KENYA

Atlas of Our Changing Environment

UNEP

In the footsteps of *One Planet Many People*, and *Africa: Atlas of Our Changing Environment*, this is the newest in a suite of UNEP Atlases that have inspired decision-makers to action through the power of photographs.

This Atlas does two unique things:

• it assesses Kenya's progress towards its own goals of improving the environment to achieve development goals; and

• it delivers a stunning bird's-eye view of environmental change through the use of paired satellite images taken years apart.

In the first case, it demonstrates that the social and economic pillars of Kenya's development plan, Vision 2030, need to be built on a solid foundation of environmental sustainability. Similarly, it teases out the links between the environment and the Millennium Development Goals (MDGs), showing how the 7th goal, environmental sustainability, underpins them all. In its second unique contribution, the Atlas contains an array of visual tools, including current and historical remote sensing images, maps, and photographs, that help scientifically document site-specific environmental change across the country.

This Atlas will serve as an important educational tool to improve local, national, and international knowledge about environmental change in Kenya and to stimulate action at all levels to protect the rich resources that are the base of its culture, economy, and human well-being.

KENYA ATLAS OF OUR CHANGING ENVIRONMENT

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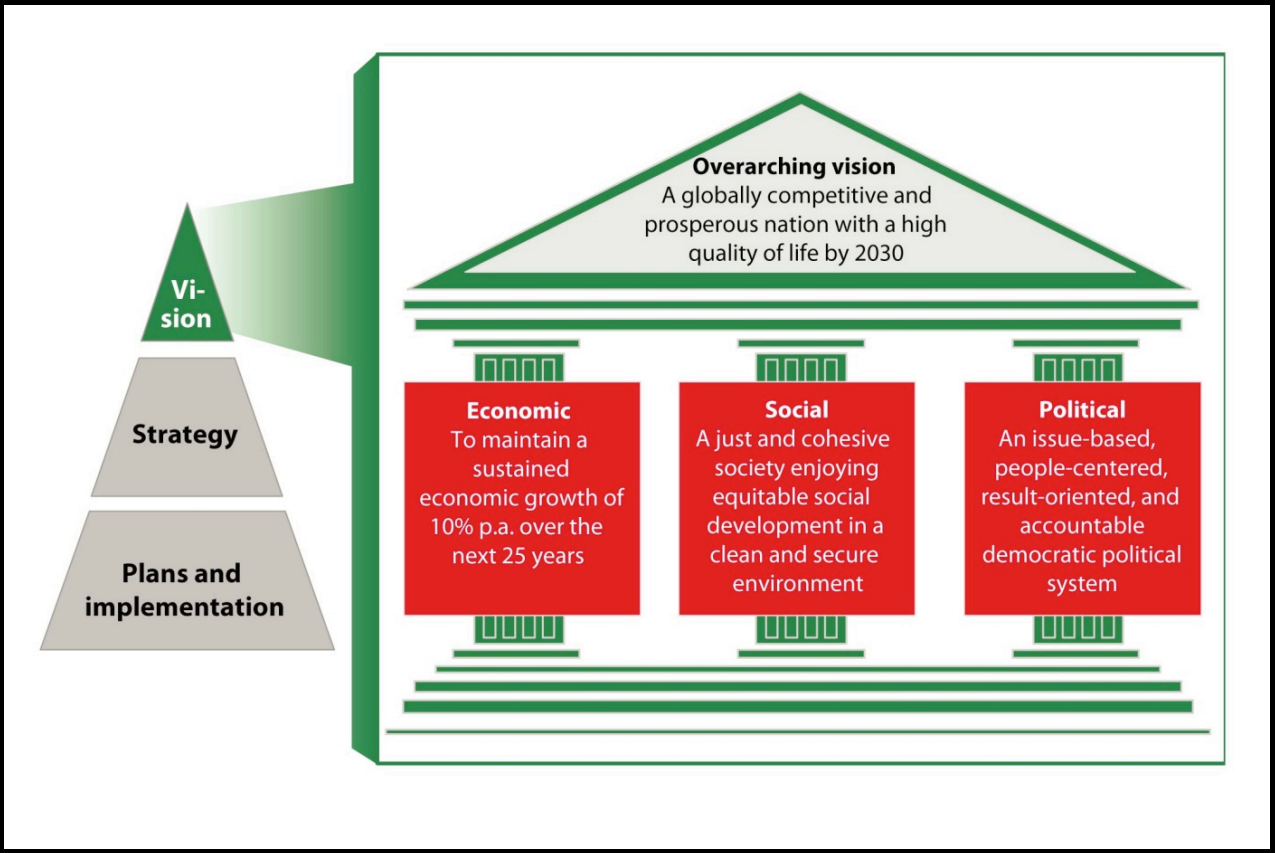
Policy relevant questions being addressed

- How is the environment related to Kenya's Vision 2030
- What is the status and trend of environment in Kenya?
- What progress has Kenya made towards MDG7 – Environmental Sustainability?
- What are the transboundary issues which need international cooperation?
- What are "scientific and visual evidences" of significant local environmental changes in Kenya?
- What and Where are place based early warning of emerging issues?

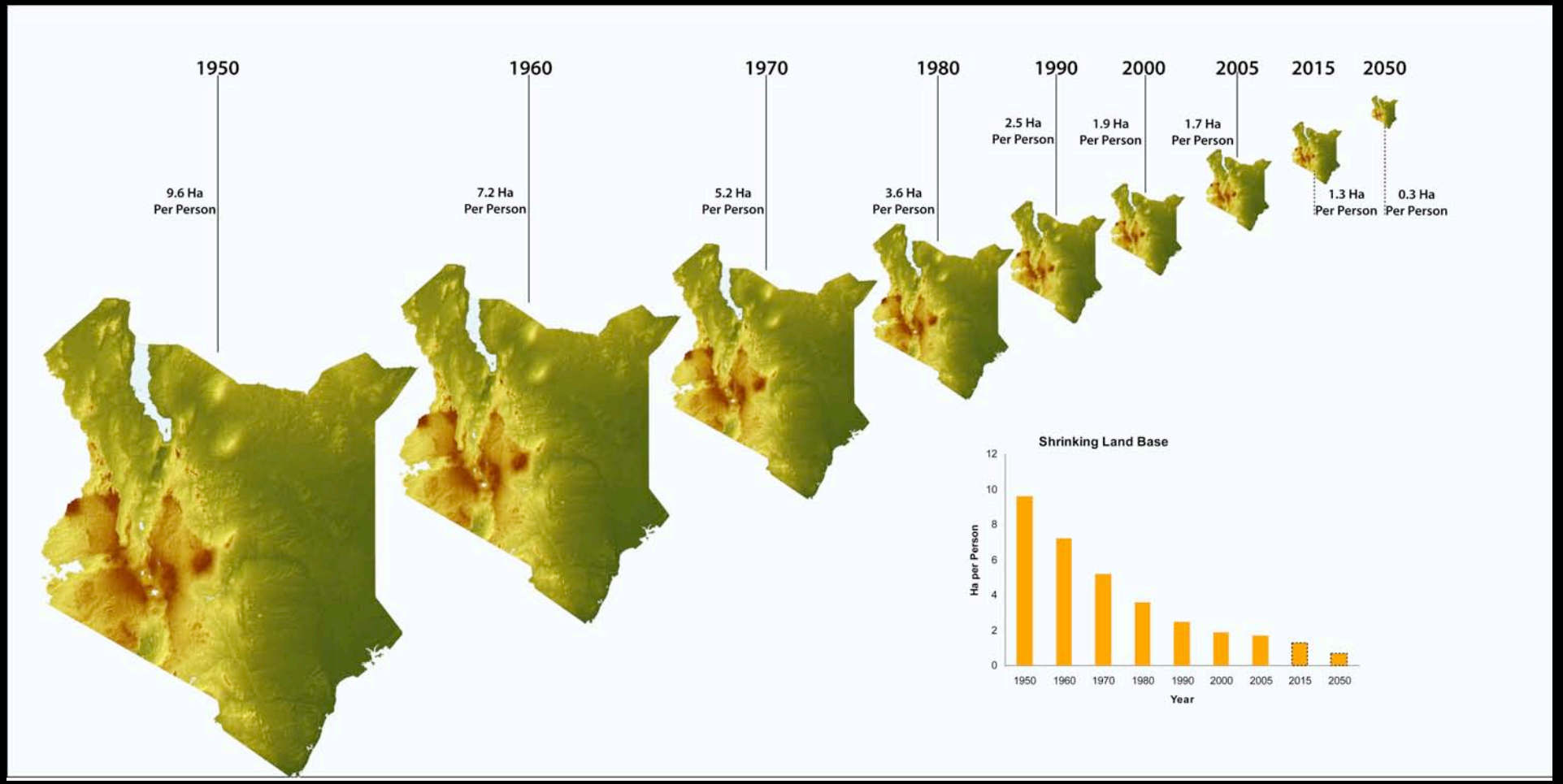
Kenya Atlas :Vital Statistics

- 168 pages
- 47,153 words
- 70 Satellite images
- 30 locations of environmental changes
- 229 Ground photos
- 65 Maps
- All materials are non copy-righted, available for free use

Vision 2030 aims to make Kenya a "middle income country providing high quality life for all its citizens by the year 2030".

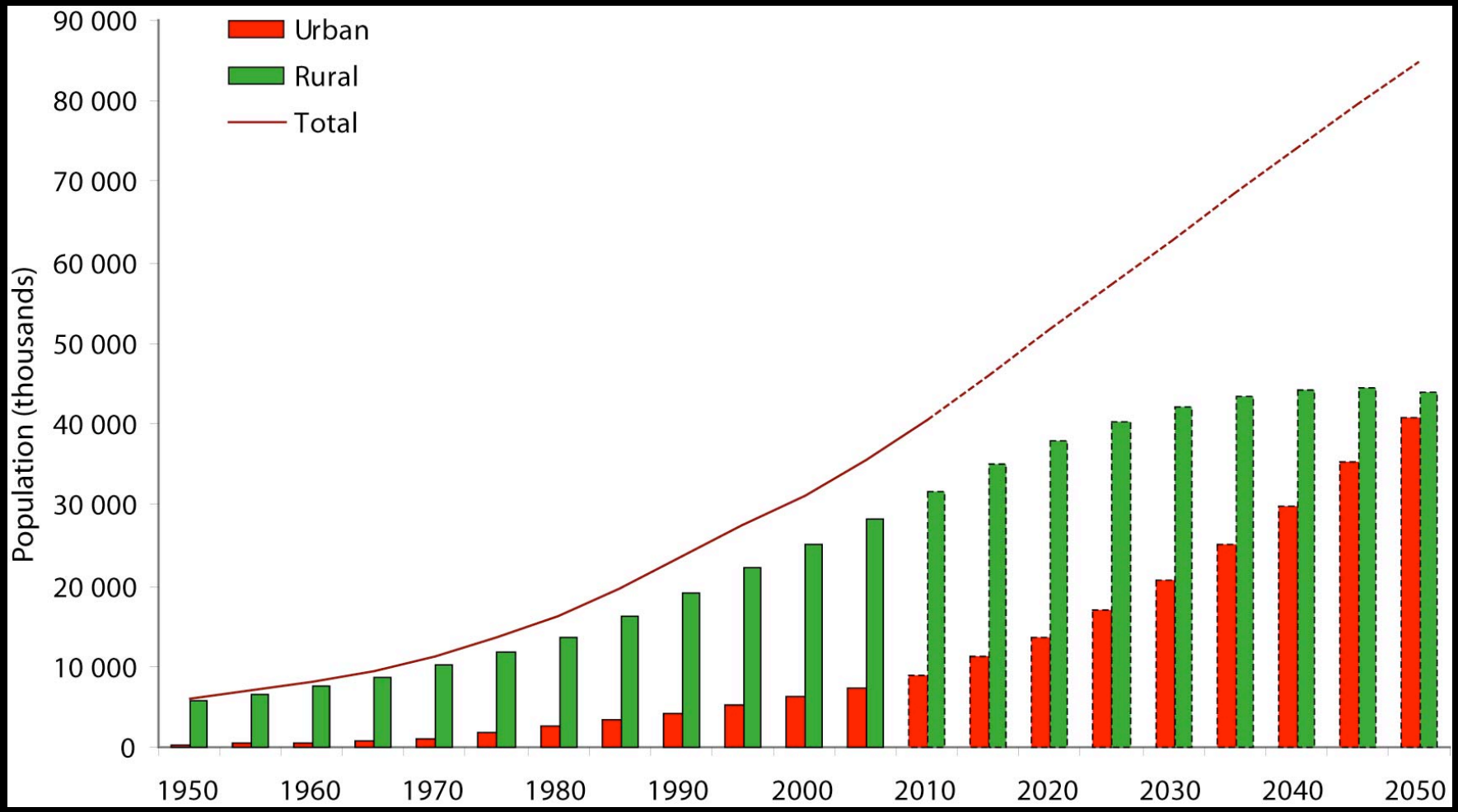


Shrinking Kenya



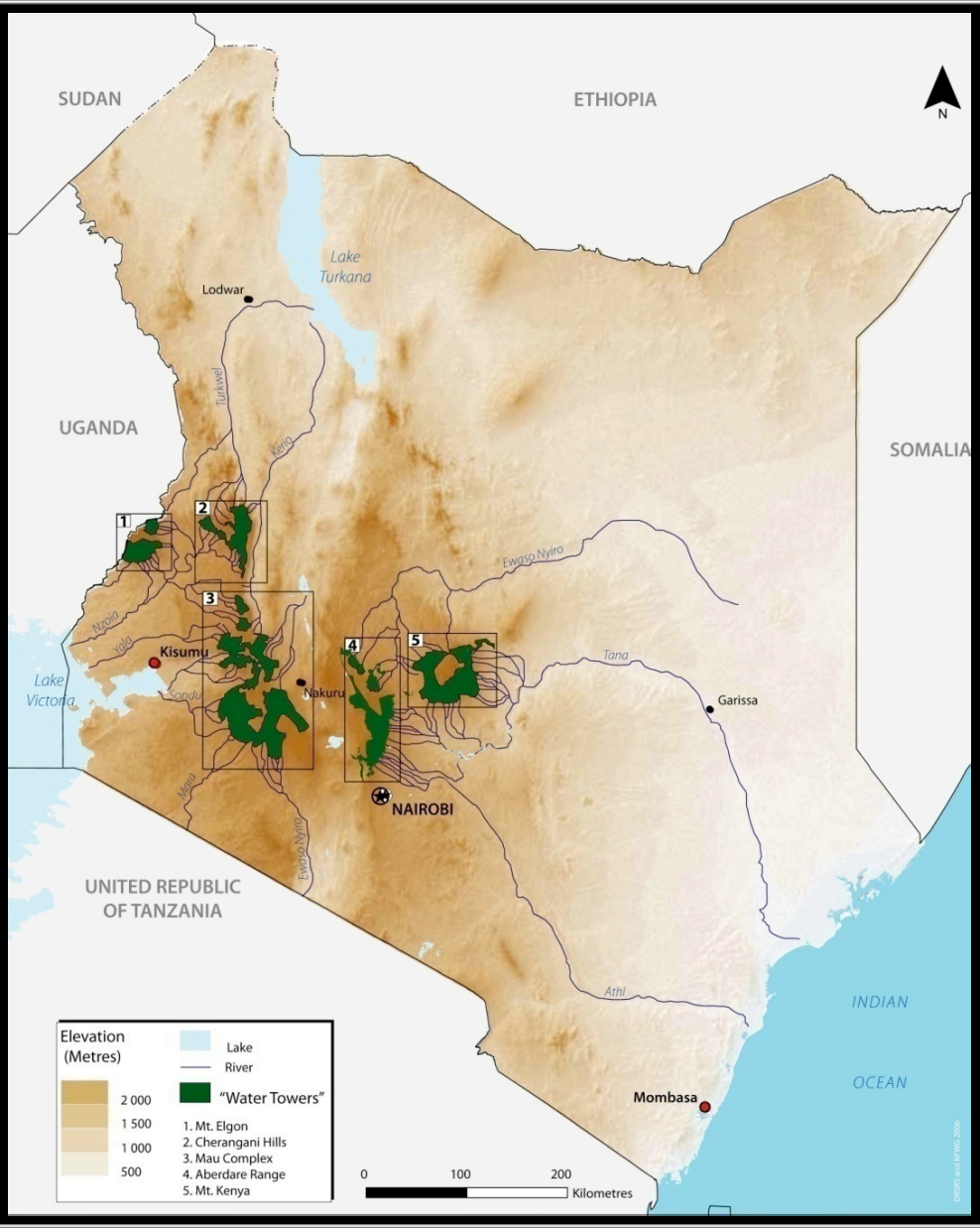
From a population of 8 million in 1960, Kenya's population is projected to reach 51 million by 2025.

Kenya's projected rural and urban population, 1950-2050



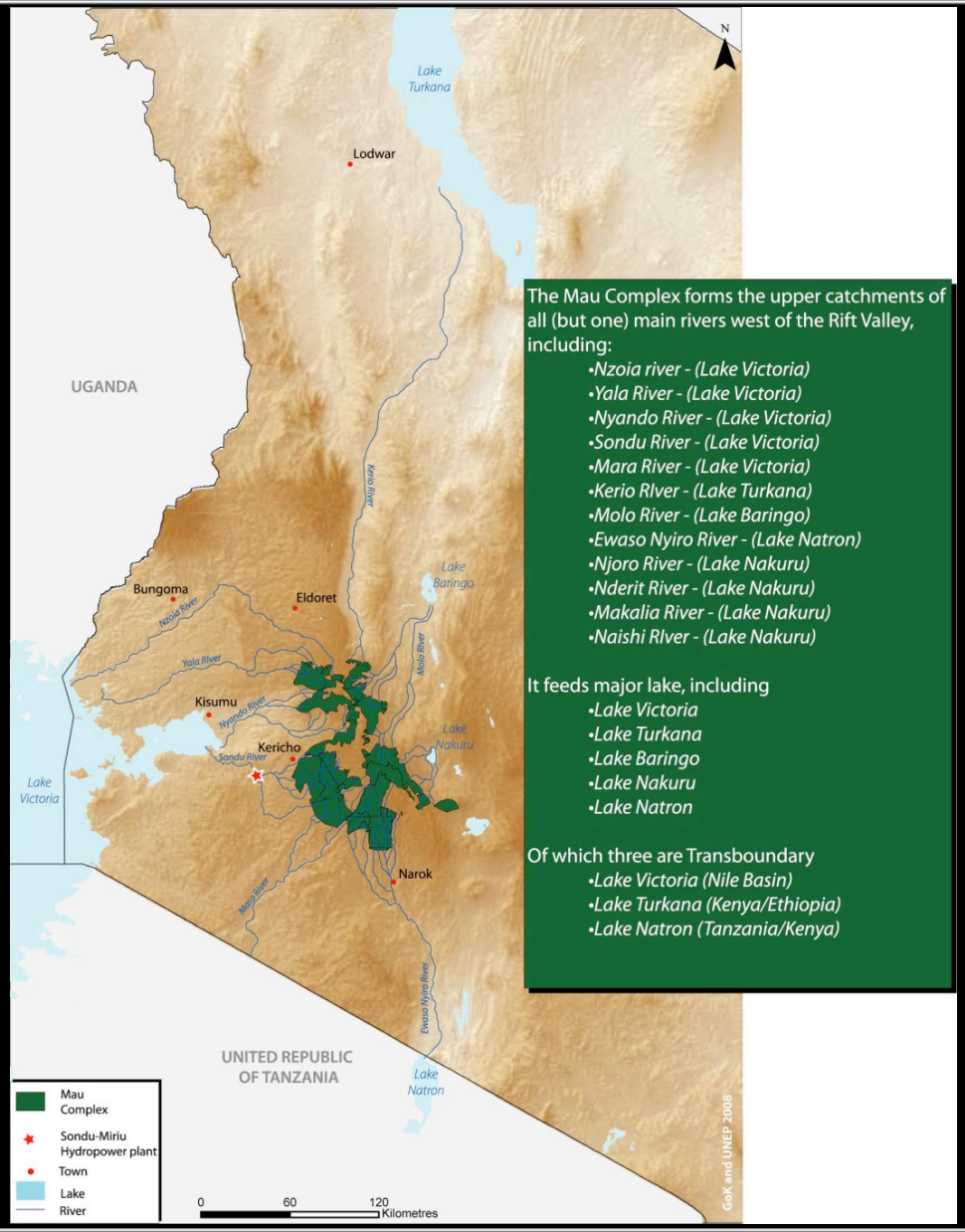
By 2030, it is projected that 33 per cent of Kenyans will live in urban areas

The “Five Water Towers”



1. Mt. Elgon
2. Cherangani Hills
3. Mau Complex
4. Aberdare Range
5. Mt. Kenya

Mau Complex: A critical water catchment



The Mau Complex forms the upper catchments of all (but one) main rivers west of the Rift Valley, including:

- *Nzoia river - (Lake Victoria)*
- *Yala River - (Lake Victoria)*
- *Nyando River - (Lake Victoria)*
- *Sondu River - (Lake Victoria)*
- *Mara River - (Lake Victoria)*
- *Kerio RIver - (Lake Turkana)*
- *Molo River - (Lake Baringo)*
- *Ewaso Nyiro River - (Lake Natron)*
- *Njoro River - (Lake Nakuru)*
- *Nderit River - (Lake Nakuru)*
- *Makalia River - (Lake Nakuru)*
- *Naishi RIver - (Lake Nakuru)*

It feeds major lake, including

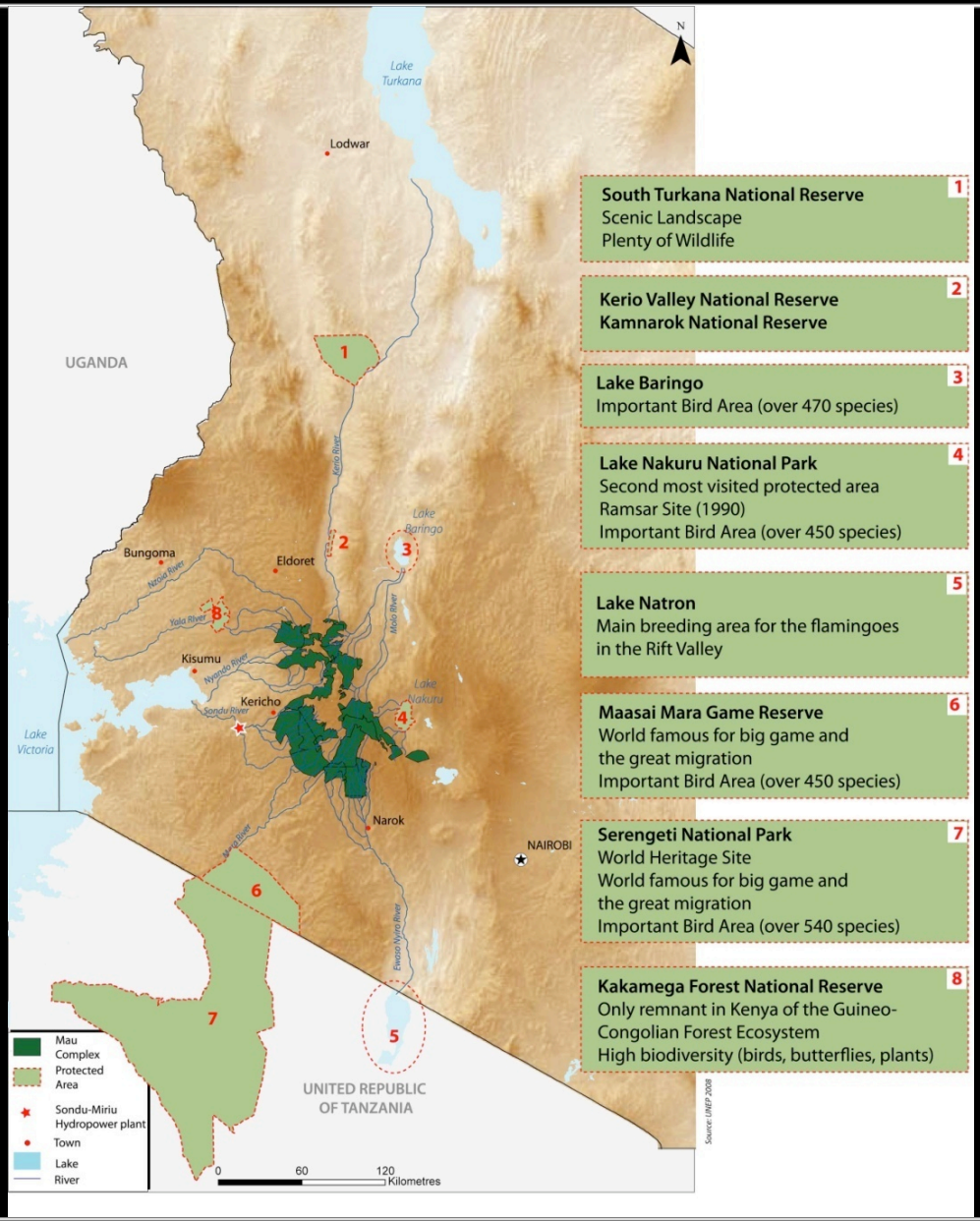
- *Lake Victoria*
- *Lake Turkana*
- *Lake Baringo*
- *Lake Nakuru*
- *Lake Natron*

Of which three are Transboundary

- *Lake Victoria (Nile Basin)*
- *Lake Turkana (Kenya/Ethiopia)*
- *Lake Natron (Tanzania/Kenya)*

Mau complex is a critical water catchment for numerous rivers and lakes

Mau Complex: Supporting major tourism destinations



1 South Turkana National Reserve
Scenic Landscape
Plenty of Wildlife

2 Kerio Valley National Reserve
Kamnarok National Reserve

3 Lake Baringo
Important Bird Area (over 470 species)

4 Lake Nakuru National Park
Second most visited protected area
Ramsar Site (1990)
Important Bird Area (over 450 species)

5 Lake Natron
Main breeding area for the flamingoes in the Rift Valley

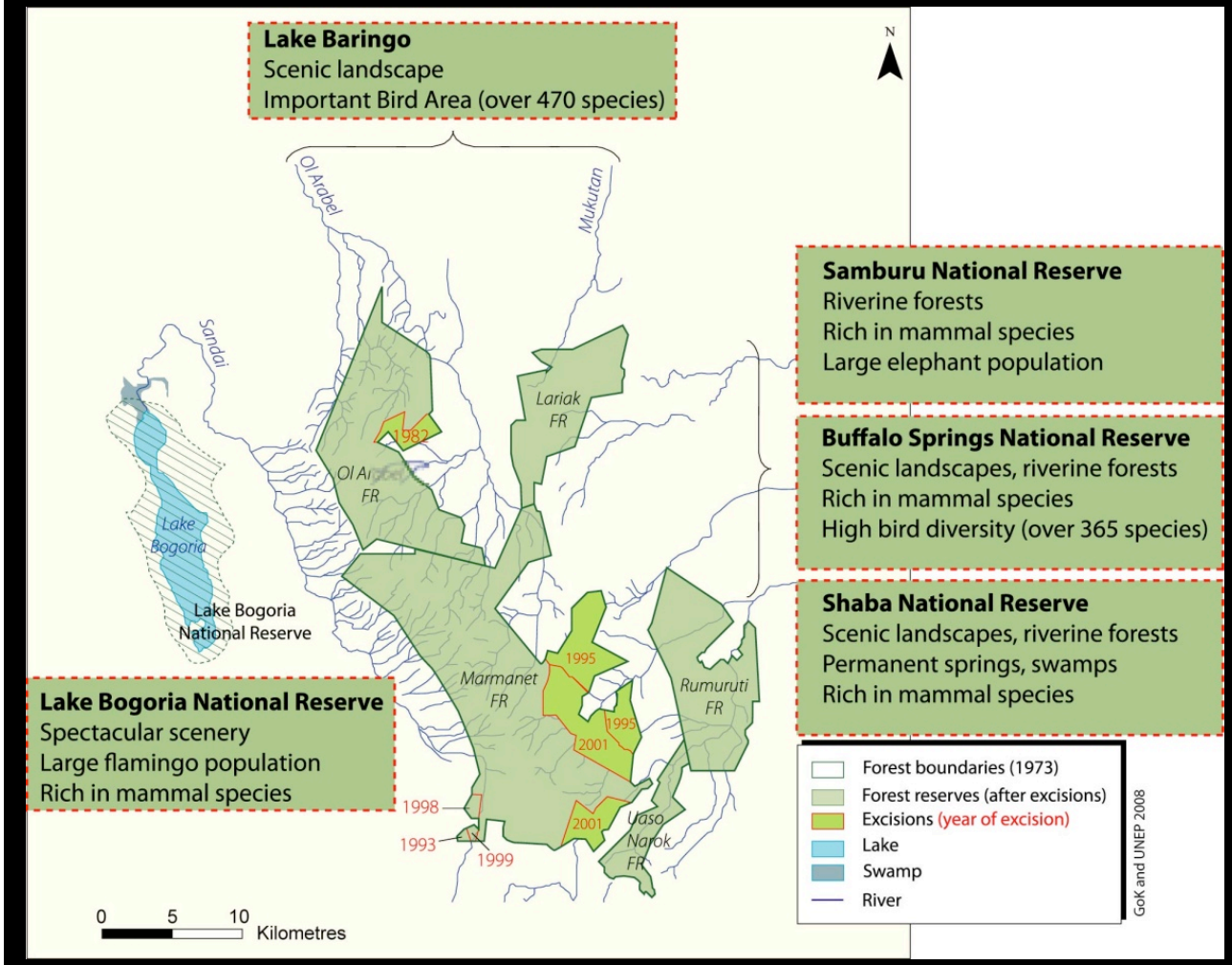
6 Maasai Mara Game Reserve
World famous for big game and the great migration
Important Bird Area (over 450 species)

7 Serengeti National Park
World Heritage Site
World famous for big game and the great migration
Important Bird Area (over 540 species)

8 Kakamega Forest National Reserve
Only remnant in Kenya of the Guineo-Congolian Forest Ecosystem
High biodiversity (birds, butterflies, plants)

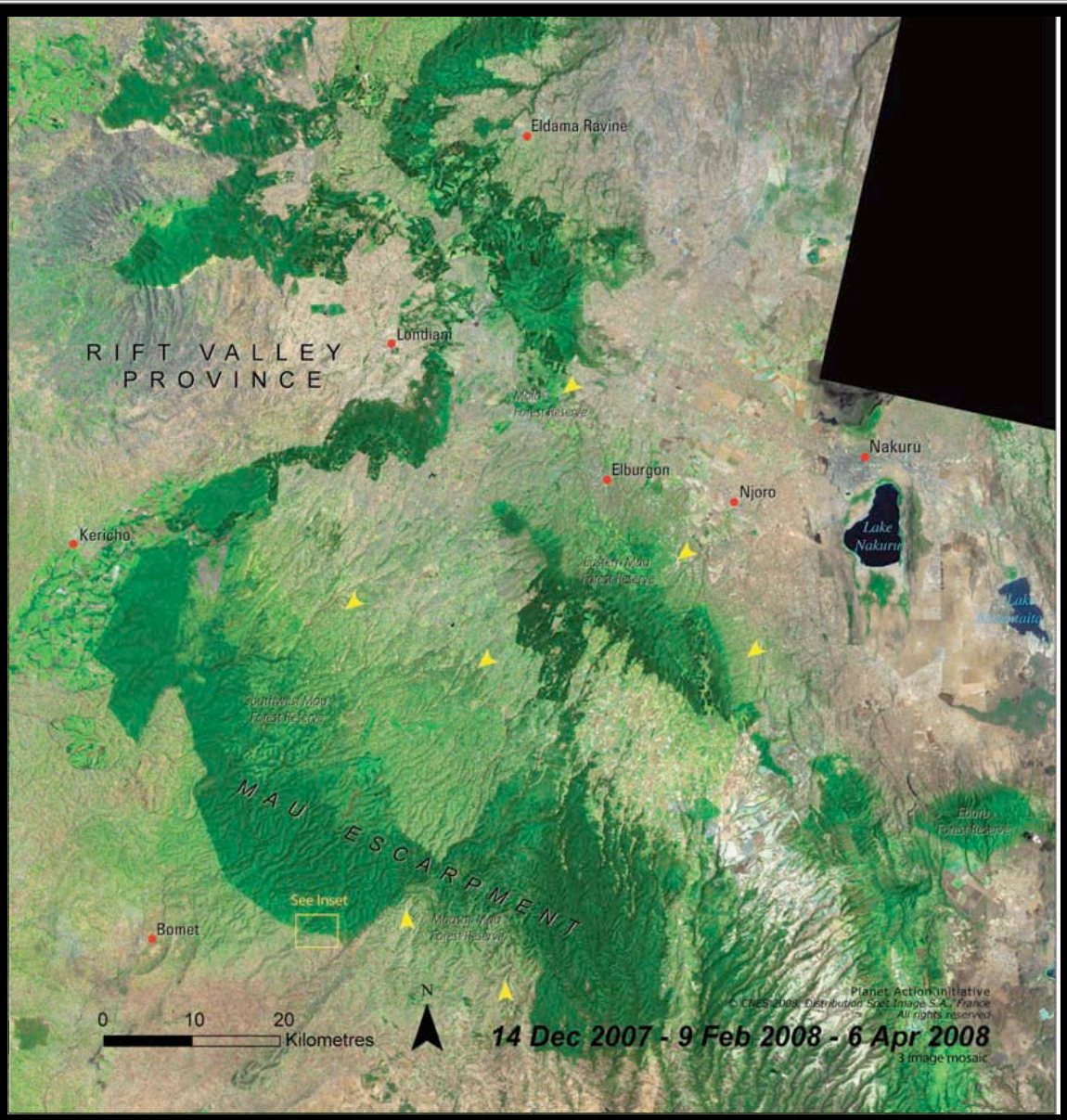
The rivers flowing from the Mau Complex are the lifeline for major tourism destinations including the Maasai Mara Game Reserve and Lake Nakuru National Park.

