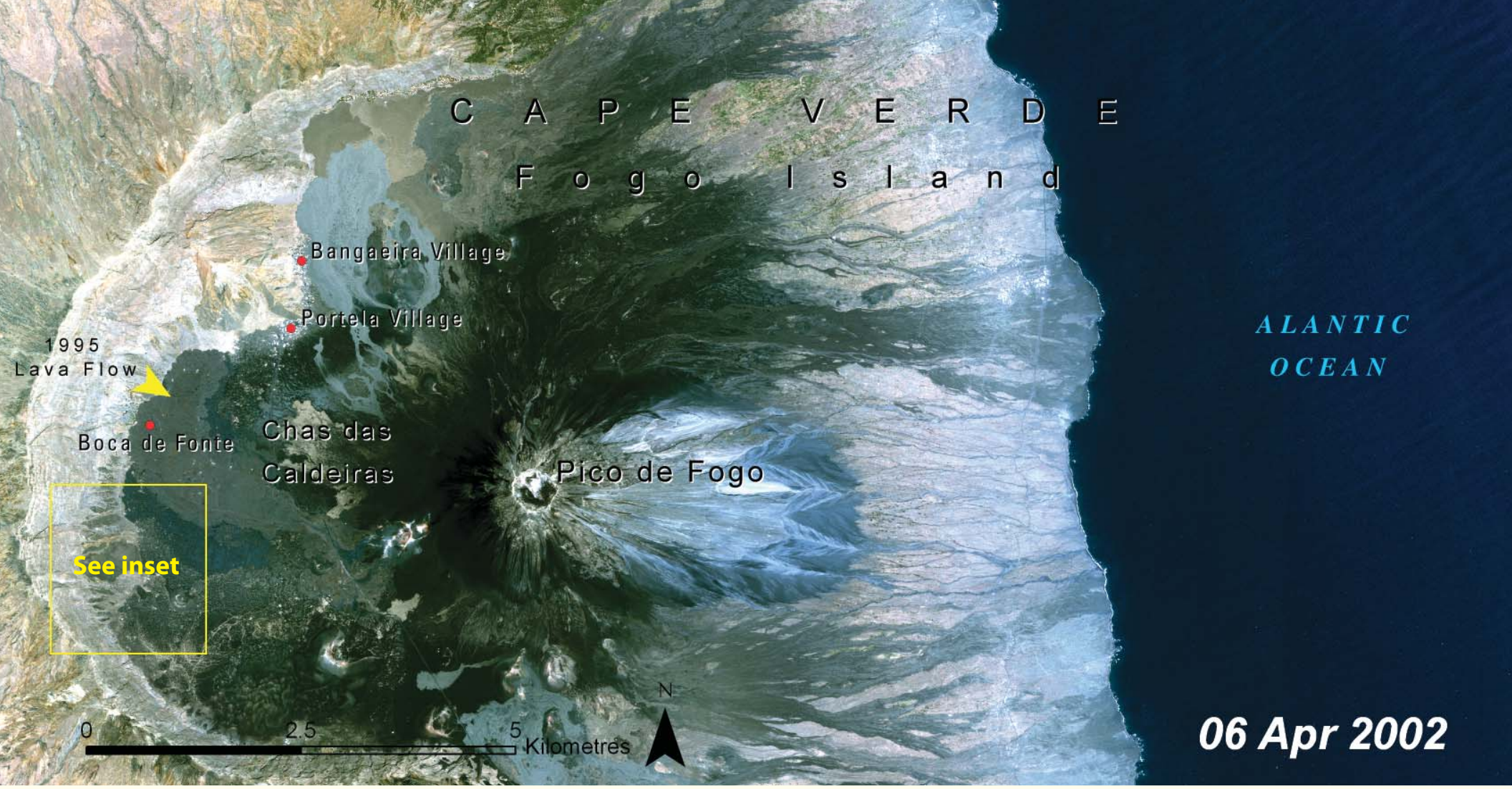
Livestock Production

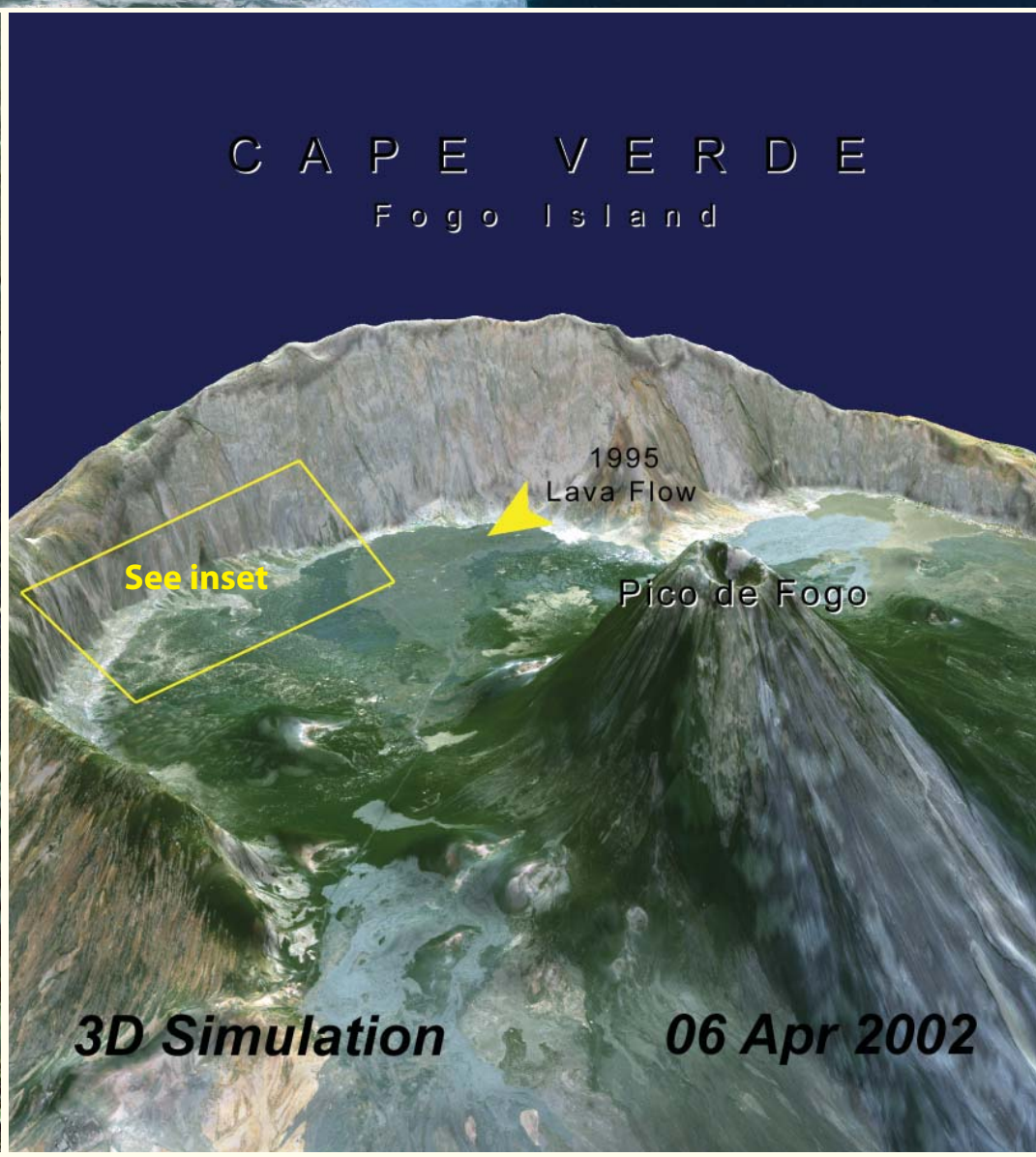


Source: FAOSTAT

The islands of Cape Verde support globally important biodiversity, but an estimated 47 per cent of birds and 25 per cent of reptiles are threatened with extinction (CBD 2007). Several bird species, including the Cape Verde swift and the Cape Verde sparrow, are endemic, as are a number of bird sub-species. The islands also provide important breeding and nesting grounds for rare seabirds such as Fea's petrel, which is found in only a few locations worldwide. Introduced predators, including rats and cats, the harvesting of eggs and nestlings for food, and habitat loss threaten all of the islands' birds.

The only native mammal of Cape Verde is the long eared bat (Plecotus austriacus).

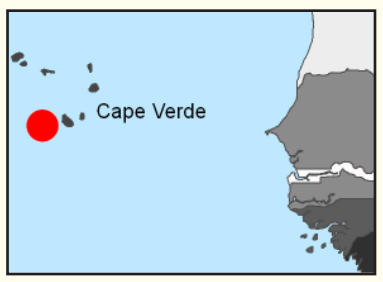




Volcanic Eruptions: Pico de Fogo, Cape Verde

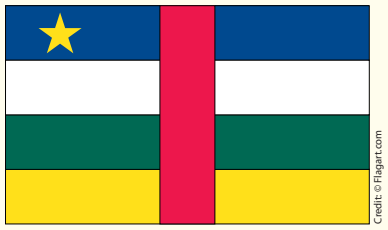
On 2 April 1995, residents on Fogo Island reported a red glow atop Pico de Fogo volcano. It was the beginning of volcanic eruptions that would continue for seven-and-a-half weeks, sending lava across the floor of Cha das Calderiras (Plain of Craters) that eventually covered 4.3 km^2 of farmland, destroyed the village of Boca de Fonte, and forced the evacuation of approximately 1 300 residents. Despite the danger, people live in the caldera and raise coffee, wine grapes, fruits, and other crops in the fertile volcanic soils (red arrows).

The 1995 eruption on the southwest slope sent lava flowing to the northwest across the main road through the caldera (yellow arrows). Studies are ongoing as to the stability of Pico de Fogo.

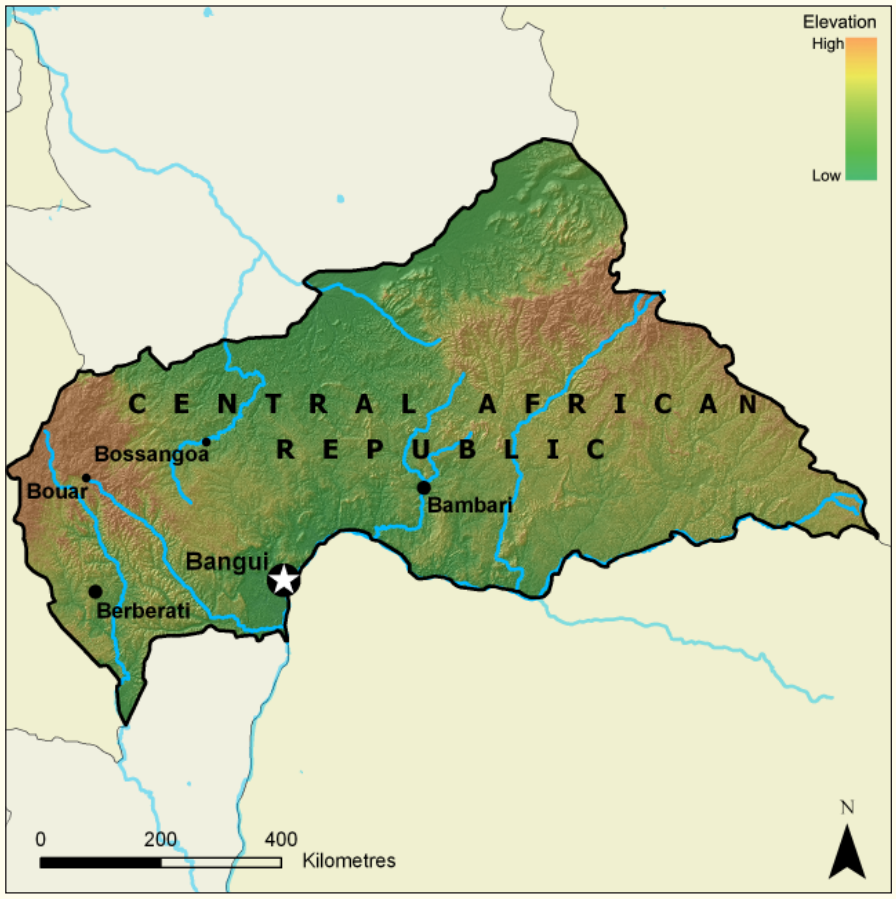


Central African Republic

Total Surface Area: 622 984 km²
Estimated Population in 2006: 4 093 000



Central African Republic (CAR) is a landlocked country situated in the centre of the African continent. The climate is generally tropical, and typical land cover includes dense tropical rain forests in the south, wooded savannahs in the centre, and grassland savannahs in the north. Central African Republic is rich in biological resources such as wildlife and timber, as well as valuable mineral deposits including diamonds, gold, and uranium.



Important Environmental Issues

- Subsistence and Commercial Poaching
- Deforestation and Land Degradation
- Diamond Mining and Pollution

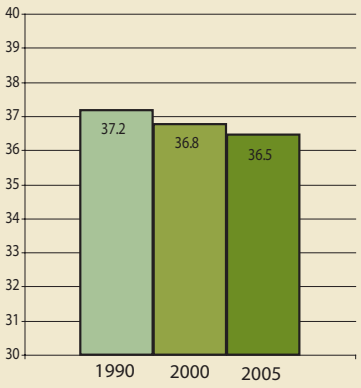
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

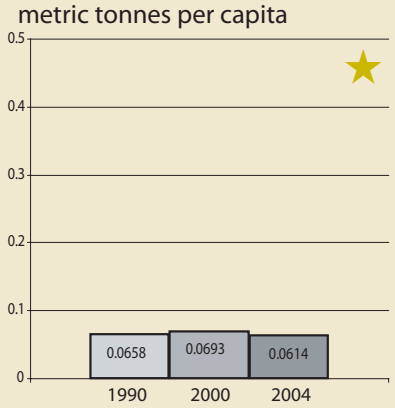
With forest covering 36 per cent of the total land area, deforestation and degradation are the primary environmental issues. The country once had the third-largest area of rain forest in Africa. Today, most of this has been degraded by logging. About 16 per cent of the country's land is some form of protected area, home to about 3 600 species of plants, 663 birds, 131 mammals, 187 reptiles, and 29 amphibians.

★ Indicates progress

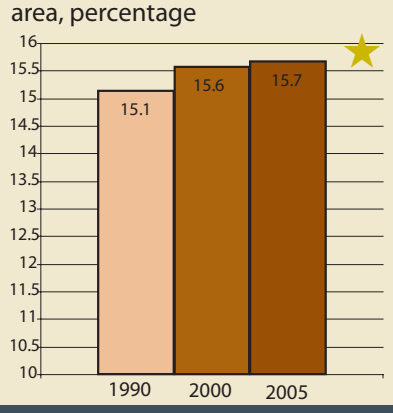
Land area covered by forest, percentage



Carbon dioxide (CO_2) emissions, metric tonnes per capita

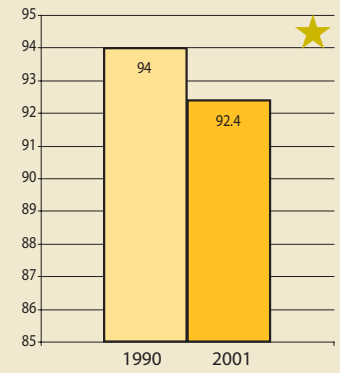


Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage

Slum population as percentage of urban

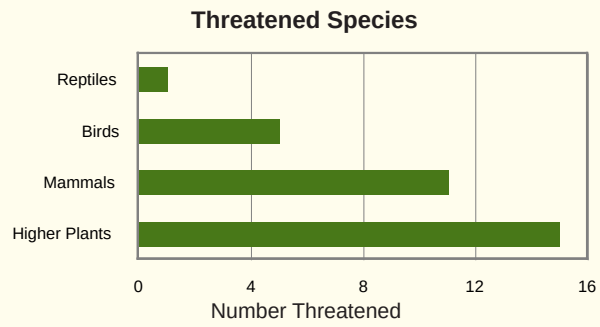


Tropical forests cover 36 per cent of the Central African Republic, and the rain forests in the southwest contain some trees reaching a height of 46 metres.

Subsistence and Commercial Poaching

Poaching is one of the biggest threats to the Central African Republic's wildlife, which includes forest elephants, gorillas, chimpanzees, lions, and hippopotamuses. The country has a long history of subsistence hunting and the practice is perpetuated by widespread and severe poverty. More recently, a growing transnational market for bushmeat, hides, and ivory has led to a new poaching boom.

Poaching decimated the country's last remaining rhinos in the 1980s, while the savannah elephant population in the north was reduced by 75 per cent. Today, approximately 1 800 elephants remain, including the northern savannah elephants and two forest elephant populations in the south (Blanc and others 2007). The elephants' range once covered over one-third of the country, but it is now largely confined to a few protected areas, which have some of the highest densities of forest elephants in Africa.

