"Kenya aims to be a nation living in a clean, secure, and sustainable environment by 2030"

-Kenya Vision 2030
(GoK 2007)

Chapter 1: Environment and Vision 2030

As a newly industrializing country, Kenya faces the challenge of improving its economic performance and the lives of its citizens without undermining the environment upon which so much of its national earnings and individual people's livelihoods depend. This chapter introduces the theme of environmental change in Kenya through the lens of the country's long-term national development plan known as Kenya Vision 2030. It looks at a select number of salient and emerging issues that need to be considered to achieve the Vision's goals and targets, including how to protect the country's water sources that feed hydropower, support wildlife and tourism destinations, irrigate both export and small holder farms, and nurture grazing areas. It also highlights the importance of planning for weather-related disasters to enable development goals to be achieved.

Kenya's Vision 2030

Kenya Vision 2030 is the country's new development blueprint for the period 2008 to 2030. It aims to make Kenya a "middle income country providing high quality life for all its citizens by the year 2030". The first phase of the Kenya Vision 2030 covers the period 2008 to 2012 during which a number of "flagship" projects will be implemented. Vision 2030 is based on three pillars: the economic pillar, the social pillar, and the political pillar. In one way or another, these pillars are all interrelated and the fibre that binds them together

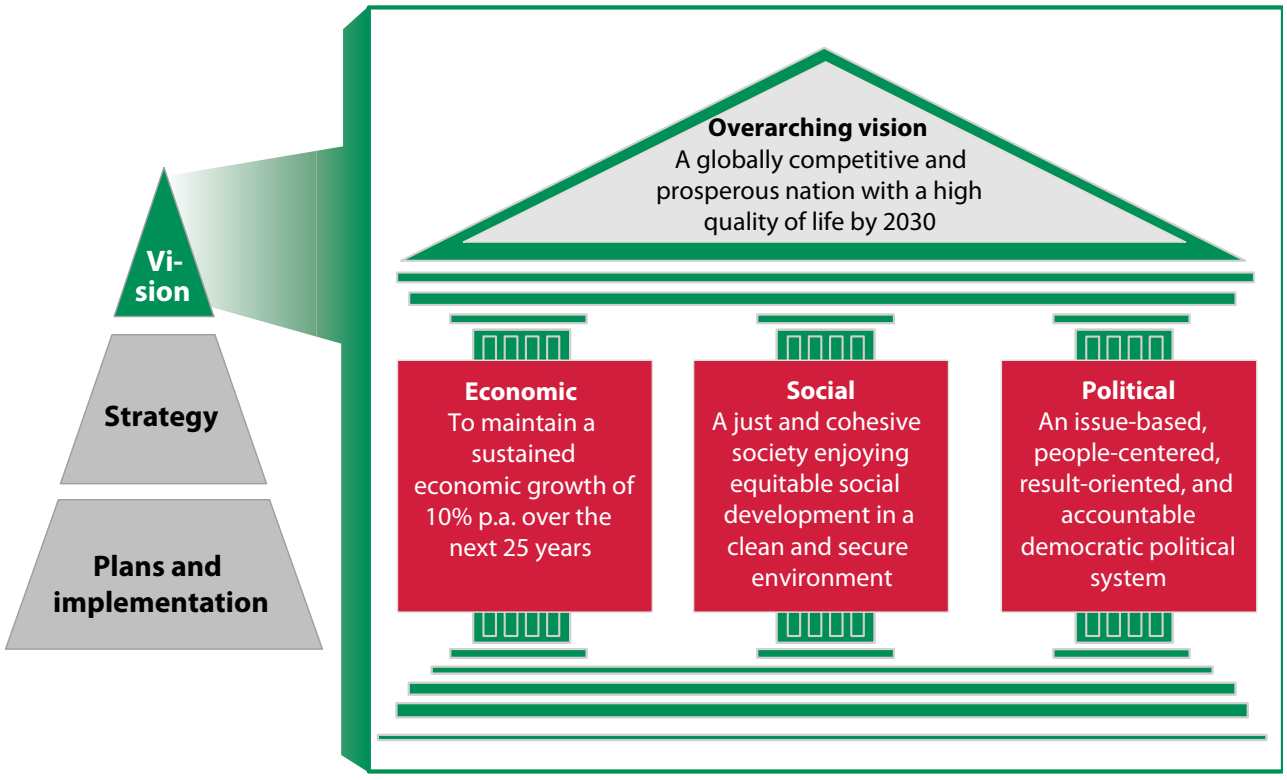
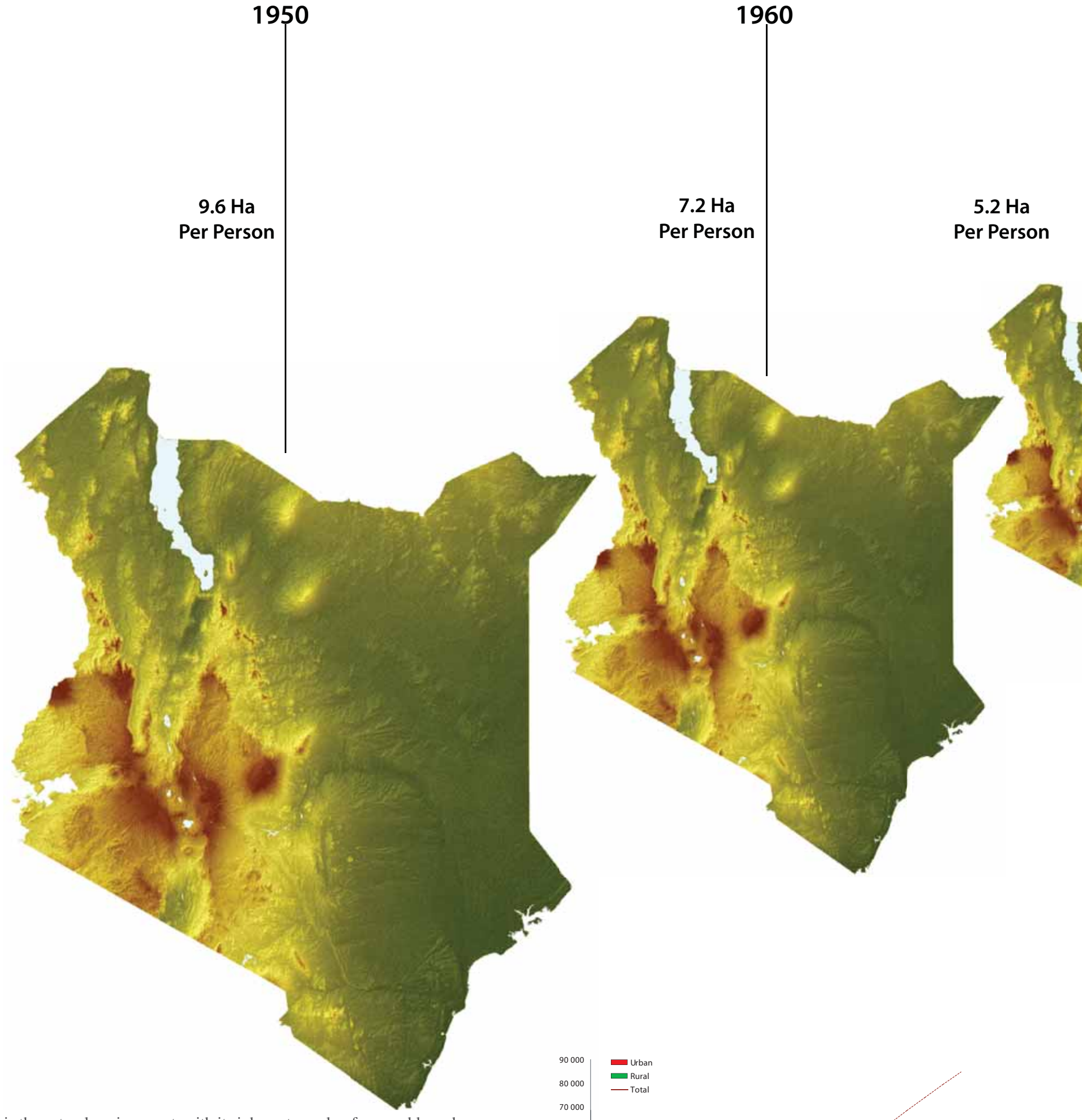