Marmanet forests: Critical to major conservation areas



The rivers flowing from the Marmanet forests provide water to five major conservation areas:

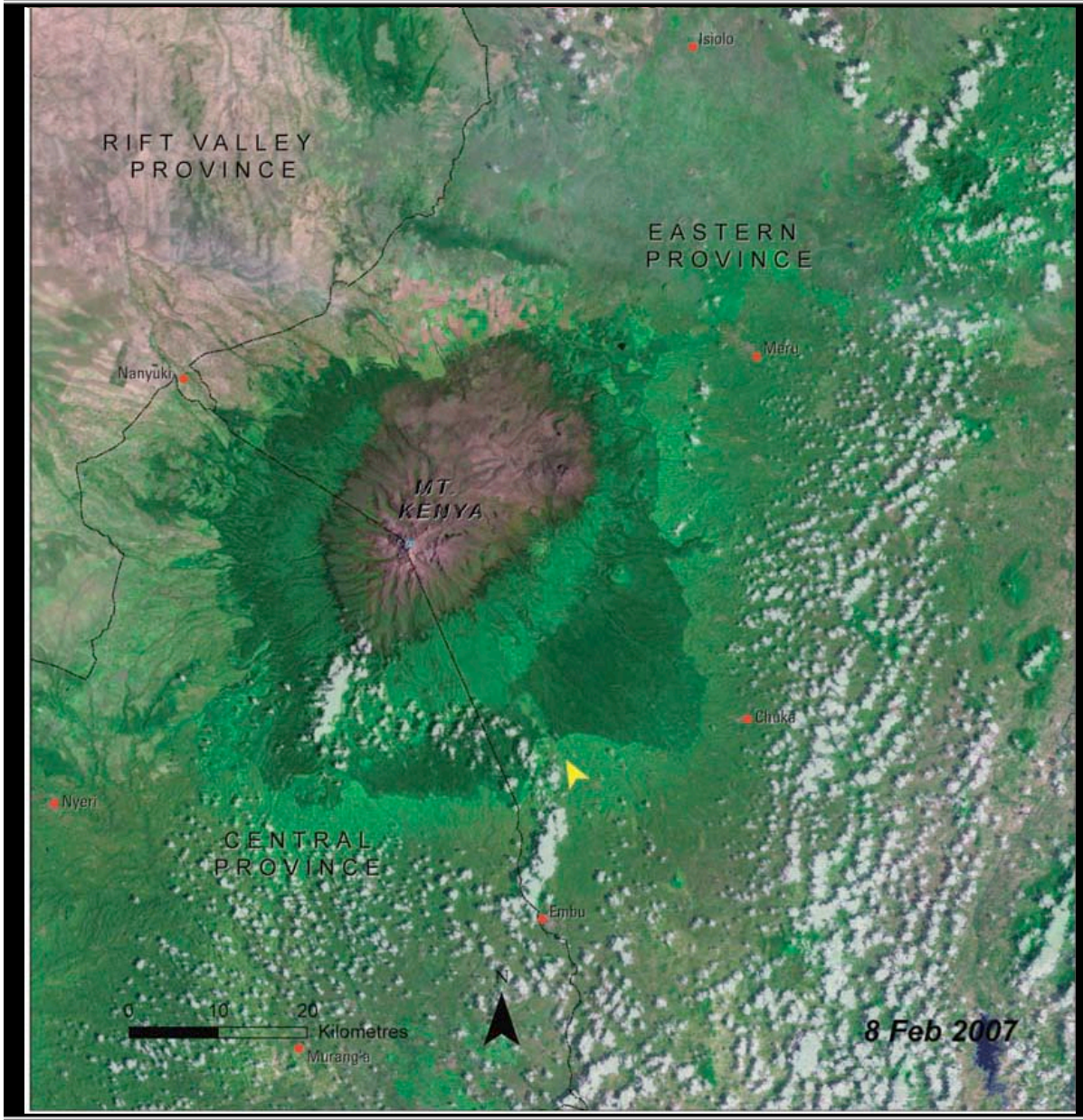
The Mau Forest Complex: Degrading Forests



1973

2008

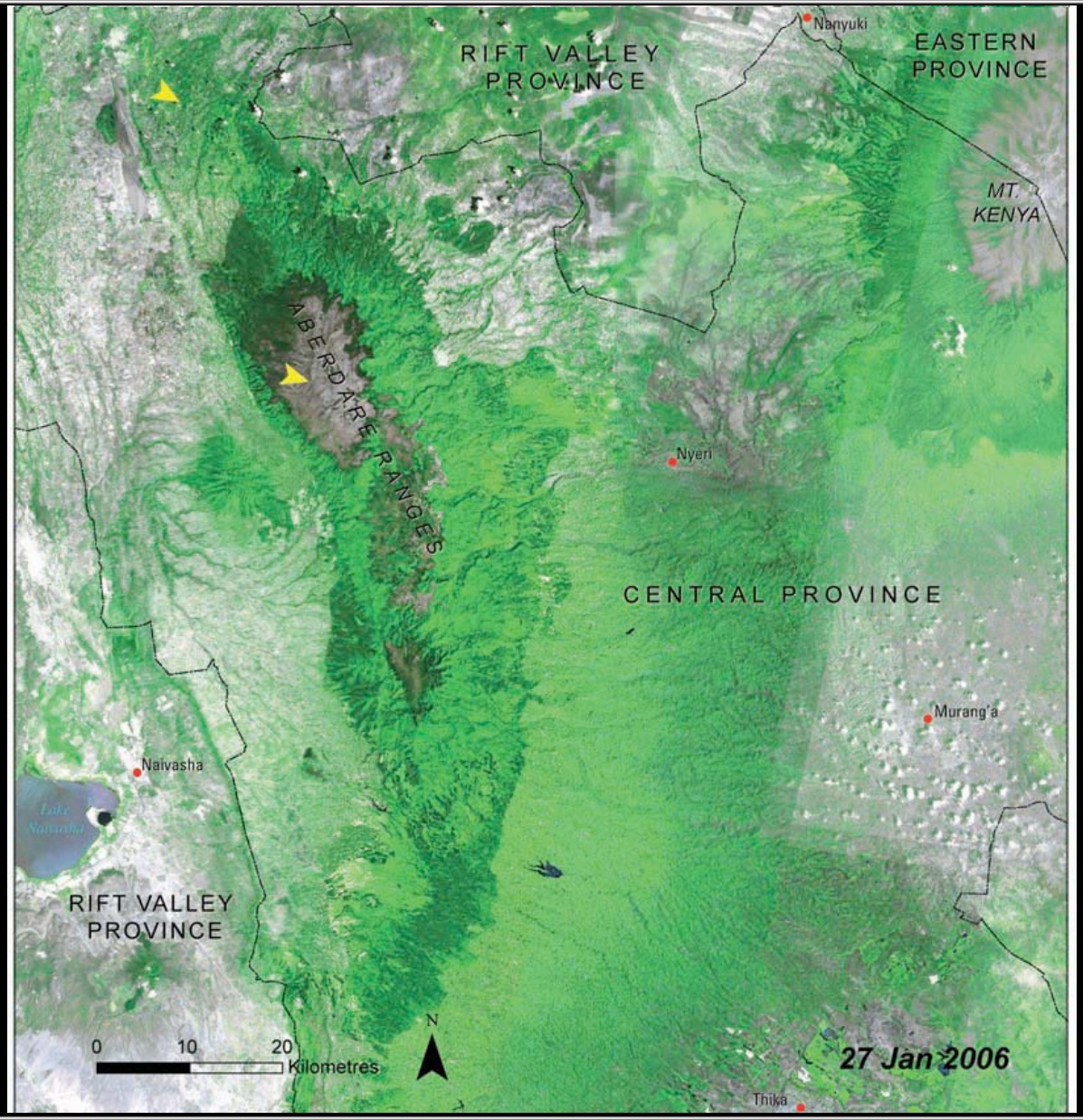
Mount Kenya: Disappearing Glaciers



1976

2007

The Aberdare Range: Forest Devastation

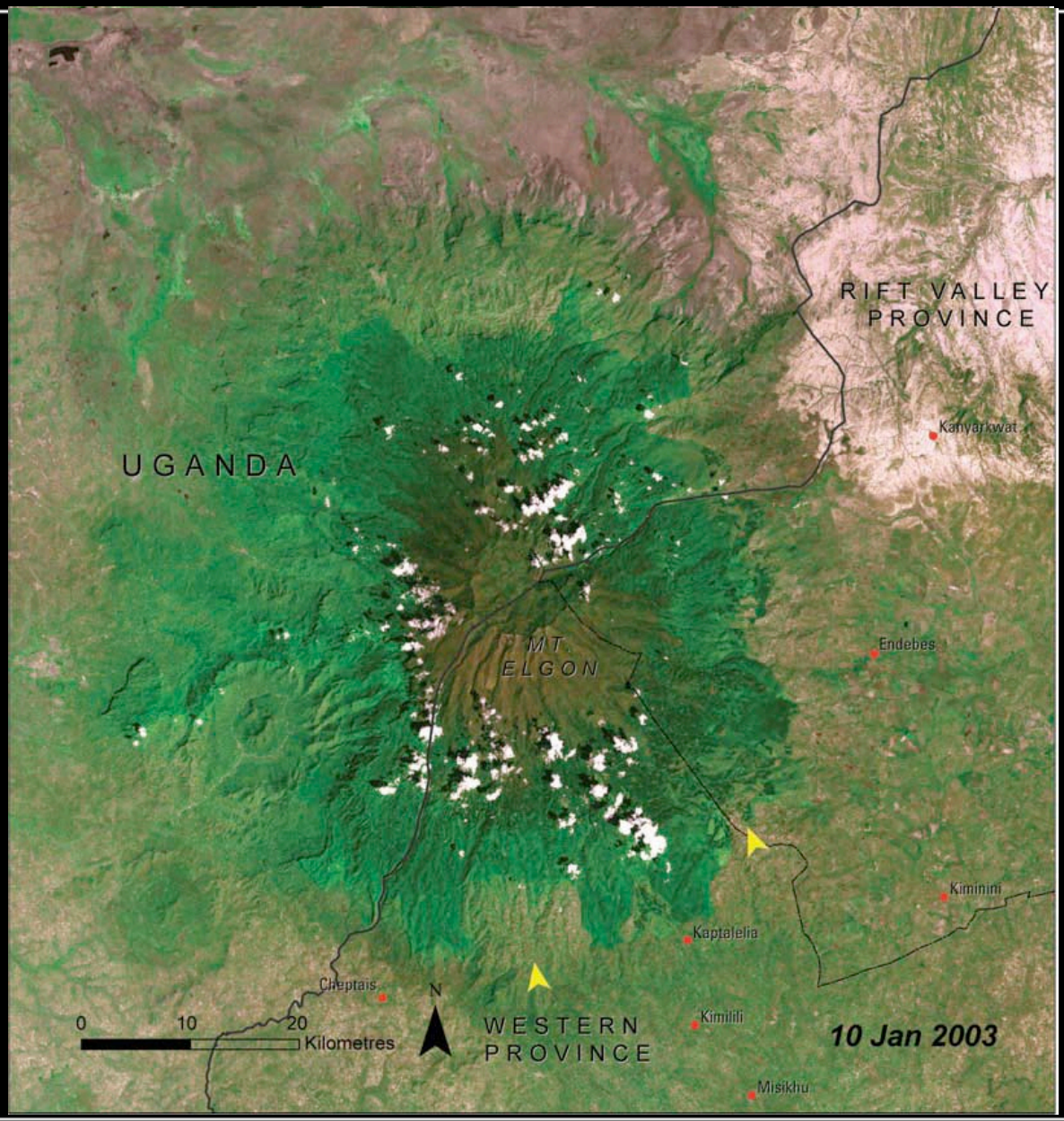


1987

2006

Forest regeneration

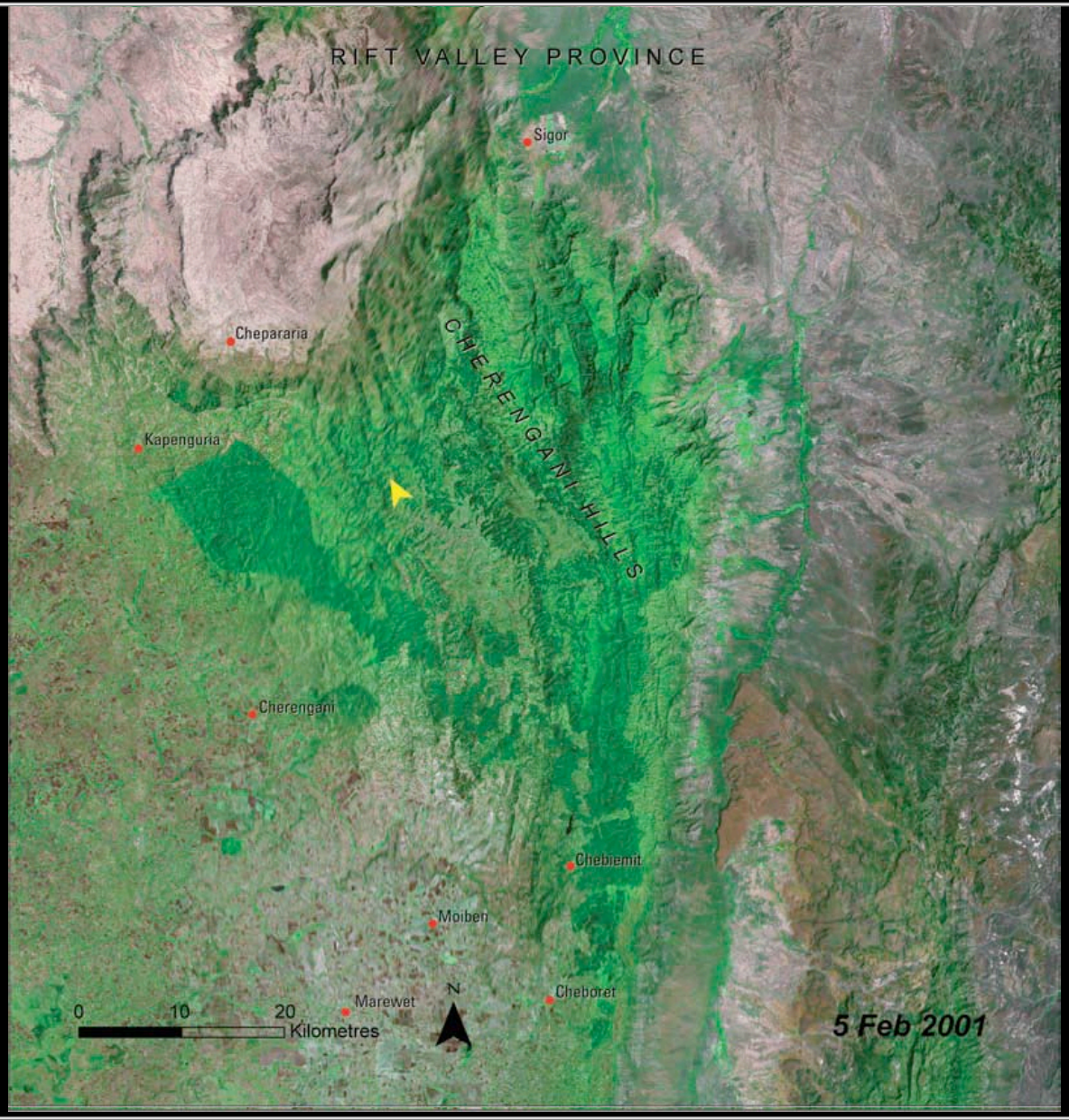
Mount Elgon: Legal Logging



1973

2003

The Cherangani Hills: Indigenous Forests

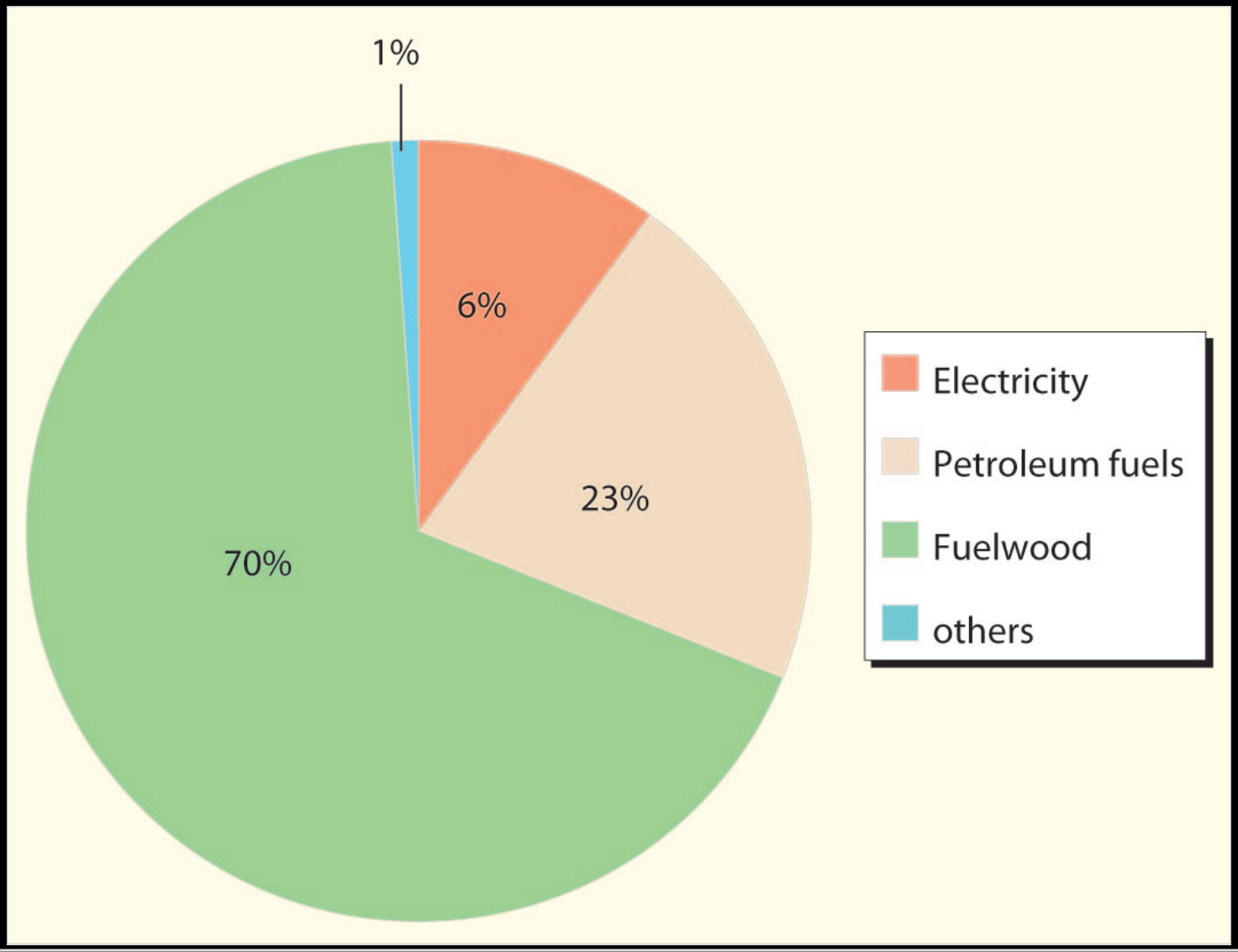


1973

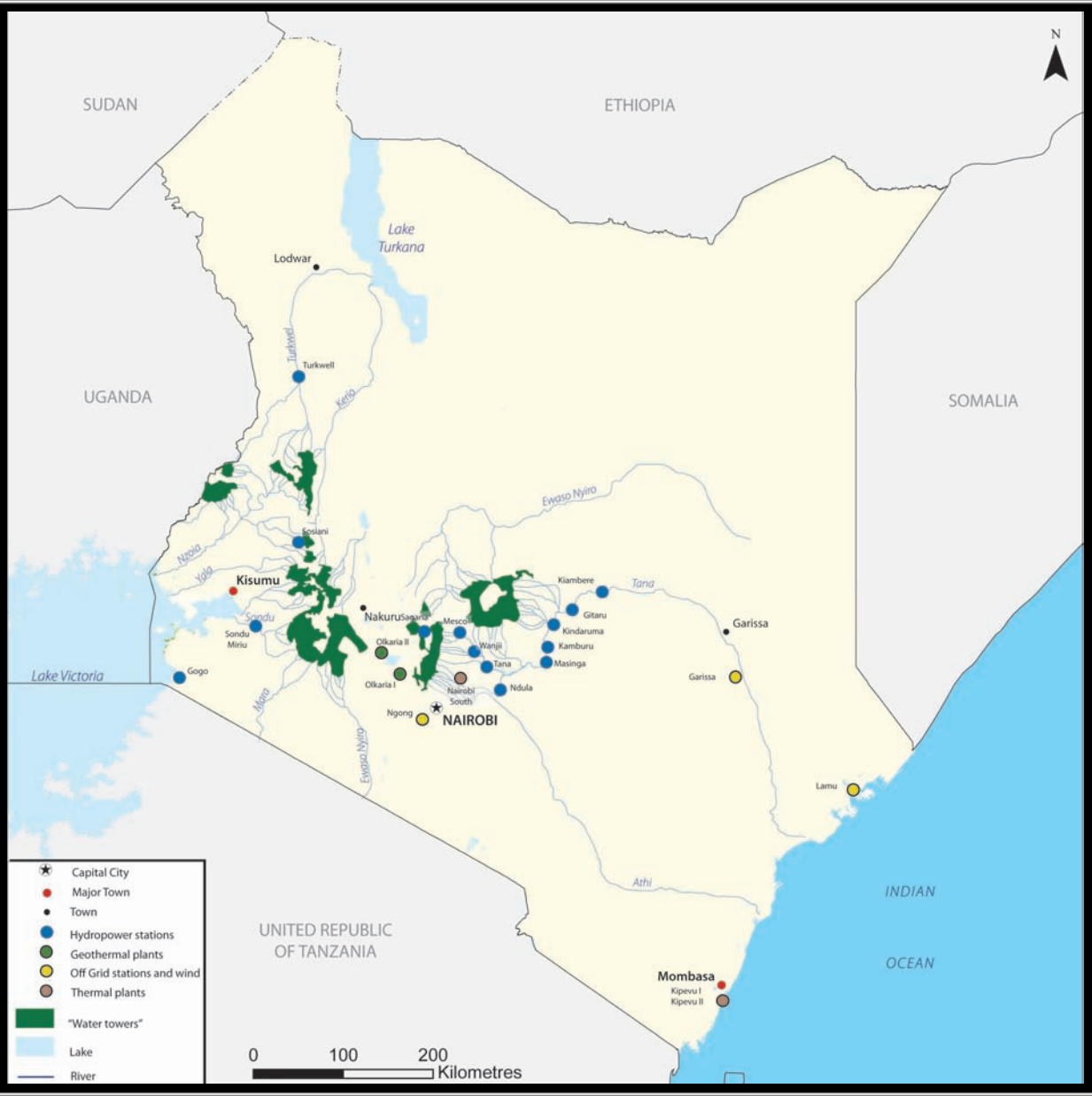
2001

The least affected of the five forested water towers

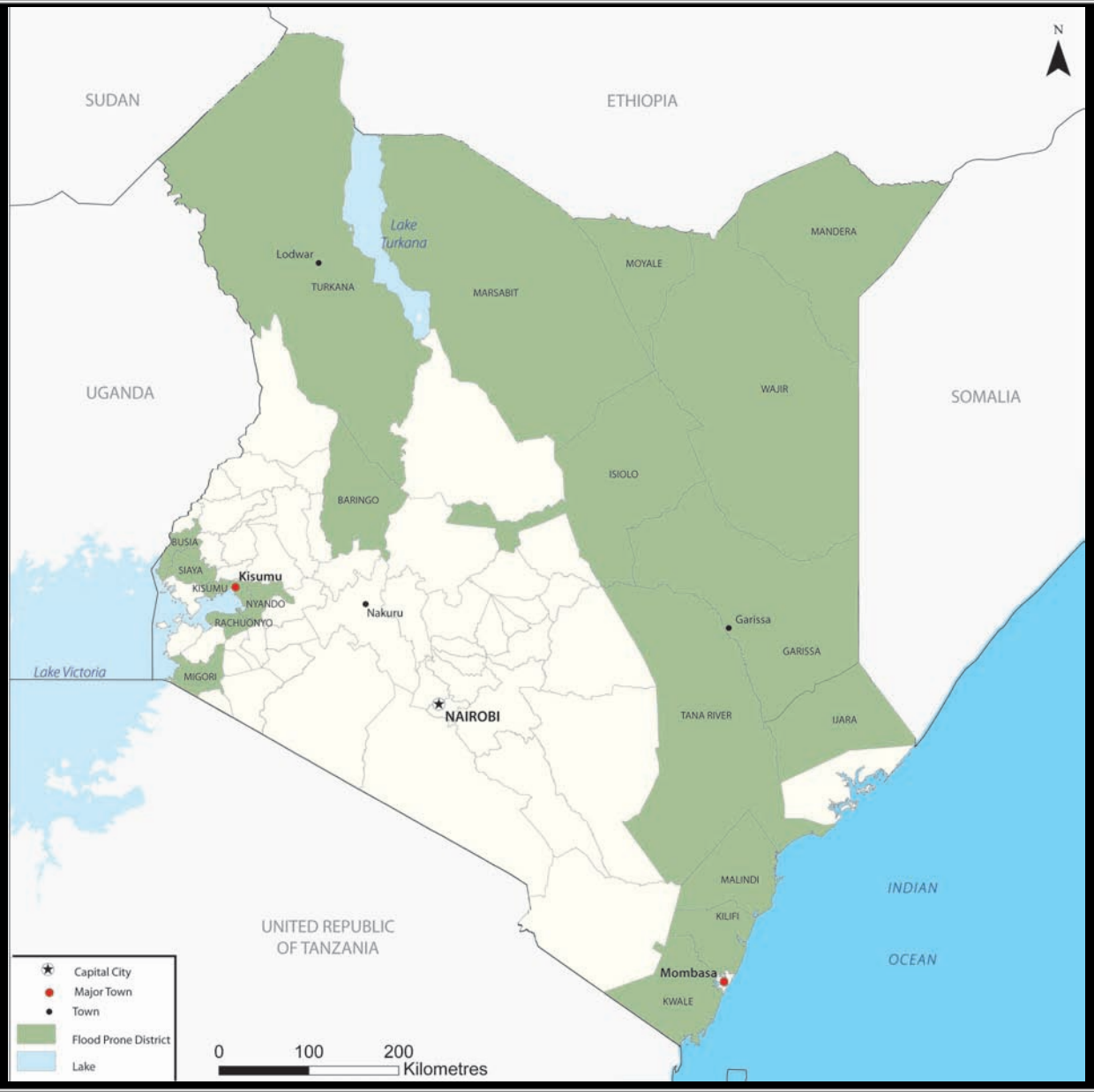
Sources of national energy



Location of power stations



Environmental Disasters and Challenges to Vision 2030



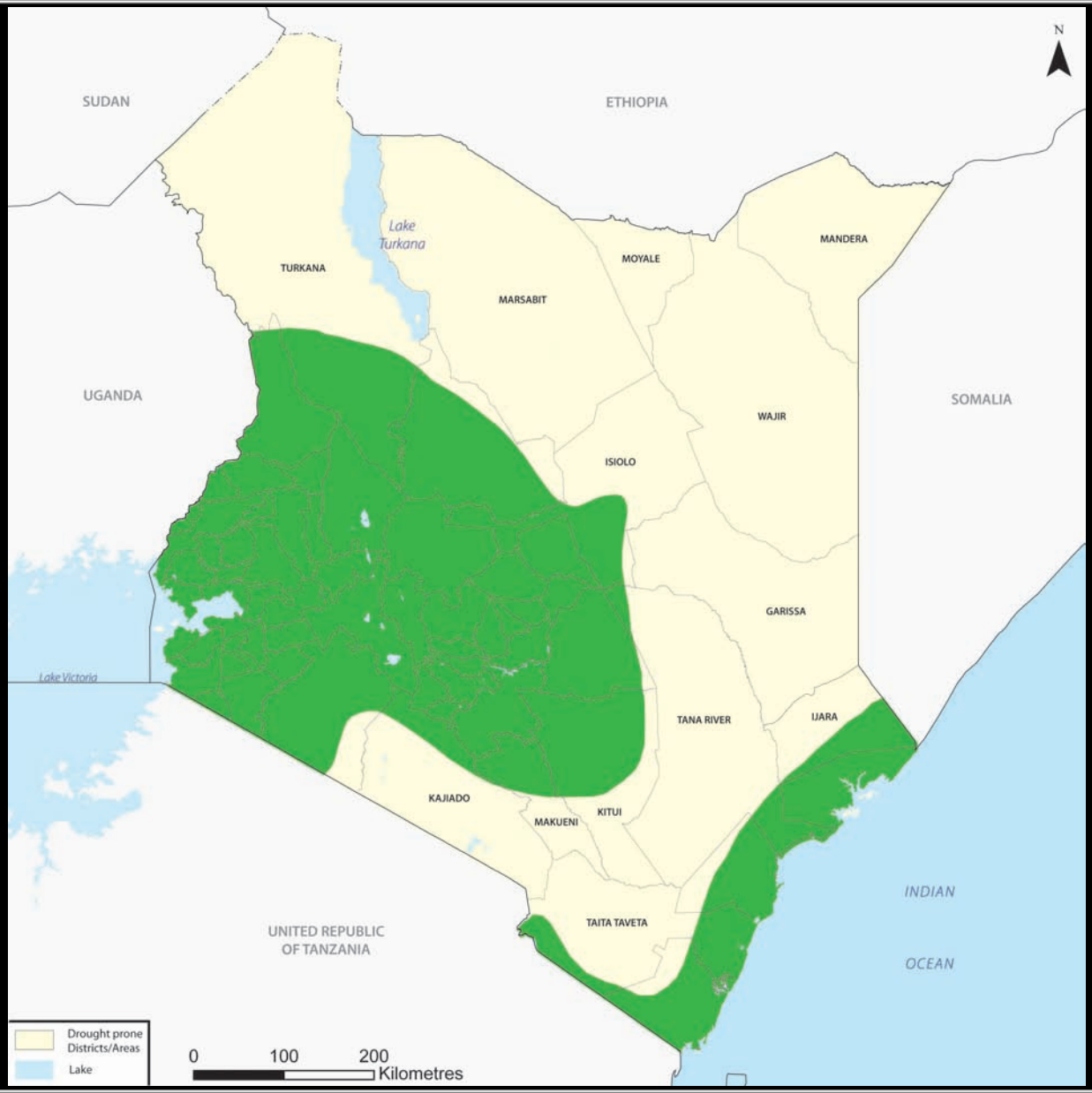
Flood prone

Districts

Environmental Disasters and Challenges to Vision 2030

Floods in Tana River Delta

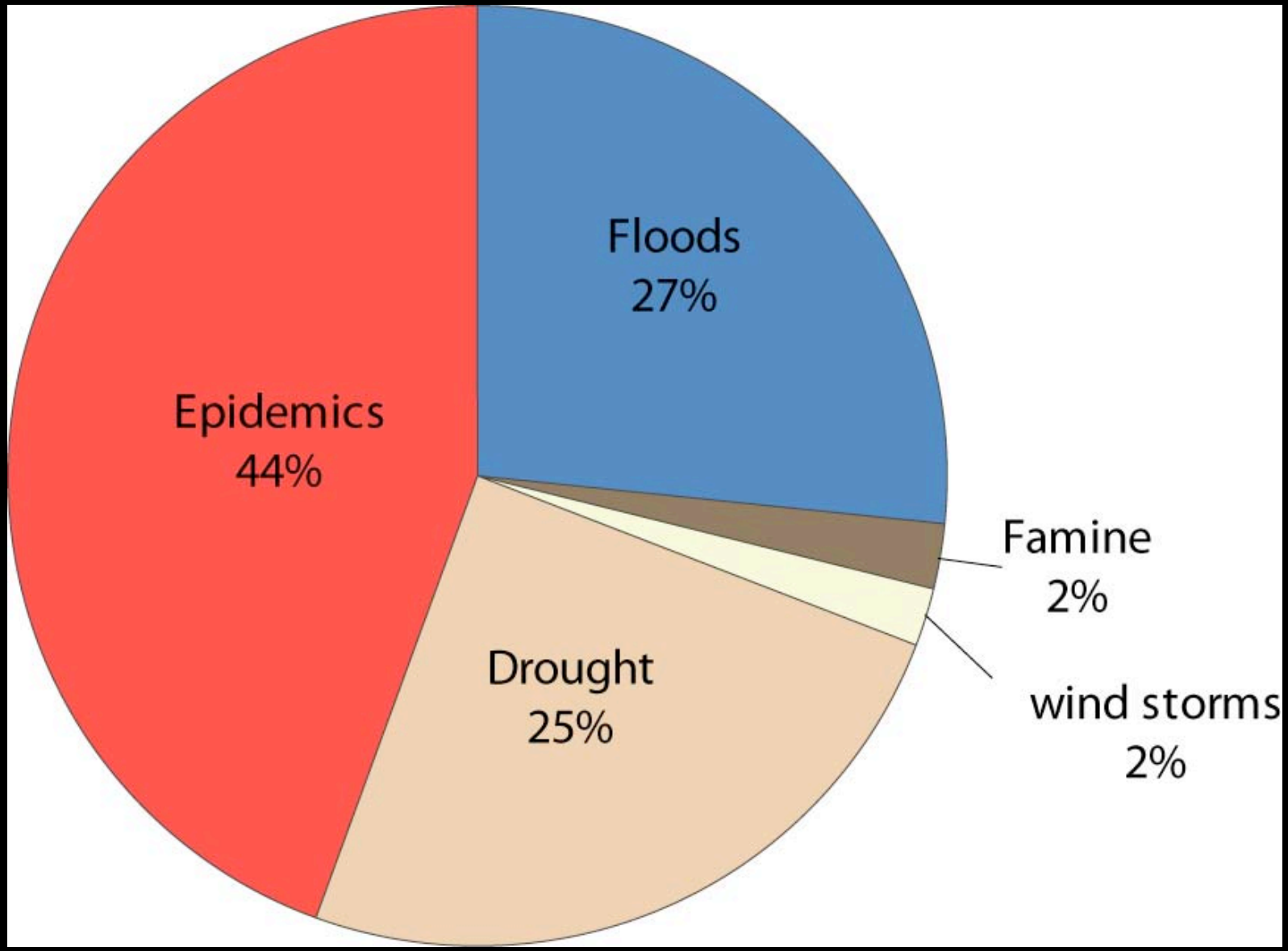
Environmental Disasters and Challenges to Vision 2030