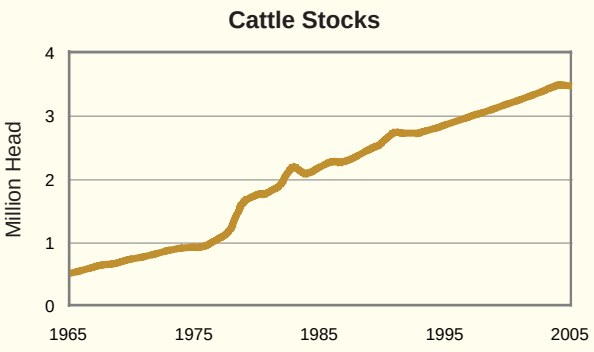


Source: IUCN Red List

Deforestation and Land Degradation

Land degradation, manifested as widespread soil erosion and localized desertification in the far north, is a growing problem in Central African Republic. Poor agricultural practices and overgrazing—cattle stocks have increased almost four-fold in the last three decades (FAO 2007)—are significant contributors.

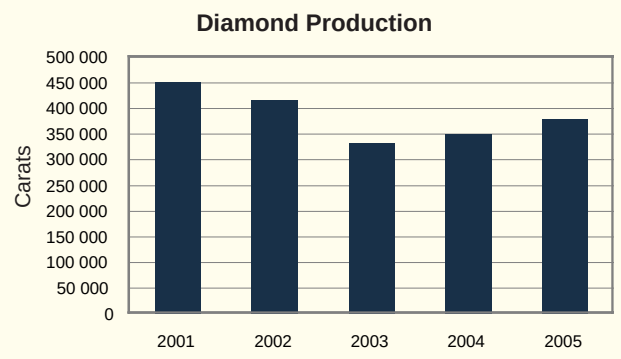
However, deforestation and forest degradation are the biggest land degradation problems. Between 1990 and 2005, CAR lost roughly 450 000 hectares of forest (FAO 2005), leaving roughly 37 per cent of the country deforested (UN 2007). The expansion of logging and mining roads into previously remote forests has facilitated degradation by people seeking commercial timber and fuelwood.



Source: FAOSTAT database

Diamond Mining and Pollution

Diamond mining in Central African Republic is mostly artisanal in nature, but it is still the most important extractive industry in the country, accounting for 60 per cent of export earnings in 2004 (Bermudez-Lugo 2005). The mining is typically conducted in and around streams, which causes localised destruction of riverine ecosystems as well as more dispersed impacts such as waterway sedimentation and pollution. Furthermore, there is typically increased bushmeat hunting and deforestation near mining camps (CARPE 2005).

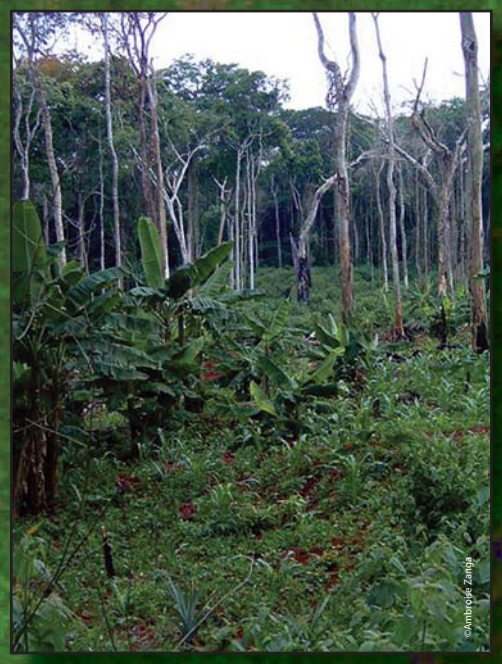


Source: USGS Mineral yearbook 2005

CENTRAL AFRICAN REPUBLIC

Madamboya

Bangassou
Forest Reserve



Zipo

Yalinga

Bangassou

CONGO

Dekoa

DEMOCRATIC REPUBLIC
OF THE CONGO

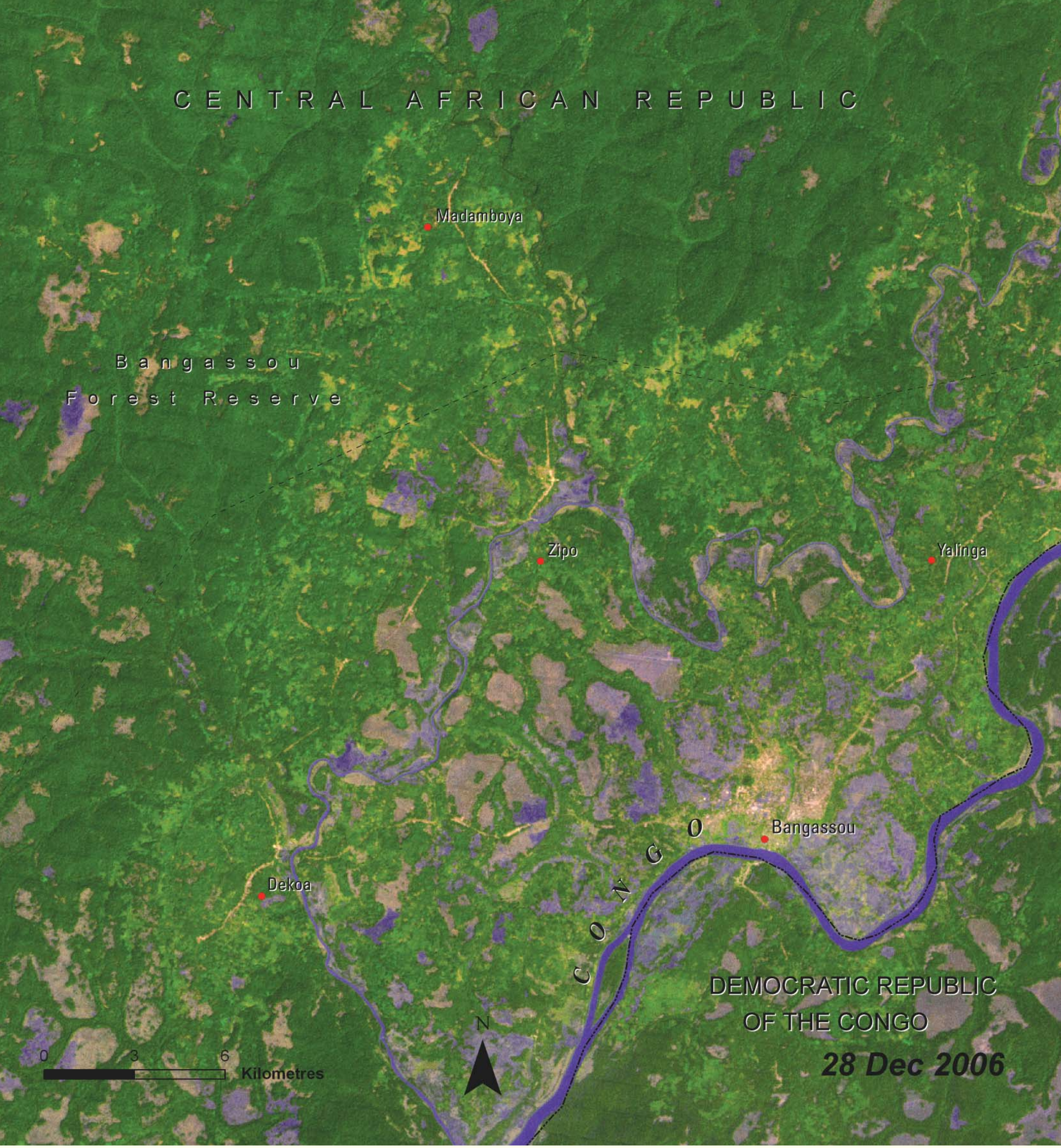
12 Dec 1975

N

0 3 6
Kilometres

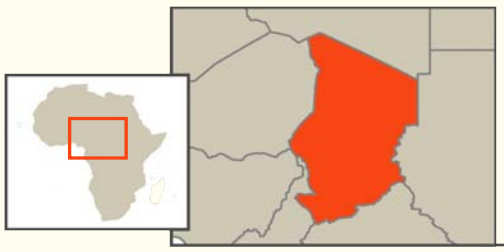
Biodiversity of Bangassou: Central African Republic

The Bangassou Forest is a mosaic of lowland rain forest and secondary grasslands in southeastern Central African Republic covering an estimated 1.2 to 1.5 million hectares. This region is very isolated; little is known about its forests and there has been no commercial exploitation of the forest products in this area. While this is not a protected area, there has been oversight from the regional Office of Water and Forests and a community conservation project. The Bangassou Forest is an area with high biodiversity and a wide range of habitats.



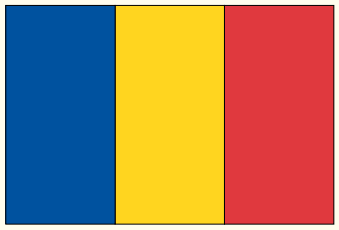
Only about 20 000 people live in the forest itself; however, the city of Bangassou has a population of over 24 000. The growth of Bangassou and the apparently increasing gaps in the forest canopy between 1975 and 2006 (light coloured areas, particularly between Zipo and Madamboya) suggest that pressure on the forest may be increasing.

The Bangassou Forest is one of only two areas in Central African Republic where elephants still live. Estimates of the elephant population have declined from 2 640 in 1989 and 1 600 in 1995 to perhaps as few as 500 to 1 000 in 2004. This is widely believed to be the result of poaching which appears unlikely to decrease under current circumstances.



Republic of Chad

Total Surface Area: 1 284 000 km²
Estimated Population in 2006: 10 032 000



Chad, named after the shallow lake on its southwestern border, is a large, sparsely inhabited country in the heart of Africa. The Lake Chad Basin forms a vast plain covering over 80 per cent of the country (FAO 1997), connecting the northern Sahara Desert region to the tropical zones of the south. Nearly half of the population lives in the southern one-fifth of the country, where water resources are most abundant.

Important Environmental Issues

- Drought
- Desertification and Land Degradation
- Access to Water and Sanitation

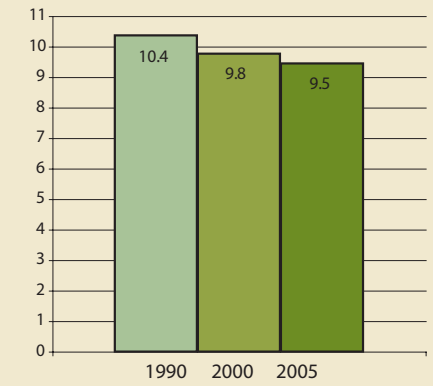
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

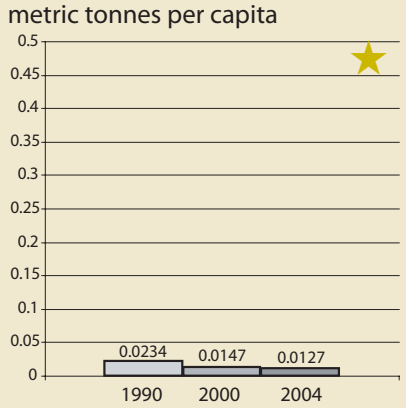
The main environmental problem in Chad is increasing desertification after a decade marked by below-average rainfall and periodic droughts. Linked to this major problem is that of Lake Chad, one of the most striking symbols of Africa's deteriorating environment. The lake is very responsive to changes in rainfall. In less than 30 years, Lake Chad has shrunk from 25 000 km² to a current 2 000 km².

★ Indicates progress

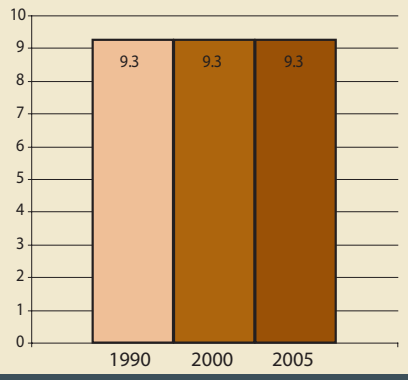
Land area covered by forest, percentage



Carbon dioxide (CO_2) emissions, metric tonnes per capita

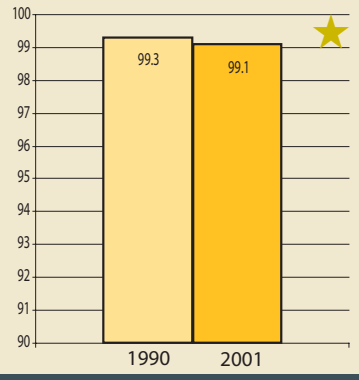


Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage

Slum population as percentage of urban



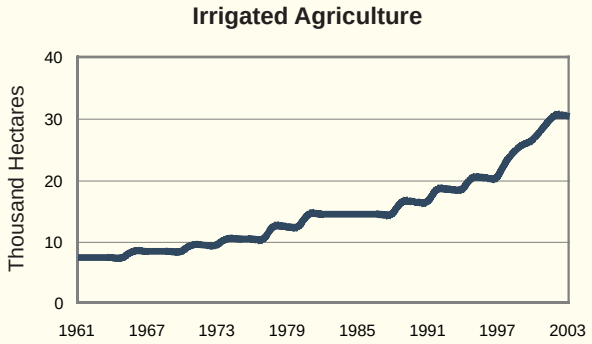
Lake Chad is the most significant water body in the Sahel.

worldlakes.org (2008)

Drought

Lake Chad is the fourth-largest lake in Africa (in terms of surface area) and the largest wetland in the Sahel region. In recent decades, the lake has shrunk dramatically, now measuring only one-twentieth of its 1963 size. Increased water extraction for irrigation is estimated to be responsible for at least 50 per cent of this decrease, although repeated severe drought is also to blame (Coe and Foley 2001).

Since 1910, Chad has experienced at least seven major droughts impacting over 1.5 million people (EM-DAT 2007) and an unknown number of species of flora and fauna. Severe droughts in the late 1960s, early 1970s, and mid-1980s have contributed to unprecedented levels of desertification, wetland degradation, and water scarcity.

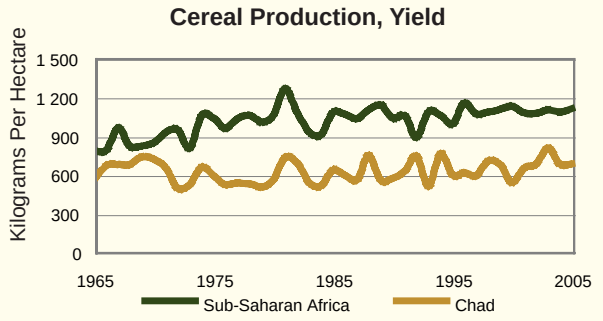


Source: FAOSTAT database

Desertification and Land Degradation

Chad is more susceptible to desertification than any other Sahelian country—an estimated 58 per cent of its land is already classified as desert and another 30 per cent is highly vulnerable (UNEP 2006). The flood plains and wetlands surrounding Lake Chad and its tributaries, which support close to 20 million inhabitants, are particularly prone to degradation resulting from deforestation, bush burning, and unsustainable agricultural practices. These human factors, in combination with natural aridity, have reduced the fertility of soils that are already known to produce some of the lowest crop yields in sub-Saharan Africa.

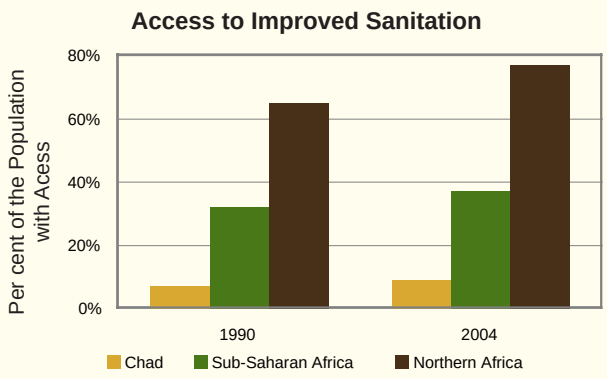
A possible increase in pollution from oil drilling presents yet another threat to land resources. Oil exploration began in 2000, and by 2004, a pipeline to Cameroon's Atlantic coast was generating significant export revenue. As of January 2006, proven oil reserves were estimated at 1 500 million barrels (EIA 2007).