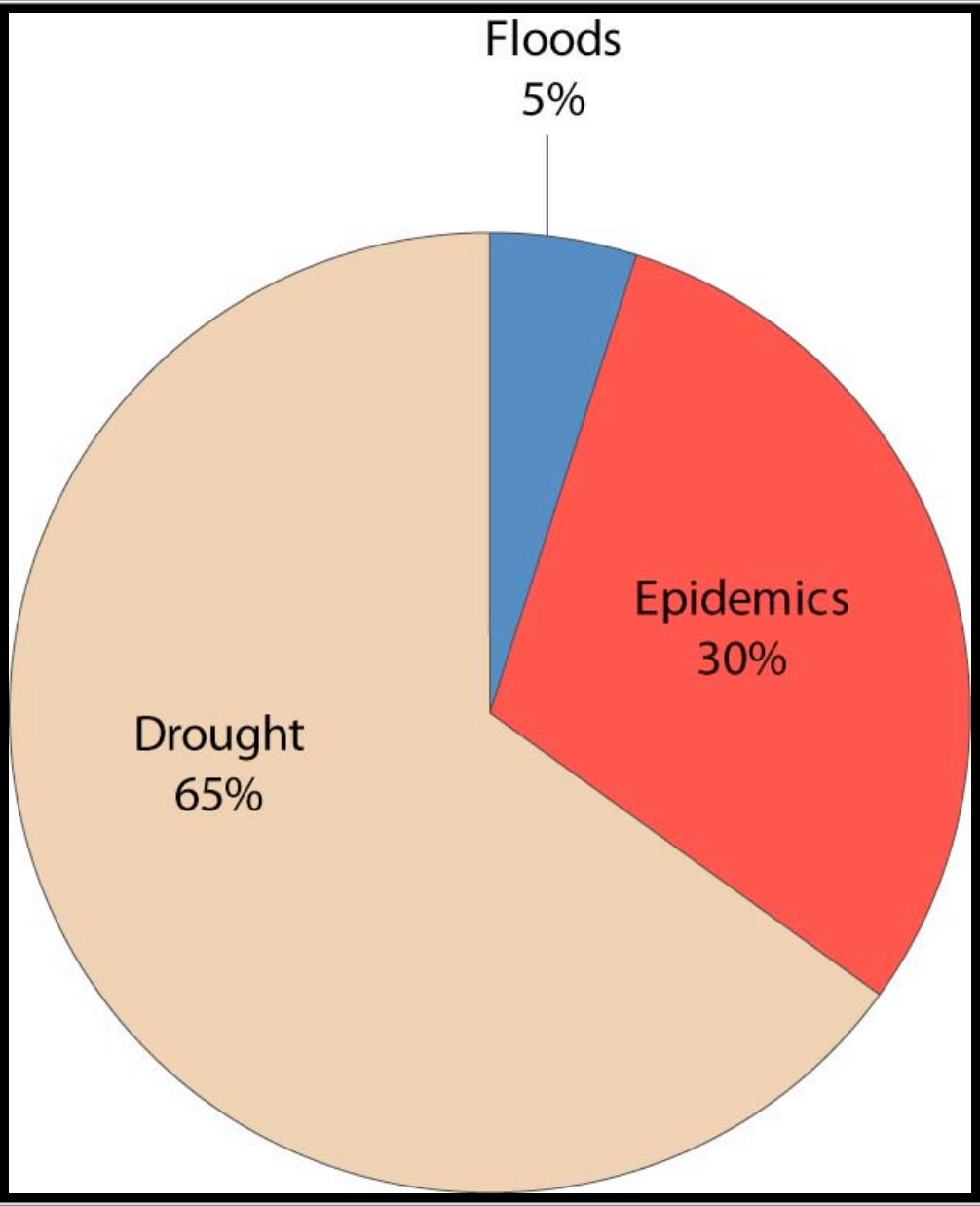
Drought prone Districts

Impacts of Drought

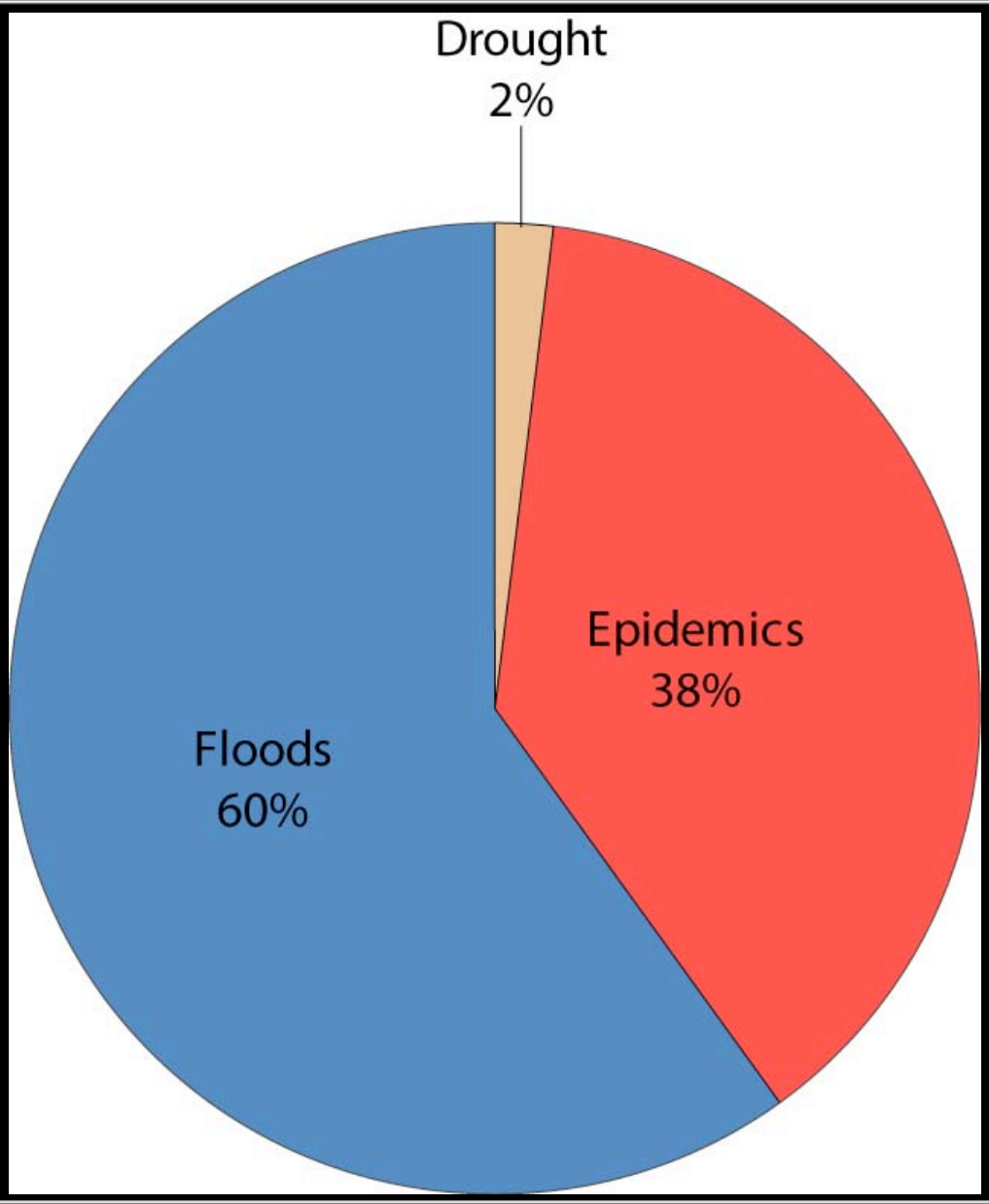
Prevalence **of hazards in Kenya**



People affected by hazards in Kenya



People killed or affected adversely by hazards in Kenya

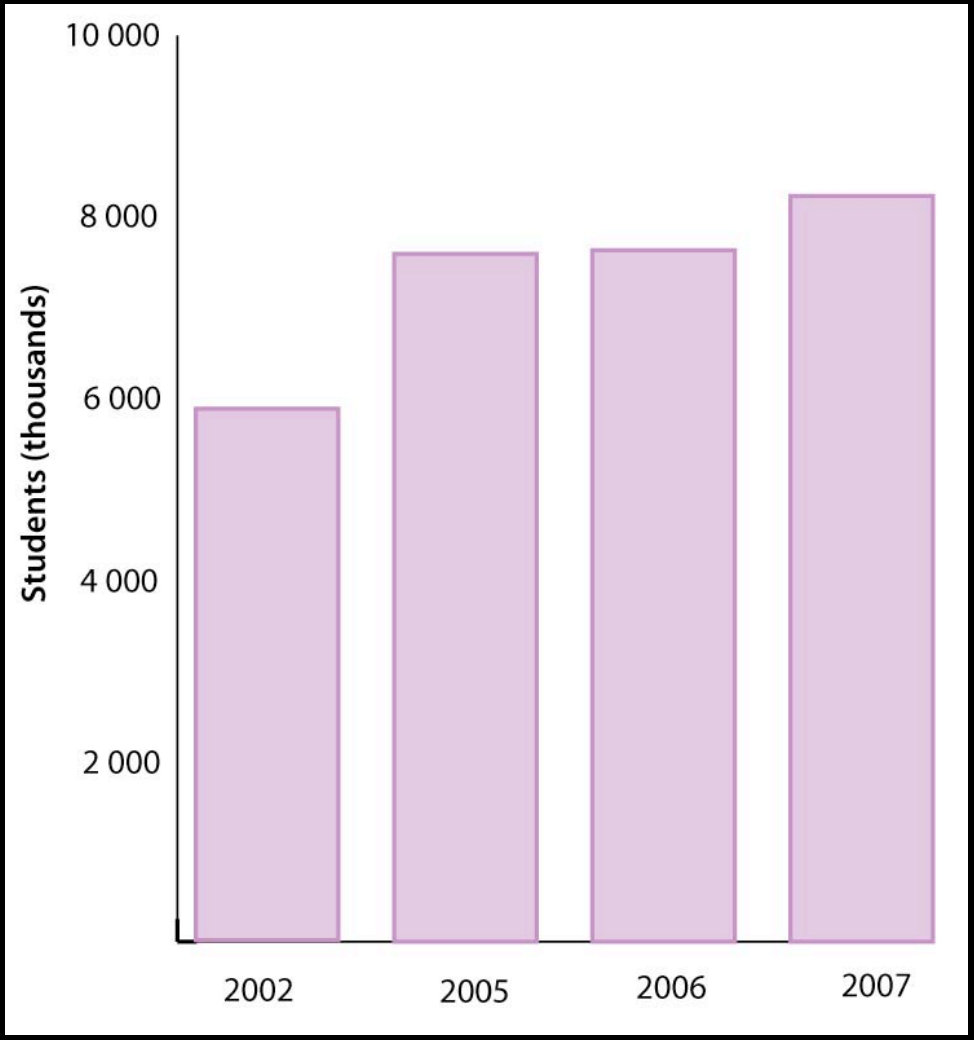


Environmental Links to the MDGs

Environmental resources and conditions have a significant impact on many aspects of poverty and development, and achieving environmental sustainability is fundamental to achieving all of the MDGs.

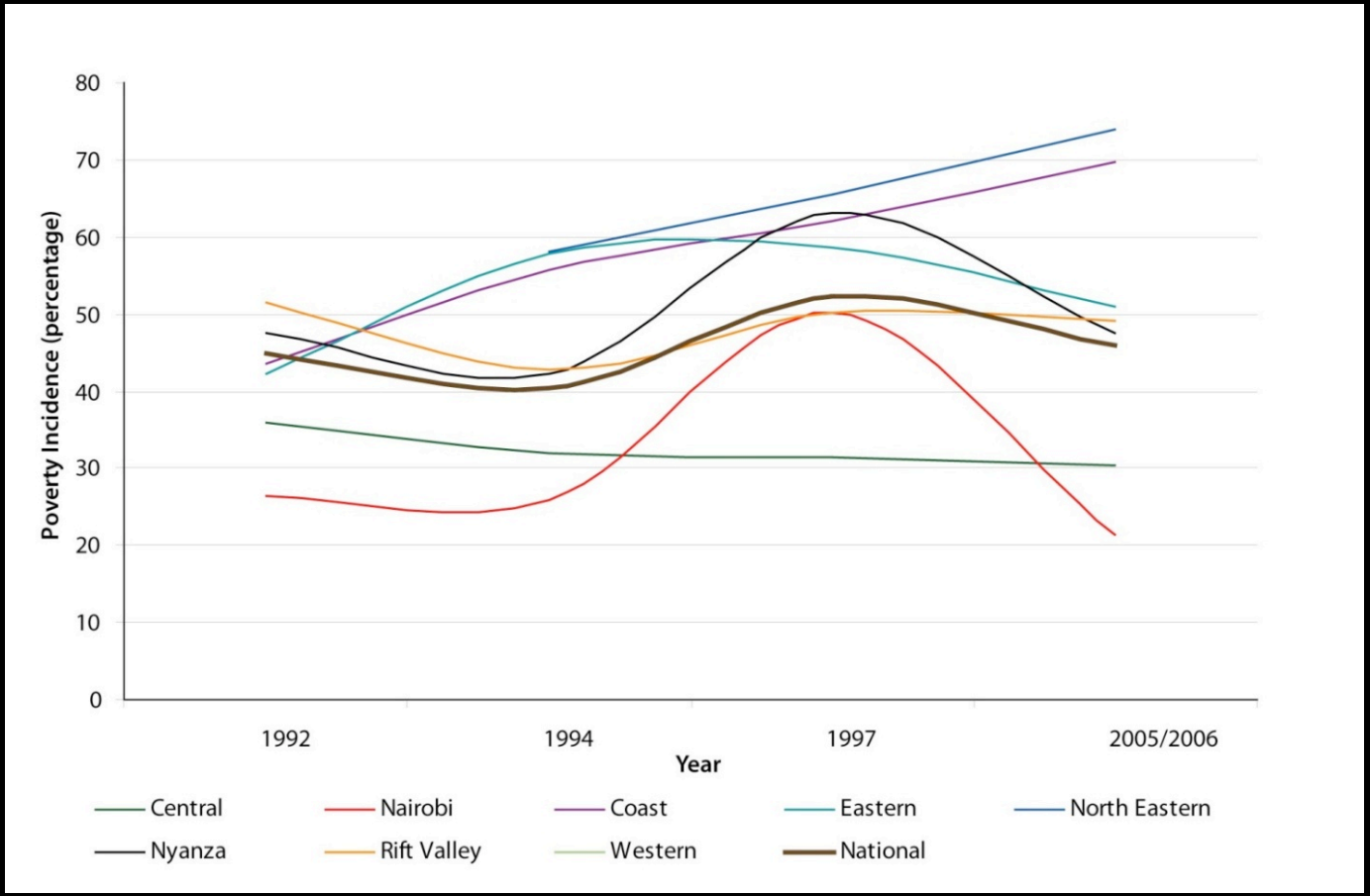
One of the most powerful ways to help achieve the first MDG - eradicate extreme poverty and hunger - is to ensure environmental quality and quantity is maintained in the long term.

Primary school enrollment, 2002-2007



90 per cent of girls and 95 per cent of boys enrolled in primary school

Poverty incidence, 1992-2006

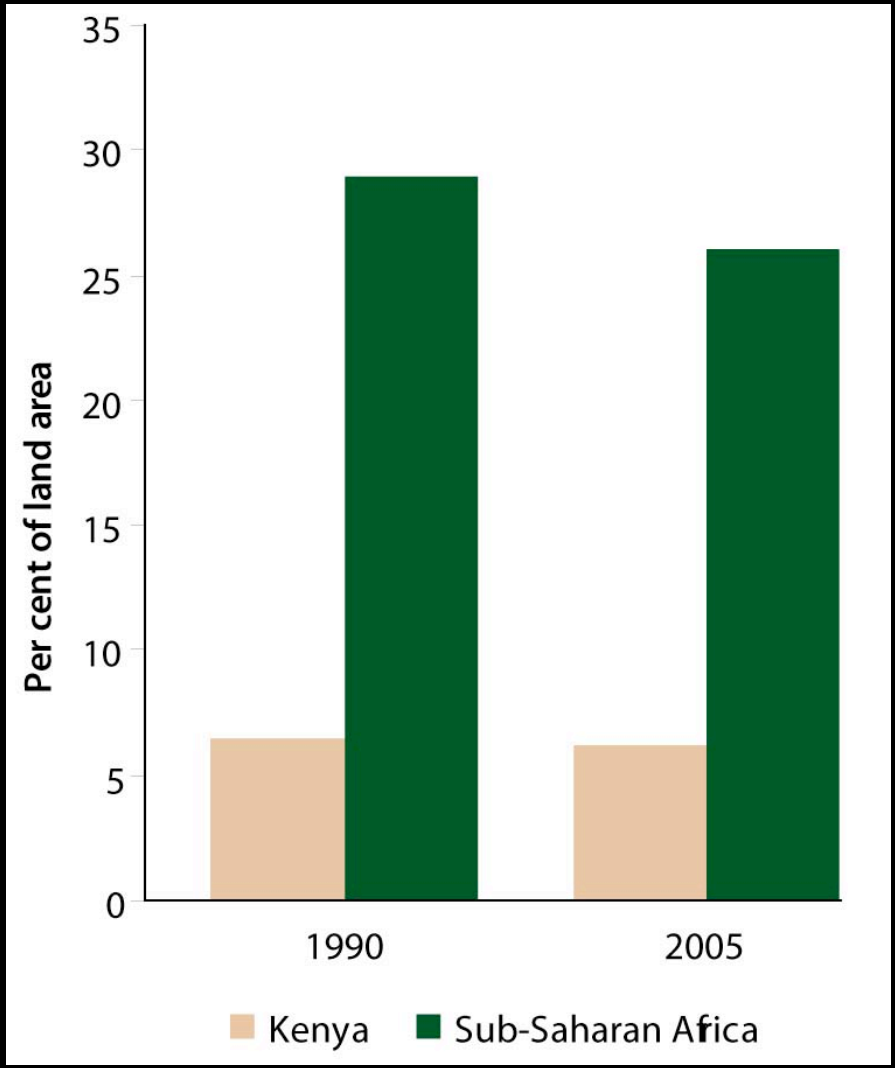


Poverty incidence decreased in all provinces between 1997 and 2005/06 except the Coast and North Eastern Provinces

Kenya's progress towards MDG 7: Ensure Environmental Sustainability

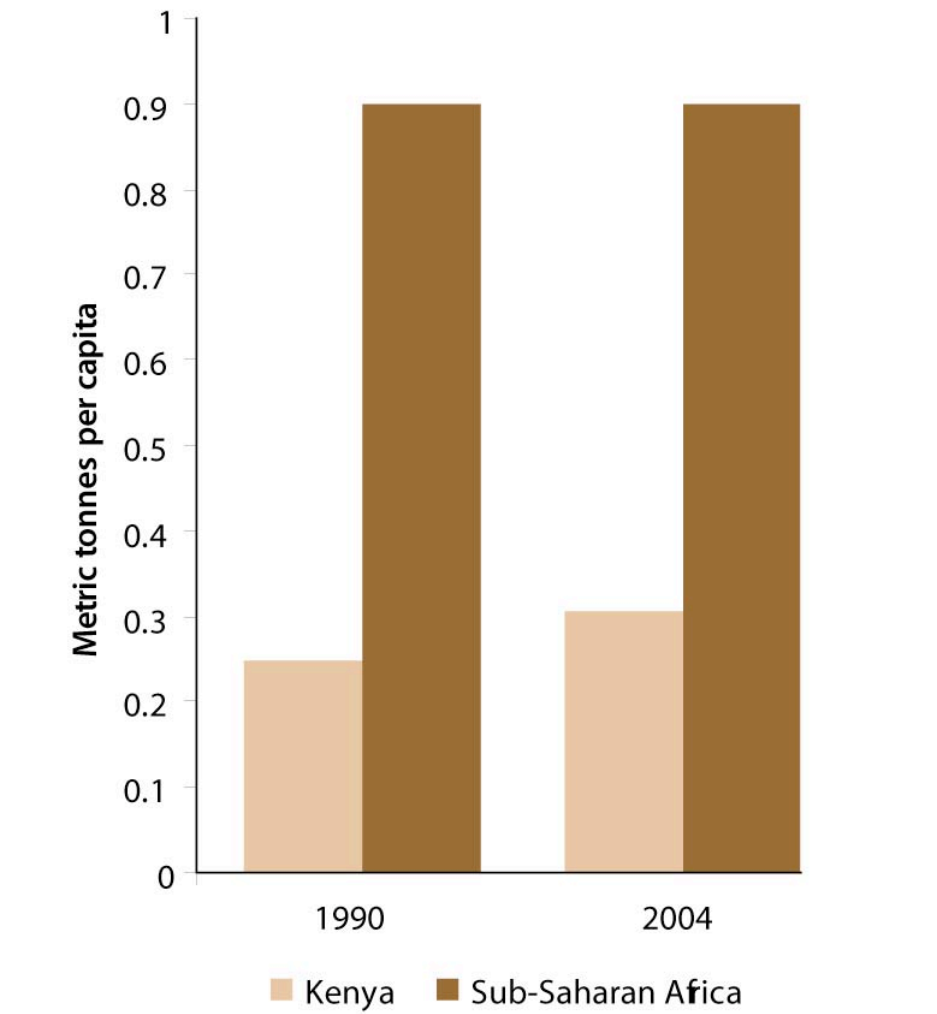
MDG 7— Ensure Environmental Sustainability	
Target A:	Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources
Target B:	Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss
Target C:	Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation
Target D:	By 2020, achieve a significant improvement in the lives of at least 100 million slum dwellers

Land area covered by forest



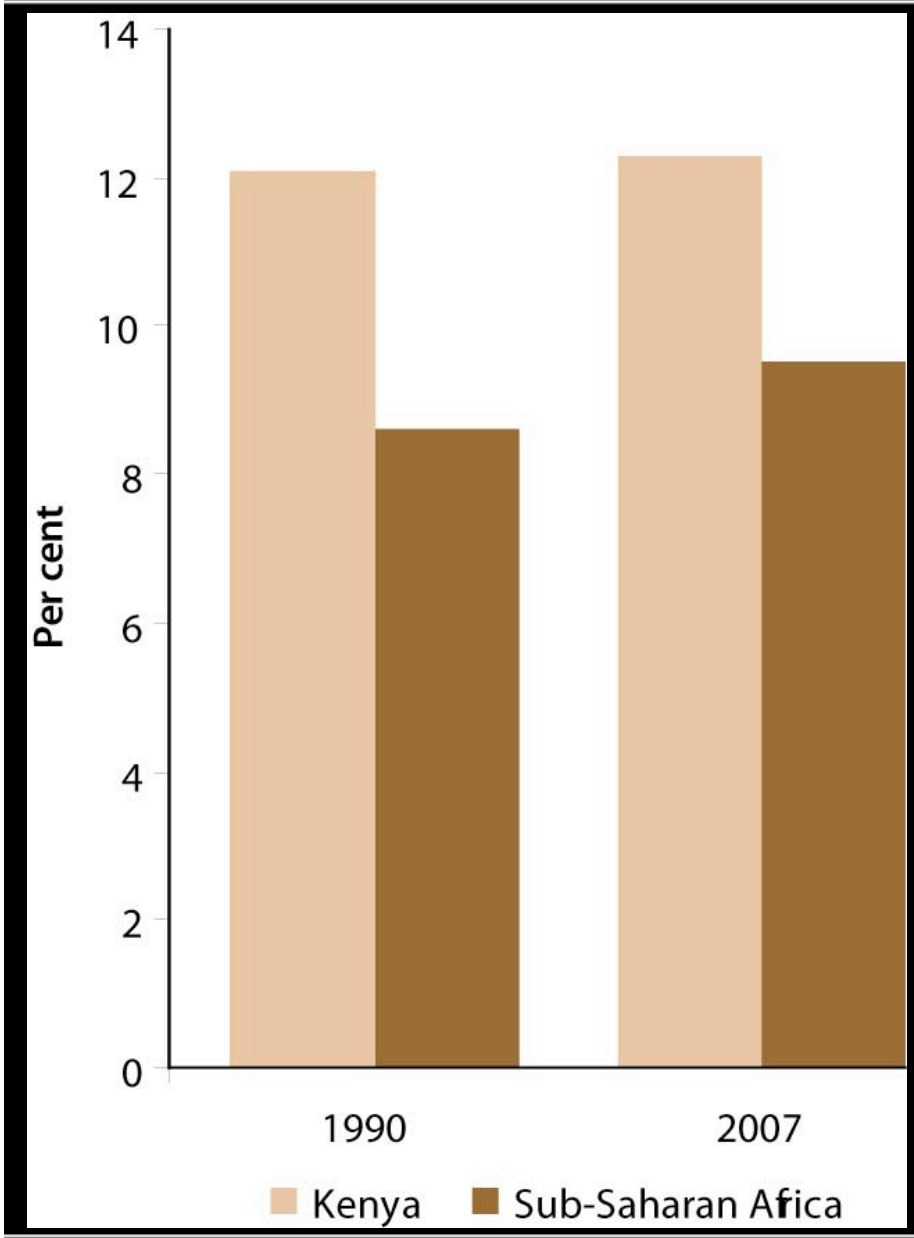
Between 1990 and 2005, Kenya's proportion of forested land decreased by 0.3 per cent

Carbon emissions



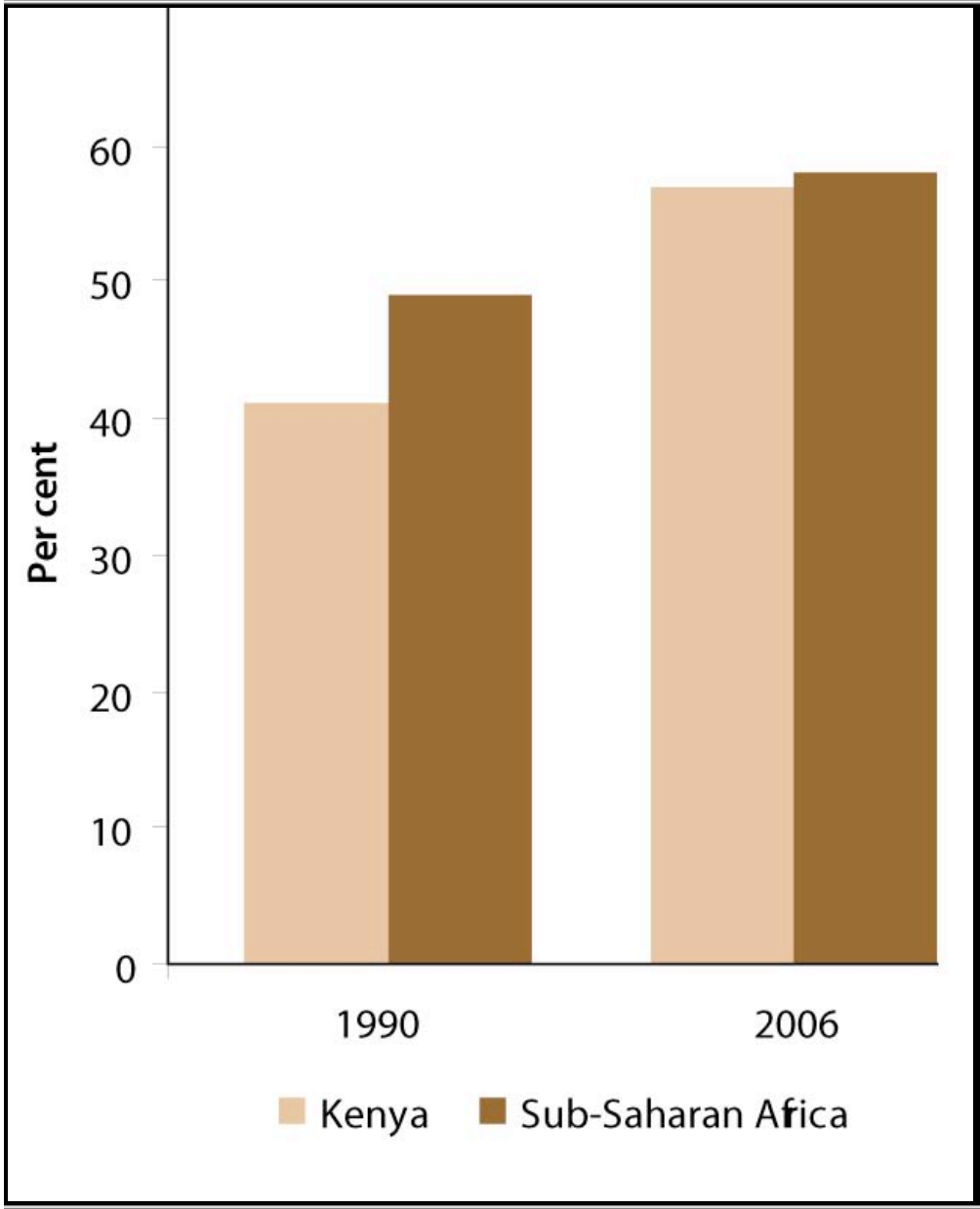
Carbon pollution is one of the leading environmental health problems in the country affecting both rural and urban populations

Proportion of the total area set aside as terrestrial and marine protected areas



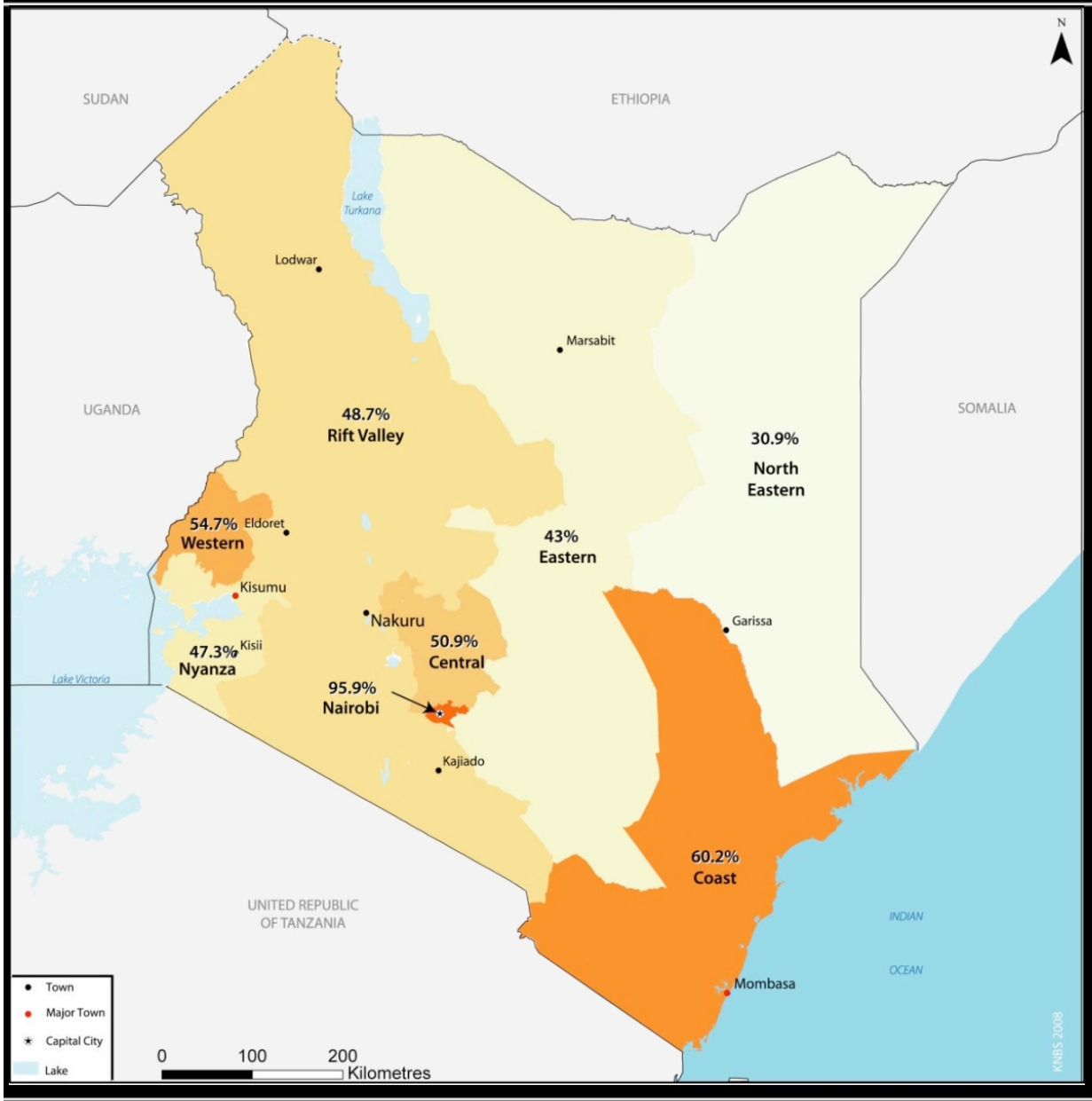
- **348** designated protected areas,
- **75 238 km²** or **12.7 per cent** of the nation's total territorial area.
- **Five Biosphere Reserves** and **three World Heritage Sites**.

The proportion of the population using an improved drinking water source



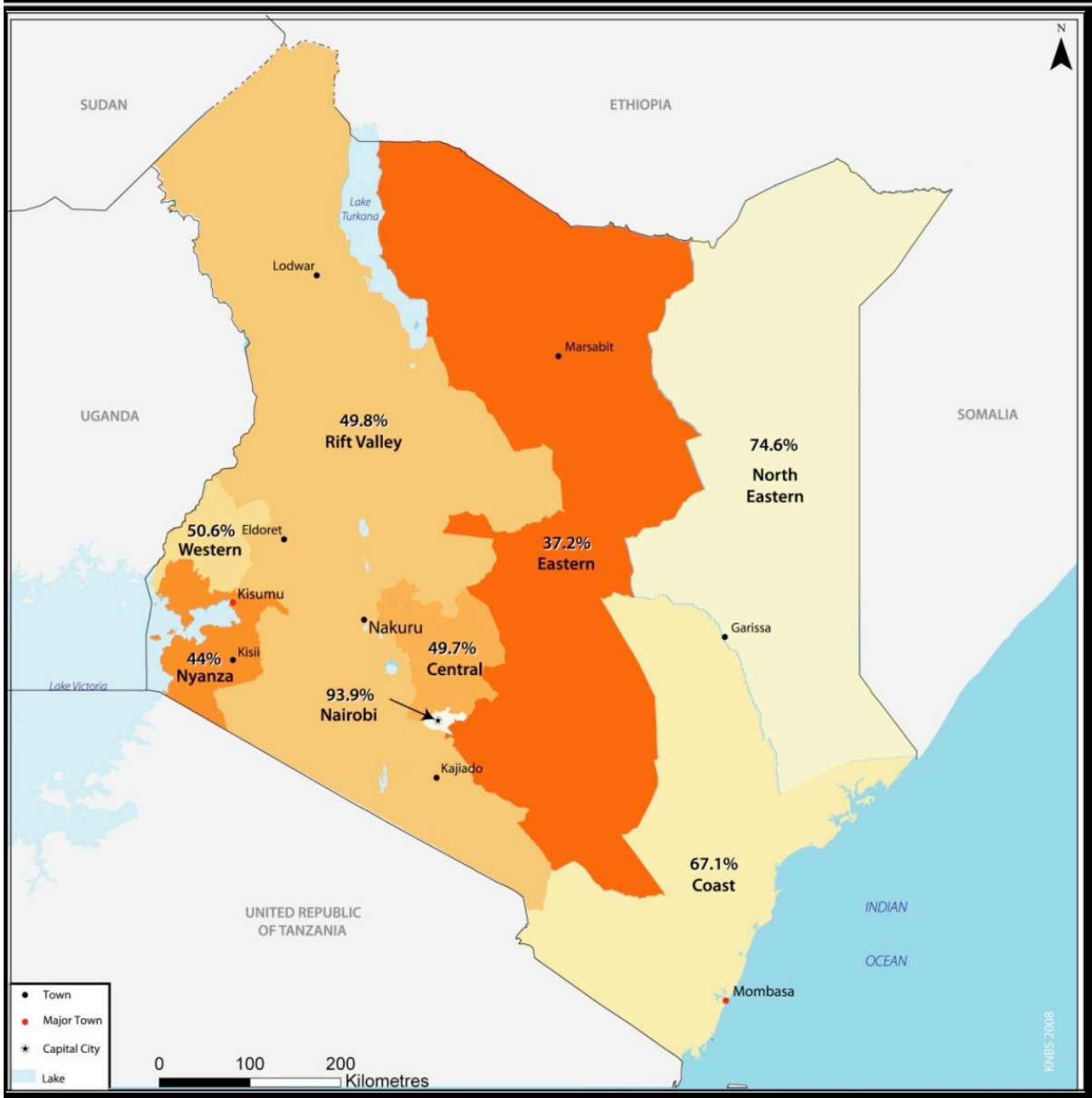
In 2006, approximately 57 per cent of Kenyan households used water from sources considered safe.

Percentage of households with access to safe water, 2005-2006



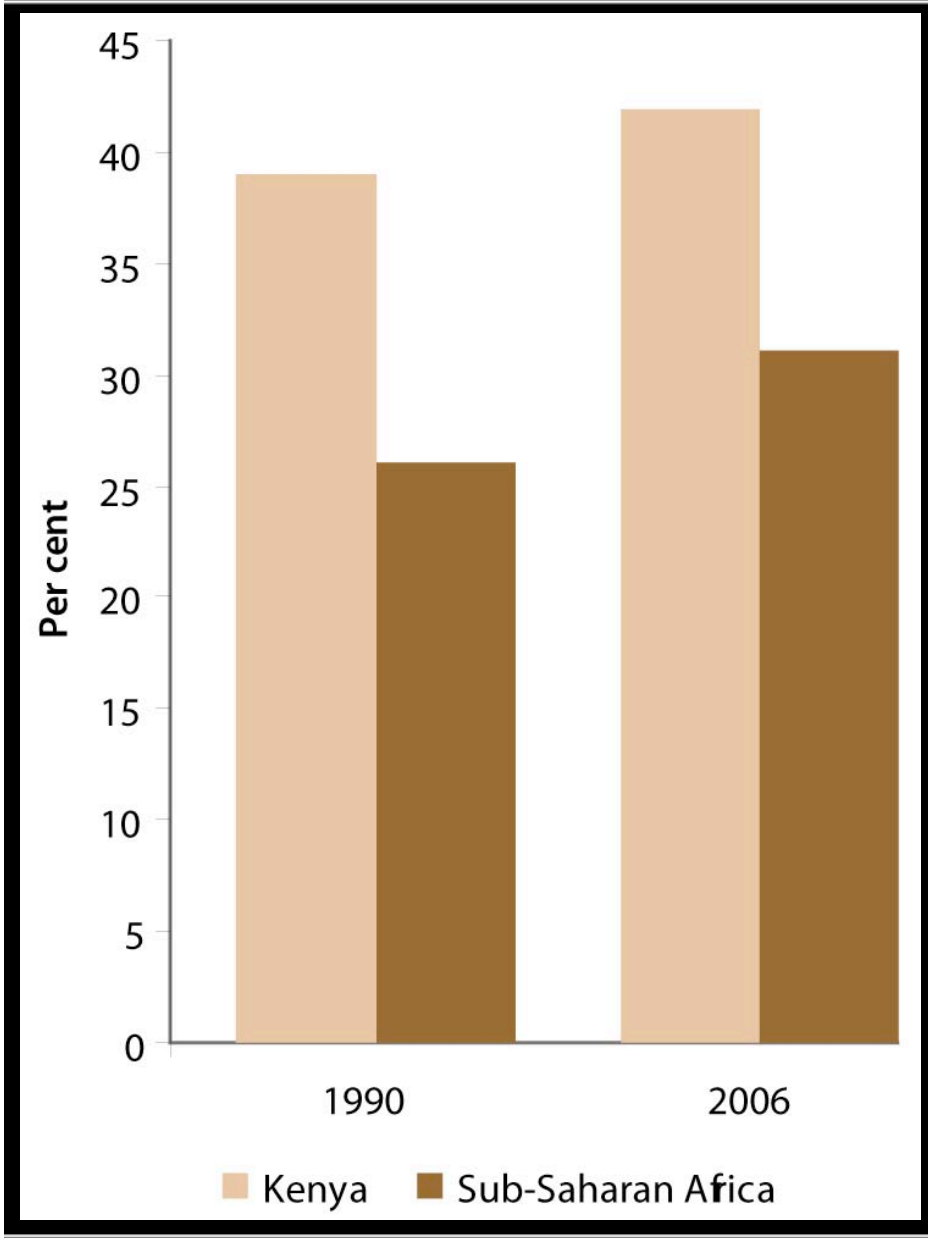
Only 49 per cent of Kenya's rural population has access to clean water compared to 83 per cent in urban areas

Percentage of households with access to an improved water source



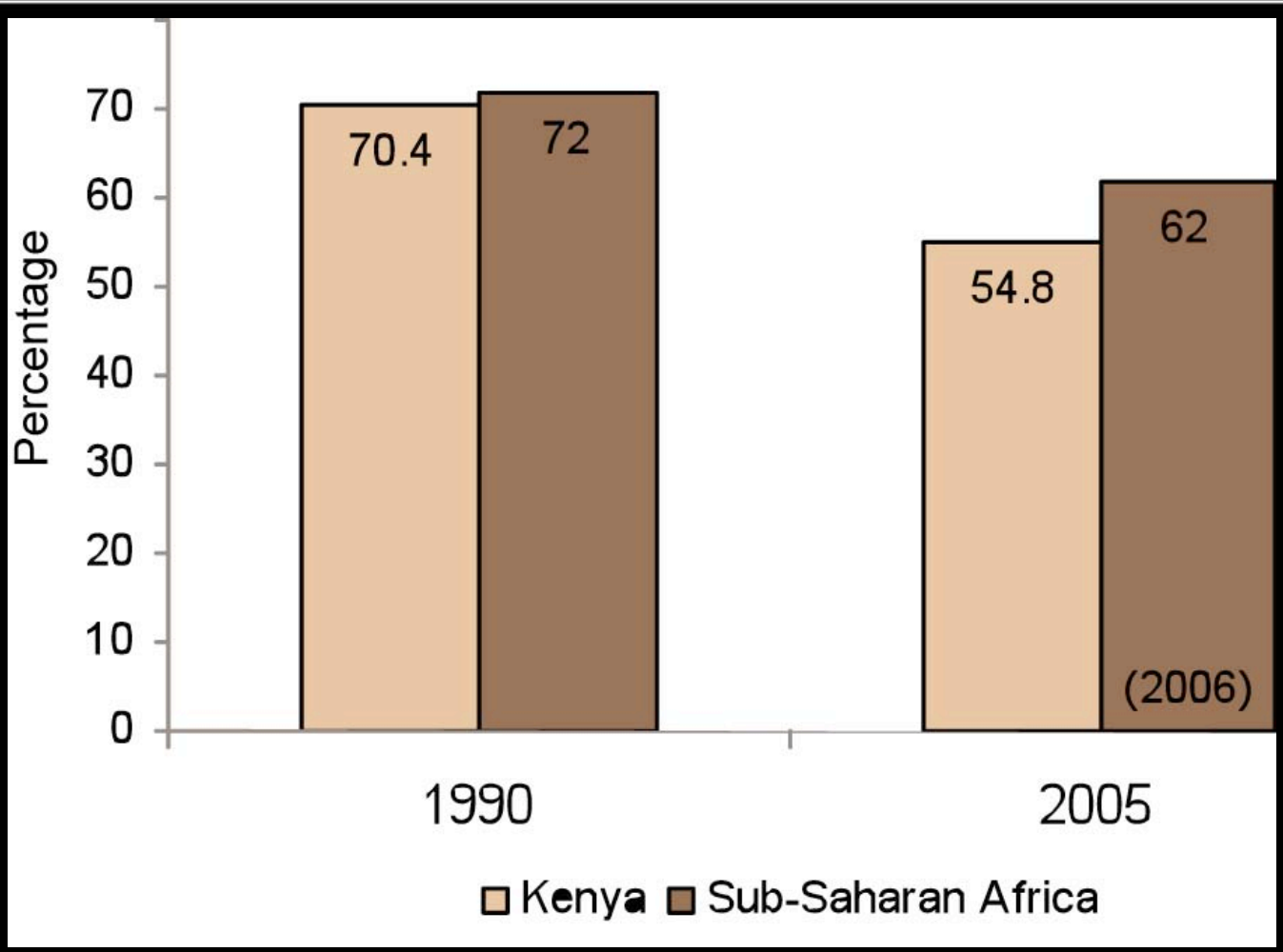
Access to improved water source is varied countrywide with huge regional disparities

The proportion of the population using an improved sanitation facility



Only 19 per cent of the Kenyan population living in urban areas has access to proper sanitation facilities

The proportion of slum populations in urban areas

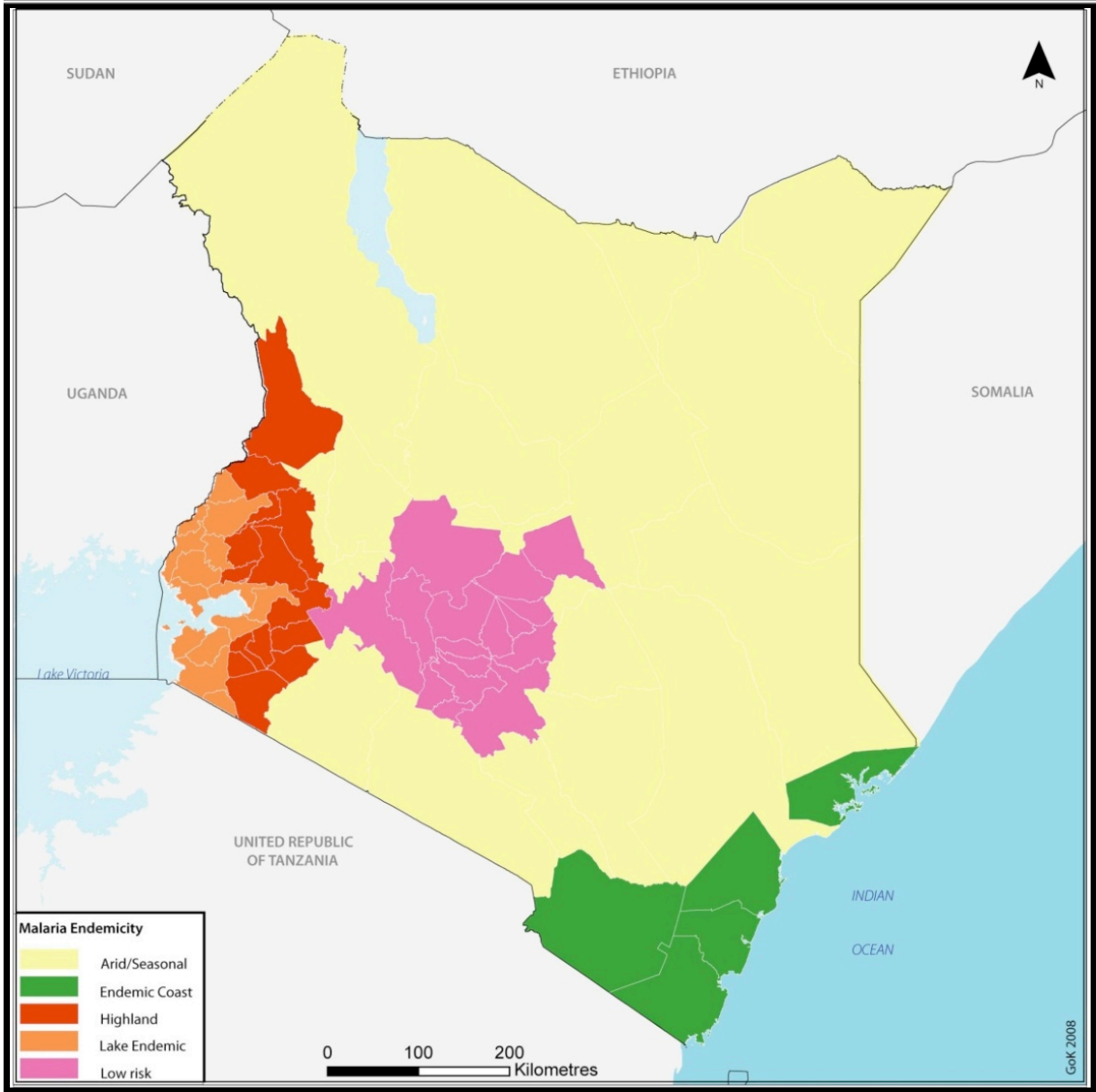


There has been a decline in the proportion of urban people living in slums (a decrease of 15.6 per cent since 1990)

Slum upgrade project

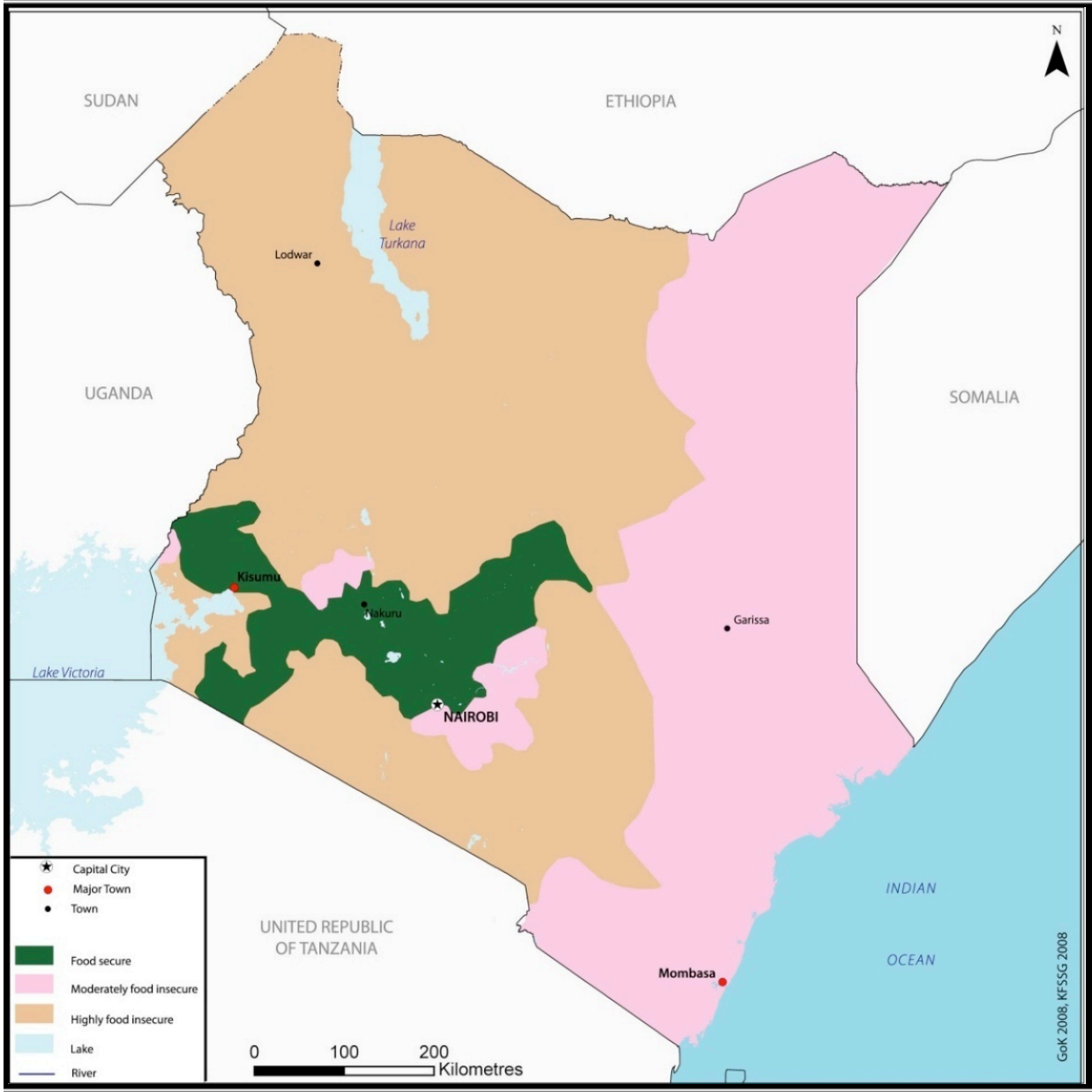
Climate Change and the MDGs

- Climate Change and Human Health
- Climate Change and Food Security
- Climate Change and Floods and Droughts
- Climate Change and Land Degradation
- Climate Change and Pests



Malaria Endemicity

Climate Change and Food Security



Food security distribution

Climate Change and Floods and Droughts

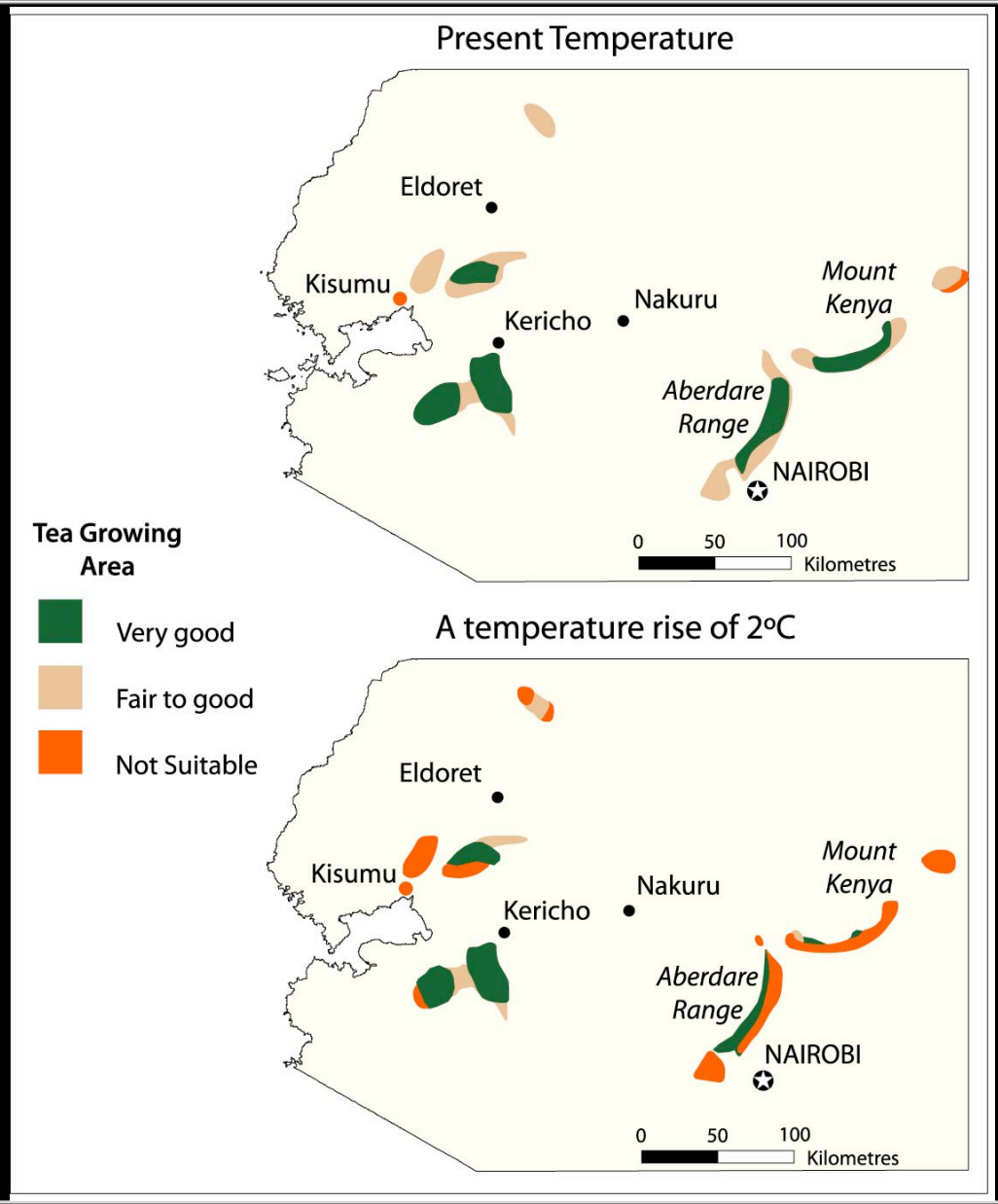
Increased frequency of floods and droughts over the past 10 years:

1996-1997;

1999-2001; and

2003-2006.

The impact of higher temperatures on tea production in Kenya

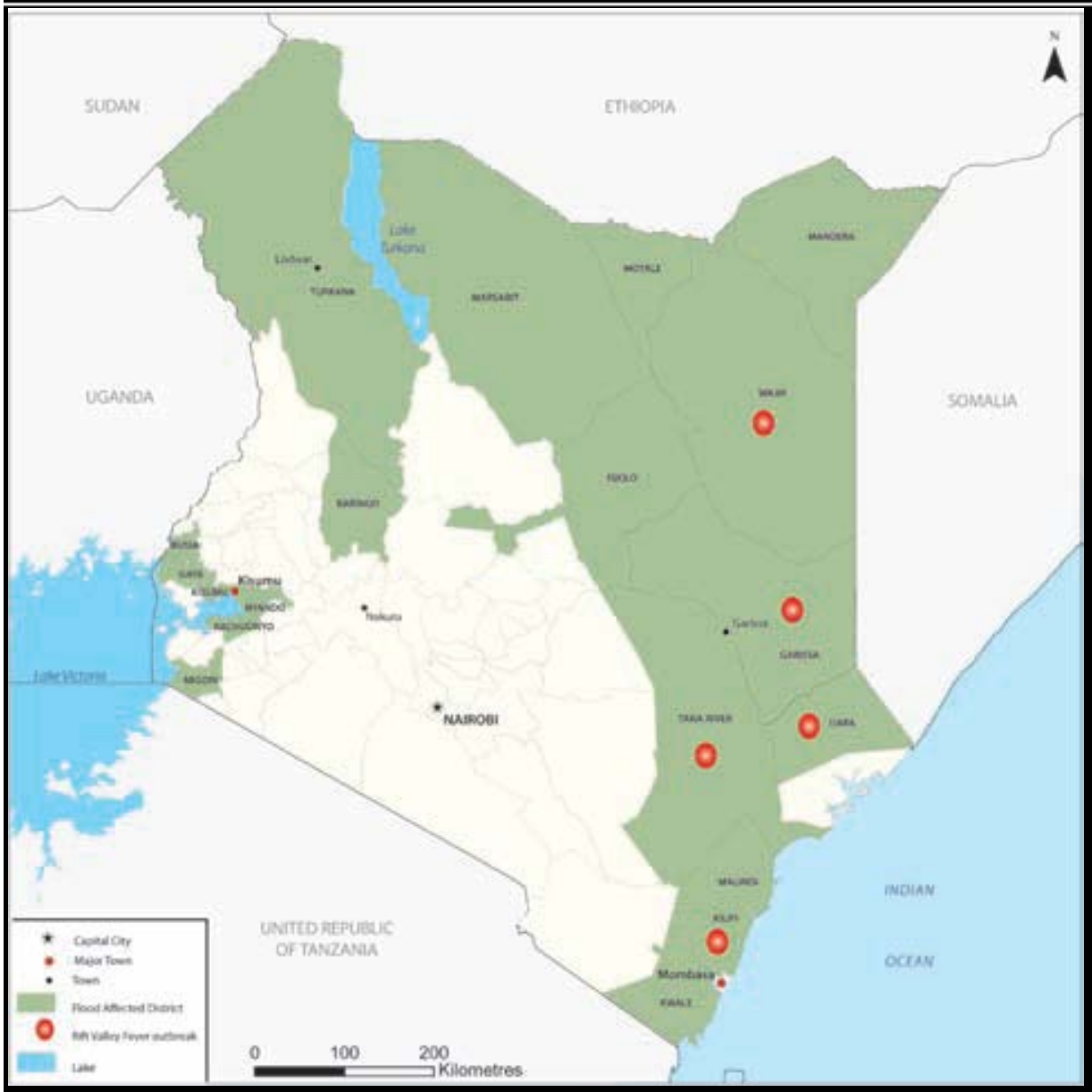


Source: WGCCD 2005

Climate Change and Land Degradation

Floods and droughts can trigger or exacerbate the processes of land degradation, such as desertification, erosion, and landslides, affecting the amount and quality of land available for agricultural activities

Climate Change and Pests

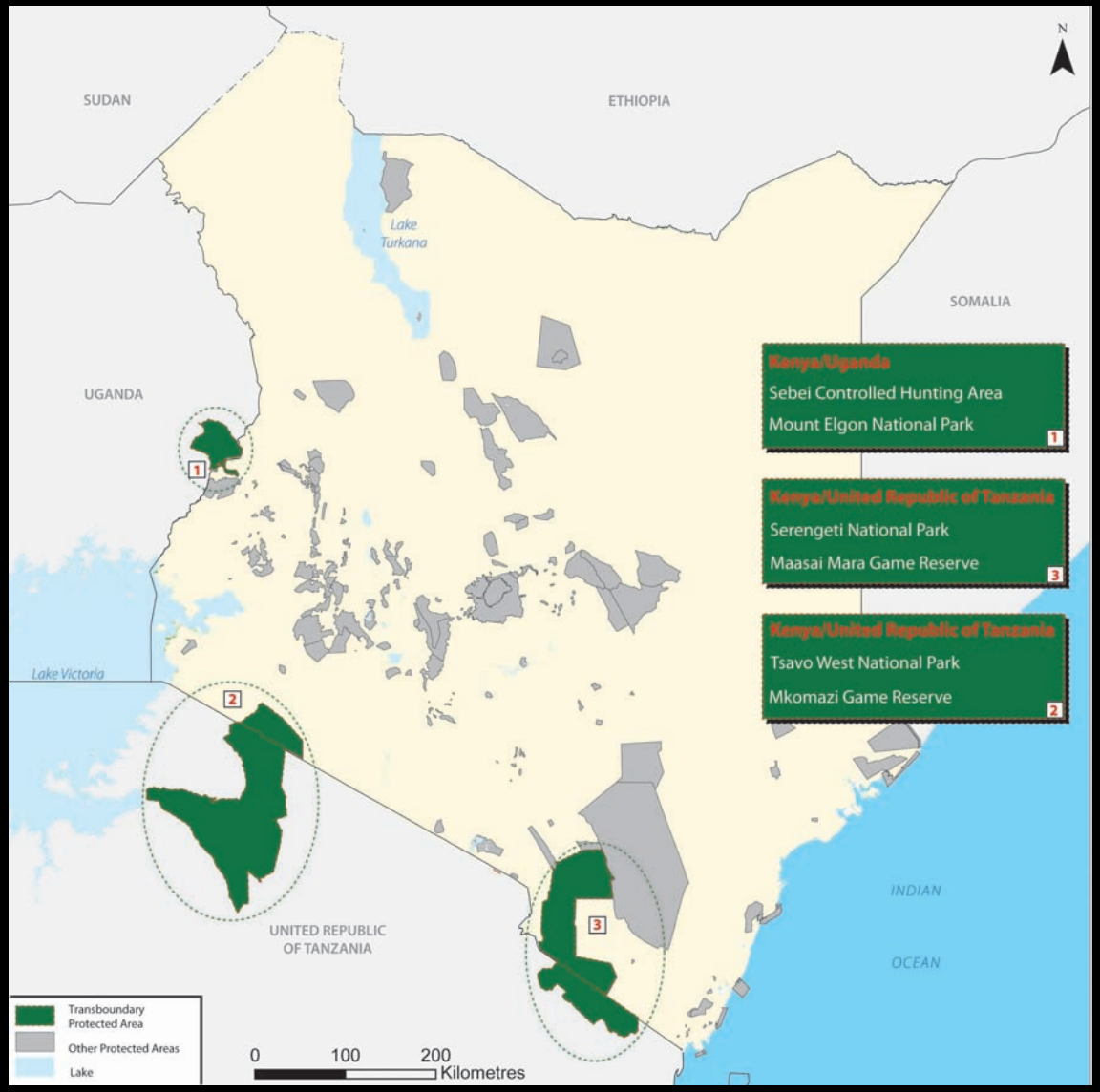


Regions of Rift Valley Fever outbreaks are located within Flood affected areas

Transboundary environmental issues of importance to Kenya and her neighbours:

- **Transboundary protected ecosystems;**
- **Transboundary water resources;**
- **Transboundary movement of people;**
- **Transboundary movement of pests and disease.**

Transboundary protected ecosystems



Kenya/Uganda

- Mount Elgon N.P.
- Sebei Controlled Hunting Area and Mt. Elgon National Park

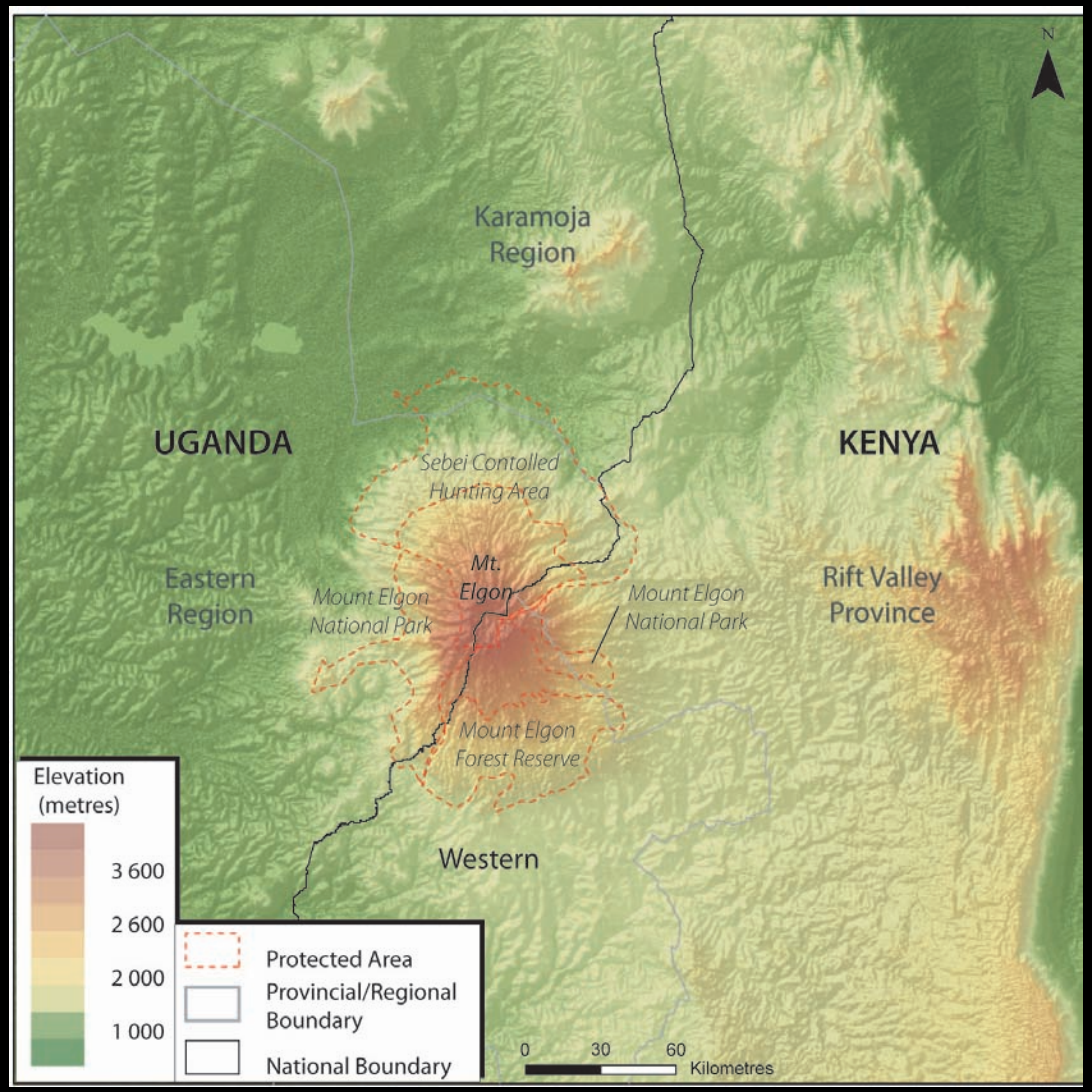
Kenya/Tanzania

- Maasai Mara G.R.
- Serengeti National Park

Kenya/Tanzania

- Tsavo West N.P.
- Mkomazi game Reserve

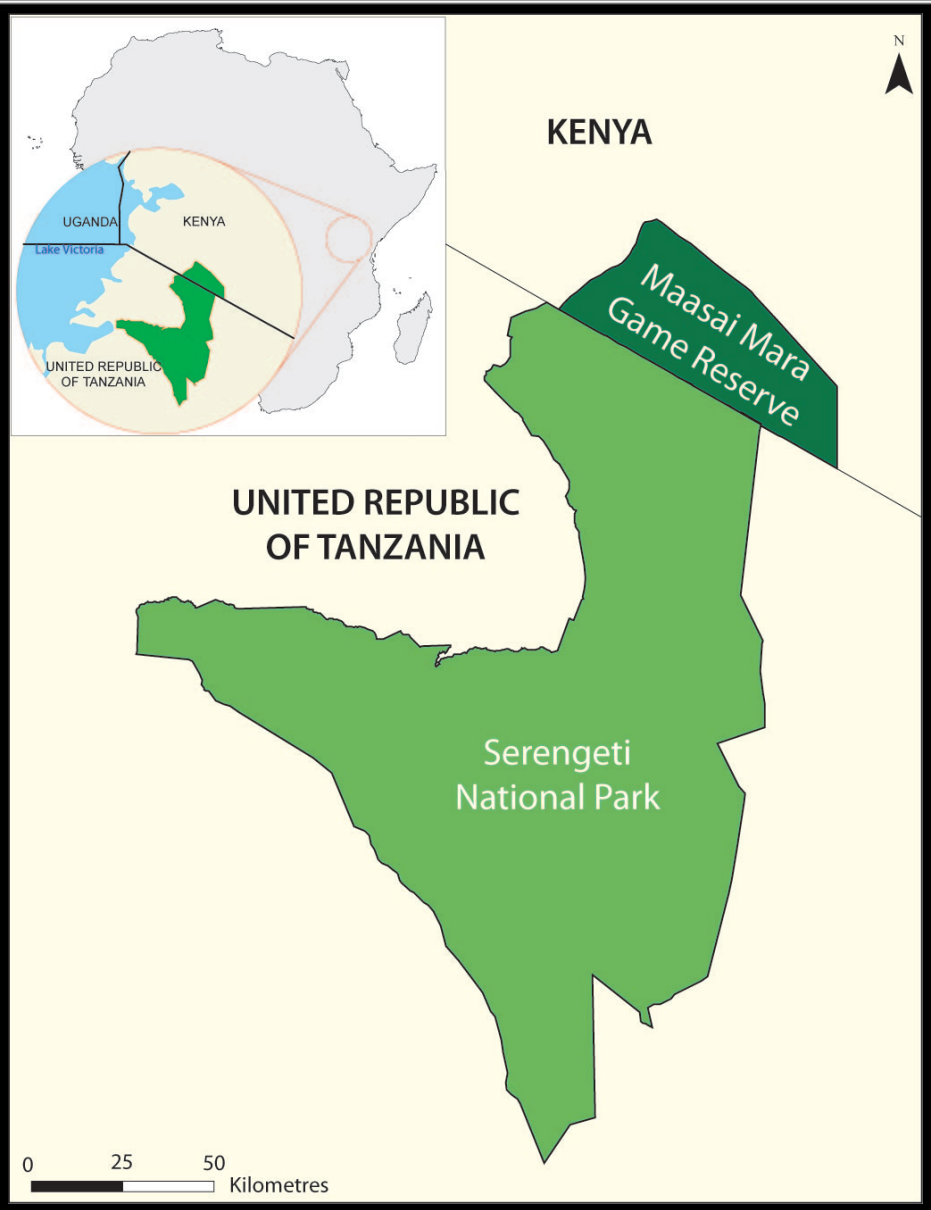
Mt. Elgon



Local populations use the protected area to:

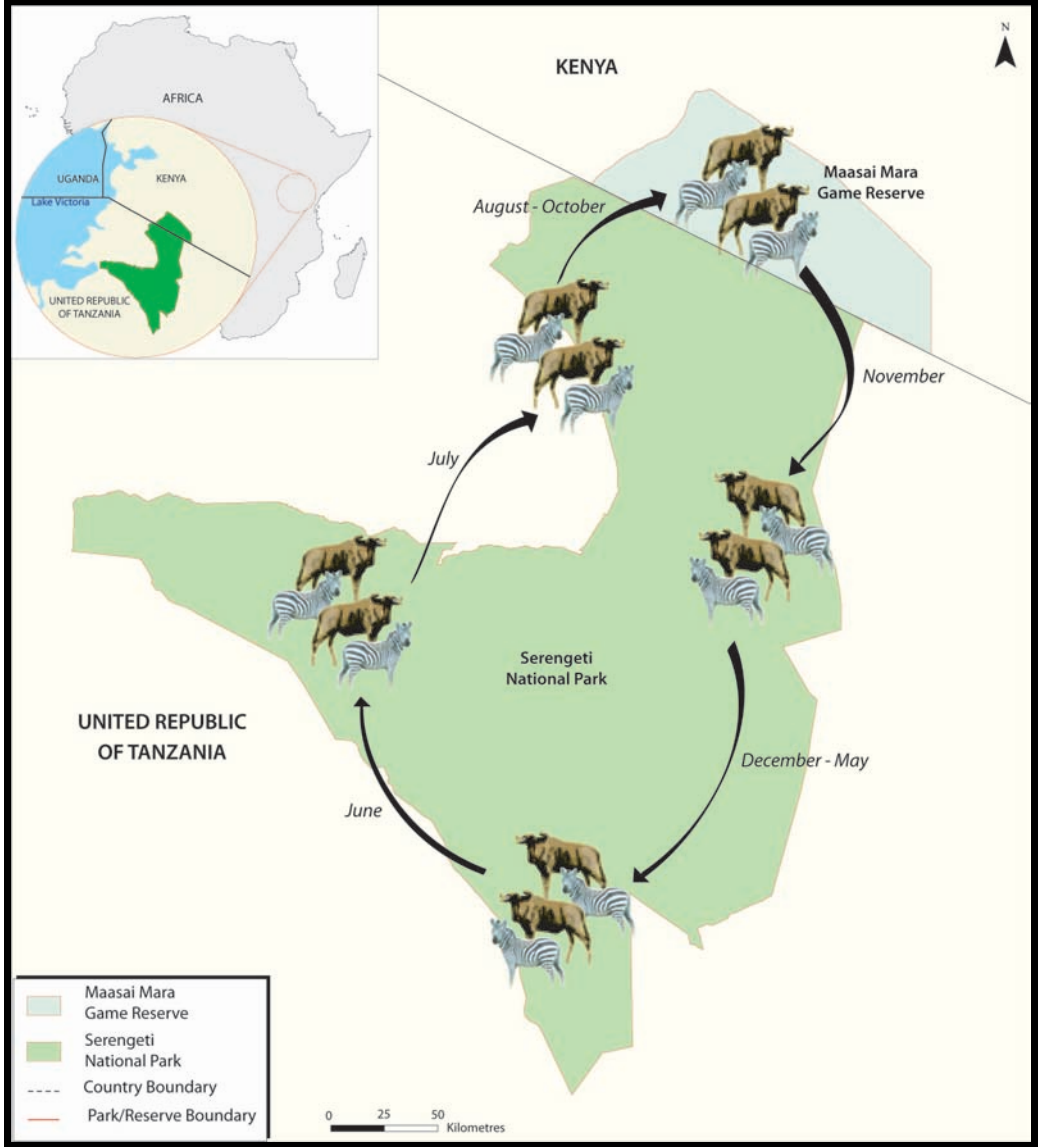
- **Gather non-timber forest products,**
- **cut timber,**
- **Graze livestock,**
- **Clear land for farming, and**
- **hunting.**