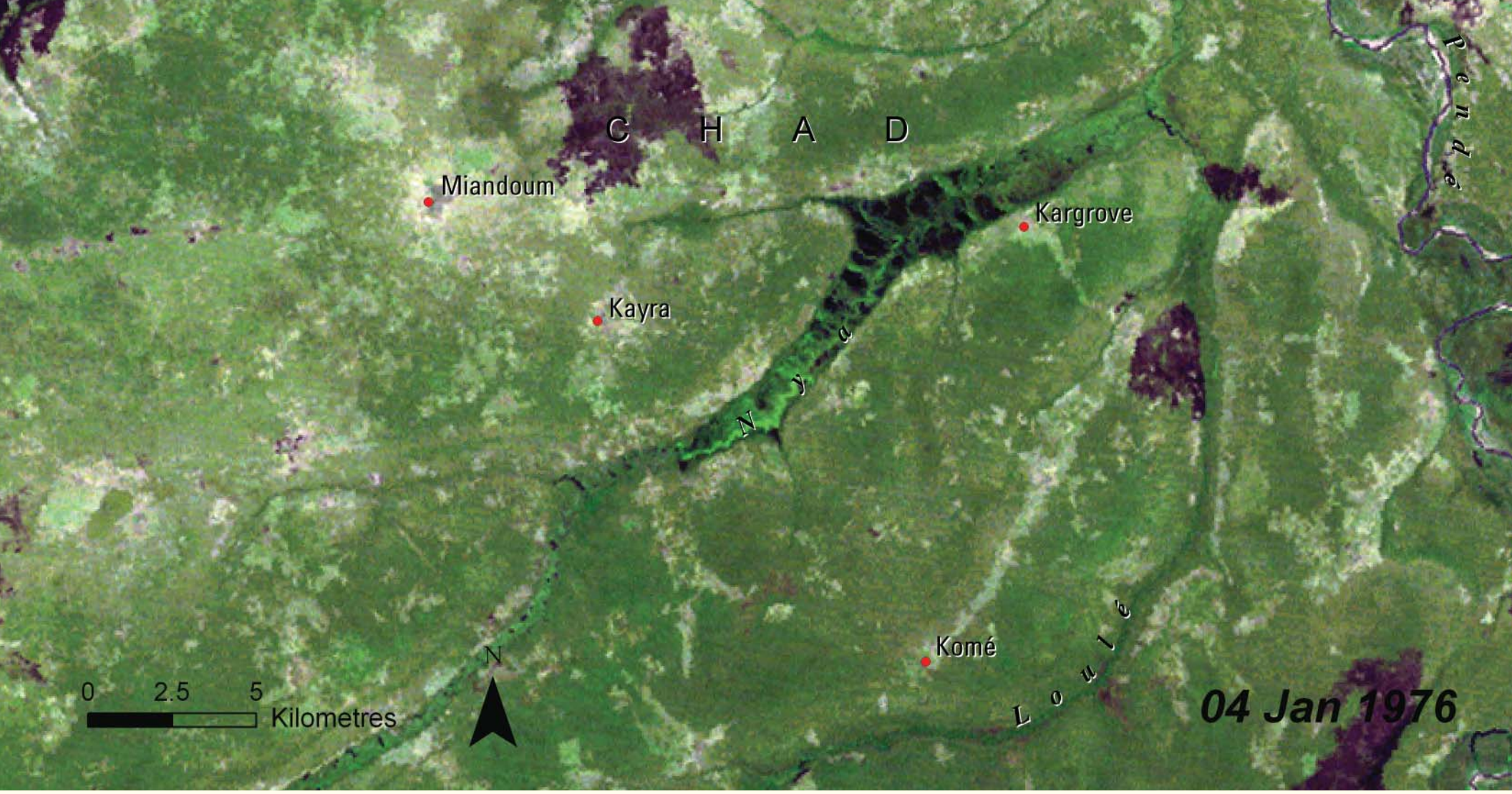
Source: FAOSTAT database

Access to Water and Sanitation

Chad has the third-lowest level of access to safe water and the lowest level of access to adequate sanitation in all of Africa. Water infrastructure is largely undeveloped and surface water resources are limited, so people are forced to walk long distances to fetch fresh water for domestic use and livestock. The arrival of thousands of Sudanese refugees in recent years has worsened the problem in eastern Chad. Lack of access to adequate water and sanitation has had pronounced impacts on human health: approximately one out of every five children dies before reaching the age of five (UNICEF 2006), primarily due to water-related diseases.



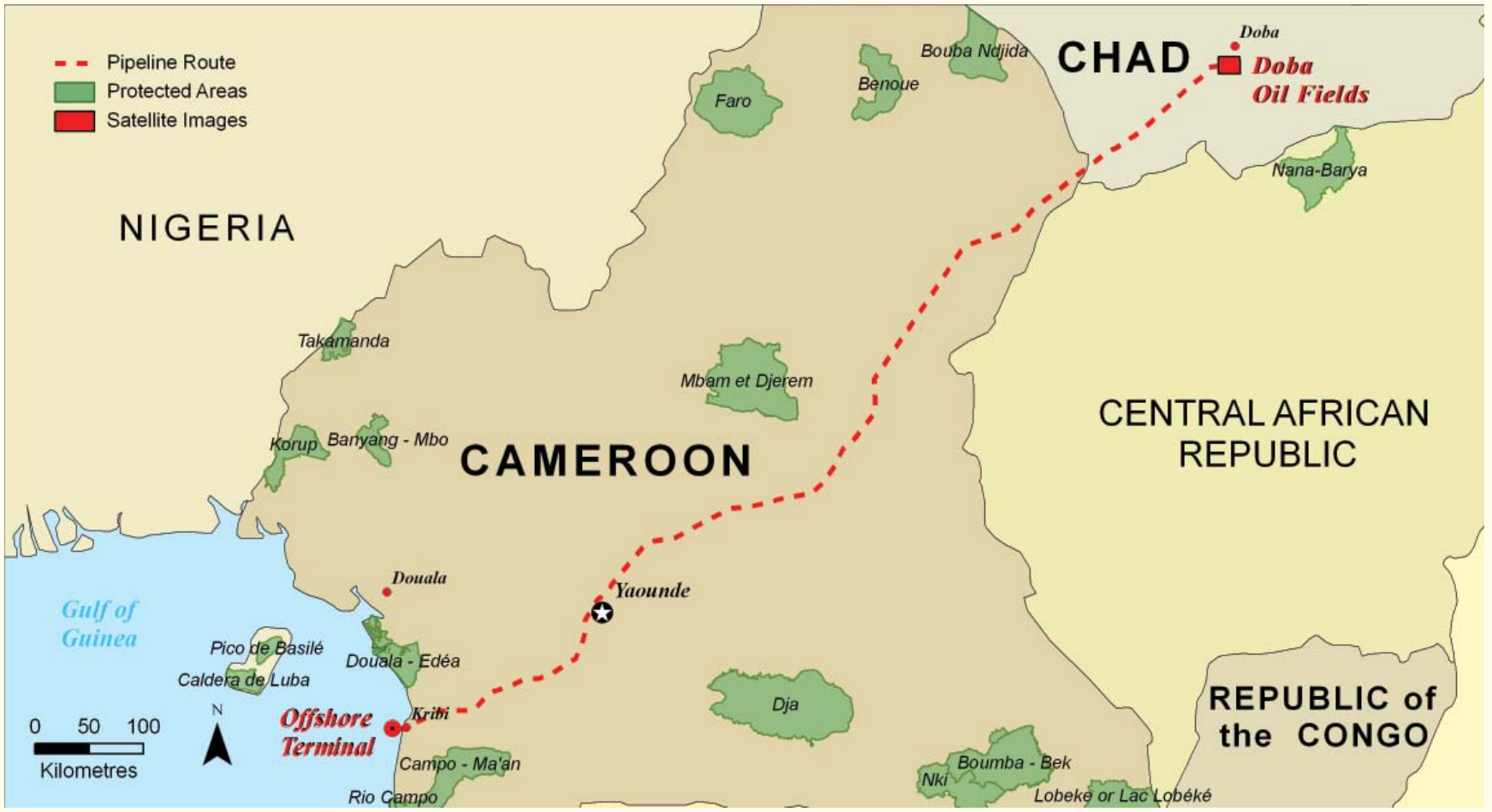
Source: MDG Indicators



Massive Oil Development: Doba, Chad

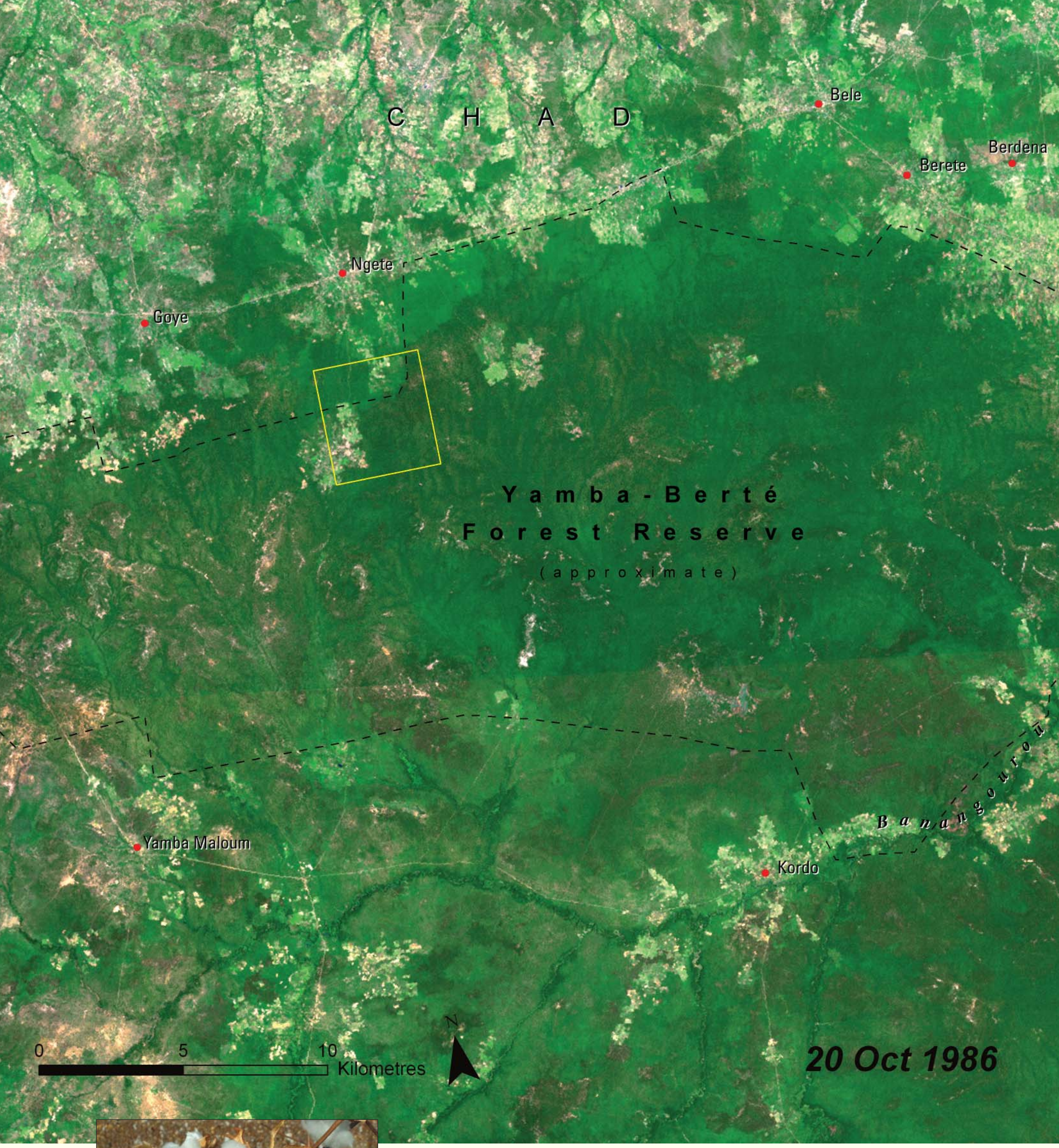
The Chad Export Project brought an investment of approximately US$3 500 million to one of the poorest countries in the world. Among the stated goals was to "provide additional resources to alleviate poverty through social sector and infrastructure development." Concerns were voiced by non-governmental organizations at the outset; these concerns included displacement of people from traditional land and livelihoods, environmental degradation, opportunity for corruption, and inadequate capacity to enforce environmental regulations.

Kome Oil Field is the largest of the three clusters of oil wells at Doba.



The project included drilling 300 oil wells in farmland surrounding Doba and construction of a 1 050-km pipeline across Cameroon to Kribi on the Atlantic Coast. Small patches of light green in the 1976 satellite image show agriculture already present in the area. By 2007, the intensity of agriculture had increased greatly and three clusters of oil wells, concentrated over three oil fields, can be seen. The fields of well pads show as light coloured squares at the end of access roads (yellow arrows).

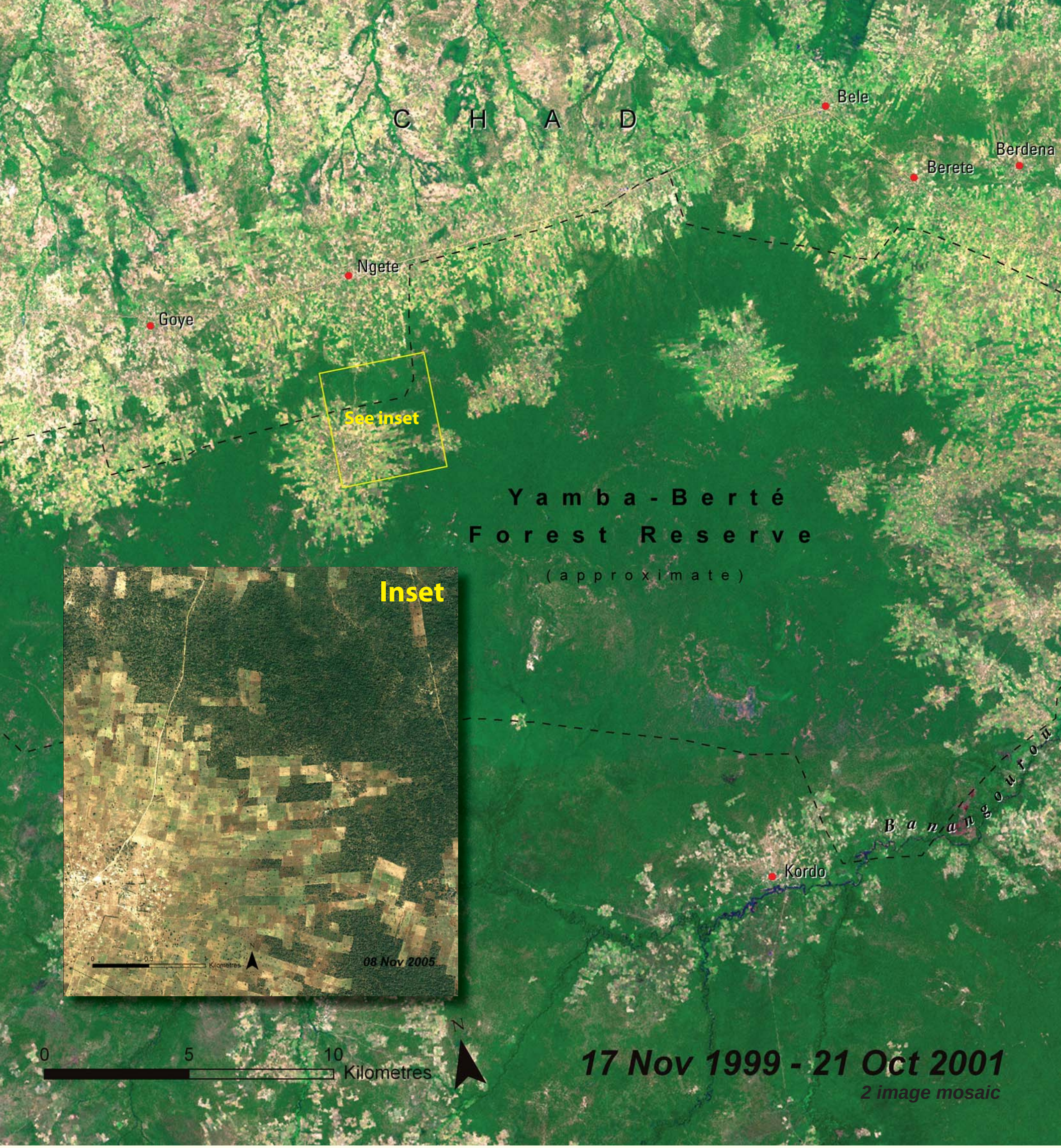
While the project has brought an influx of revenue, it remains to be seen if this translates to a better life for the people living in the vicinity of the oil fields or in Chad as a whole. World Bank documents rate the project's performance in this regard as "moderately satisfactory." Other reports have taken a less favourable view.



Agriculture in the Yamba Berté Forest Reserve: Chad

The Yamba Berté Forest Reserve in southwestern Chad is made up of critical gallery forests, pristine woodlands, and a network of small lakes and swamps. The dense forest includes trees that can grow as tall as 35 m. The reserve is important habitat for gazelles, monkeys, warthogs, giraffe, elephants, and the rare giant eland (*Taurotragus derbianus*).

Yamba Berté is located in a zone of savannah woodland that stretches across southern Chad and also supports a dense human population and most of the country's agriculture. The introduction of cotton in the 1930s and draft animals in the 1950s supported a large increase in



agriculture. During the drought years (1968, 1972-1973, 1983-1984) large numbers of people migrated to the area because of its higher rainfall and the economic opportunity of its larger cities. In addition to subsistence crops such as maize, millet, and sorghum, the area is ideal for growing cotton and groundnuts, which are the two primary cash crops.

The 1986 image shows agriculture around Yamba Berté, including some encroachment on the reserve area. The second image, captured 15 years later, shows dramatically increased agriculture around the reserve and several areas where the reserve boundary has been breeched. The high-resolution image (inset) shows the detail in one area of encroachment.

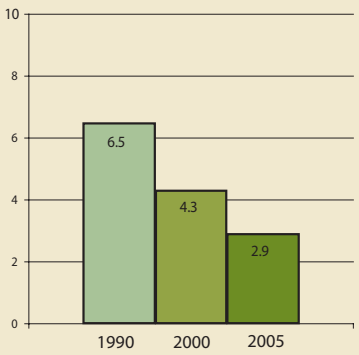
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goals 7 Indicators

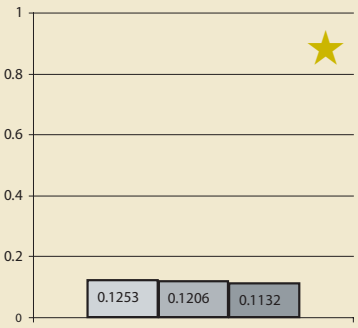
Deforestation and decreasing access to sources of clean water are environmental concerns in Comoros. Population growth has increased the demand for firewood, threatening the remaining forest areas.

★ Indicates progress

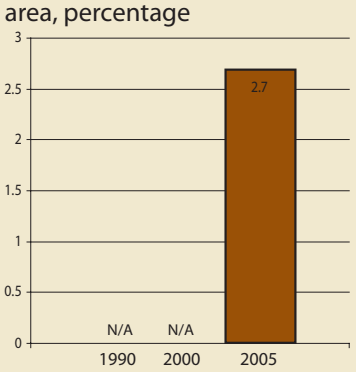
Land area covered by forest, percentage



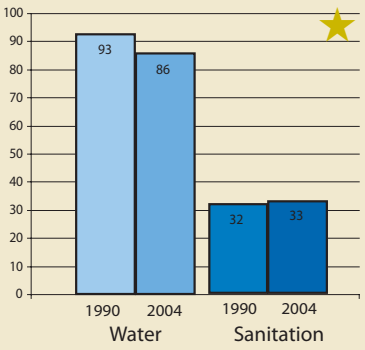
Carbon dioxide (CO_2) emissions, metric tonnes per capita



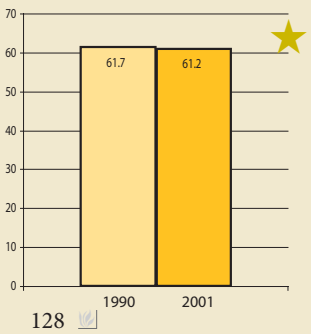
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



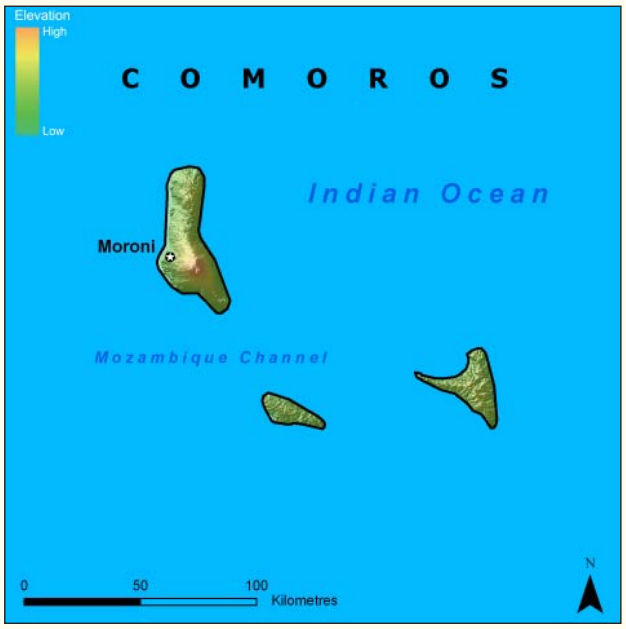
Slum population as percentage of urban



Union of the Comoros

Total Surface Area: 2 235 km²
Estimated Population in 2006: 798 000

The Union of the Comoros comprises four islands located at the entrance to the ocean channel separating Madagascar from the eastern African coast. The islands are of volcanic origin and the largest of the four, la Grande Comore, has an active volcano known as la Karthala. The climate is generally tropical with two distinct seasons and an average of 900 mm of rainfall per year. With 377 inhabitants per square kilometre, it is one of the most densely populated countries in Africa (UNESA 2006, FAO 2007).



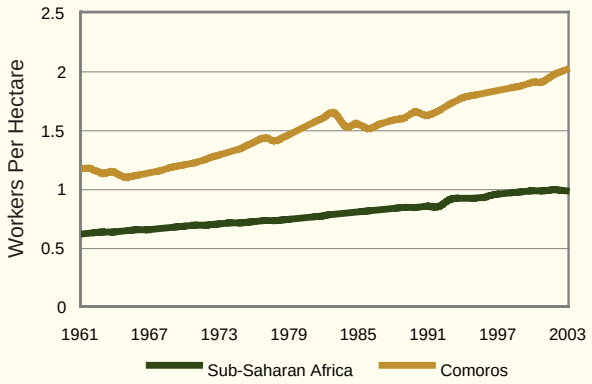
Important Environmental Issues

- Deforestation and Soil Erosion
- Threats to Coastal Ecosystems

Deforestation and Soil Erosion

Between 2000 and 2005, Comoros experienced the highest rate of deforestation in Africa: 7.4 per cent per year (UN 2007). Once heavily forested, Comoros' denuded slopes and fragile soils are now prone to severe soil erosion and desertification. Charcoal production and slash-and-burn agriculture are major threats, particularly in light of rapid population growth measured at over 2.5 per cent per year (UNESA 2005). All potentially arable land is already in use, meaning that additional agricultural land is created at the expense of remaining forests (CBD 2007). In 2004, agriculture accounted for nearly three-quarters of employment and over 40 per cent of GDP (FAO 2007).

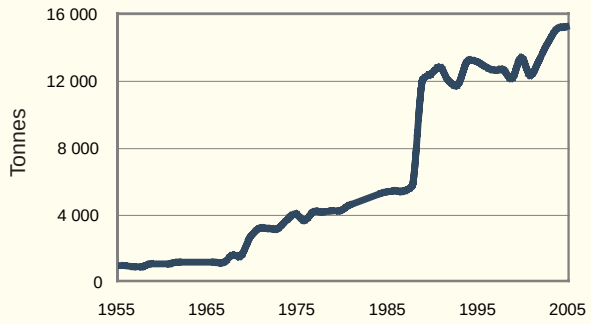
Agricultural Labour Intensity



Source: FAOSTAT

Threats to Coastal Ecosystems

Marine Fisheries Production

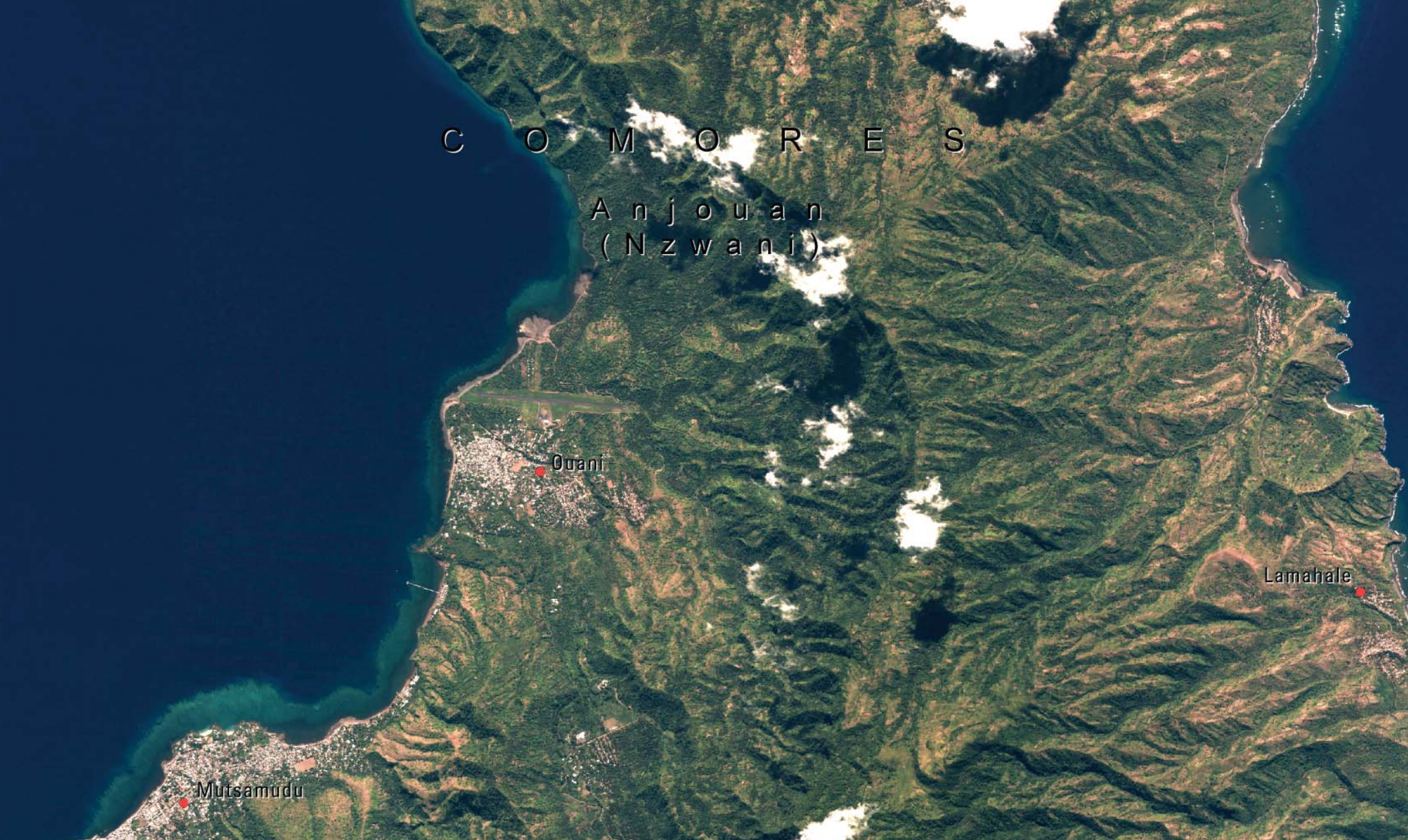


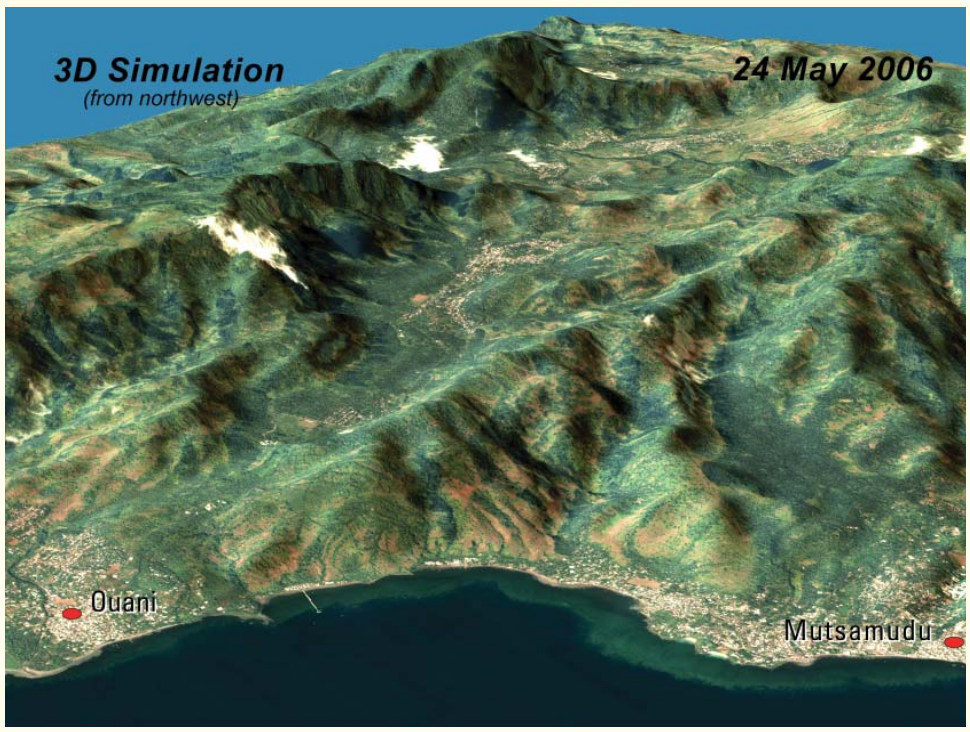
Source: FISHSTAT

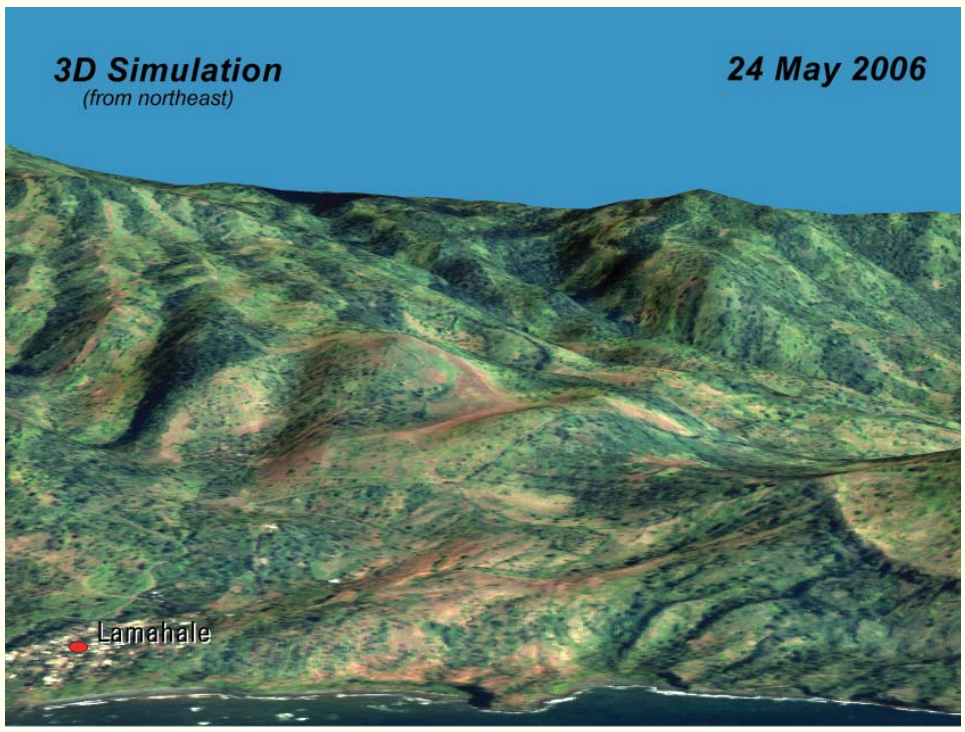
Comoros possesses 430 km² of coral reef (UNEP-WCMC 2001), an area equivalent to one-fifth of the nation's total land area. Fishing directly employs over 8 000 people (FAO 2000-2007) and is an important economic and subsistence activity, but it is almost entirely artisanal in nature. The use of dynamite, poison, and other destructive fishing techniques has caused some reef degradation, but corals are also threatened by increased siltation resulting from coastal erosion. Due to the near-shore concentration of fishing activities, localised over-harvesting of Comoros' limited fisheries is also a problem (FAO 2000-2007).

Comorian waters harbour the coelacanth, a rare, primitive fish once thought to have been extinct for 65 million years.

nationsencyclopedia.com (2007)



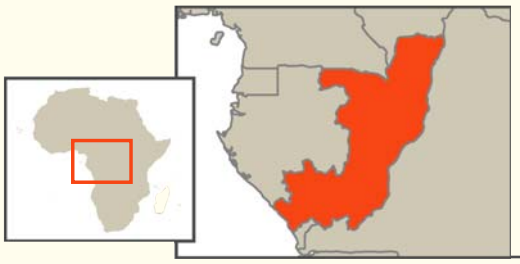




Agriculture and Erosion: Anjouan Island, Comoros

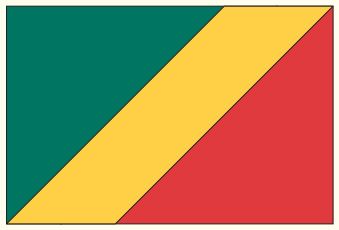
Comoros' population quadrupled between 1950 and 2000. On Anjouan Island, where population density of is 446 people/km^2, agricultural land is in short supply and many areas of steep terrain not suitable for agriculture have nevertheless been cultivated. Traditional agriculture leaves many trees in the fields, which help control soil erosion. However, pressure for food production is leading to more open field agriculture and some monoculture farming on the island of Anjouan. These more intense methods of agriculture encourage soil erosion.

The large image above shows Anjouan's fragmented forest. The reddish yellow areas on the simulated 3-D images show agricultural lands on Anjouan's slopes. As a whole, Comoros lost about 60 per cent of its forest cover between 1950 and 1985.