Maasai Mara Game Reserve and Serengeti National Park

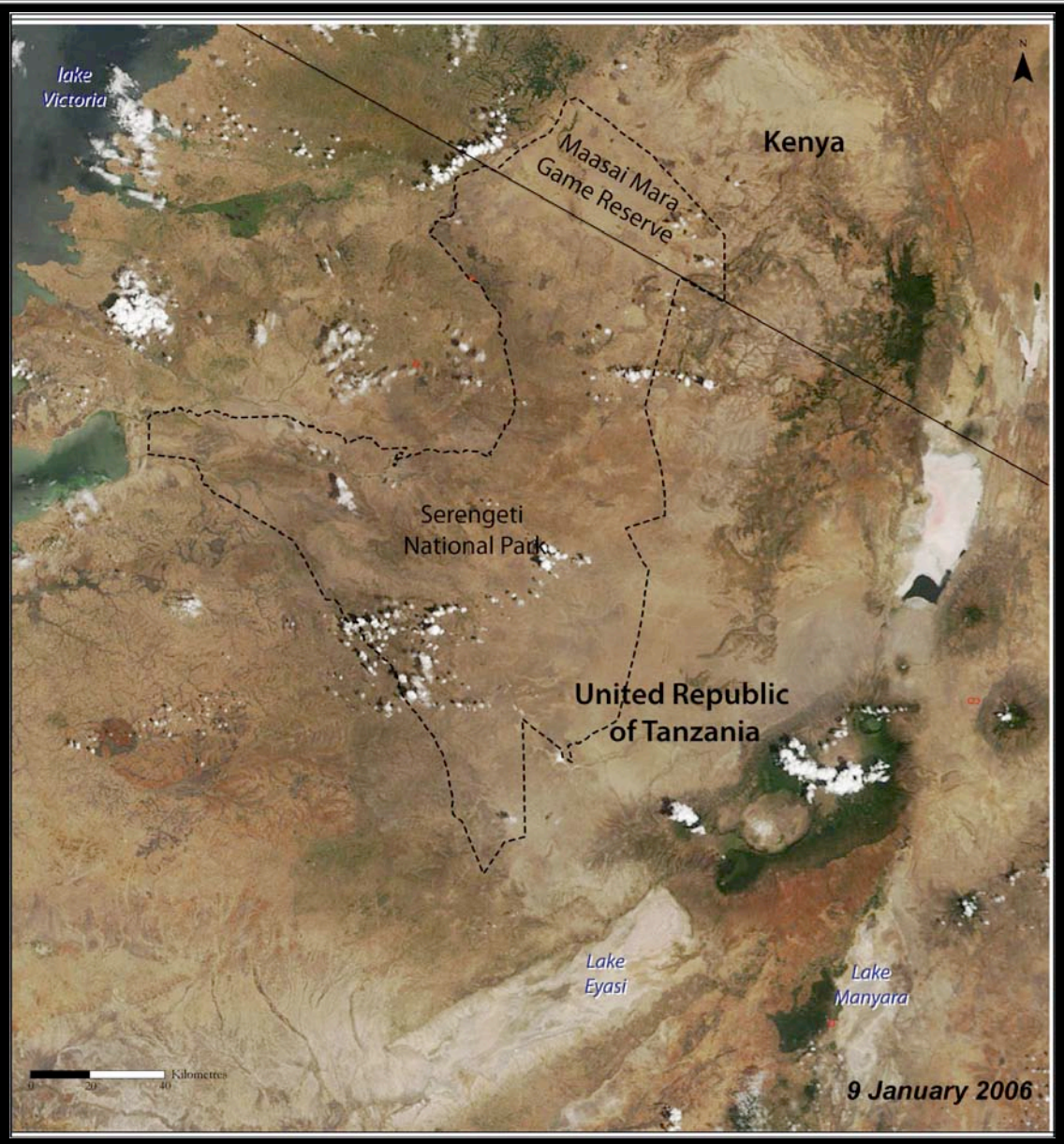


One of the greatest regions of migrating wildlife in the world

The Great Migration



Drought disrupts the great migration

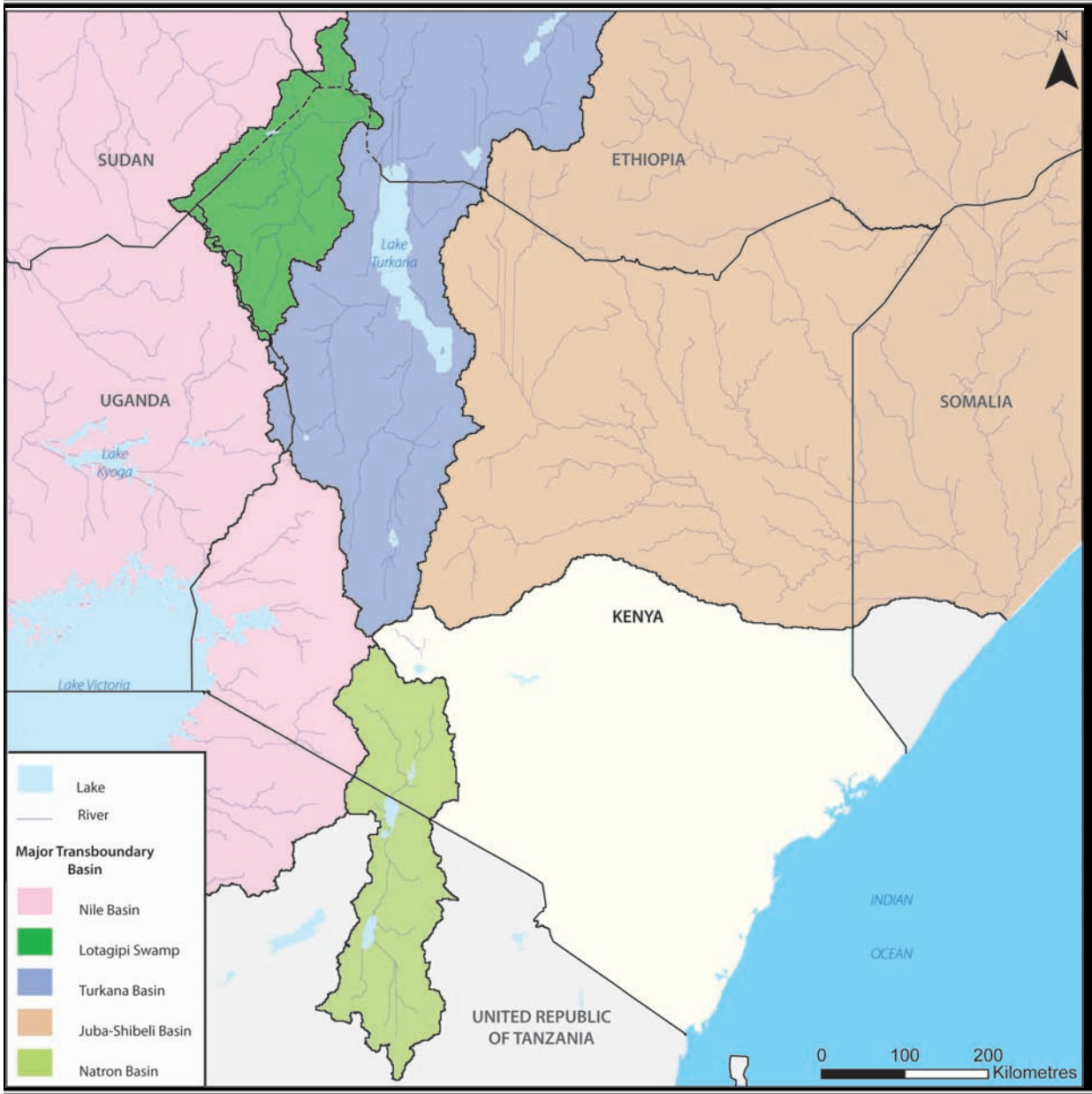


January 2005

January 2006

- **Widespread drought in East Africa.**
- **Partially disrupted the migration**

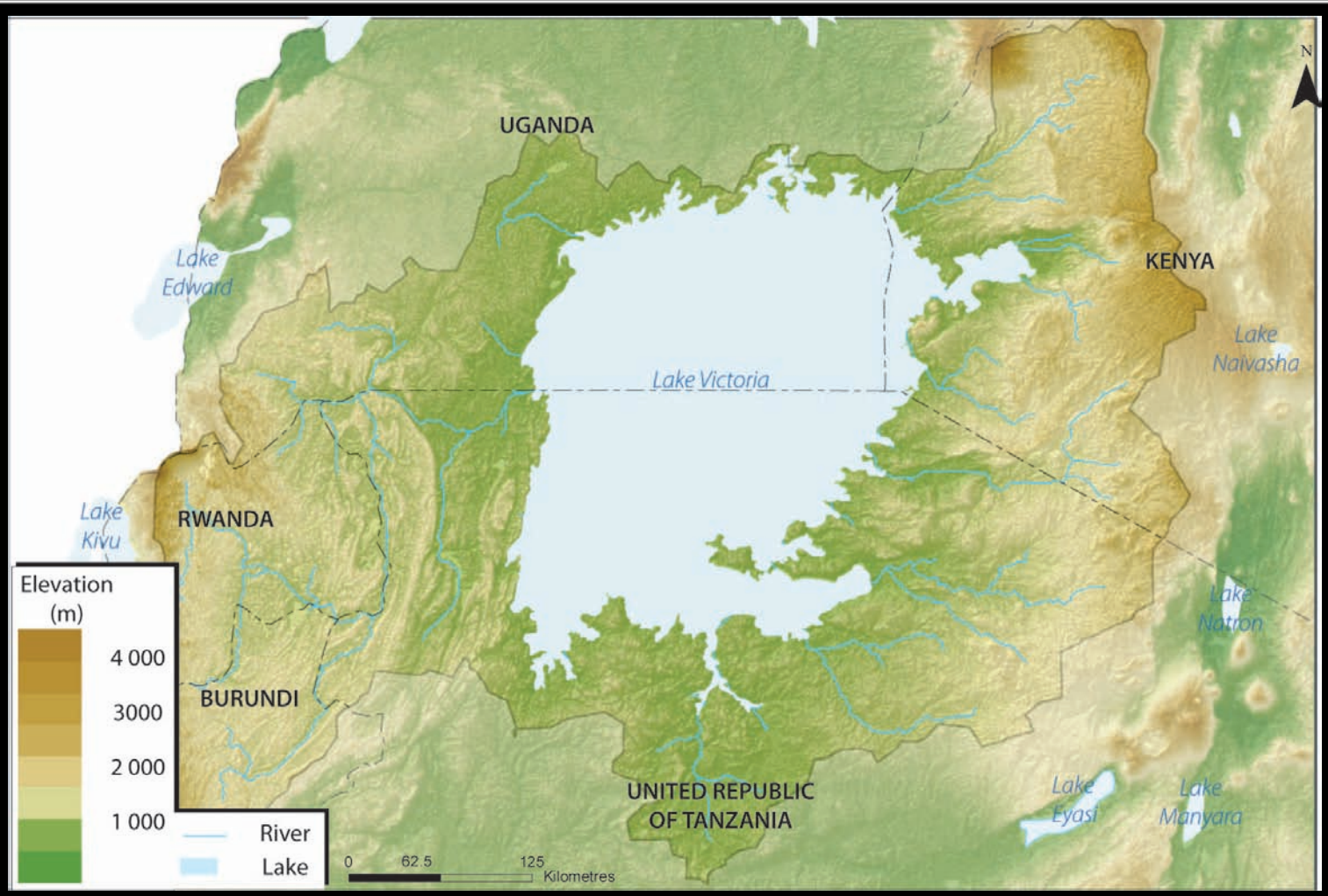
Transboundary water resources



Five major transboundary basins in Kenya

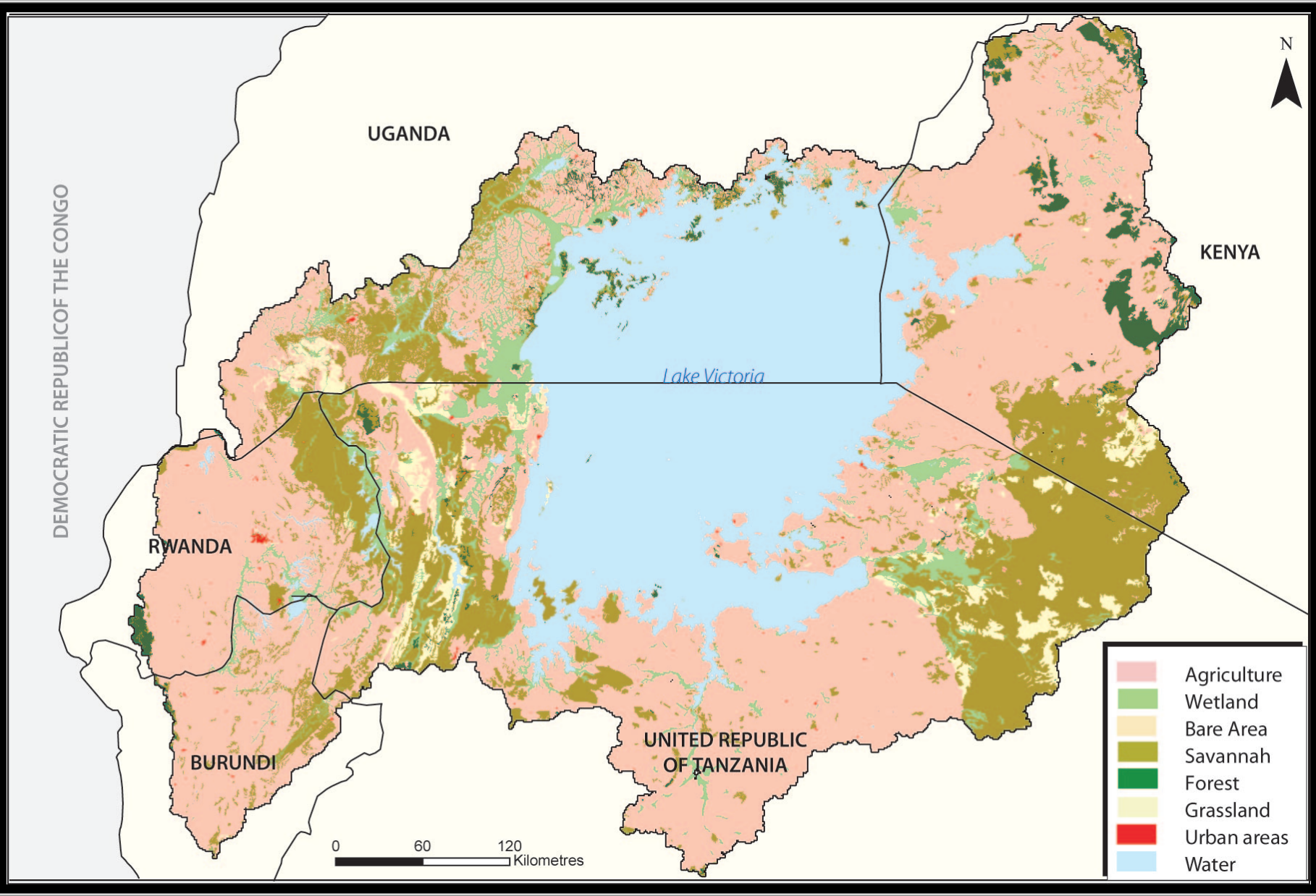
- **Lake Victoria Basin**
- **Lake Turkana Basin**
- **Lake Natron Basin**
- **Juba-Shebelle Basin**
- **Lotagipi Swamp**

Lake Victoria Basin

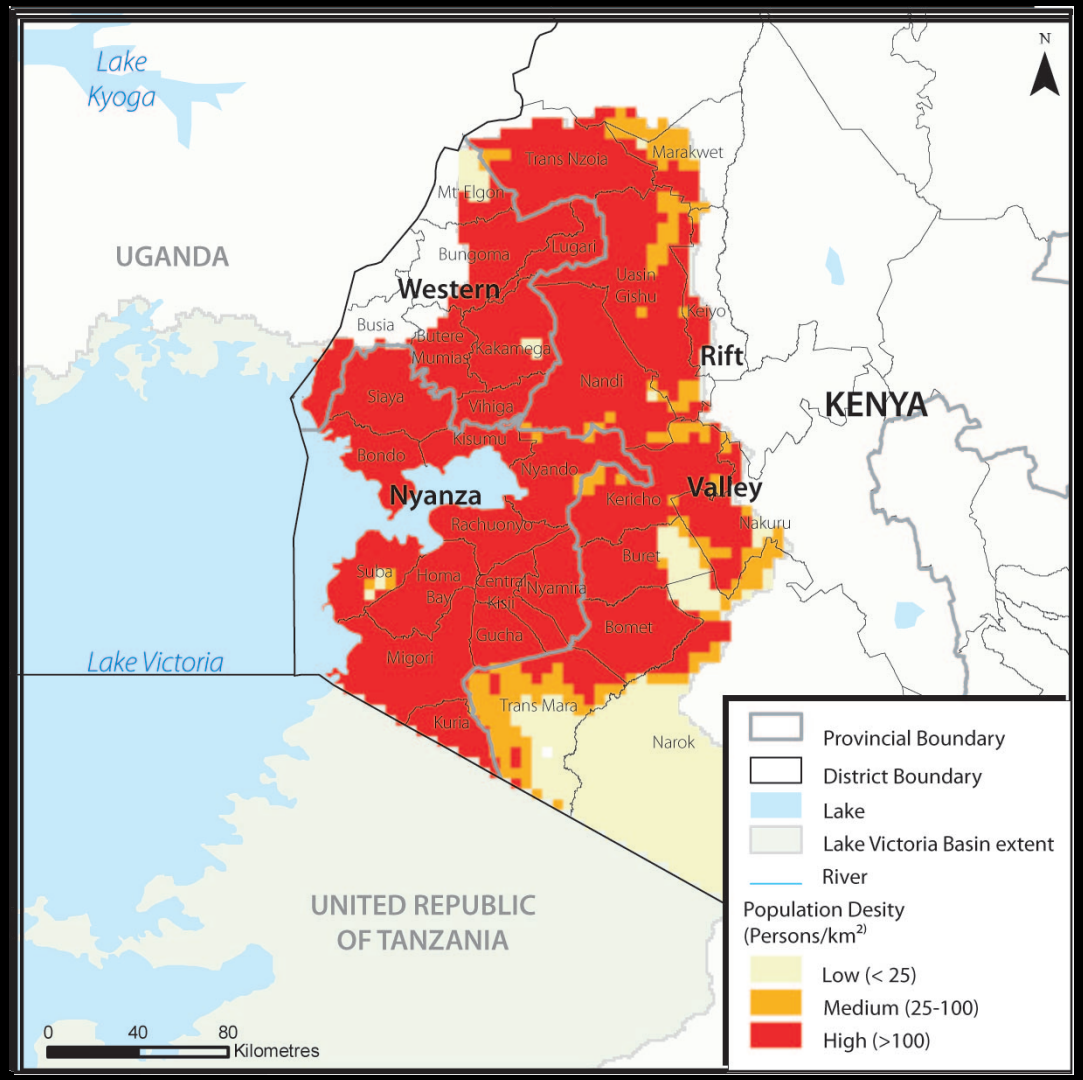


- Shared by Kenya, Uganda, the United Republic of Tanzania, Rwanda, and Burundi
- About 251 000 km^2

Lake Victoria Basin Land Cover



Population density change within the Kenyan portion of Lake Victoria Basin, 1960-2005



1960

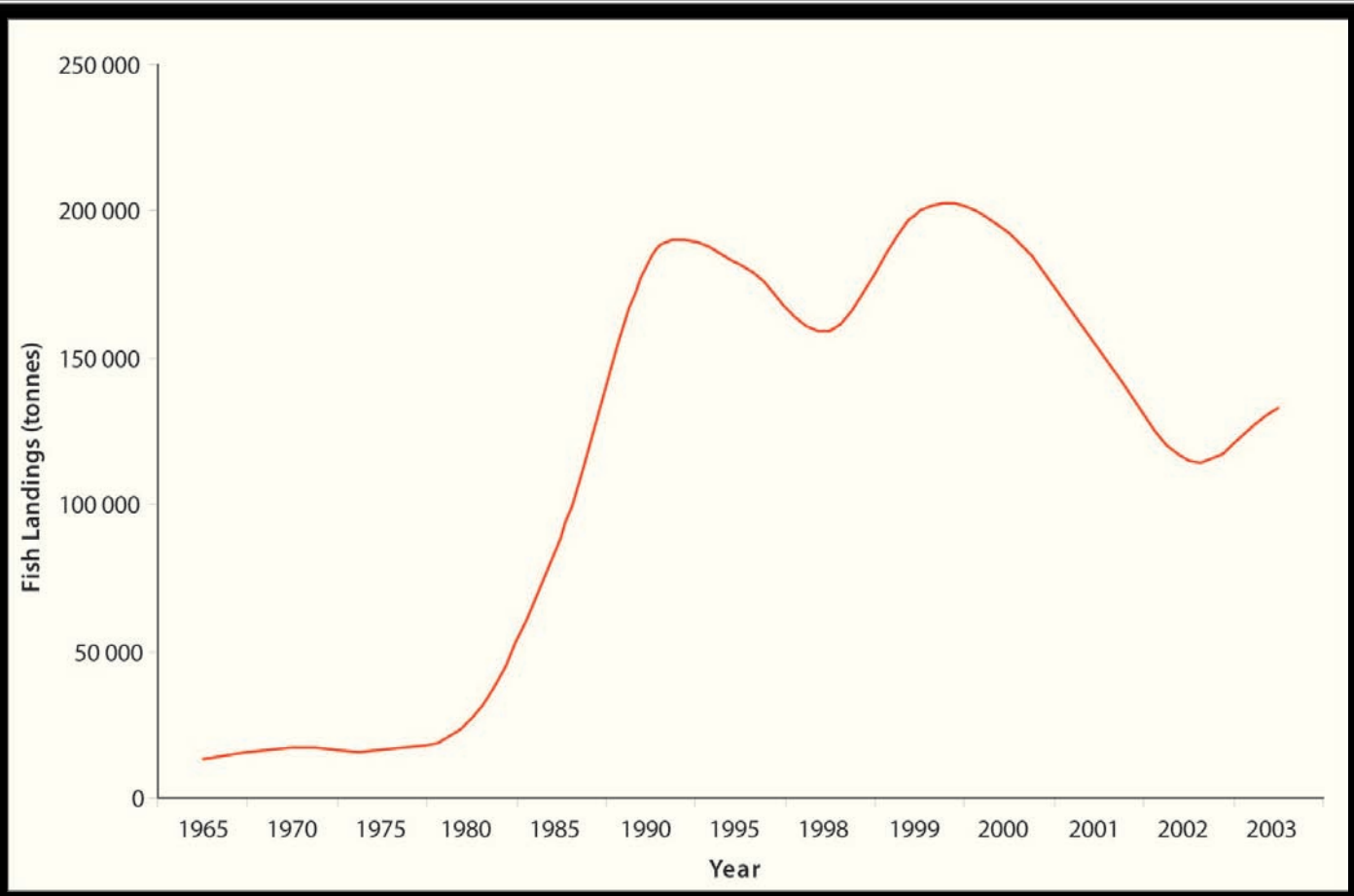
1980

2000

2005

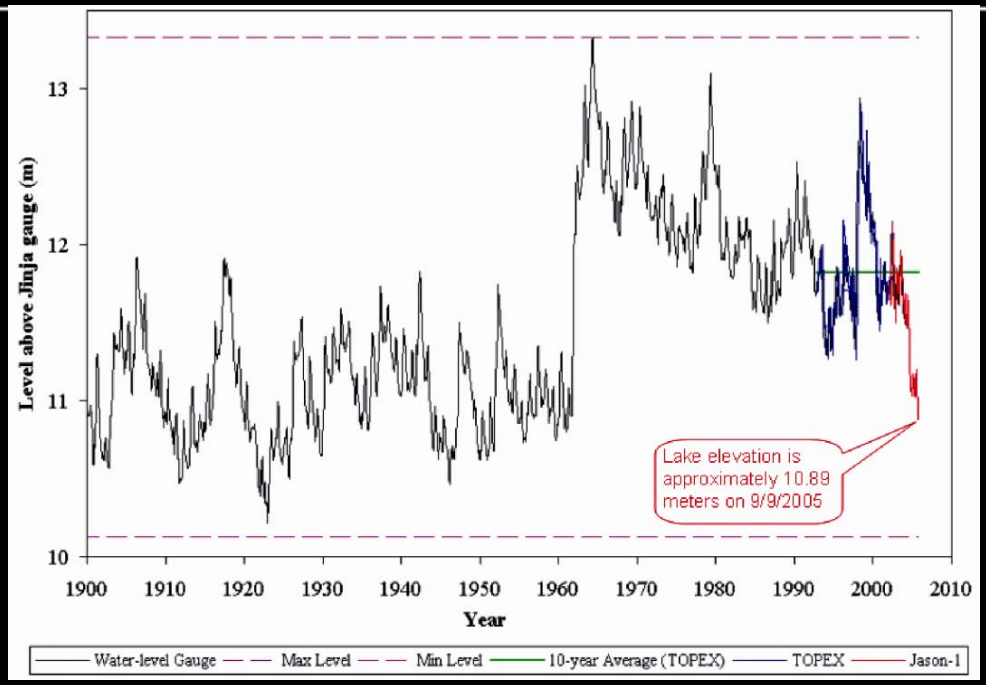
Increased population density since 1960 exerts greater pressures on the region's resources

Lake Victoria fish landings

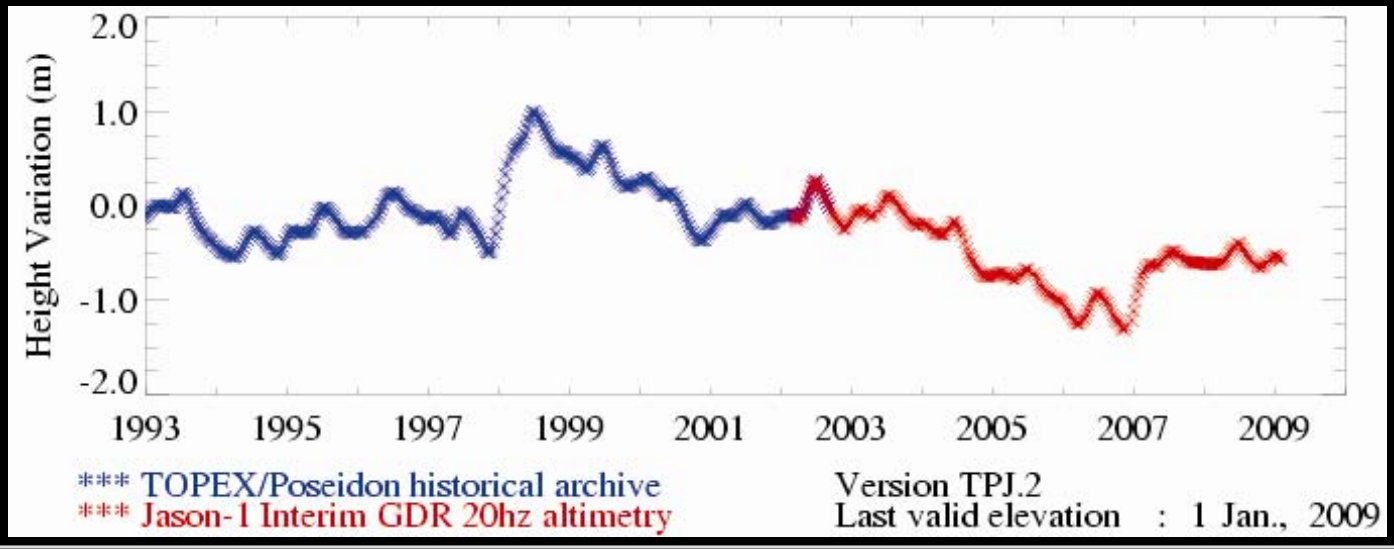


Fish landings in Lake Victoria were generally low until the early to mid-1980s, when populations of Nile Perch exploded

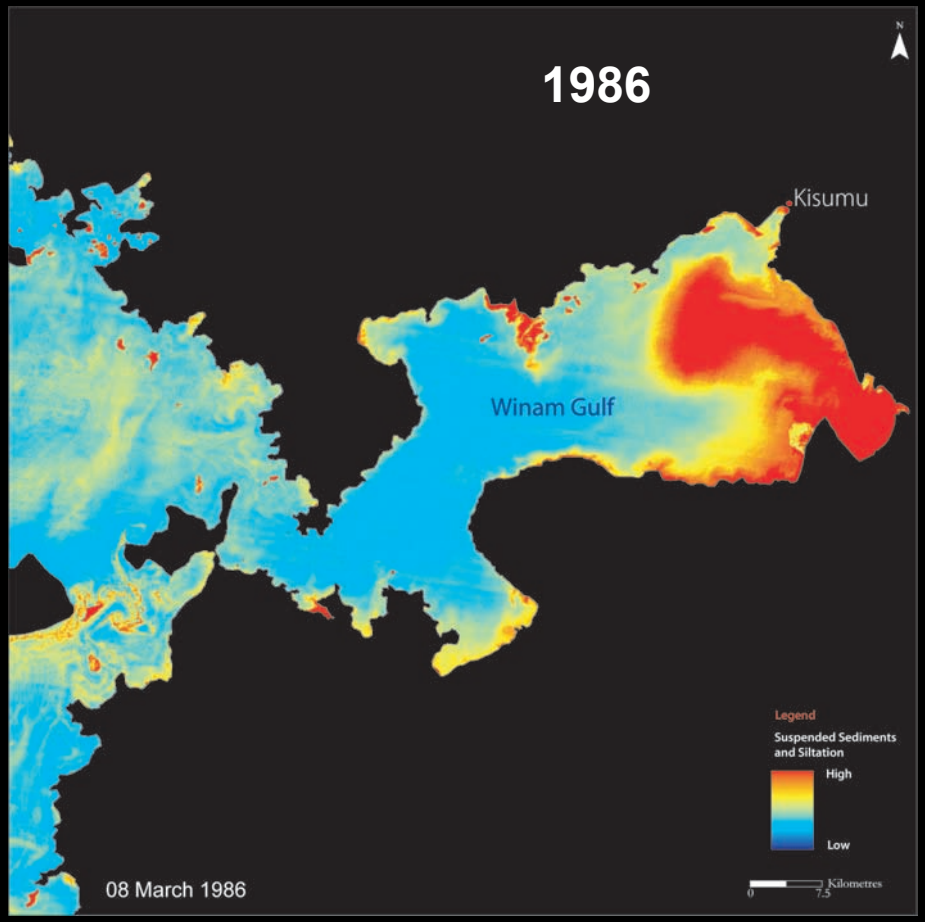
Lake Victoria water level

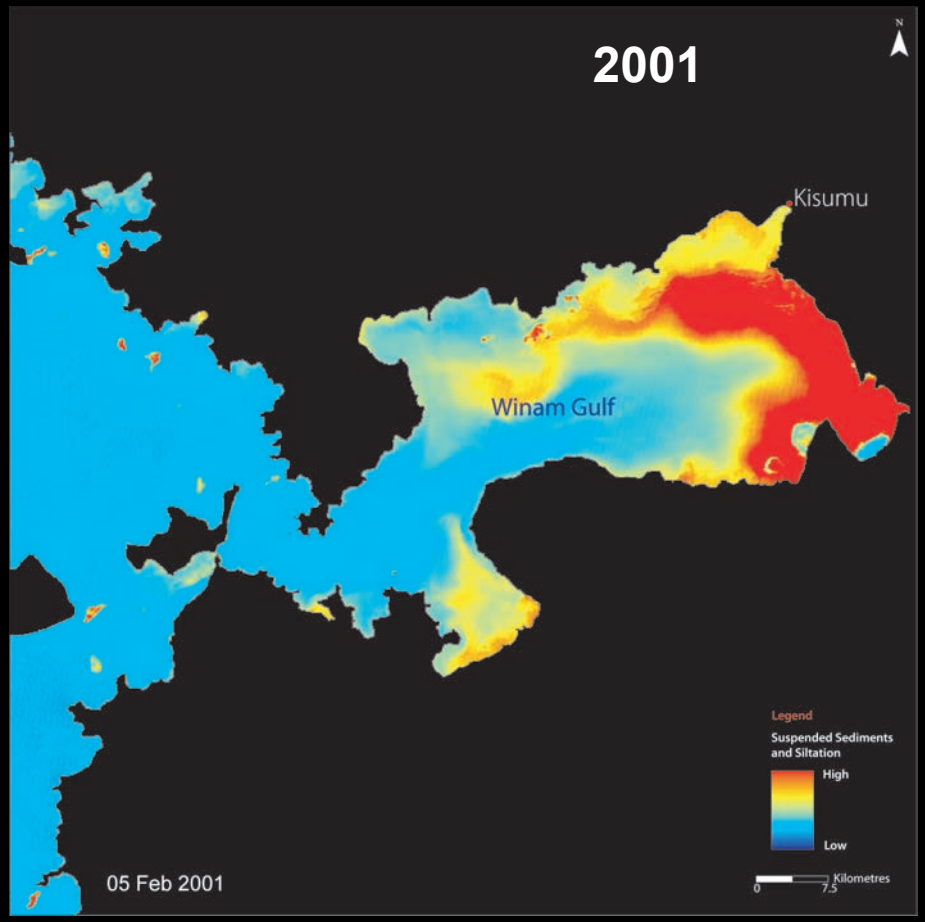


Water levels in Lake Victoria were unusually high from the mid-1960s until December 2005. Since then water levels dropped roughly a metre.



Winam Gulf


1986
N
Kisumu
Winam Gulf
Legend
Suspended Sediments and Siltation
High
Low
0
7.5
Kilometres
08 March 1986


2001
N
Kisumu
Winam Gulf
Legend
Suspended Sediments and Siltation
High
Low
0
7.5
Kilometres
05 Feb 2001

Mara River Basin (Part of Lake Victoria Basin)

Juba-Shebelle Basin

Occupies about one-third of the land areas of Ethiopia, Kenya, and Somalia (about 2.7 per cent of the African continent)

Lake Natron Basin

Deforestation in the Mau forest, hundreds of kilometres away, poses a serious threat to the lake's salinity balance.

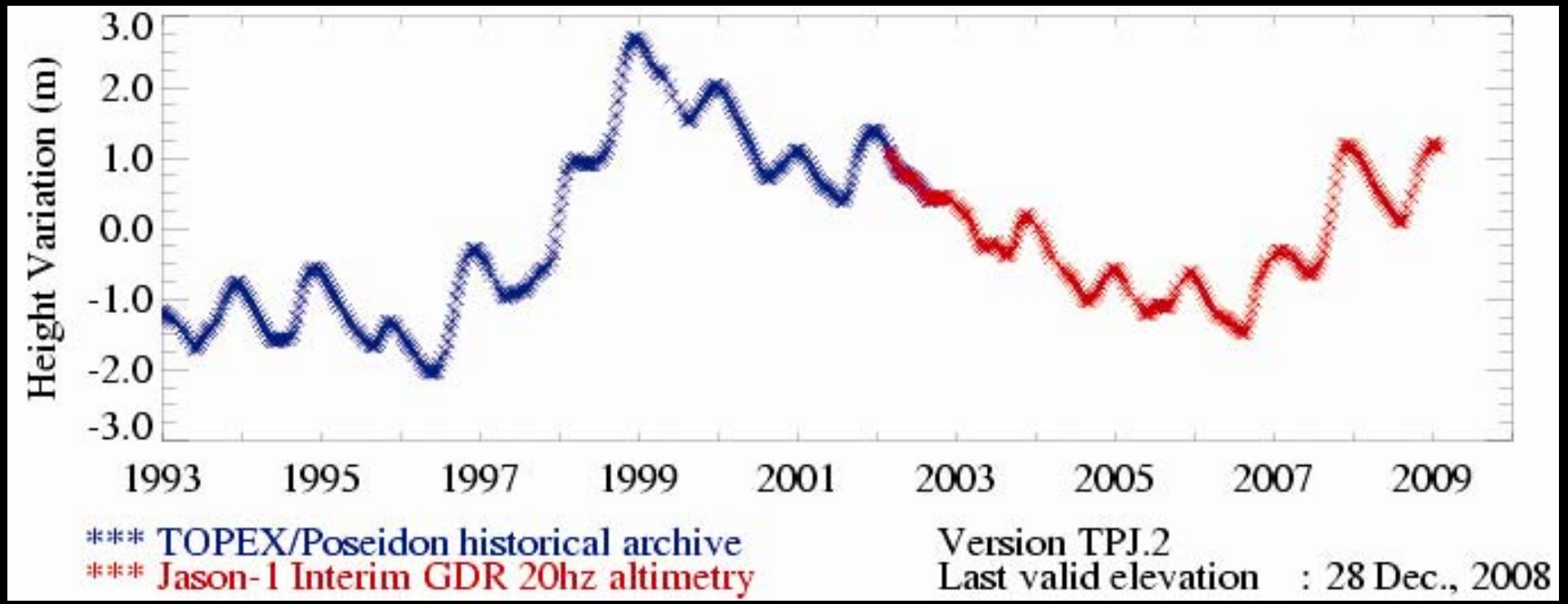
Lake Turkana Basin

Basin covers 209 157 km^2

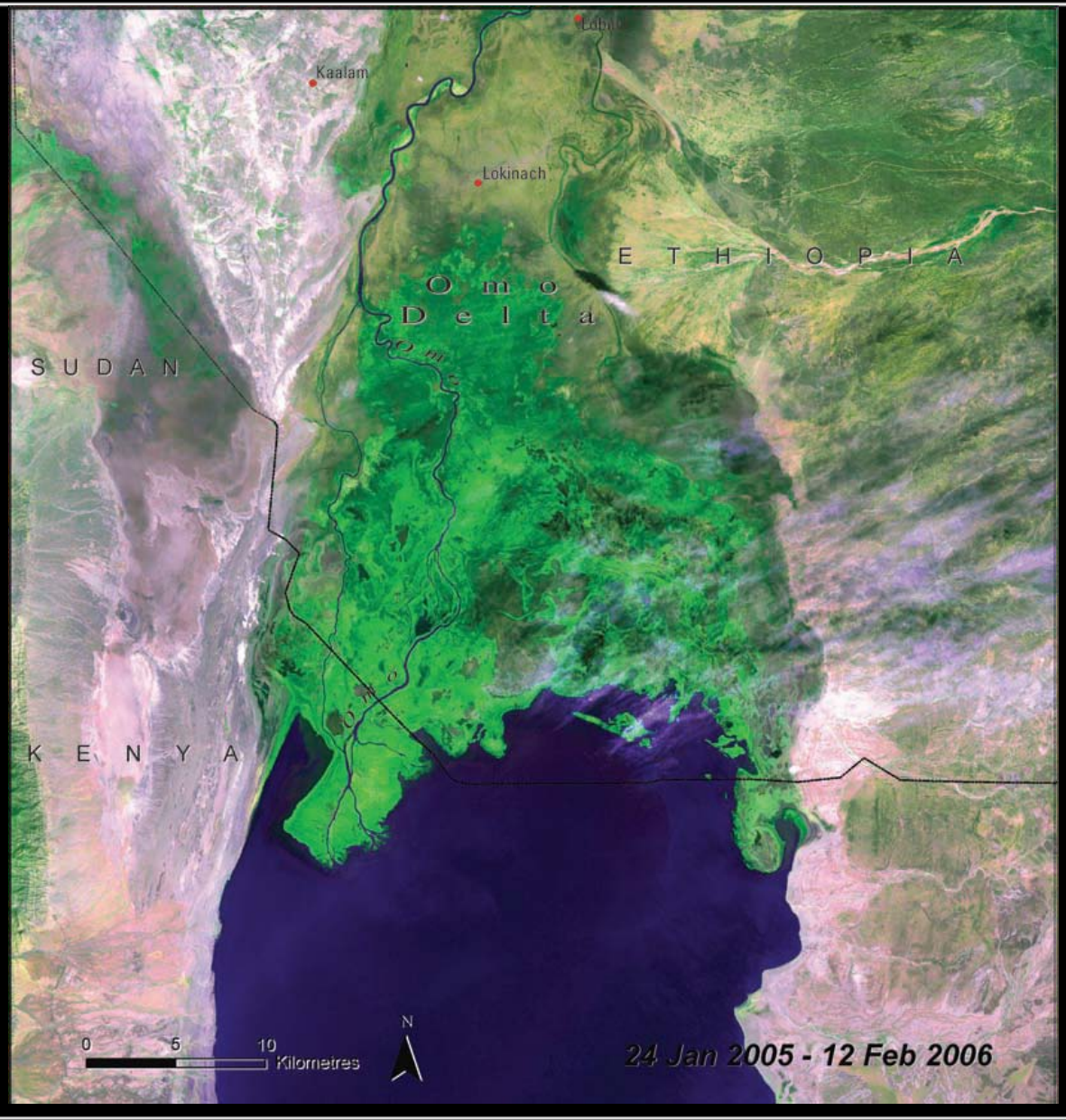
Includes:

- **Lake Abaya Hayk',**
- **Lake Ch'amo Hayk',**
- **Lake Ch'ew Bahir**
- **Lake Turkana,**
- **Lake Baringo, and**
- **Lake Bogoria**

Lake Turkana water level variation



The Omo Delta: Expanding Land



1973

2006

Lotagipi Swamp

- 120 km long, 85 km of which extends into Kenya.
- Wetland flooded during rainy season
- No protected status

Transboundary movement of people

Kenya's relative political stability has made it a safe haven for refugees fleeing conflicts in neighbouring countries, including Uganda, Rwanda, Burundi, Ethiopia, Somalia, and Sudan.