Republic of the Congo

Total Surface Area: 342 000 km²
Estimated Population in 2006: 4 117 000



Republic of the Congo is a tropical country with ample precipitation, receiving an average of 1 600 mm of rain per year. Nearly three-quarters of the country lies within the Congo River basin, where ground and surface water resources are some of the most abundant in Africa. Approximately 70 per cent of Republic of the Congo's 4.1 million inhabitants live in its two main cities, Brazzaville and Pointe-Noire, and in the towns and villages along the railroad connecting them.

Important Environmental Issues

- Wildlife Poaching
- Threats to Coastal Ecosystems and Inland Wetlands
- Deforestation

Progress Towards Environmental Sustainability

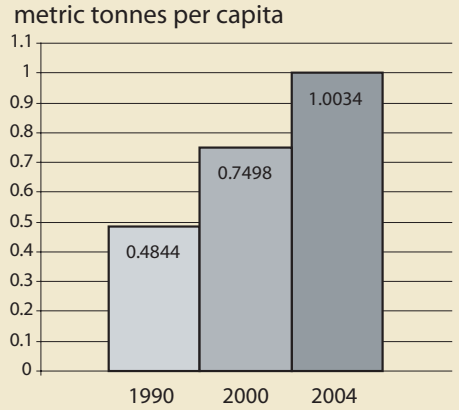
As defined by the United Nations Millennium Development Goal 7 Indicators

The most significant environmental problems in Republic of the Congo are deforestation of Africa's second-largest block of tropical rain forest, increasing slum populations, and the lack of protection for wildlife (which for the period of 1990-2005 has shown signs of improvement). The country enjoys remarkable biodiversity for its size—it is home to 597 species of birds, 166 mammals, 58 amphibians, 149 reptiles, and more than 6 000 species of plants.

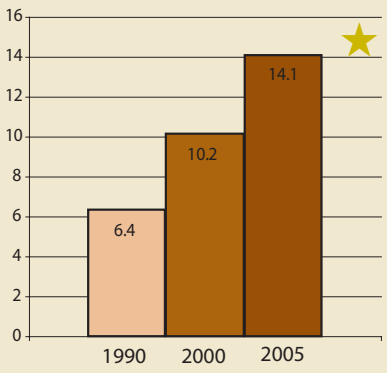
★ Indicates progress

Land area covered by forest, percentage

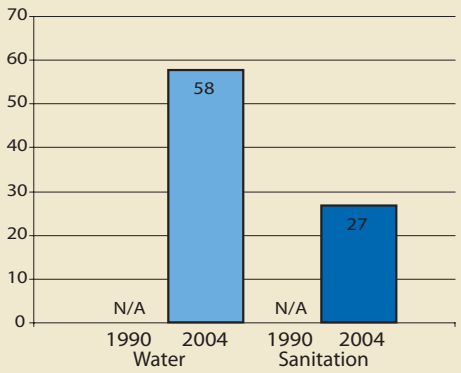
Carbon dioxide (CO_2) emissions, metric tonnes per capita



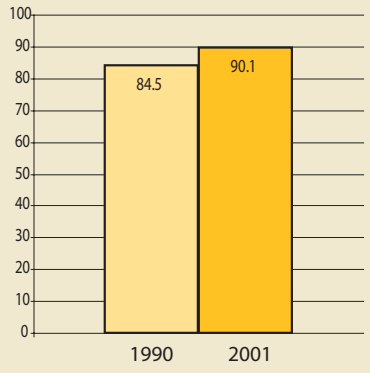
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban



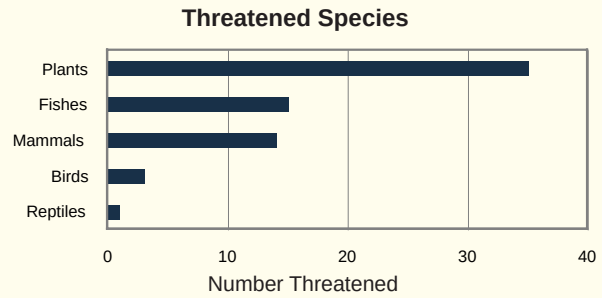
Republic of the Congo is second only to Democratic Republic of the Congo in terms of tropical rain forest coverage among African countries.

rainforests.mongabay.com (2007)

Wildlife Poaching

To conserve its unique and endangered wildlife, which include elephants, chimpanzees, and alligators, Republic of the Congo has designated 14 per cent of its land as protected areas. However, illegal poaching for bushmeat and ivory, driven by both domestic and international demand, remains an enormous threat to wildlife.

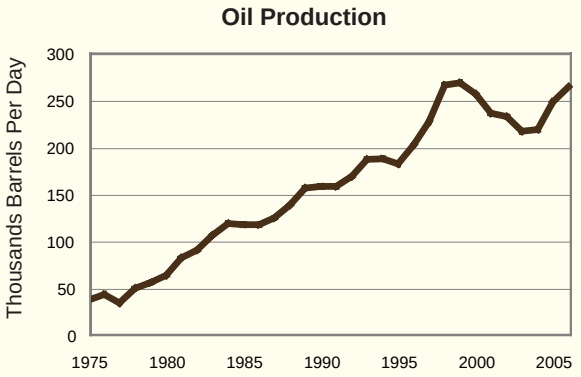
Poaching is facilitated by the expansion of logging roads into previously remote forests. Some 6 000 km of new logging roads have been constructed during the last 30 years (Laporte and others 2007), threatening the country's estimated 17 000 forest elephants, which constitute one of the largest elephant populations left in Central Africa (Blanc and others 2007).



Source: IUCN Red List

Threats to Coastal Ecosystems and Inland Wetlands

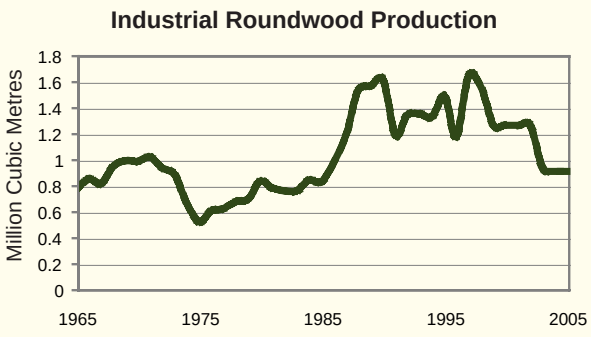
Wetlands and seasonally flooded areas cover approximately one-fifth of Republic of the Congo's surface area, serving as important stores of floral and faunal biodiversity and regulating river flow (FAO 2005). Inland, these regions include swampy forests and large savannah floodplains, which are threatened by logging, mining, and agricultural activities. On the coast, wetland resources include mangroves and brackish lagoons. Pollution from off-shore oil production is a significant threat to coastal ecosystems. The country is sub-Saharan Africa's fifth-largest oil producer with proven reserves of 1 500 million barrels (EIA 2007).



Source: BP Statistical Review of World Energy 2007

Deforestation

The Republic of the Congo is one of the most heavily forested countries in Africa, with forests covering roughly two-thirds of its land. Over half of this area has been opened to logging through timber concessions (CARPE 2006). While the majority of logging occurs as selective harvests that target only the most valuable species, the industry still contributes to forest degradation and loss of biodiversity (FAO 2003). Fuelwood harvesting and slash-and-burn agriculture also drive deforestation.



Source: FAOSTAT

C O N G O

0 6 12 Kilometres

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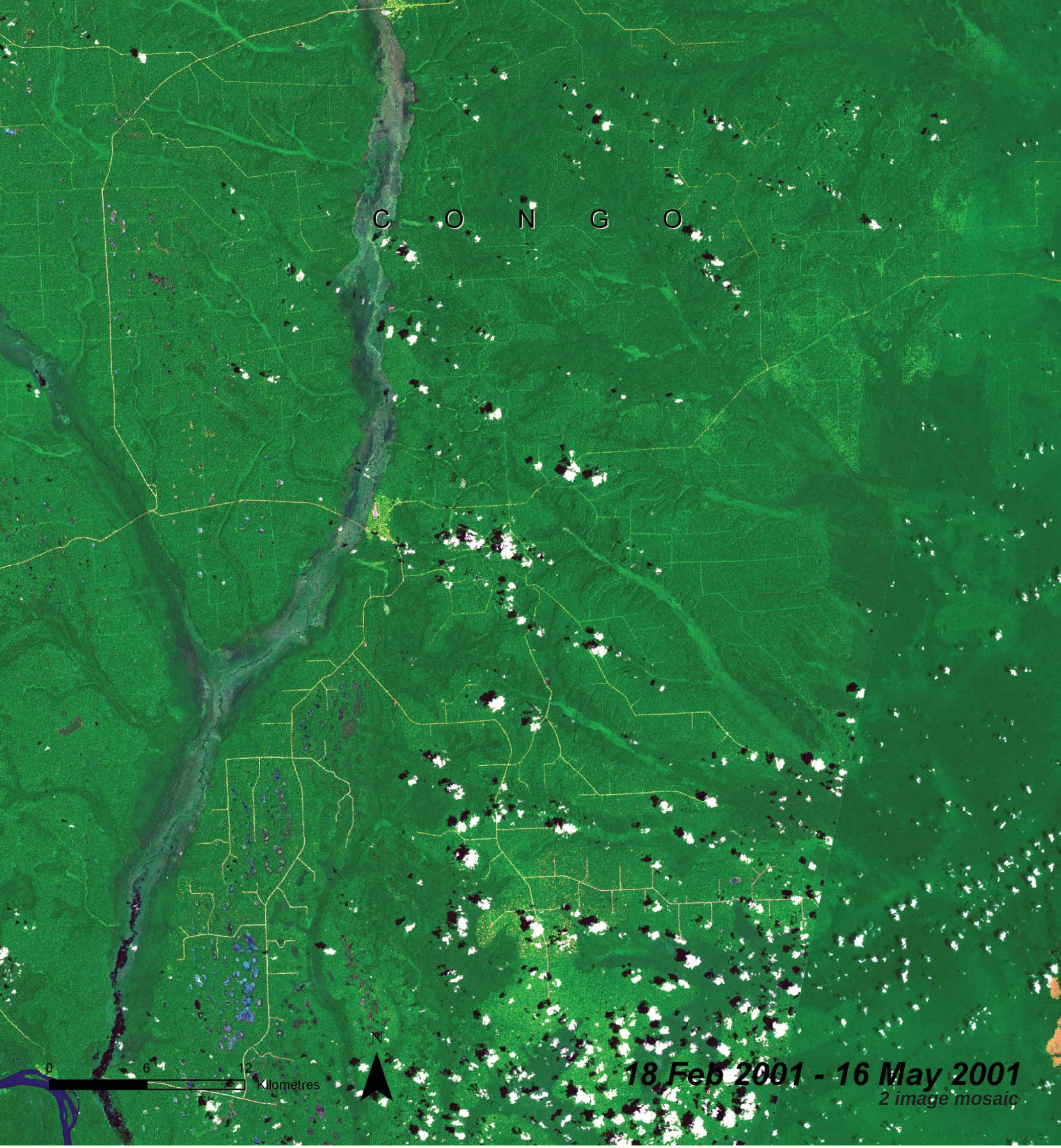
25 Feb 1976 - 20 Apr 1976

2 image mosaic

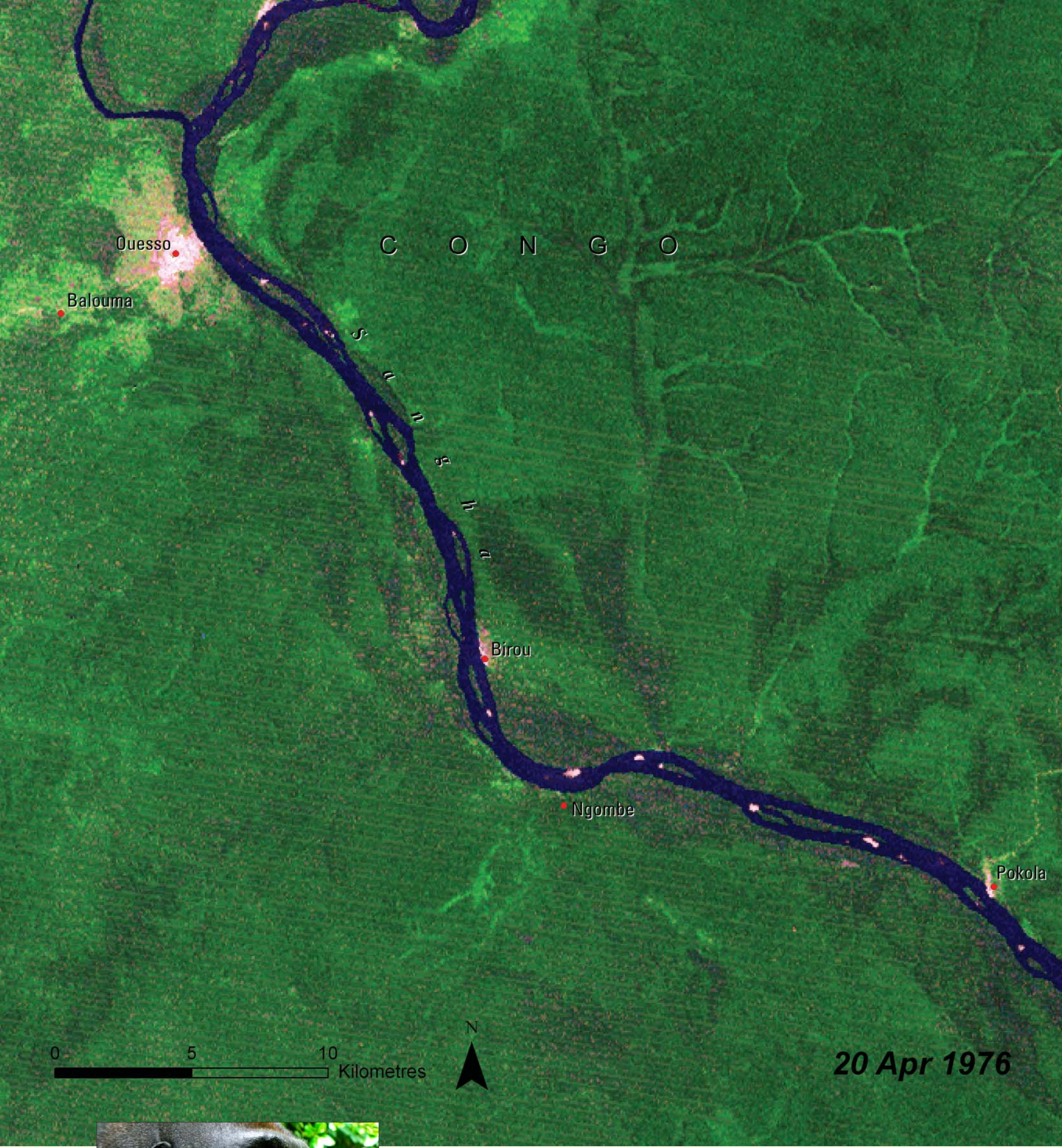
Logging Roads in the Rain Forest: Congo

In the dense tropical rainforest of sparsely populated northeastern Republic of the Congo, large tracts of relatively intact forest support a high concentration of biodiversity—including several large mammal species, approximately 1 700 plant species, 428 bird species, and many fish species. These forests play an important role in regulating local rainfall and climate. Tropical rain forests also absorb large amounts of carbon dioxide, a major greenhouse gas.



The 1976 image shows a large intact tract of humid tropical forest. By contrast, the 2001 image shows an extensive network of logging roads. The associated felling and removal of logs are causing considerable damage to the forest. The roads also provide access for bushmeat hunters and farmers into previously remote, intact forest. This has led to extreme over-hunting of vulnerable species including western lowland gorillas, elephants, and leopards.