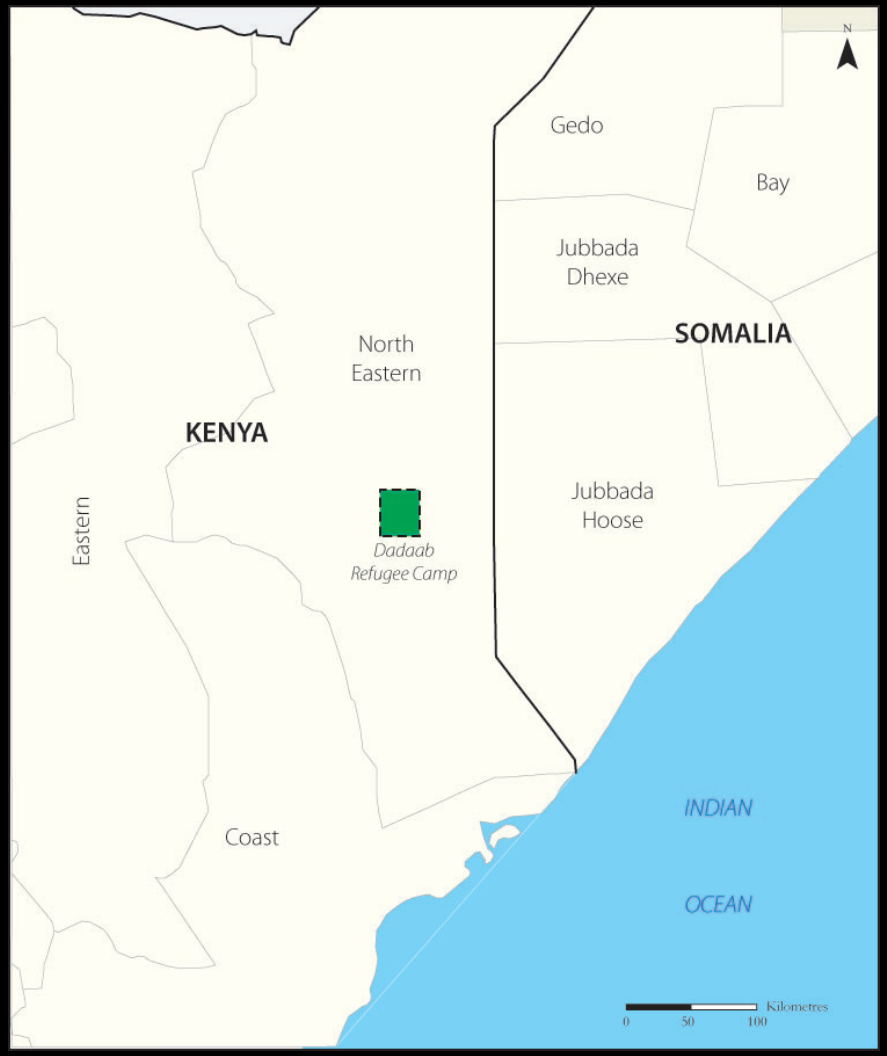
It has also been a transit area for refugees resettling in other countries or being repatriated

Kakuma Refugee Camp

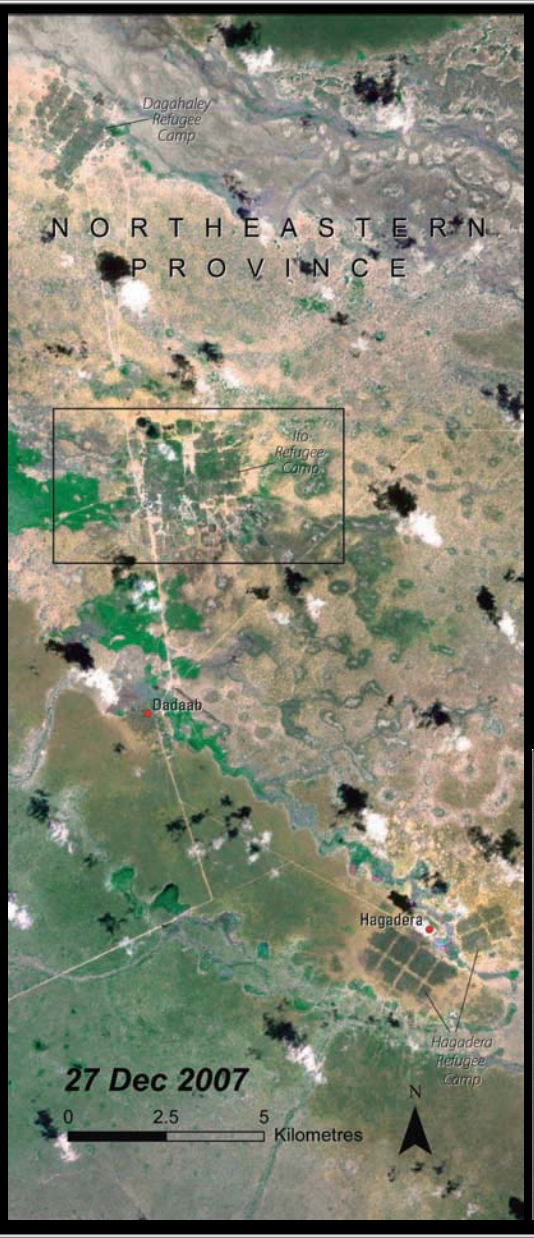
One of the oldest and largest refugee camps in the world

The camp has led to severe land degradation in the surrounding areas because of overgrazing and meeting firewood needs

Dadaab Refugee Camp



Ifo, Dagahaley, and Hagadera refugee camps date back to 1991 when civil wars erupted on a large scale in Somalia

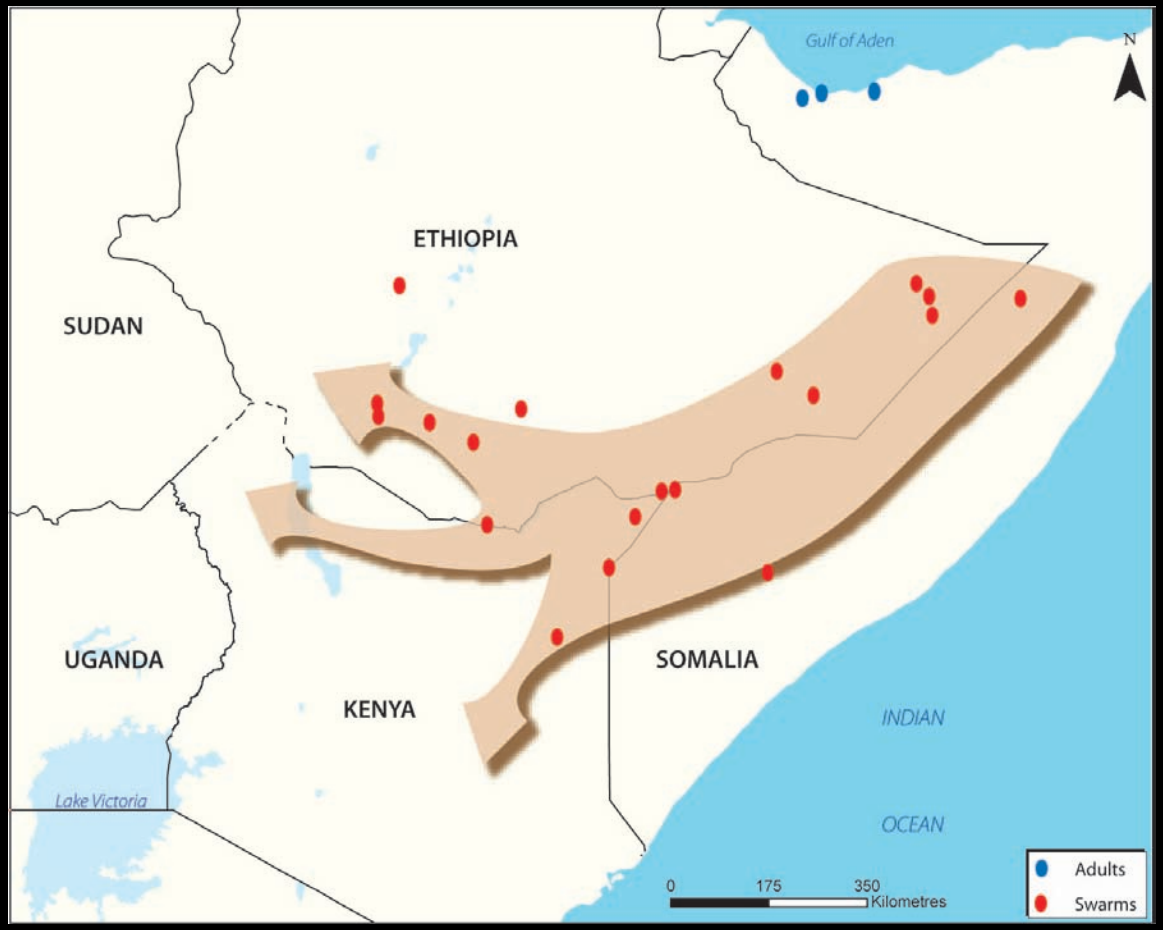


In the 2007 image, Ifo, Dagahaley, and Hagadera refugee camps stand out distinctly, revealing the impact of a high concentration of people on the environment.

Transboundary movement of pests and disease

Pest infestations, such as plagues of desert locusts, the Africa Armyworm, and Red-billed Quelea birds, though periodic, are serious transboundary issues.

Desert Locust Invasion



Visually stunning series of satellite photos that in a glance shows readers the extent to which human activities have wrought changes on Kenya's landscapes.

Land Use and Land Use Change

Kenya's land area: 582 646 km^2

2.2 per cent: surface water.

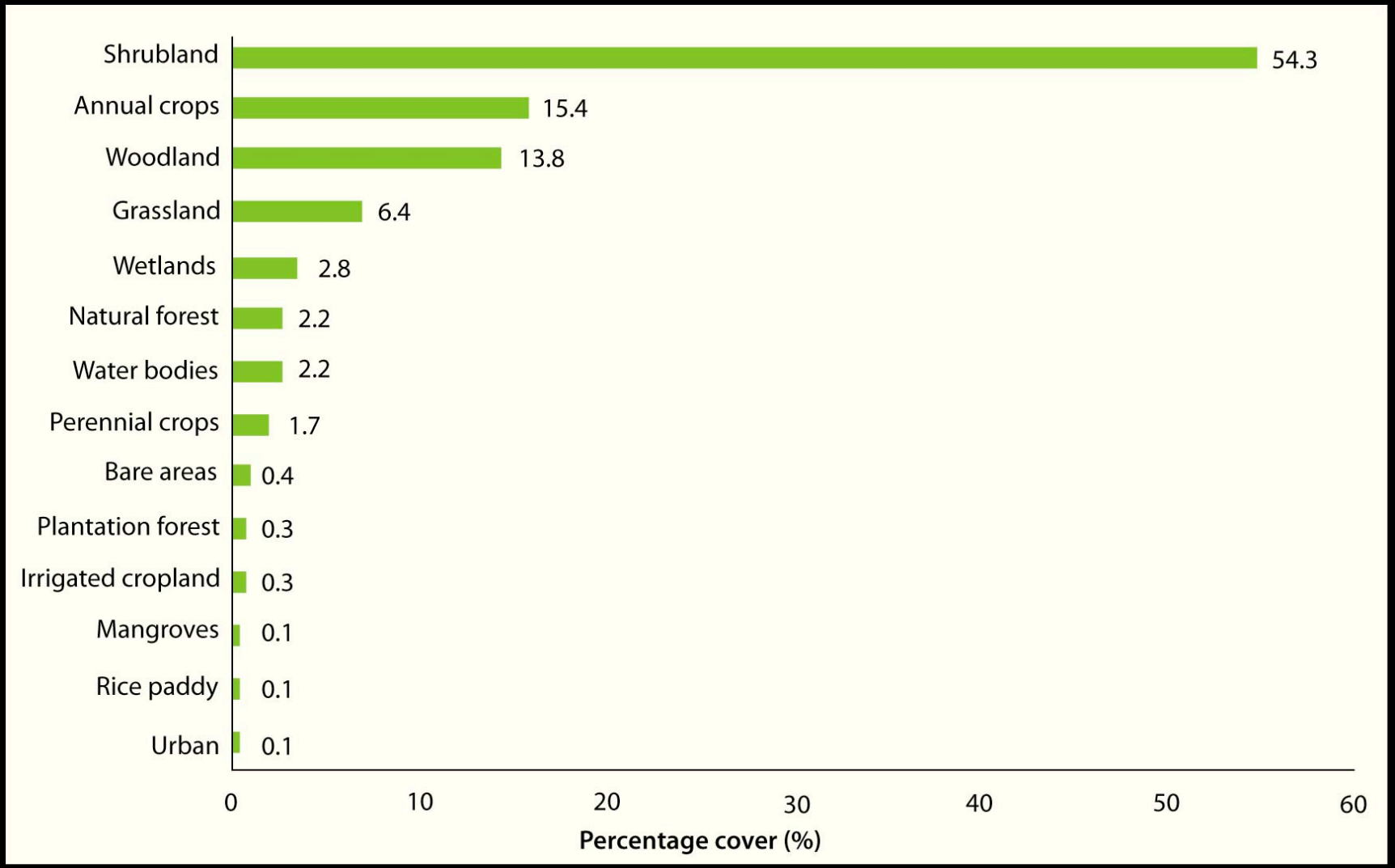
General land use

Pastoral in semi-humid and semi-arid zones and agricultural in the moist and humid zones.

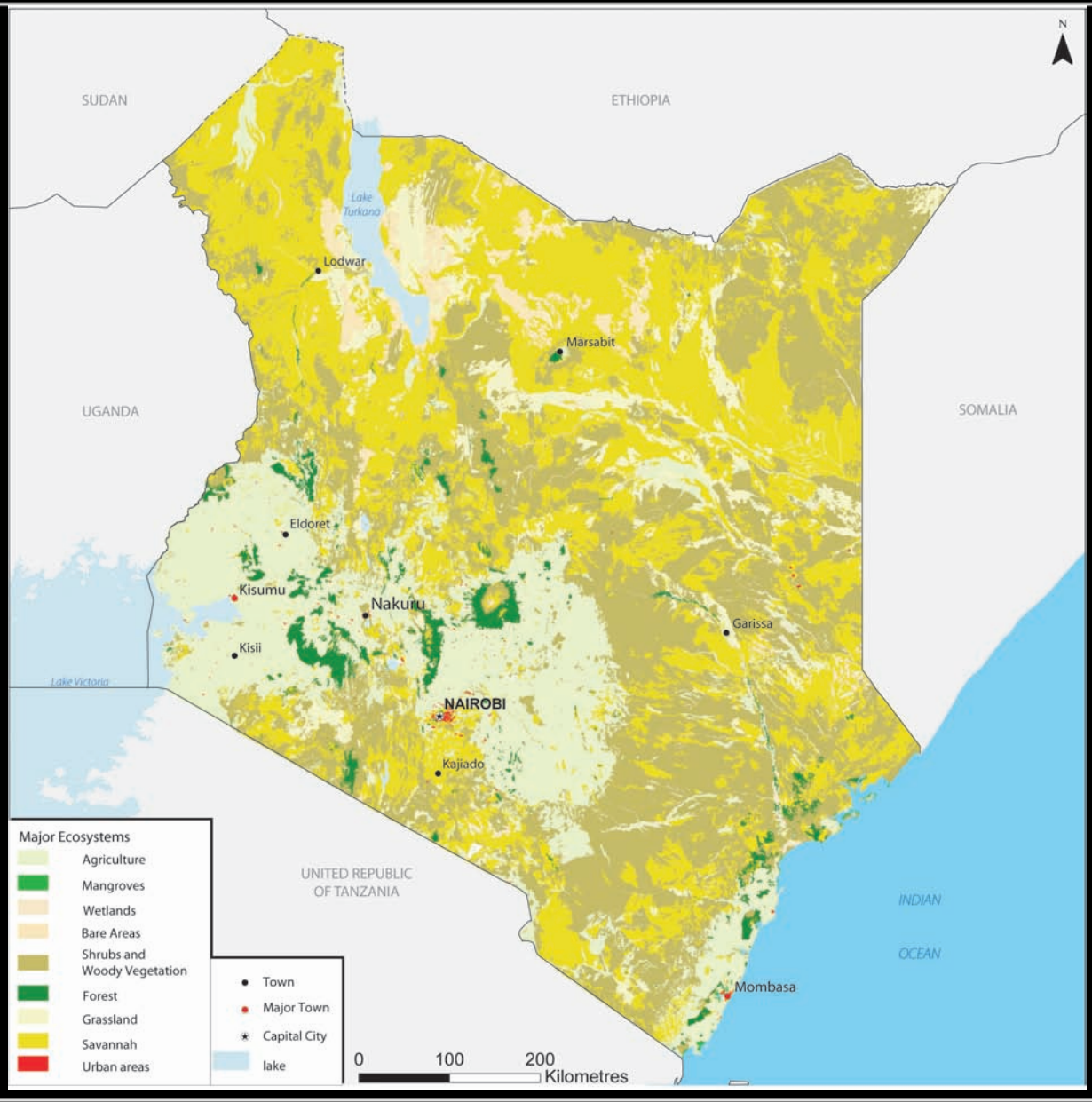
Arid or semi-arid lands (ASALs): over 80 per cent of the total area.

Medium to high potential for agriculture: 17 to 20 per cent

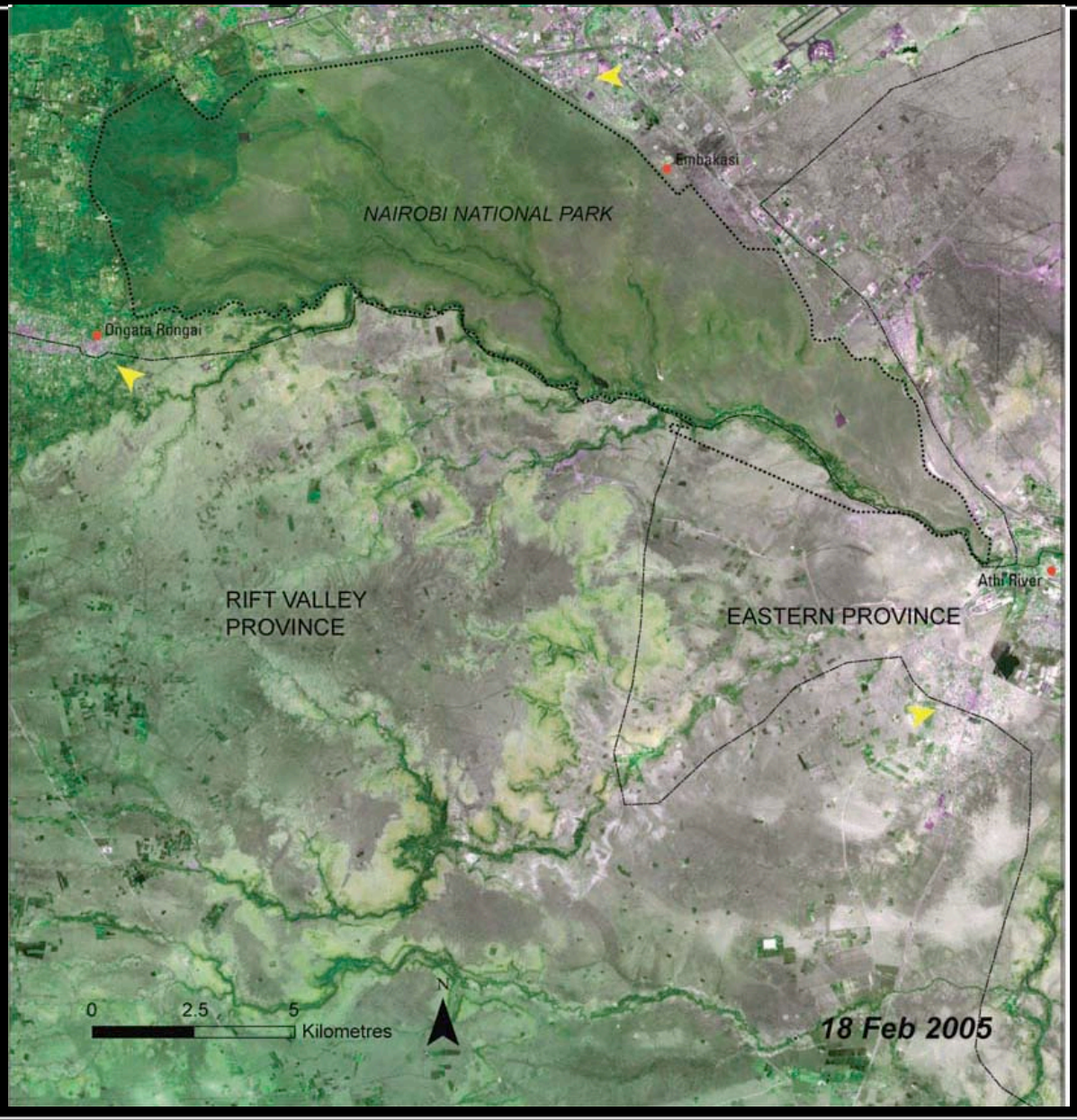
Land use and land cover types



Land cover map of Kenya



Nairobi National Park: Barriers to Wildlife

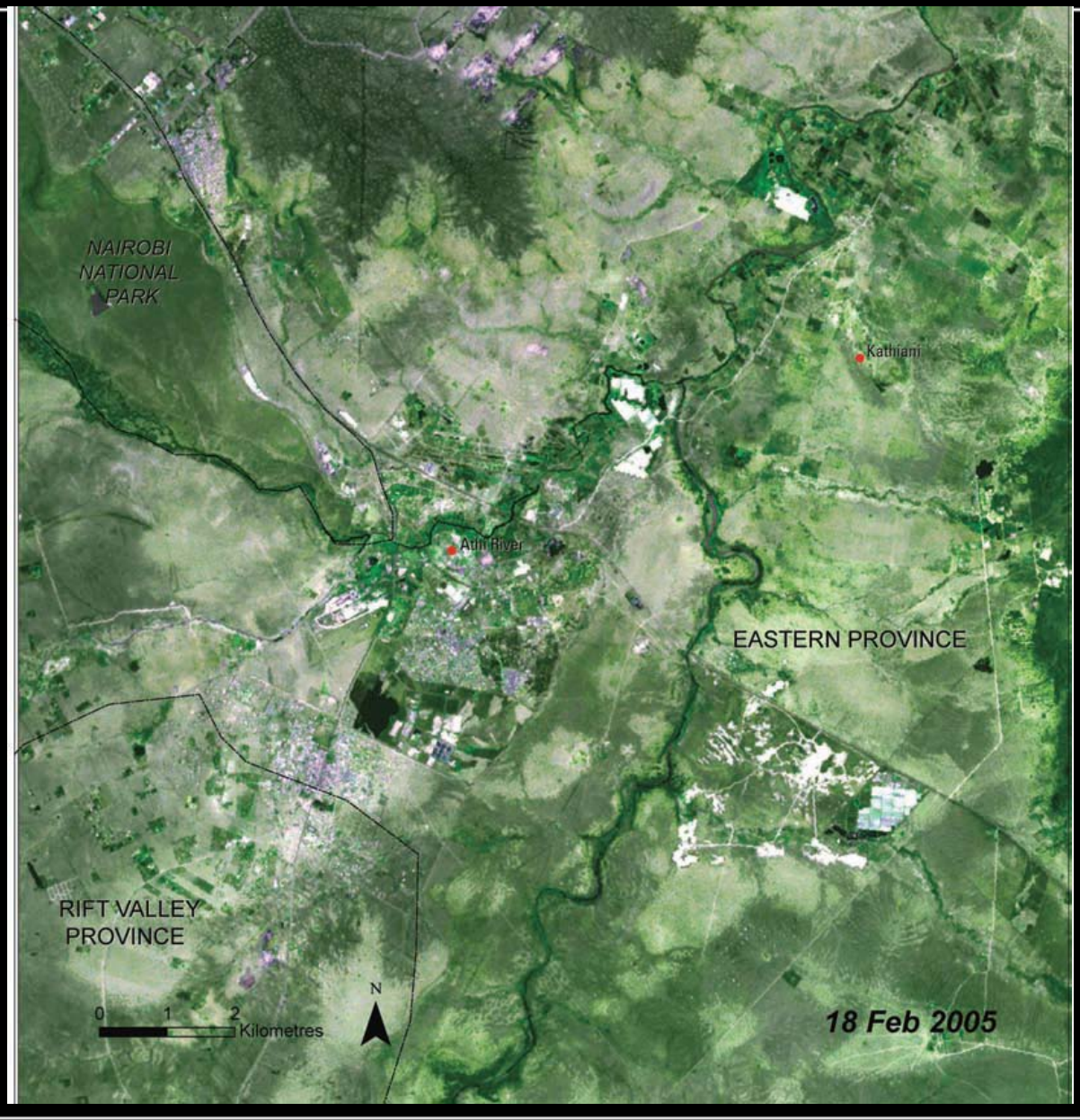


1988

2005

Challenges include population growth and increasing settlements south of the park.

Mlolongo Township Urban Sprawl



1986

2005

From a small long-distance truck stopover, Mlolongo grew rapidly until its present population of over 12 000 people

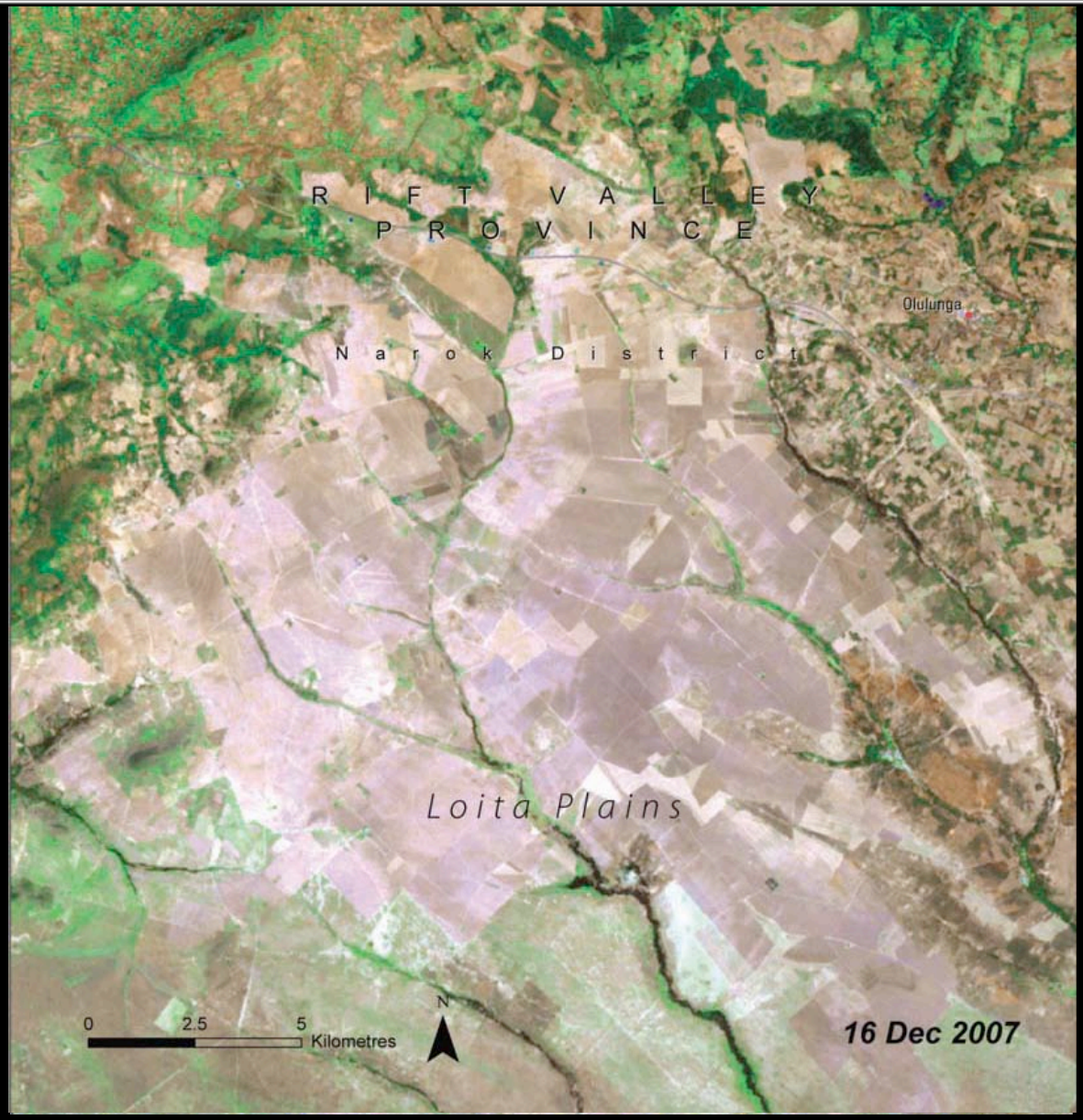
Lake Naivasha Greenhouse Footprints

1973

2008

Many commercial greenhouse flower farms have been built since the early 1980s.