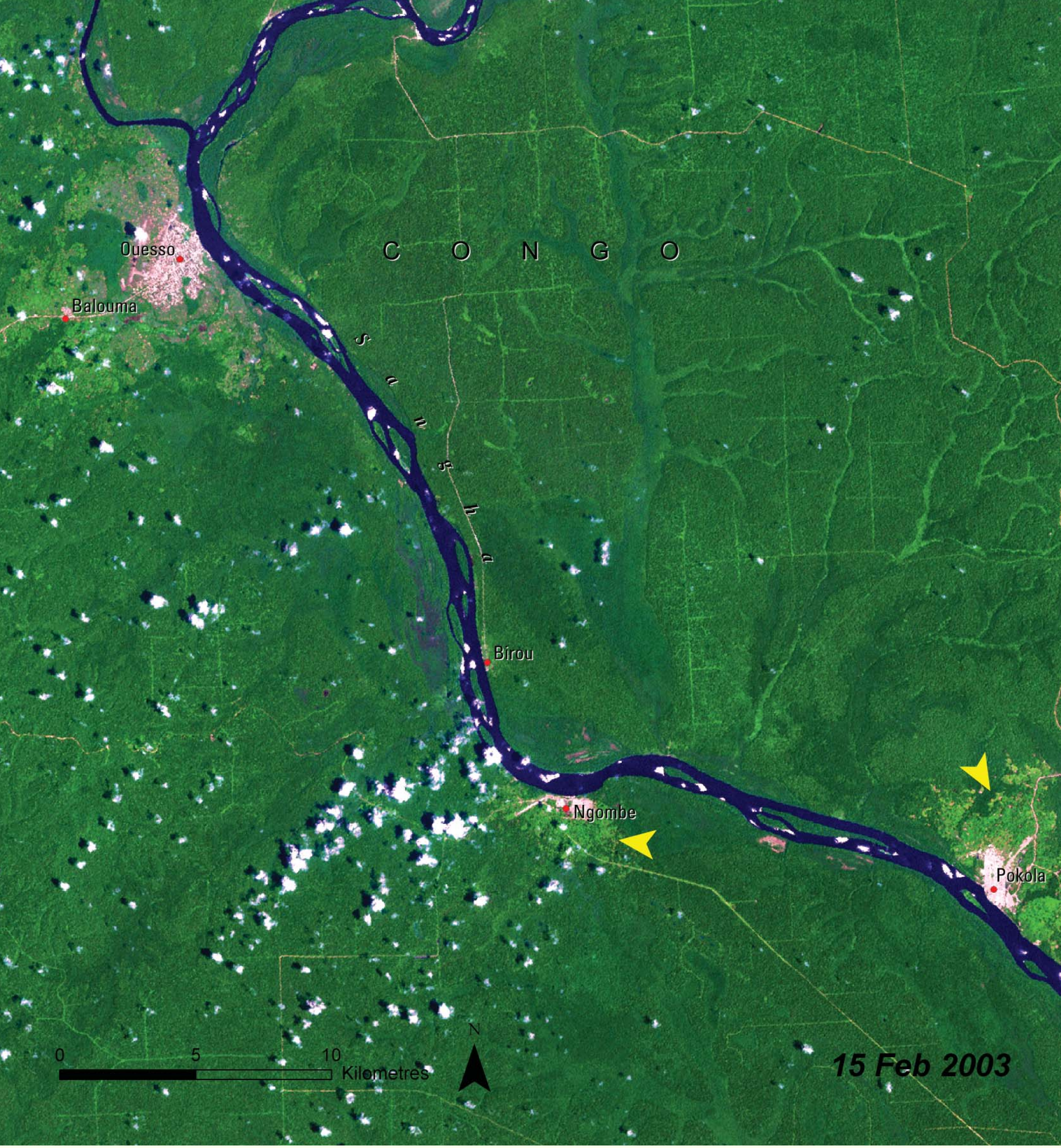
Global demand for timber is expected to encourage substantial deforestation in the long term. If this deforestation triggers a landscape-scale transition from forest to woodland or savannah, the consequences for biodiversity and climate would be catastrophic.



Bushmeat on the Roads: Ouesso, Congo

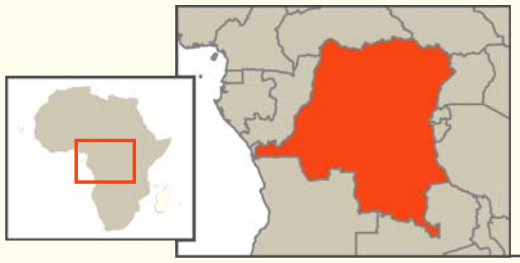
Ouesso, the largest town in northern Republic of the Congo with roughly 25 000 people, is surrounded by relatively intact tropical rain forests with a range of fauna including elephants, gorillas, chimpanzees, and bongos. Bushmeat accounts for the vast majority of protein in the diet of local people. Hunters largely ignore laws governing the taking of wild game; the harvest is only limited by accessibility and technology.

Inaccessibility of the area around Ouesso has also limited timber exploitation. Of seven companies logging in the area in the 1990s, four went bankrupt under the burden of high



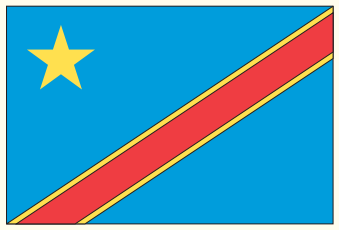
transportation costs. However, the area's inaccessibility appears to be changing. In the 1976 image few roads are visible and towns in the area are quite small, with little visibly disturbed forest surrounding them. By 2003, roads have penetrated throughout the area, towns have grown significantly, and, particularly near Pokola, the area of disturbed forest has grown (yellow arrows).

Logging roads, vehicles, and increased job opportunities have been shown to dramatically increase the range in which bushmeat hunting takes place. It also changes hunting from a subsistence activity to a commercial activity with meat being transported as far away as Brazzaville. There is a proposal to build an Ouesso-Brazzaville rail line. Improved transportation at lower cost would likely bring more roads, increased logging, and further increase in the bushmeat trade.



Democratic Republic of the Congo

Total Surface Area: 2 344 858 km²
Estimated Population in 2006: 59 320 000



Democratic Republic of the Congo (DRC) is the third-largest country in Africa. Dense tropical forests and sweeping savannahs each cover approximately one-half of this biologically rich nation. The DRC contains roughly 30 large rivers—including the entire length of the Congo River—which is the second-longest river in Africa, and has the second-largest flow of any waterway in the world. High, glaciated peaks are found along the ridges of the Great Rift Valley in the extreme eastern zone.

Important Environmental Issues

- Wildlife Poaching
- Deforestation
- Mining and Ecosystem Degradation

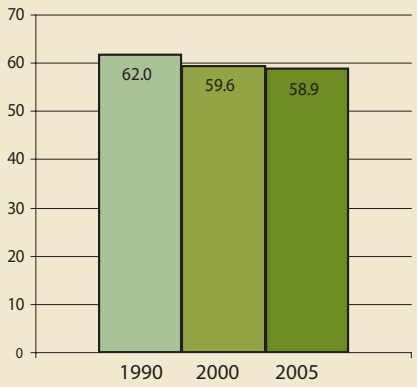
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

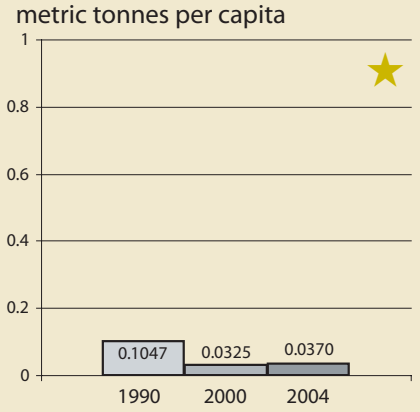
About 45 per cent of the DRC is covered by primary rain forest, which provides a refuge for several large mammal species driven to extinction in other African countries. Overall, the country is known to have more than 11 000 species of plants, 450 mammals, 1 150 birds, 300 reptiles, and 200 amphibians. Home to the greatest extent of tropical rain forest in Africa, deforestation caused by agricultural activity and the national dependence on fuelwood is evident.

★ Indicates progress

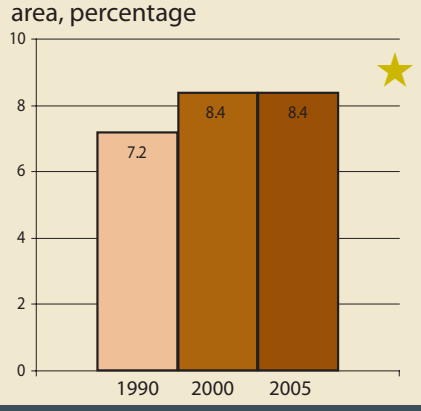
Land area covered by forest, percentage



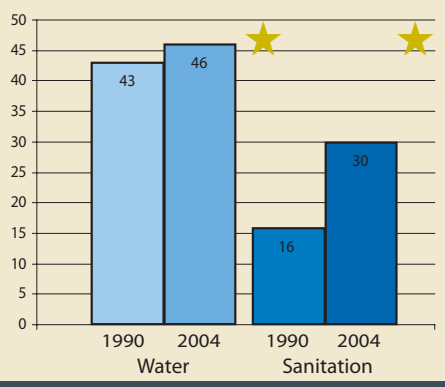
Carbon dioxide (CO_2) emissions, metric tonnes per capita



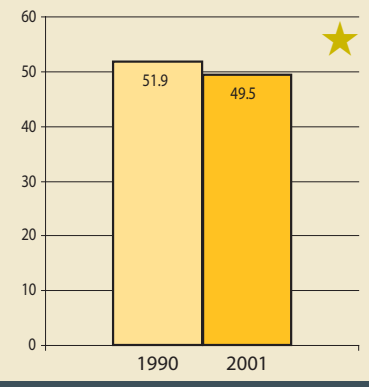
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

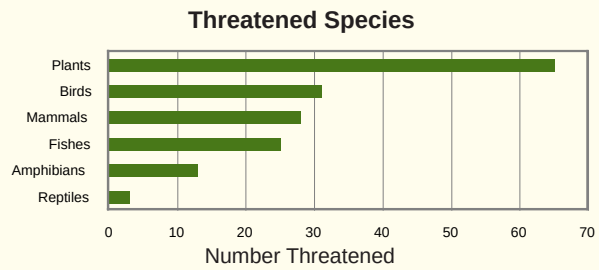


Salonga National Park, Africa's largest tropical rainforest reserve, is home to the bonobo (Pan paniscus), a small chimpanzee-like ape which is found only in Democratic Republic of the Congo.

Wildlife Poaching

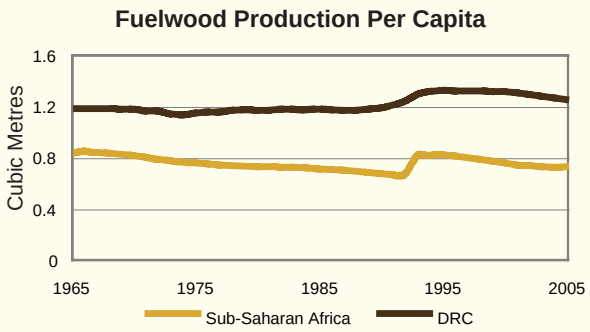
The forests and savannahs of Democratic Republic of the Congo support abundant and rare wildlife (UNEP-WCMC 2004). The DRC is home to more types of great apes than any other country on Earth, including the critically endangered lowland eastern gorilla and the bonobo.

Poaching is an issue throughout Central Africa, although the situation is perhaps most severe in the DRC, where armed conflict, widespread poverty, and illegal mining all contribute to the problem. In Virunga National Park, hippopotami have been poached almost to local extirpation, even though their numbers were estimated at 30 000 only three decades ago (Owen 2006).



Source: IUCN Red List

Deforestation

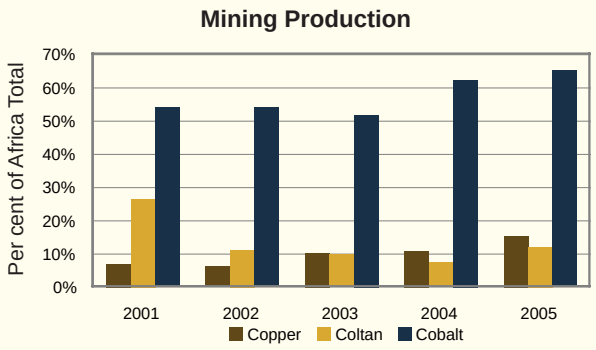


Source: FAOSTAT database

Democratic Republic of the Congo is nearly 60 per cent forested and alone accounts for one-fifth of Africa's total forest area (FAO 2003). Much of this forest is relatively undisturbed, making it an ecosystem of global importance. But many areas are threatened by fuelwood collection, agriculture, and logging. As a result of these activities, the DRC has lost nearly two million hectares of forest since 2000, which is the fifth-highest total in Africa (FAO 2005).

Mining and Ecosystem Degradation

The DRC possesses substantial mineral resources, including diamonds, gold, copper, and columbite-tantalite, or coltan, a valuable metal used in electronics. Mining of these various deposits increases human activity in forest interiors, causing substantial degradation to surrounding ecosystems and increasing exploitation of forest resources such as wildlife and timber. Coltan mining in Kahuzi-Biega National Park, for example, has been implicated in the precipitous decline of the lowland gorilla population, which now numbers less than 1 000 (Ecologist 2004).



Source: USGS Mineral Summaries

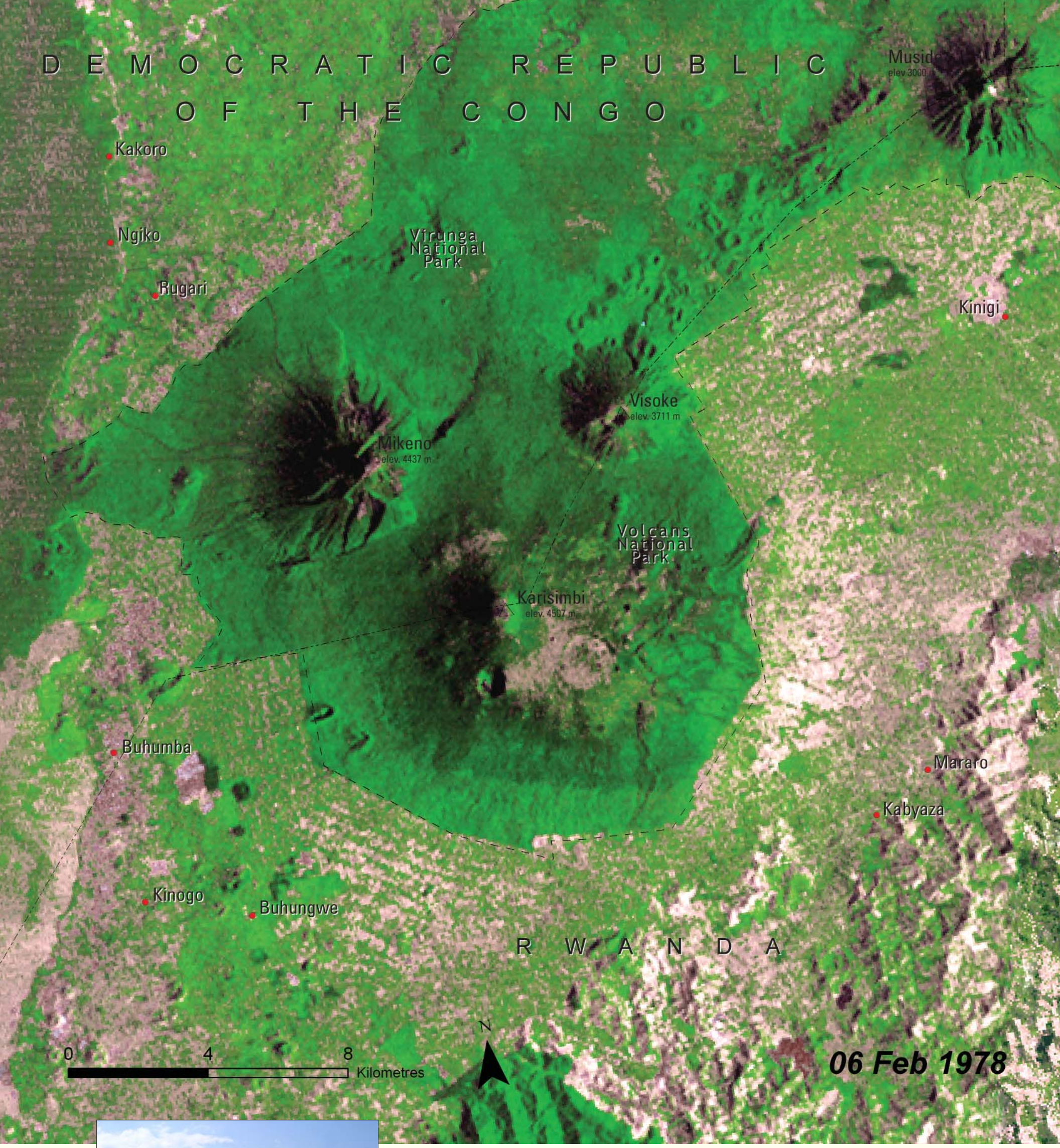
Bodalangi
Bogbo
DEMOCRATIC REPUBLIC OF THE CONGO
Kande
Bokia
Yamuha
Bongelenza
Bwehe
Yandongi
Bongolu
Yabia
Yangome
Yamisole
Yalibongo
Modjamboli
Botsori
Bongolu
Yampaka
Yamisika
Yamolumba
N
0 9 18 Kilometres
Dobo
Congo
Bumba
12 Dec 1975
Yambinga

Deforestation Surrounding Bumba: DRC

A pattern of deforestation concentrated along the local roads in the Nord-Ubangi and Mongala provinces of the DRC can be seen clearly in the 1975 image as loops of light green through the otherwise dense rain forest. In the 2003 image, these deforested corridors have widened, almost to the point of joining. Most of this deforestation is the result of agricultural conversion, fuelwood collection, settlement, and artisanal logging. Networks of logging roads can also be seen within two of the patches of largely intact forest in the lower right corner of the 2003 image.

While industrial logging has had a relatively small impact in the DRC in the past, it has recently become the most extensive form of land use in Central Africa. More than half of the area visible in these images is under logging concession. The selective logging practised by commercial logging companies has been shown to have long-lasting impacts on forest composition. Logging roads have been shown to significantly increase bushmeat hunting.

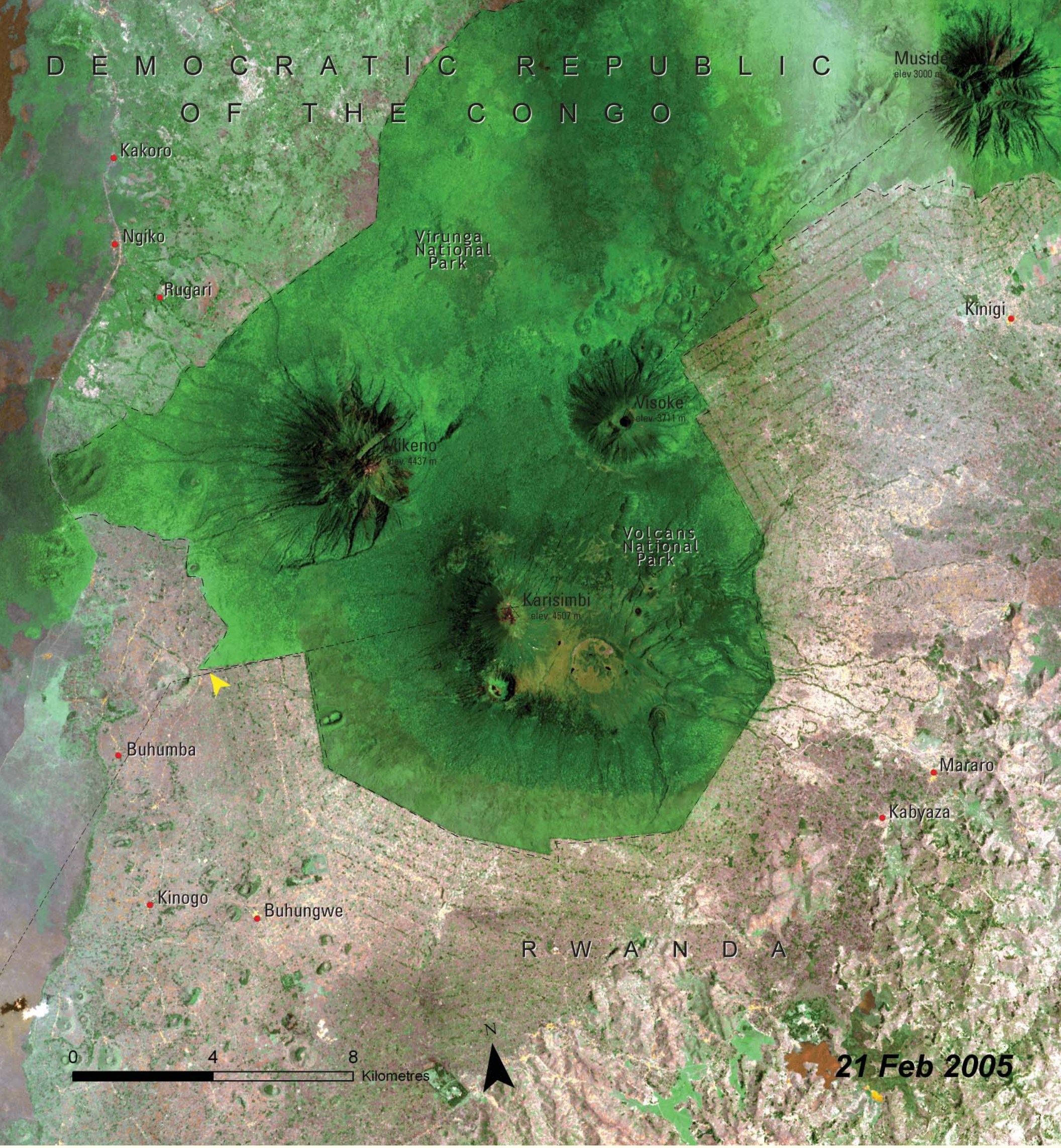
In addition to local and logging roads, a recent study for the World Bank suggests the road from Bangui, CAR, to Kisangani, DRC, be improved as part of a continental road network. The study shows that the network would increase trade on this route enormously. It also acknowledges concern that parts of the road network that would experience the greatest increase in trade correspond to areas with the highest biodiversity.



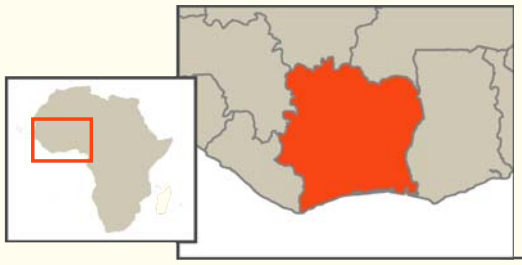
The Gorillas of Virunga National Park: DRC

The Virunga Park area is home to over half of the world's 700 surviving mountain gorillas (*Gorilla beringei beringei*). In an area approximately 40 km by 12 km with an elevation ranging from 2 300 to 4 507 metres there are a variety of ideal gorilla habitats including bamboo and montane forests.

The area includes Mgahinga National Park in Uganda, Volcans National Park in Rwanda and the Mikeno (Gorilla) sector of Virunga National Park in DRC. Surrounding these protected areas, however, are some of the densest human populations in Africa. In addition to population pressure, armed conflict in the region has made habitat and species protection very difficult.

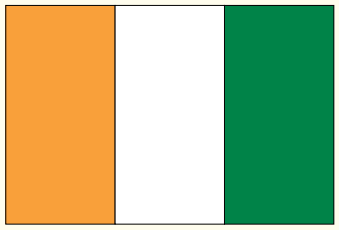


In the 1978 image, a line between the protected areas and the populated agricultural areas surrounding the parks is already apparent. While the boundary of the parks has remained largely intact since the mid-1970s, during the 1990s and early 2000s, large numbers of people moved into the area surrounding the parks, many of them refugees from armed conflict. A report by the Institut Congolais pour la Conservation de la Nature documented a large coordinated influx of people from outside the area in May and June of 2004. The report estimated that 15 km² of land at the west edge of the Park (yellow arrow) were deforested during this time. The decline in areas of green outside the protected areas suggests that few fallow fields and little natural vegetation remain—a sign of the agricultural intensity in this area.



Republic of Côte d'Ivoire

Total Surface Area: 322 463 km²
Estimated Population in 2006: 18 454 000



Côte d'Ivoire is the western-most country bordering the Gulf of Guinea, with 515 km of coastline fringed by a network of large lagoons. A dense tropical rain forest in the south, once the largest in West Africa, covers over 30 per cent of the country. Soils are particularly fertile and agriculturally productive, even in the semi-arid savannahs to the north. Approximately 65 per cent of the country's land is suitable for cultivation (FAO 2005).

Important Environmental Issues

- Deforestation
- Threats to Biodiversity
- Threats to Coastal Ecosystems

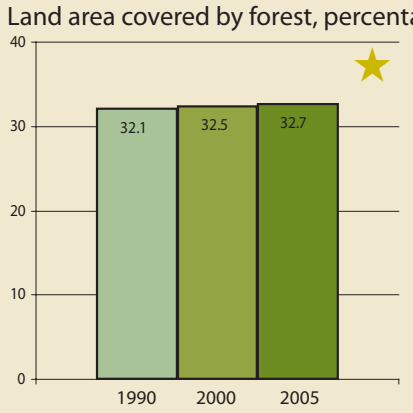
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

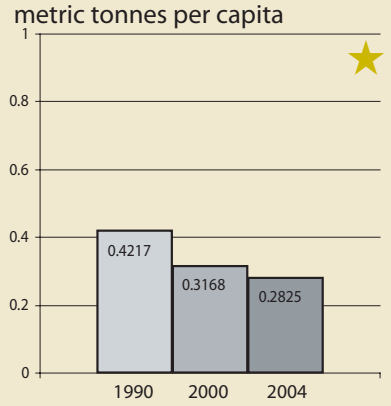
Water pollution is still a significant environmental problem in Côte d'Ivoire due to chemical waste from agricultural, industrial, and mining sources. Other than water pollution and an increase in the percentage of slum population, Côte d'Ivoire seems to be faring well in all other environmental indicators. Most of Côte d'Ivoire's biodiversity occurs in the rugged interior region and not in the coastal regions as is the case in other parts of West Africa.

★ Indicates progress

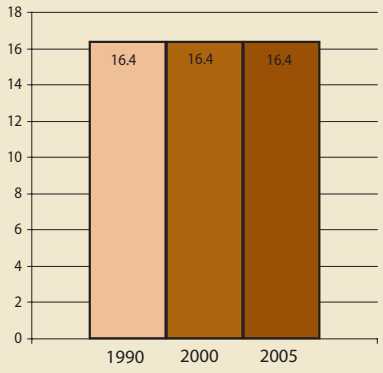
Land area covered by forest, percentage



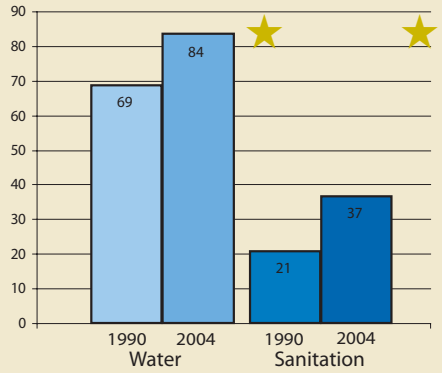
Carbon dioxide (CO_2) emissions, metric tonnes per capita



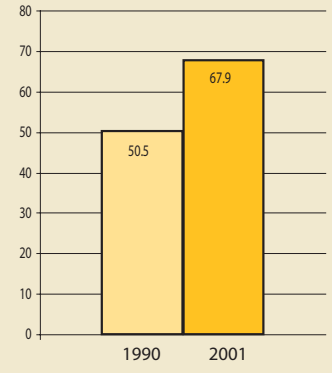
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban



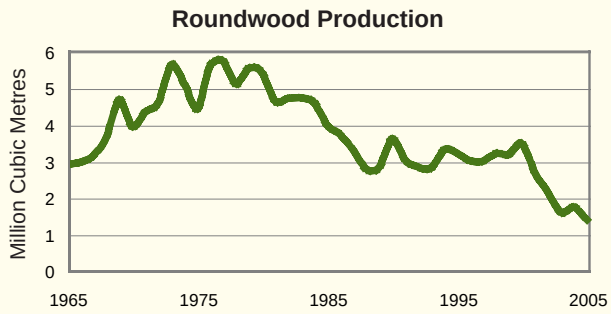
With over 1 200 animal species and 4 700 plant species, Cote d'Ivoire has the highest biodiversity of any West African country.

rainforests.mongabay.com (2007)

Deforestation

Since achieving independence in 1960, Côte d'Ivoire has lost roughly 40 per cent of its forest cover (Mongabay 2006). Although government policies have dramatically slowed the rate of deforestation since 1980, agricultural expansion and illegal logging for valuable tropical hardwoods continue to pressure the remaining primary forests, which account for only six per cent of the total forest area (Mongabay 2006).

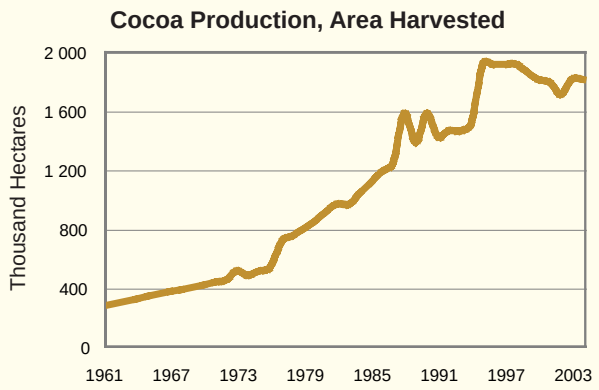
Côte d'Ivoire's Tai National Park is the single largest tract of undisturbed tropical rain forest in West Africa. The park contains some 1 300 species of higher plants, 150 of which are endemic to the Tai region, and several endangered primate species (UNEP-WCMC 1989). Primary threats include illegal poaching, logging, farming, and gold mining.



Source: FAOSTAT

Threats to Biodiversity

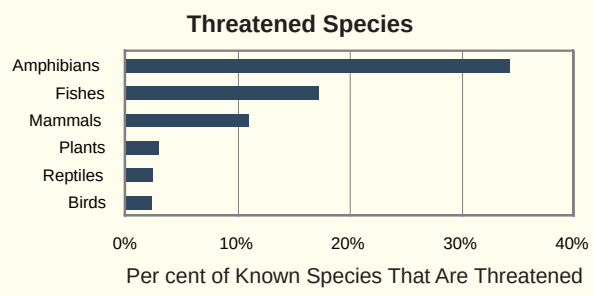
Côte d'Ivoire has the highest level of biodiversity in western Africa with over 1 200 animal species and 4 700 plant species. A total of 178 plant and animal species are currently threatened with extinction (IUCN 2007) due to deforestation, poaching, and destruction of natural habitats. In particular, cocoa farming has played a significant role in altering the natural landscapes that are important for the maintenance of biodiversity. High population growth and immigration have spurred farmers to increase use of fertilizers and pesticides and illegally expand plots into protected rain forests, where cocoa trees thrive in the hot, humid conditions.



Source: FAOSTAT

Threats to Coastal Ecosystems

Côte d'Ivoire's coast has an impressive six sites designated as Ramsar Wetlands of International Importance, totaling 127 344 hectares (Ramsar 2005). The protected areas include large mangrove forests and are biologically noteworthy for wildlife, including chimpanzee, forest elephant, pygmy hippo, manatee, and five species of turtle. However, roughly 40 per cent of the country's population lives within 100 km of the coast (CIESIN 2000), where increasing pollution from sewage and industrial effluent is degrading aquatic ecosystems and development is leading to coastal erosion. The situation is particularly severe in the southwest near the major city of Abidjan.



Source UNEP-WCMC 2004; IUCN Red List

Aniassue
Beki Forest Reserve
CÔTE D'IVOIRE
Apouesso
Comoé
Tanekrou
Bossematie Forest Reserve
Kouassikro
Bebou
Alangouanou
Mbasso
18 Jan 1986
N
0 5 10 Kilometres

The Loss of Beki Forest Reserve: Côte d'Ivoire

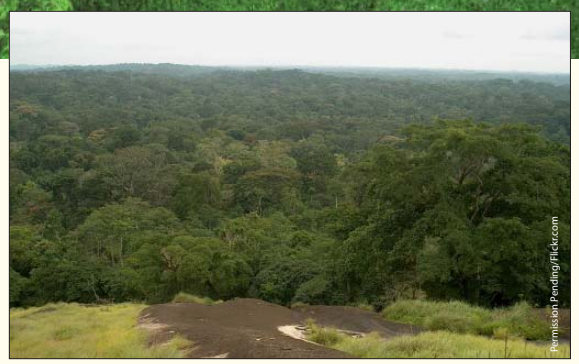
Located in southeastern Côte d'Ivoire, Beki Forest Reserve was one of 230 forest reserves established in the country in 1965. In 1971, Beki Forest Reserve covered 16 764 hectares. By 1986 its forested area had decreased by about one-fifth to 12 816 hectares. In 1995, less than one-third of the 1971 extent remained, representing an annual rate of loss around 4.5 per cent.

Much of this deforestation began in the 1980s when the government resettled two villages away from the Comoé River and adjacent to the Beki Forest Reserve. The villages had been afflicted with an outbreak of onchocerciasis (river blindness) carried by blackflies that live near

fast flowing water. To facilitate the village resettlements, authorities allowed the villagers to exploit land within the Reserve. Unfortunately, no limits were set on this authorized exploitation, and by the mid-1990s cultivation of cocoa and coffee covered much of the original forest area. In the images above, decimation of Beki Forest Reserve is apparent between 1986 and 2003, in contrast to the Bossematie Forest Reserve to the southeast.

In Côte d'Ivoire, cocoa plantations currently cover two million hectares, and have caused the loss of a significant portion of the country's natural forests. Côte d'Ivoire produced 1.275 million metric tonnes of cocoa in 2004/2005. Coffee and cocoa generate 50 per cent of the country's total export revenues and one-third of the population depends on cocoa cultivation.