Loita Plains: Grasslands Lost to Farms



1975

2007

About 1 000 per cent expansion of Large mechanized wheat farms between 1975 and 1995

Yala Swamp: Irrigation Drains a Wetland

2002

2008

In 2002, 10 000 ha were leased for a large-scale irrigated rice project

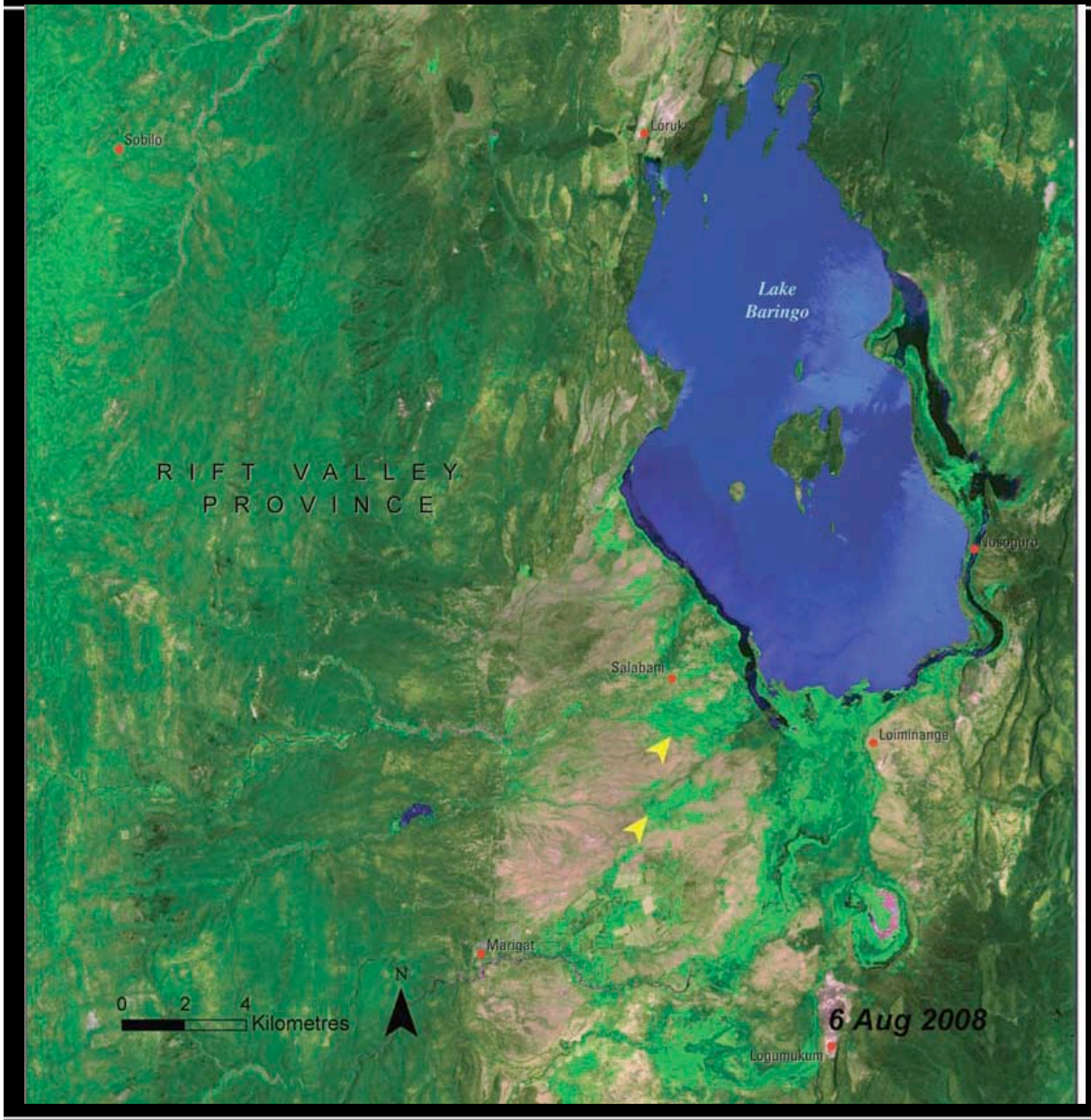
Lake Nakuru: Degrading Watershed

1973

2006

Forest loss in it's watershed threatens the Lake's water quality and water balance

Lake Baringo: Introduced Species



1973

2008

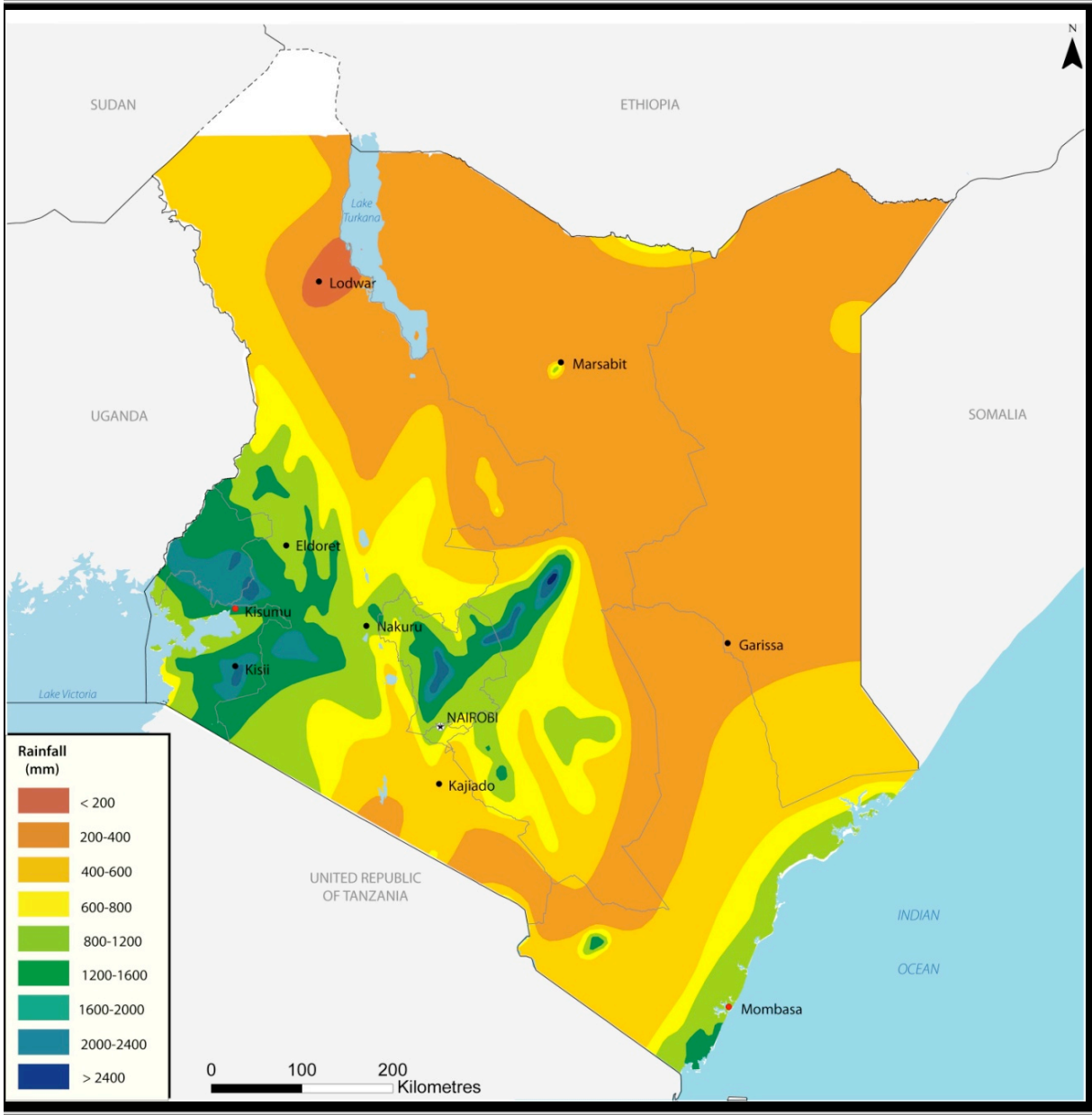
Prosopis has:

- **Blocked pathways,**
- **Altered river courses,**
- **Taken over farmlands, and**
- **Suppressed other fodder species**

Water

- Kenya's natural endowment of freshwater is already highly limited;
- Annual renewable fresh water supplies: 647 m^3 per capita
- Chronically water-scarce (UN classification): 1 000 m^3 per capita.
- By 2020, due to Population growth: 359 m^3 per capita

Rainfall



Average annual rainfall distribution

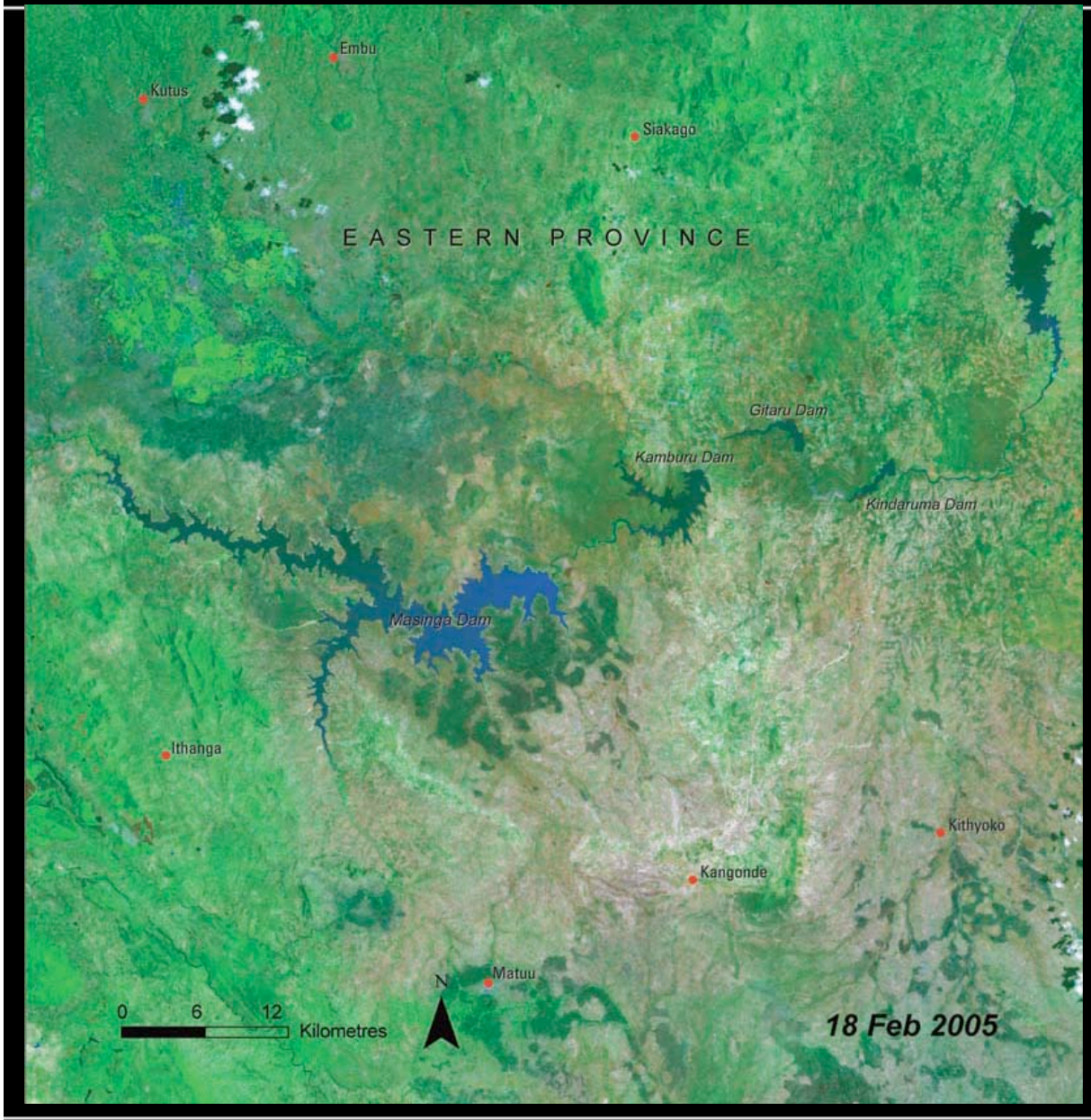
Water resources

Kenya's surface drainage systems

5 drainage areas:

- **Rift Valley Drainage Area**
- **Ewaso Nyiro River Drainage Area**
- **Tana River Drainage Area**
- **Athi River Drainage Area**
- **Lake Victoria Drainage Area**

Seven Forks Dams: Silting of Reservoirs

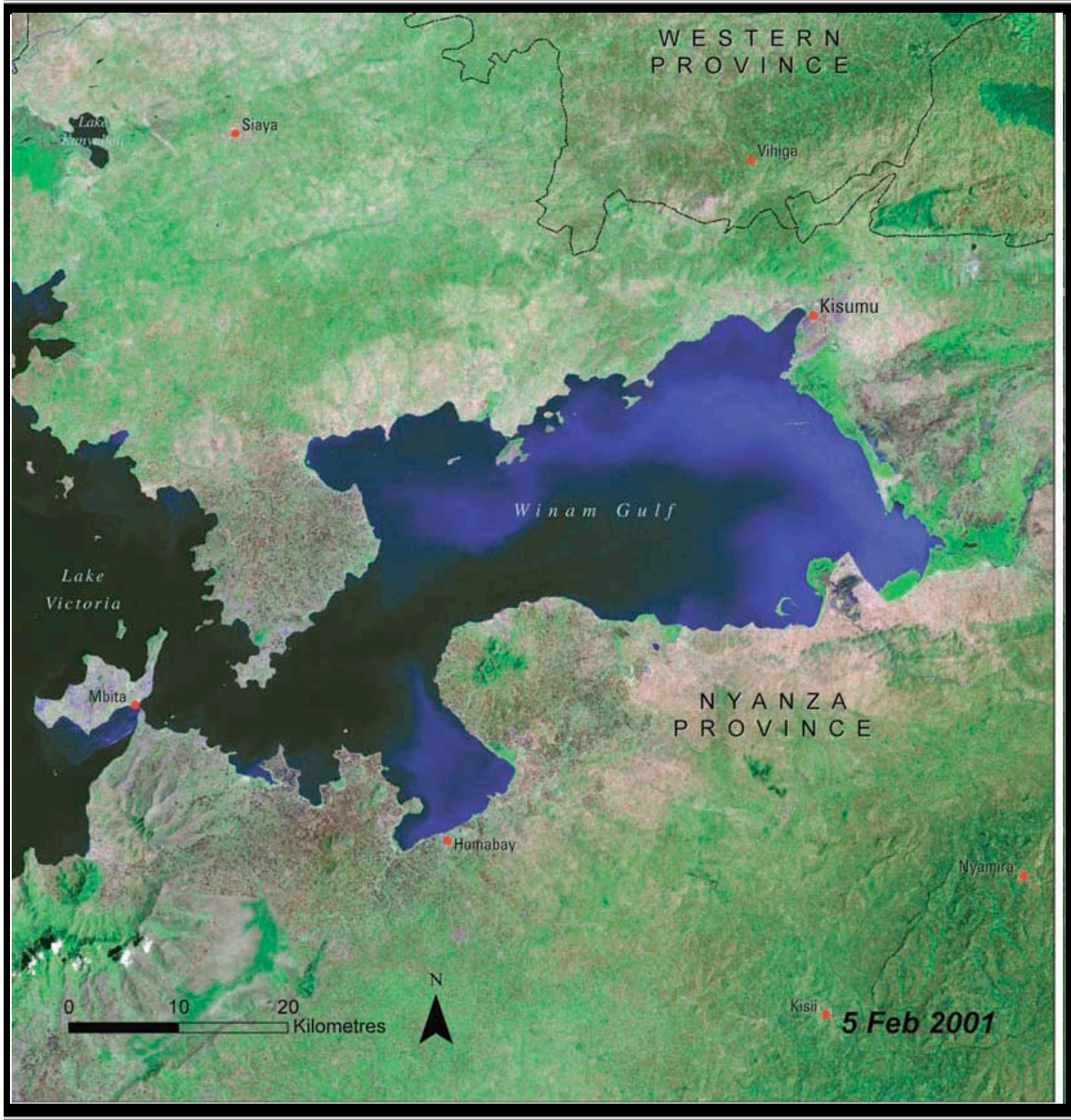


1987

2005

The Seven Forks Dams provide the bulk of Kenya's hydroelectric power

Winam Gulf: Silt and Sewage



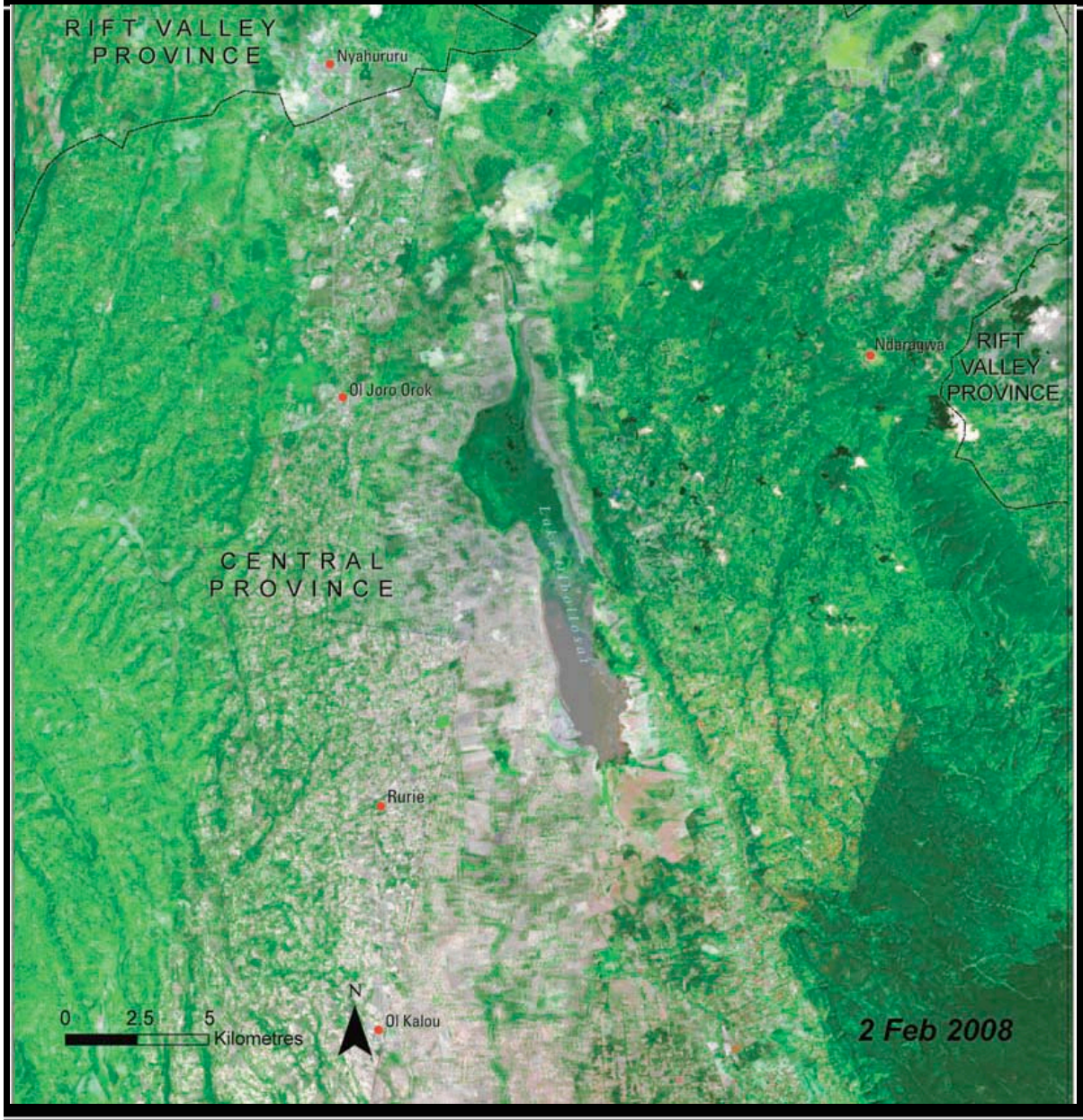
1973

2001

Environmental challenges:

- Sedimentation,
- Waste contamination,
- Agricultural runoff.

Lake Olbollosat: Disappearing Lake



1973

2008

A rapidly growing population threatens the habitat

About three per cent of Kenya's land area

Provide:

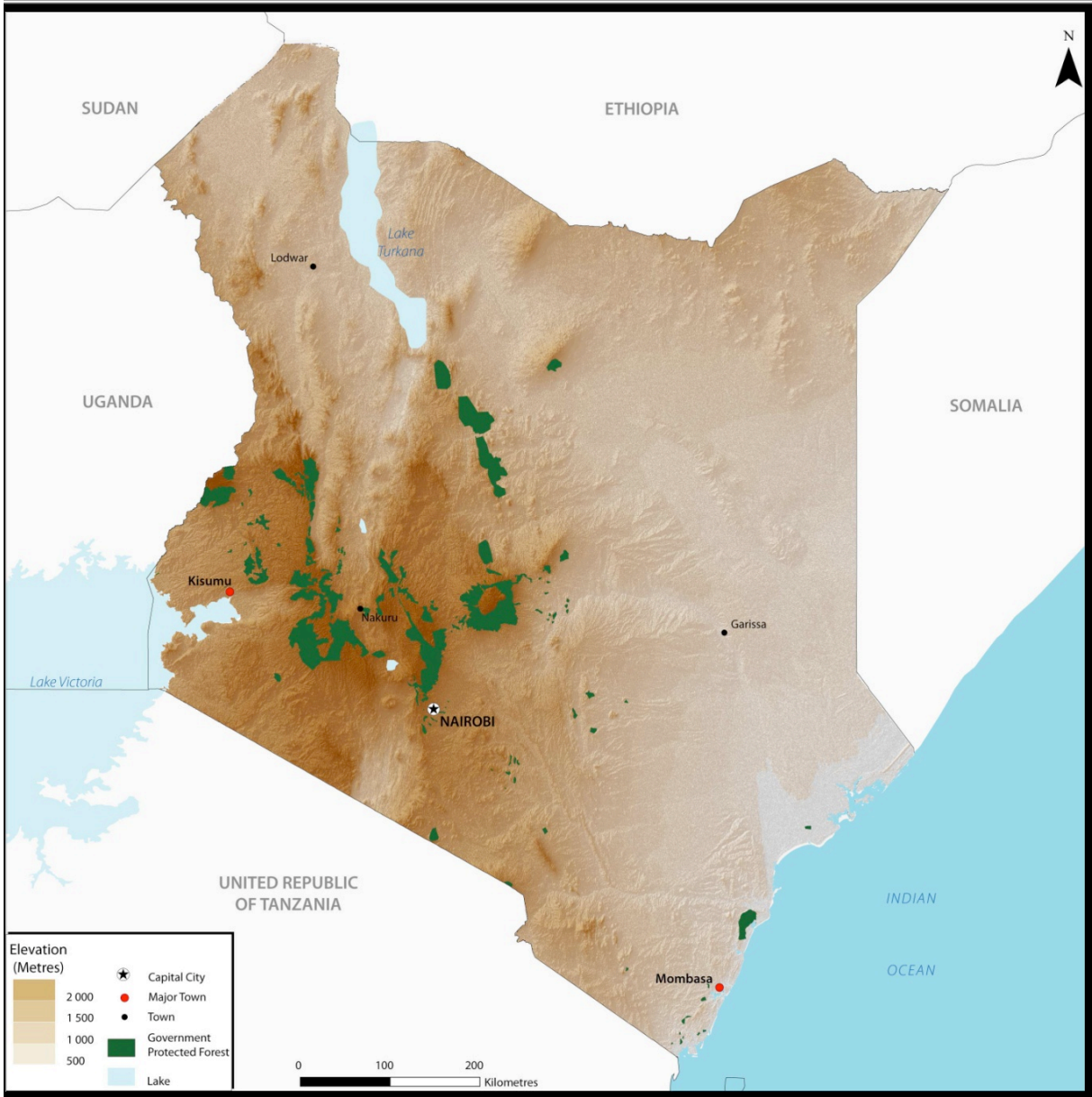
- Fuel,
- Timber,
- Food,
- Medicinal plants and other forest products, Wildlife habitat
- Tourist attractions,
- Water catchment
- Carbon sequestration, and
- Cultural and spiritual values.

Kenya's forest stocks

Classified according to climatic conditions

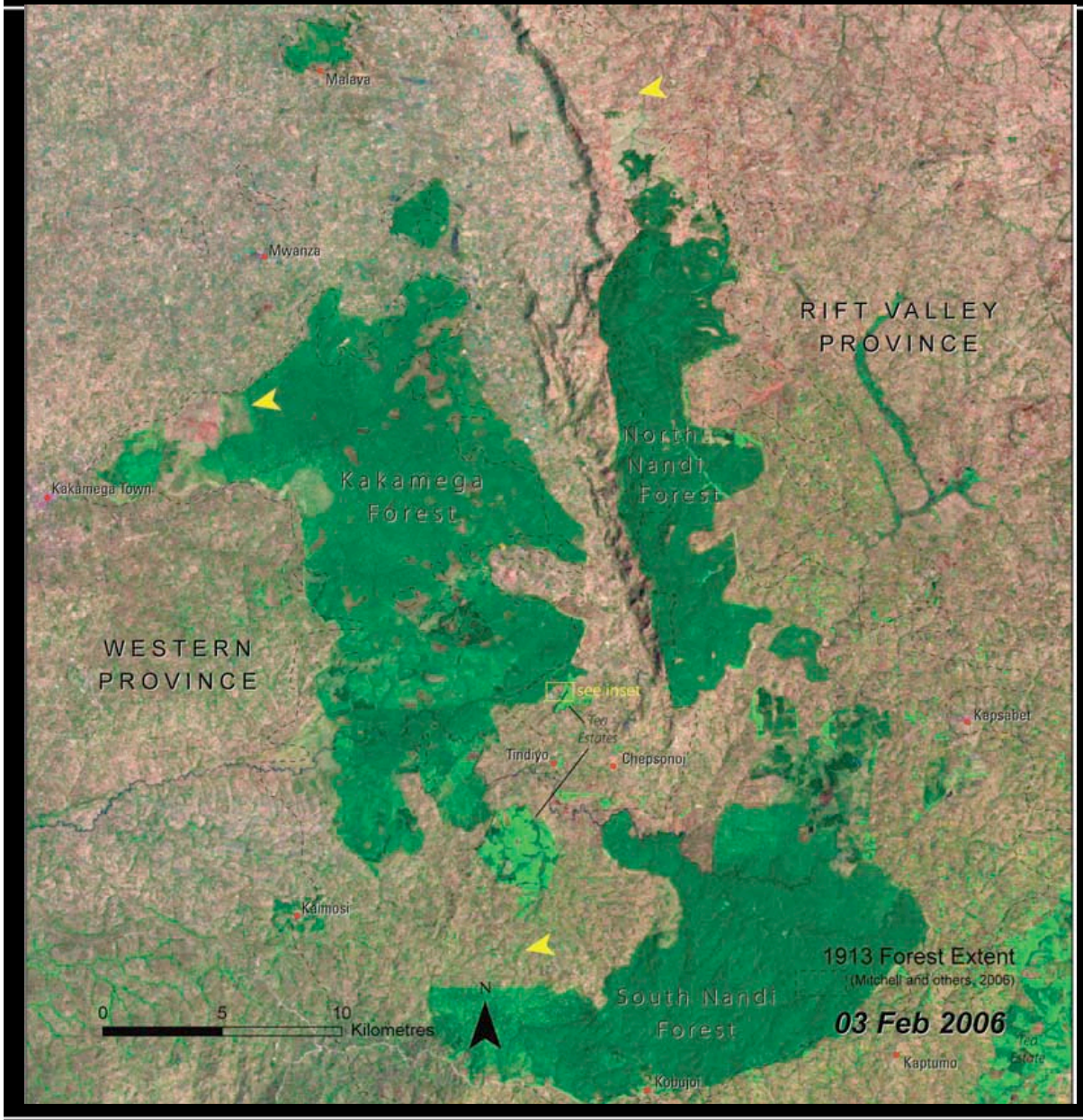
- Coastal forests,
- Dry-zone forests,
- Montane forests, and the
- Western rain forests

Kenya's Forest Reserves



Kenya has 258 forest reserves

Kakamega Forest: Kenya's Only Tropical Rain Forest

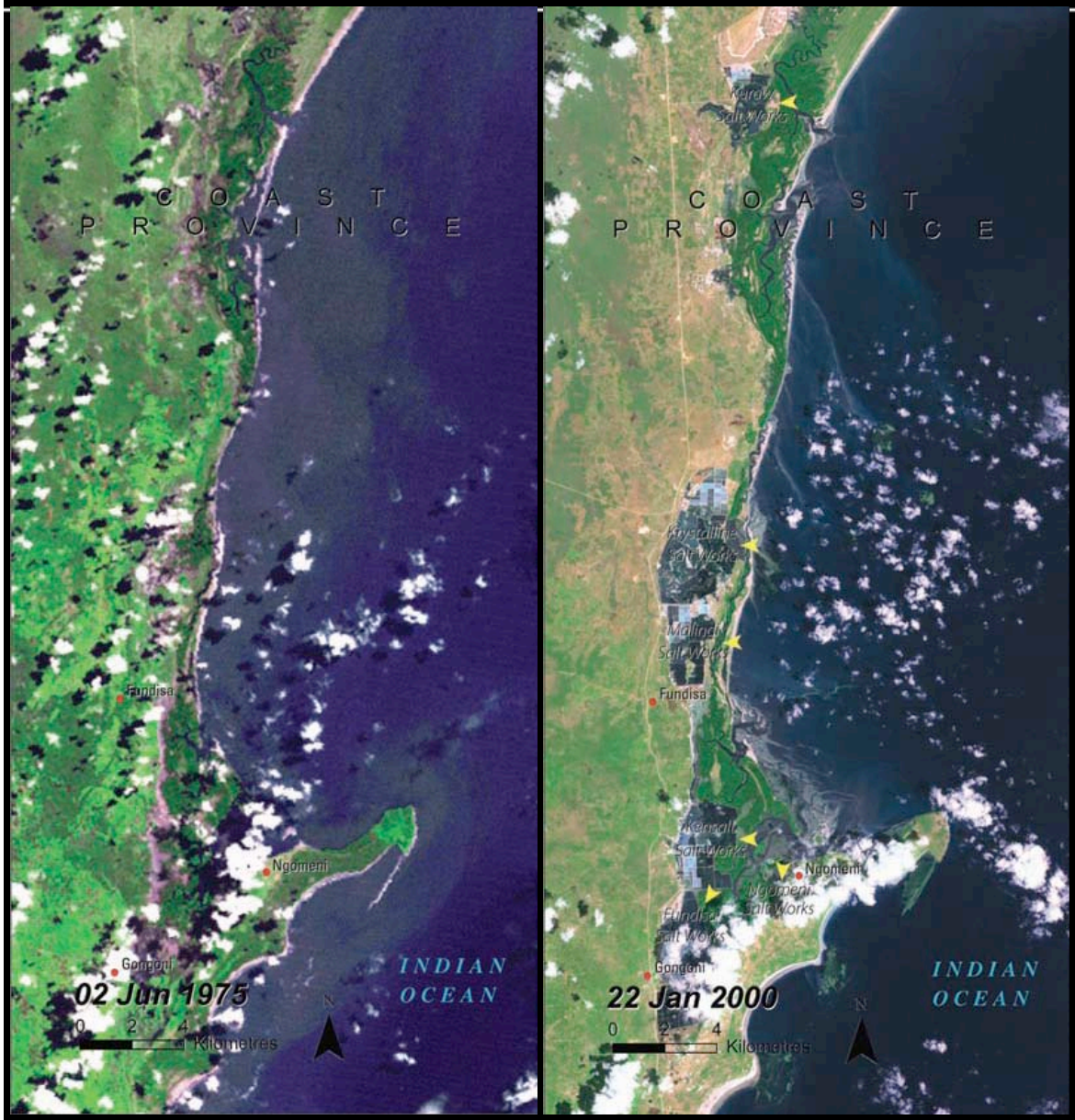


1973

2006

Kenya's only area of tropical rain forest

Ngomeni: Disappearing Mangroves

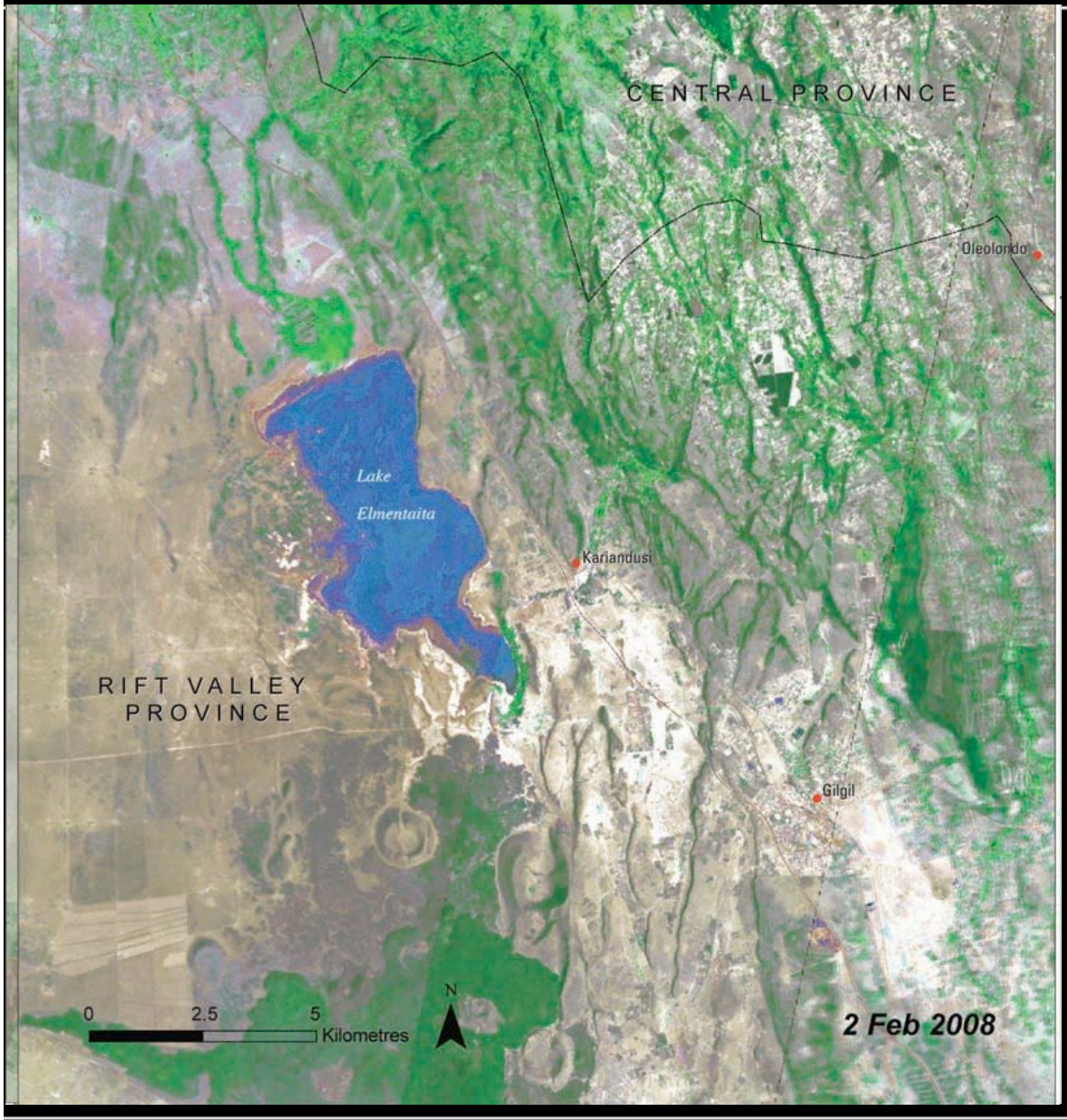


About half of the mangroves in Kenya have been lost over the past 50 years

Degrees of desertification potential, 1997

Degree of Desertification	Area (in %)
None to slight	13.0
Moderate	64.0
Severe	21.0
Very severe	1.7

Lake Elmentaita: Flamingoes Leave Habitat

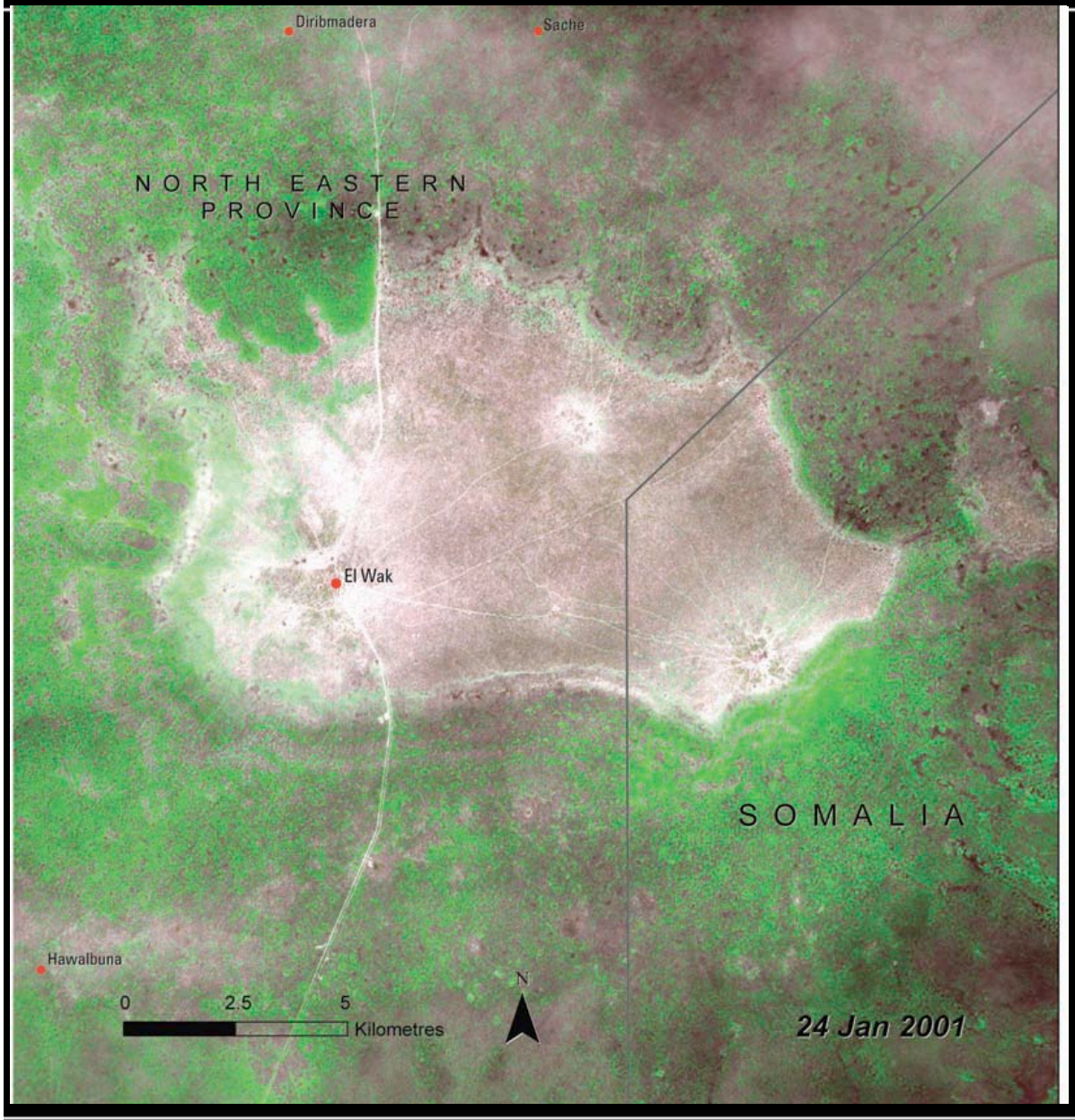


1987

2008

A record of the lake's water levels since 1958 shows a steady decline

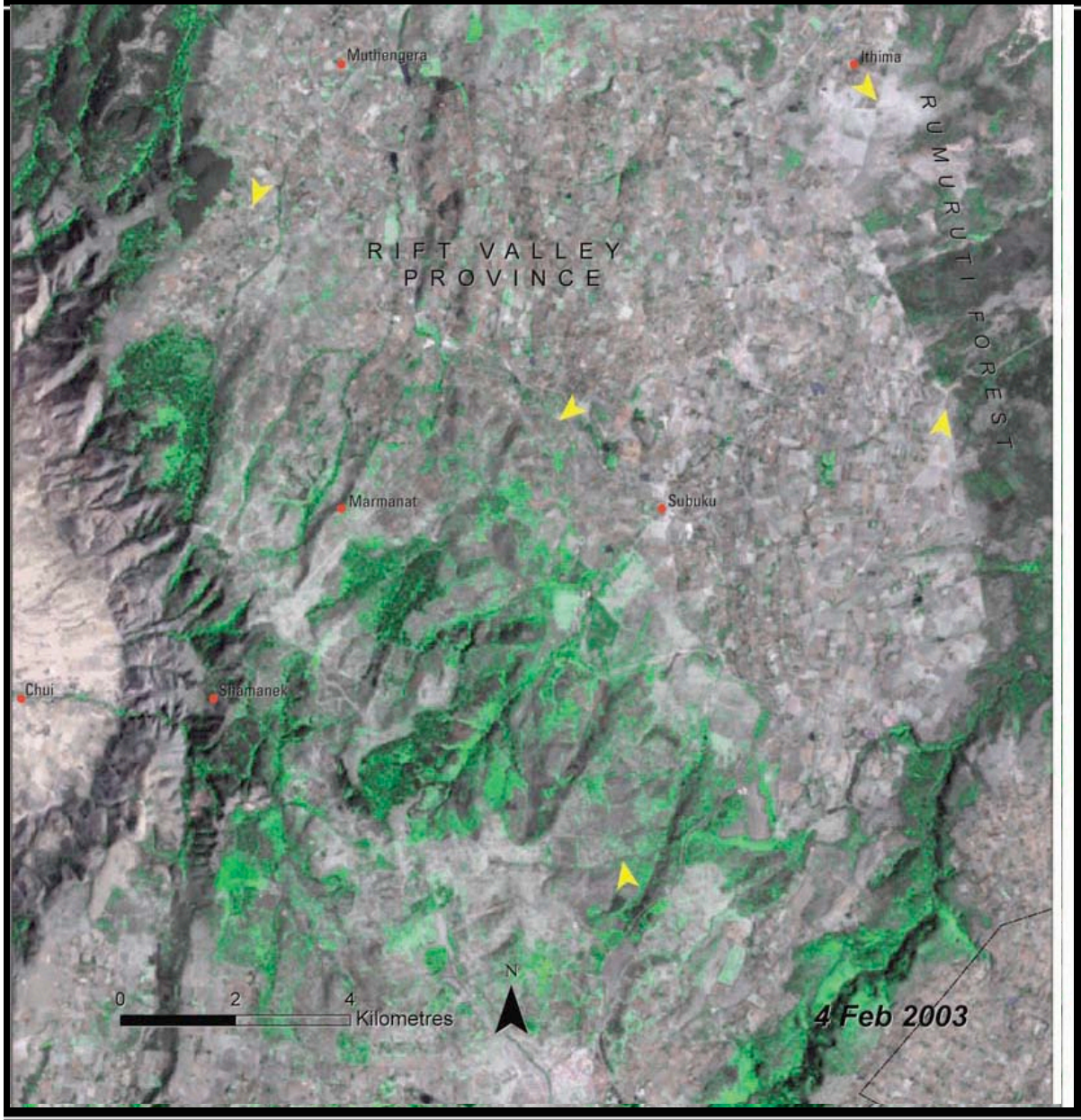
El Wak: Boreholes and Overgrazing



1973

2001

Laikipia District: Land Division and Population Growth



1986

2003

Increasing numbers of people and small farms has extensively modified the landscape of Laikipia

Samburu District: Increasing Livestock

1973

2000

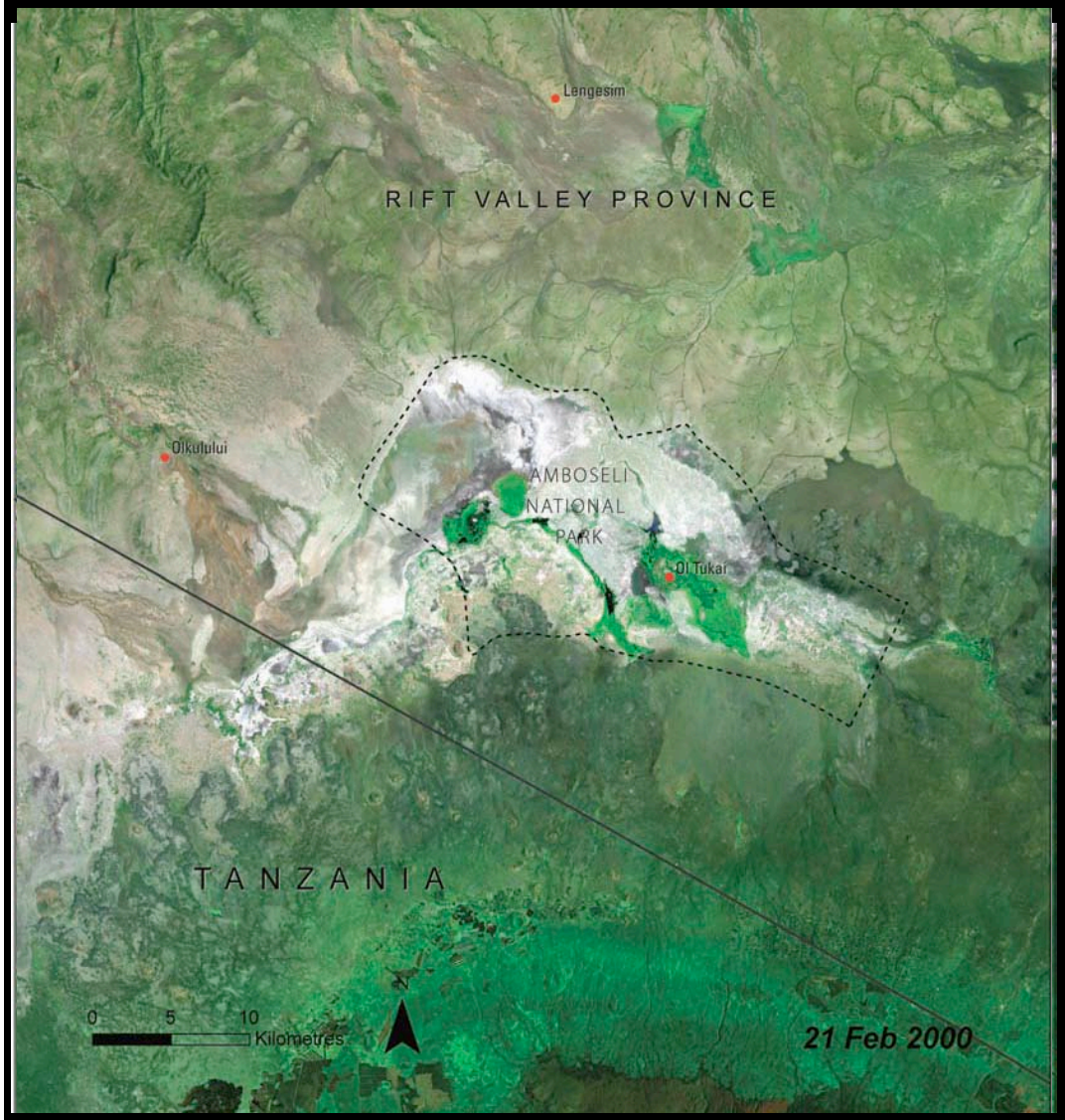
Biodiversity

Kenya is home to some 35 000 known species of flora and fauna

Closed canopy forests, which hold about half of Kenya's tree species, provide habitat for about 40 per cent of its larger mammals, 30 per cent of birds, and 35 per cent of its butterflies

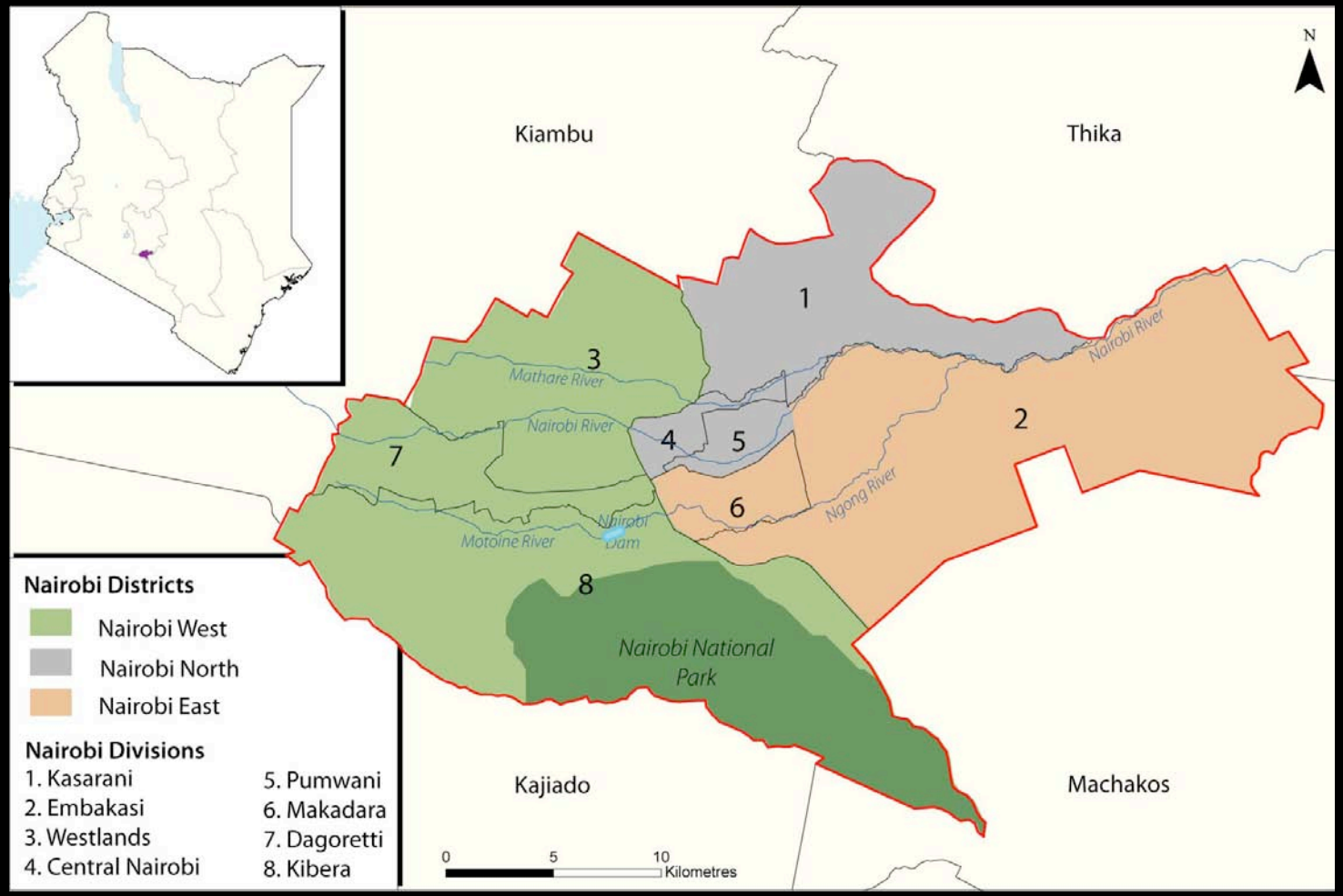
Marine and coastal areas also contain a large diversity of species, with about 456 species of fin fish, 169 coral species, 9 species of mangroves, 11 species of seagrasses, 344 mammal species, 5 species of reptiles, as well as uncounted numbers of phytoplankton, zooplankton, and other species

Amboseli Reserve: Fragmented Forests



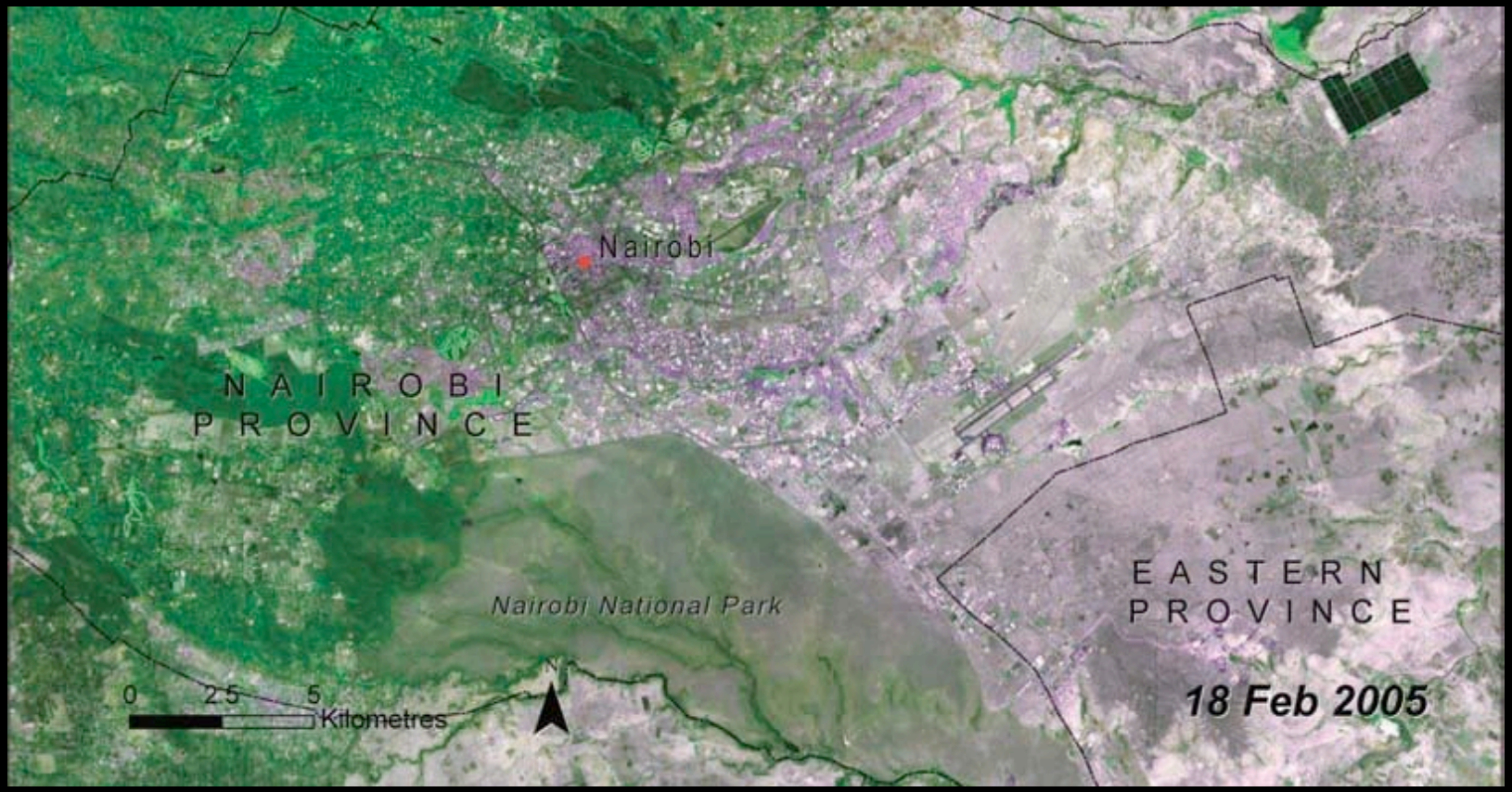
1976

2000



Nairobi's three districts and eight divisions

Nairobi



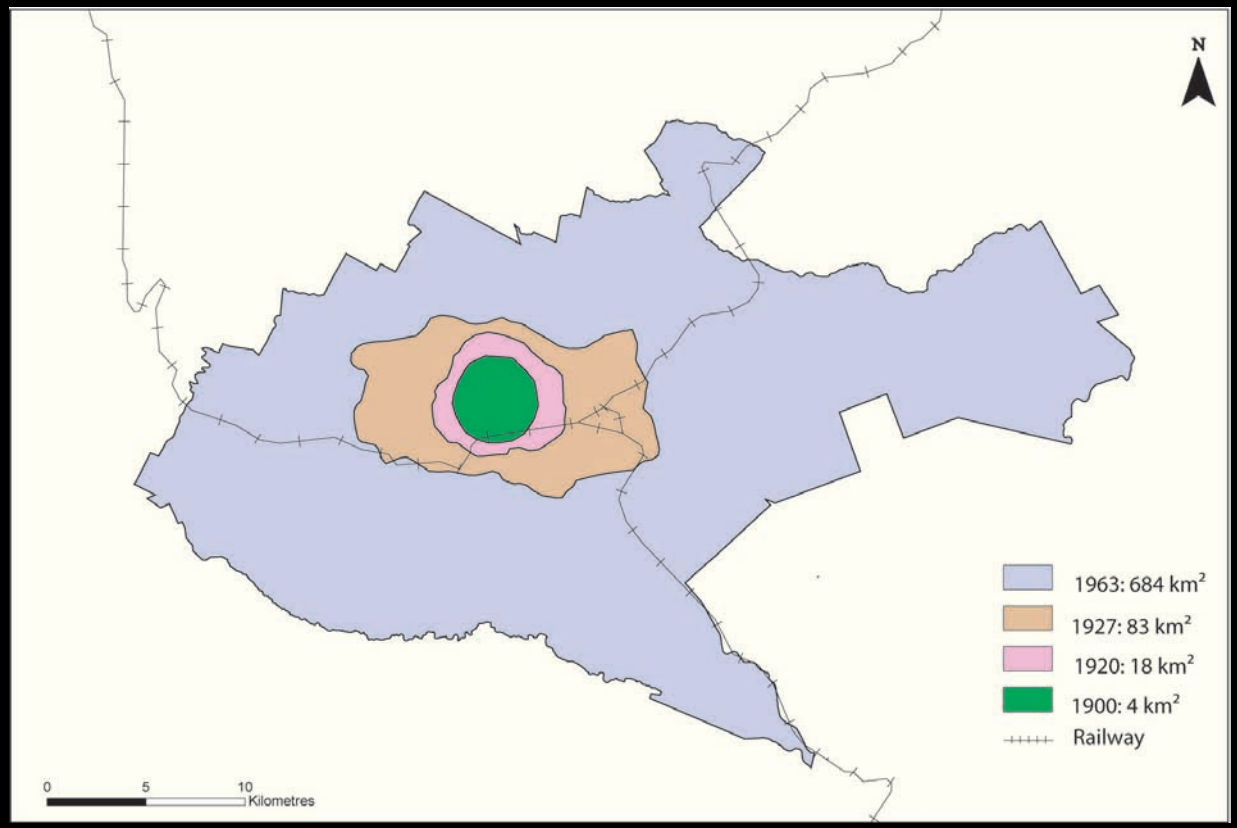
1976
1988
2005

Much of Nairobi's urban footprint is unplanned settlement driven by rapid population growth and urban poverty, among other things

Major Environmental Issues

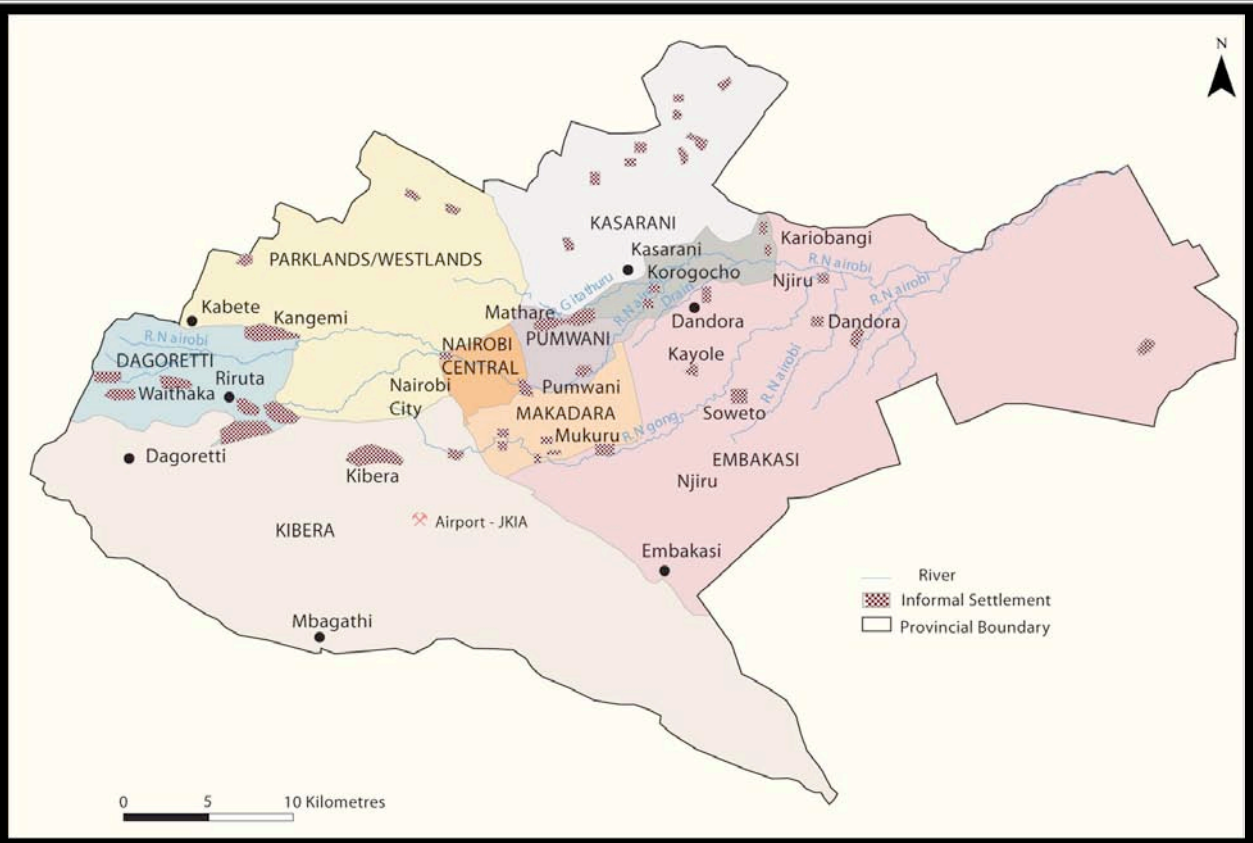
- Rapid urbanization
- Informal settlements
- Air and water pollution
- Water supply and sanitation, and
- Solid-waste management

Rapid urbanization



Nairobi has expanded from a mere four square kilometres in 1900 to more than 684 square kilometres by 1963.

Informal settlements



By 1995, there were a total of 134 informal settlements with 77 589 structures. These settlements had a combined population of 1 886 166

Air and water pollution

Average total suspended particulates (TPS) over a section of Nairobi

The main sources of atmospheric pollution are vehicles, industries, emissions from the use of charcoal and firewood, and other municipal sources such as the open burning of waste.

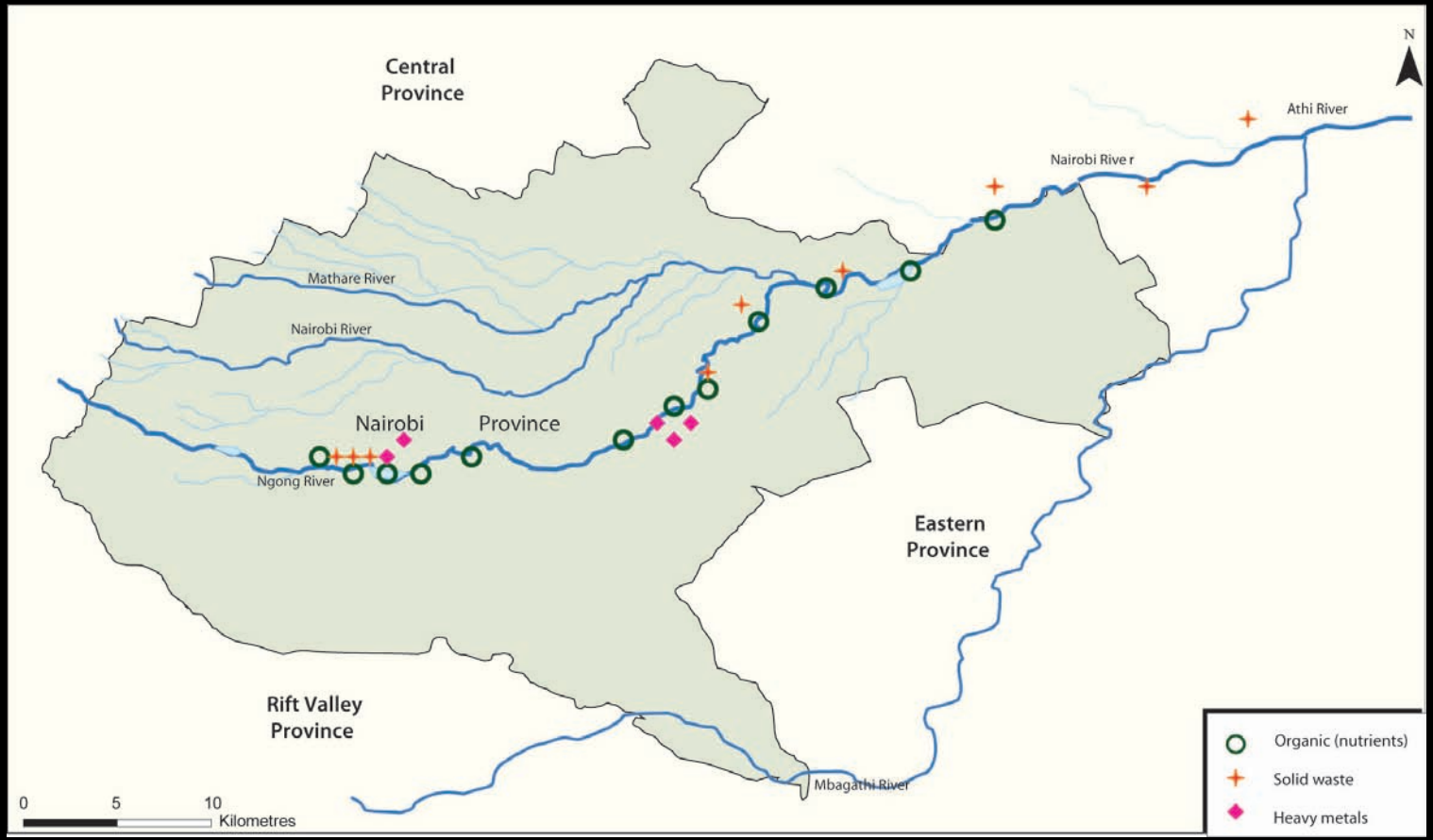
Water pollution

Several factors compromise the city's water quality:

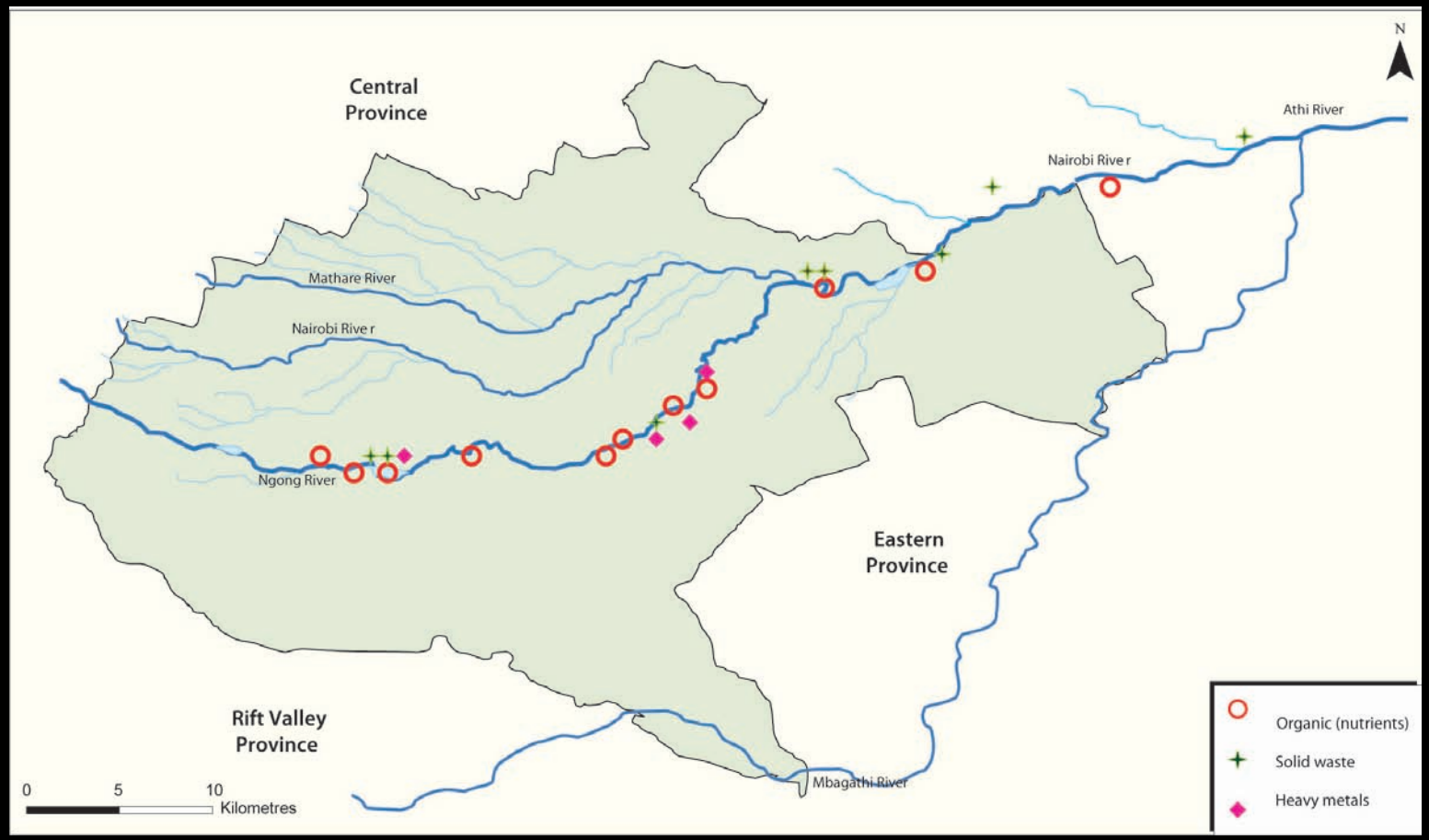
- Natural phenomena such as the high fluoride content in groundwater,

- Anthropogenic factors such as poor wastewater treatment and environmental degradation both within the city and in the surrounding countryside.

Wet season pollution hotspots



Dry season pollution hotspots



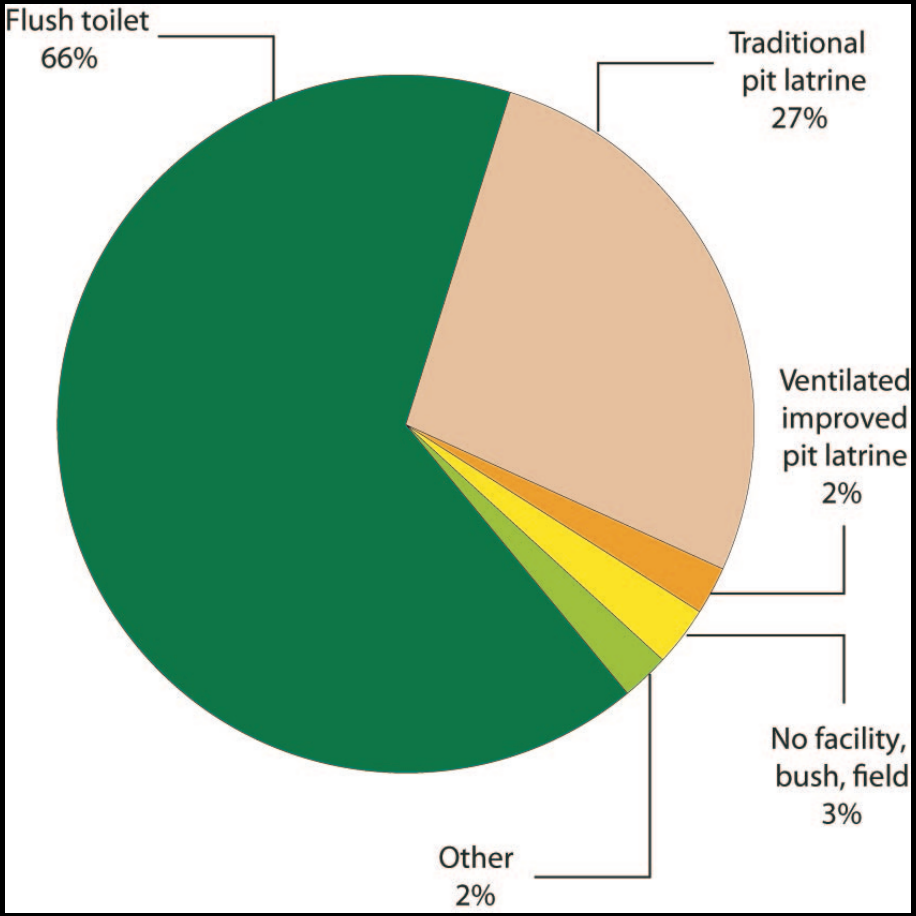
Nairobi River Basin Programme (NRBP)

To reduce the sources of water pollution in the Nairobi River and address some of the impacts on both people and the riverine ecosystem, the Nairobi River Basin Programme (NRBP) was initiated in 1999.

NRBP identified five key goals to improve the water quality and environment in the Nairobi River Basin:

- Develop environmental management and planning systems;
- Rehabilitate and restore the Nairobi Dam;
- Develop and implement water quantity and quality measuring protocols;
- Enhance service delivery, environmental conservation, and sustainable use of resources; and
- Sustain public awareness of, and participation in, environmental issues directly affecting the Nairobi River Basin

Sanitation facilities used by Nairobi residents

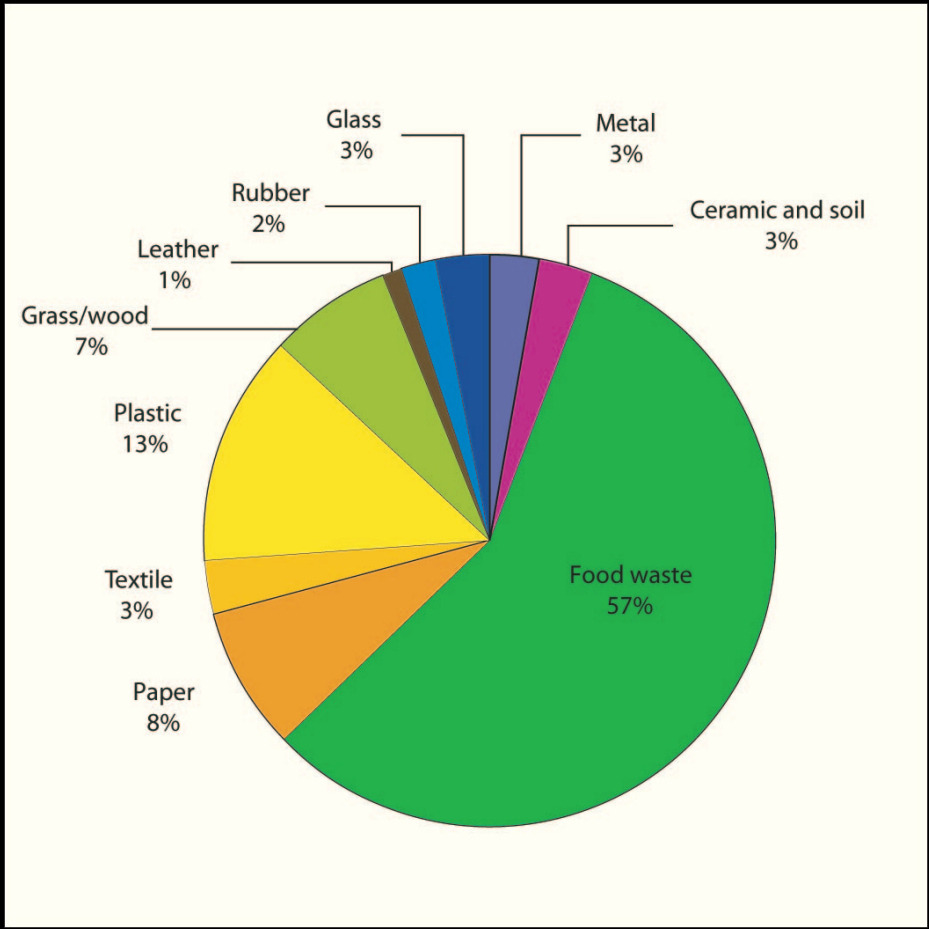


Improperly treated sewerage and uncollected garbage have contributed to a vicious cycle of water pollution, water-borne diseases, poverty, and environmental degradation.

Improved sanitation facility

The City Council of Nairobi is improving access to improved sanitation by constructing more facilities within common areas

Solid-waste management



Food waste, plastic, and paper are the most dominant forms of solid waste in Nairobi

Planning for the Future

In 2008, the Government of Kenya produced the Nairobi Metropolitan Development Plan.

Under this plan, the boundaries of the city shall be expanded to include adjoining towns and municipalities