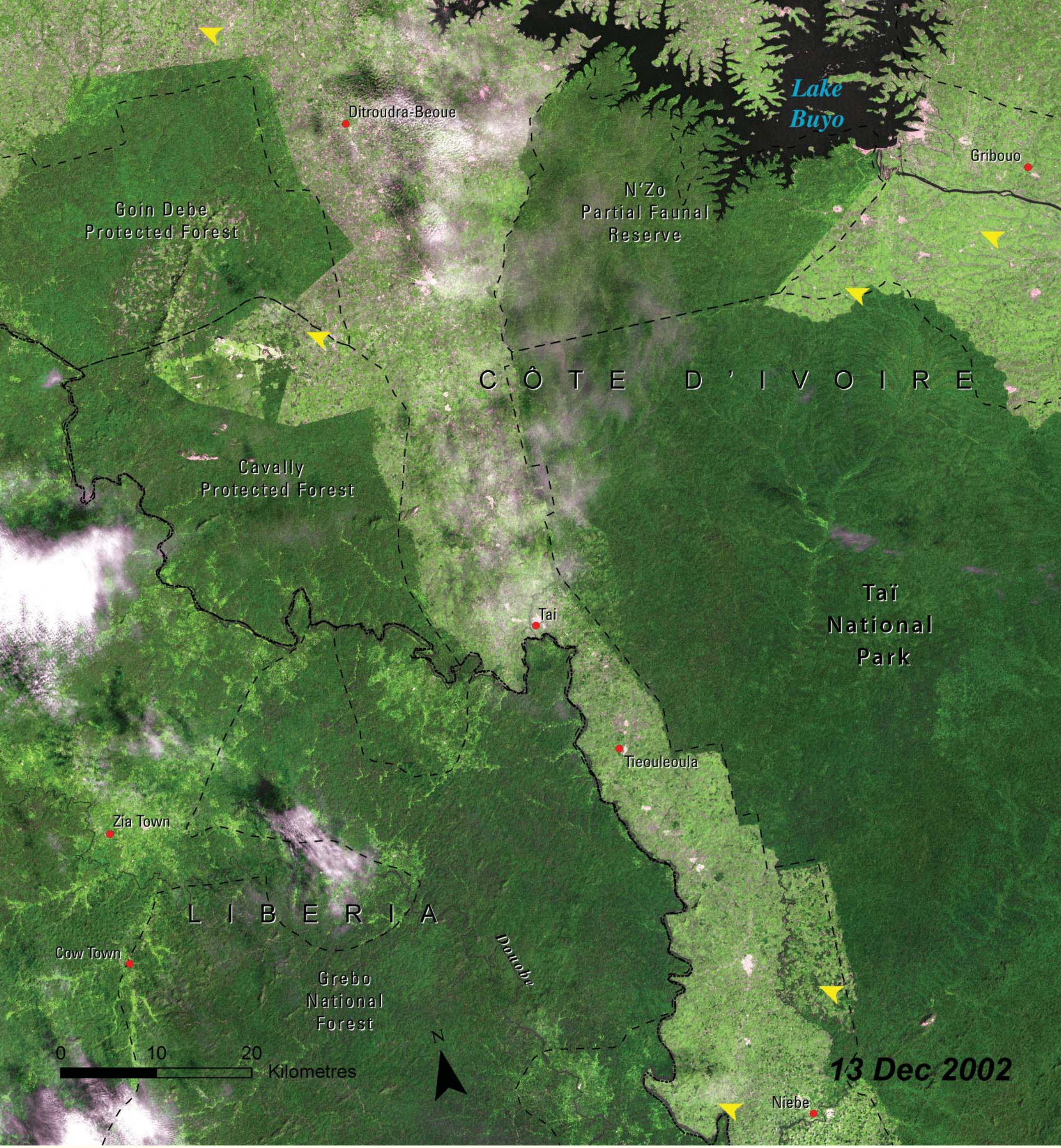
Lake Buyo
Ditroudra-Beoue
Gribouo
Goin Debe Protected Forest
N'Zo Partial Faunal Reserve
CÔTE D'IVOIRE
Cavally Protected Forest
Taï National Park
Tai
Tieouleoula
Zia Town
LIBERIA
Cow Town
Grebo National Forest
Dotuobe
0 10 20 Kilometres
N
09 Mar 1988
Niebe


Permission Pending Flickr.com

The Survival of Taï National Park: Cote d'Ivoire

Taï National Park, N'Zo Partial Faunal Reserve, and the Goin-Débé and Cavally Forest Reserves, are remnants of tropical rain forests that at one time stretched from Ghana to Sierra Leone. Taï National Park, the most pristine and heavily protected of these, contains some 1 300 plant species, over half of which are unique to the region's rain forests. Taï is also home to most of the large mammals that occur in the area, including the leopard (*Panthera pardus*), which is critically endangered.

The park was declared a forest and wildlife refuge in 1926 and more recently a National Park, a UNESCO Biosphere Reserve, and a World Heritage Site. This area was historically remote and



sparsely populated; however, roads built in the late 1960s brought periods of population influx. That population has converted most of the forest outside the protected areas to agricultural land, leaving only scattered fragments of forest. Much of this deforestation had already occurred before these images were taken; however several further areas of forest loss can be seen between 1988 and 2002 (yellow arrows).

While deforestation continues outside the protected areas, the Government of Côte d'Ivoire has maintained the Taï National Park's integrity and its core area remains in relatively good condition. The current concern within the park is commercial poaching, putting at risk all fauna, but duikers and primates in particular. Also, as these images make clear, the boundaries of the park are under increasing pressure from a growing population that is running out of unprotected land to farm.

Republic of Djibouti

Total Surface Area: 23 200 km²
Estimated Population in 2006: 807 000

Djibouti is the third-smallest country on the African continent. It has 443 km of coastline (Earth Trend 2007) at the junction of the Red Sea and the Gulf of Aden, which represents an important international shipping lane and a unique tropical marine ecosystem. The climate is mostly hot, dry desert—over 90 per cent of the country is classified as hyper-arid desert (FAO AGL 2003), and average temperatures range between 25 °C in winter and 35 °C in summer. Natural resources include geothermal energy and limited deposits of gypsum, copper, and other ores, which are currently not exploited.

Important Environmental Issues

- Water Scarcity
- Land Availability and Desertification
- Marine Resources and Pollution

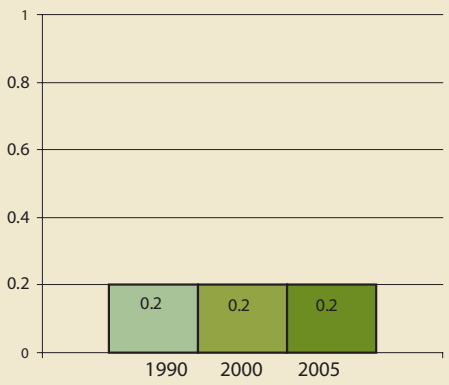
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

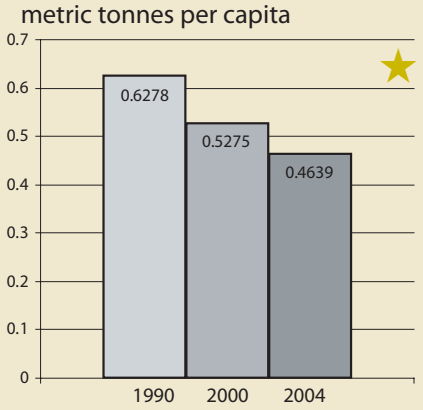
Less than one per cent of the country's total land area is forested. Djibouti's most significant environmental problems are inadequate supplies of potable water, limited arable land, and desertification. The climate is torrid, and rainfall is sparse and erratic; the limited water supply is further threatened by increasing salinity.

★ Indicates progress

Land area covered by forest, percentage



Carbon dioxide (CO_2) emissions, metric tonnes per capita



Protected area to total surface area, percentage

Proportion of total population using improved drinking water sources and sanitation facilities, percentage

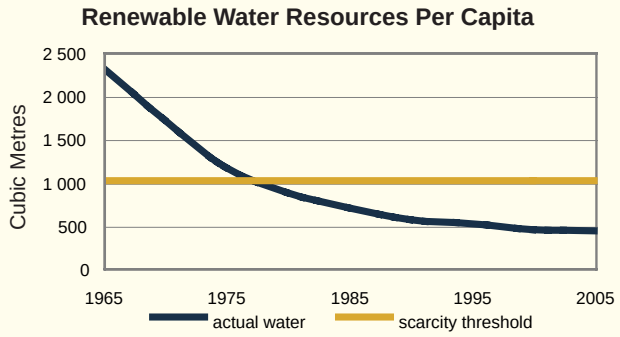
Slum population as percentage of urban

Djibouti's Lake Assal, at 156 m below sea level, is both the saltiest body of water and the lowest point in Africa.

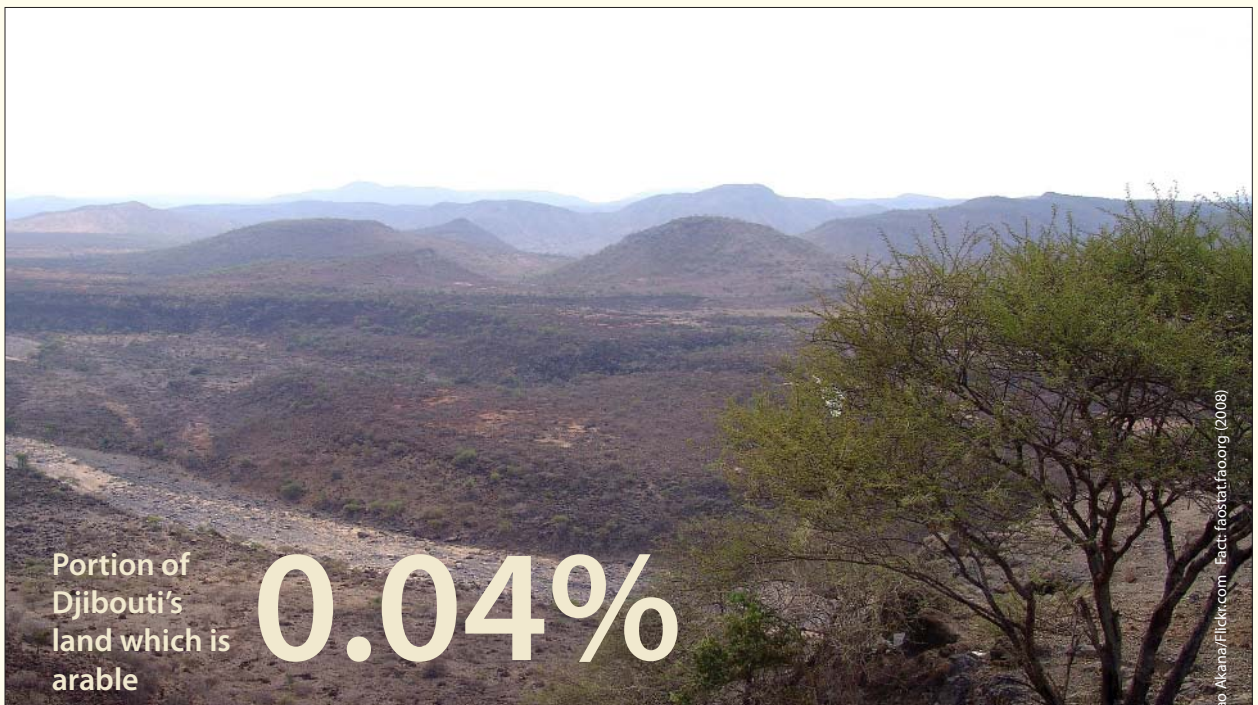
Water Scarcity

Djibouti is well below the international water scarcity threshold with only 416 m^3 available per person per year (FAO 2007a). Erratic rainfall leads to frequent droughts and floods that regularly threaten food security and rural livelihoods. There are no permanent rivers or streams in the country, so groundwater is the primary water source. However, overexploitation is increasing groundwater salinity; a 2000 survey found that over half of the country's wells contain high salt concentrations (FAO 2005) due to the intrusion of sea water.

Population growth, measured at 1.61 per cent annually (UNESA 2005), exerts the greatest pressure on scarce water resources. Domestic water use accounts for 86 per cent of total withdrawals (FAO 2007a), which is the largest proportion of any African country.

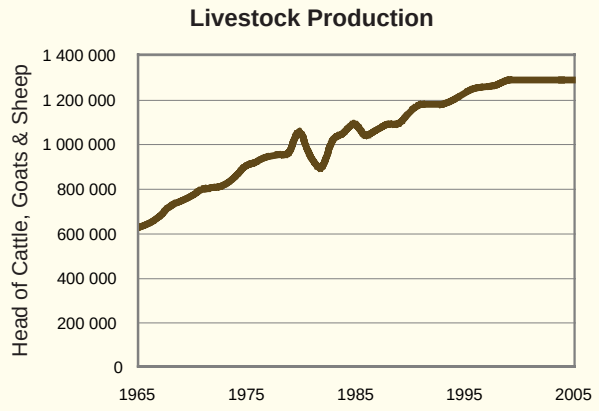


Source: AQUASTAT



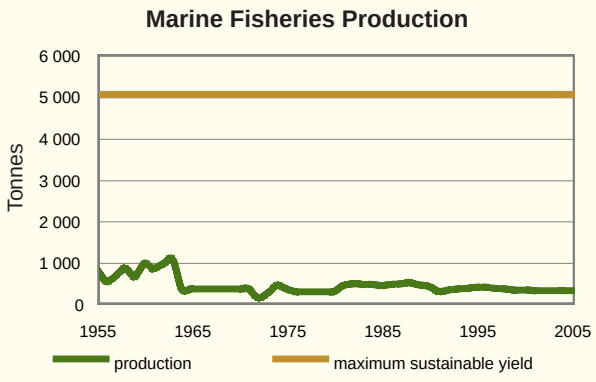
Land Availability and Desertification

Less than one per cent of land in Djibouti is arable due to poor soils and low rainfall. Over 50 per cent of land is permanent pasture (FAO 2007b), where water availability is the greatest constraint on livestock production and overgrazing contributes to land degradation and desertification. Pastoralists constitute 75 per cent of the total labour force (FAO 2007b), yet account for less than four per cent of GDP (World Bank 2006), reflecting the prevalence of rural poverty. Urban poverty is also pervasive; 83 per cent of the population lives in the country's capital and only urban area, Djibouti (UN 2006), where unemployment is over 50 per cent (USAID 2006).



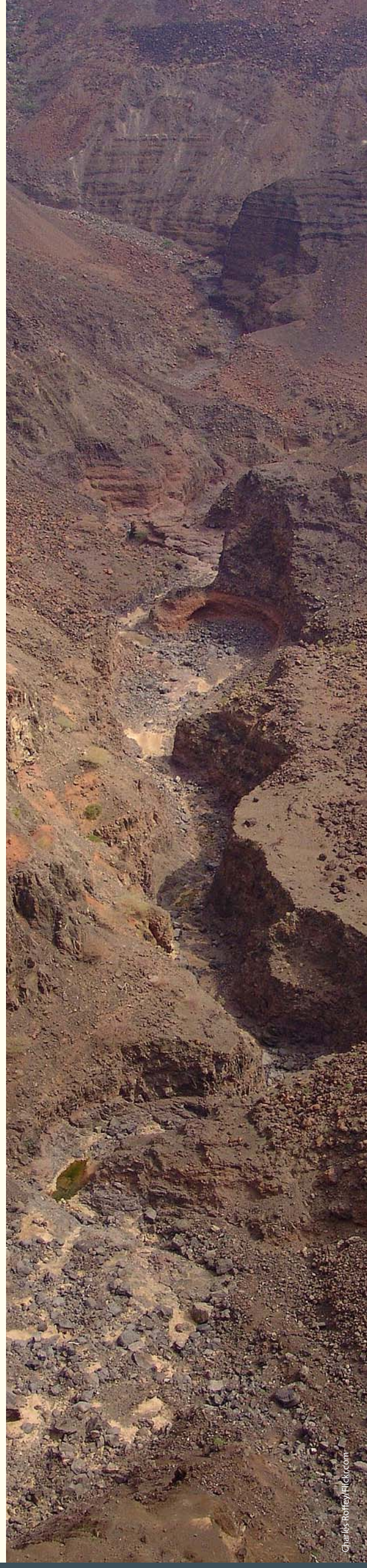
Source: FAOSTAT

Marine Resources and Pollution



Source: FISHSTAT

There are no large-scale fisheries in Djibouti, and most fishing occurs at the subsistence level. The maximum sustainable yield has been estimated at 5 000 metric tonnes of fish annually, although total catch remains at 350 metric tonnes per year (FAO n.d.). Although overfishing is currently not a threat to marine resources, coastal development, municipal waste discharge, and oil pollution from petroleum development and transport have degraded coastal ecosystems. Djibouti has designated two small marine protected areas to preserve its valuable coral reefs and coastal mangrove forests.



Gulf of Tadjoura

Gulf of Aden

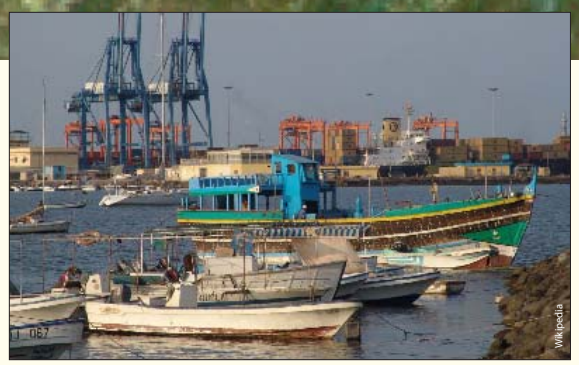
D J I B O U T I

Djibouti

0 1 2 Kilometres

N

13 Jun 1985



Rapid Population Growth: Djibouti, Djibouti

Nearly 85 per cent of Djibouti's population is urban, with the vast majority of urban dwellers living in the capital city, Djibouti. The city's population grew 10-fold between 1950 and 2002 and is projected to grow another 25 per cent, to 800 000 people by 2025. The city is poor by international standards, but its relative prosperity for the area has attracted migrants from rural Djibouti and surrounding countries.

The country of Djibouti has little arable land, little rainfall, and limited possibilities for irrigation. Because of this it imports 80 per cent of its food, mostly through the port of the