Figure 1: Thematic overview of the Kenya Vision 2030 (Source: GoK 2007)

Sunrise Over Maasai Mara

The 1 510 km² Maasai Mara Game Reserve is one of the greatest regions of migrating wildlife in the world. It is shared by Kenya and the United Republic of Tanzania. Every year, herds of wildebeest, zebras and other herbivores migrate between Maasai Mara and Serengeti National Park (Tanzania) during the Great Migration (July - October)



is the natural environment, with its inherent supply of renewable and non-renewable goods and services.

Development objectives and the need to protect and maintain the natural environment must go hand in hand. This is because environmental sustainability, including the conservation of biodiversity, underpins human well-being (UN 2005). Our natural environment not only provides us with the basic goods needed for sustenance, such as water, food, and fibre, but it also purifies the air and water, produces healthy soils, cycles nutrients, and regulates the climate. These ecosystem services provided by the environment

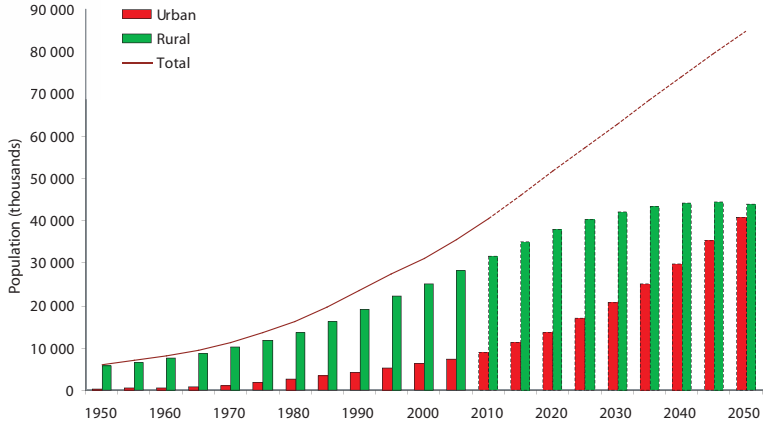
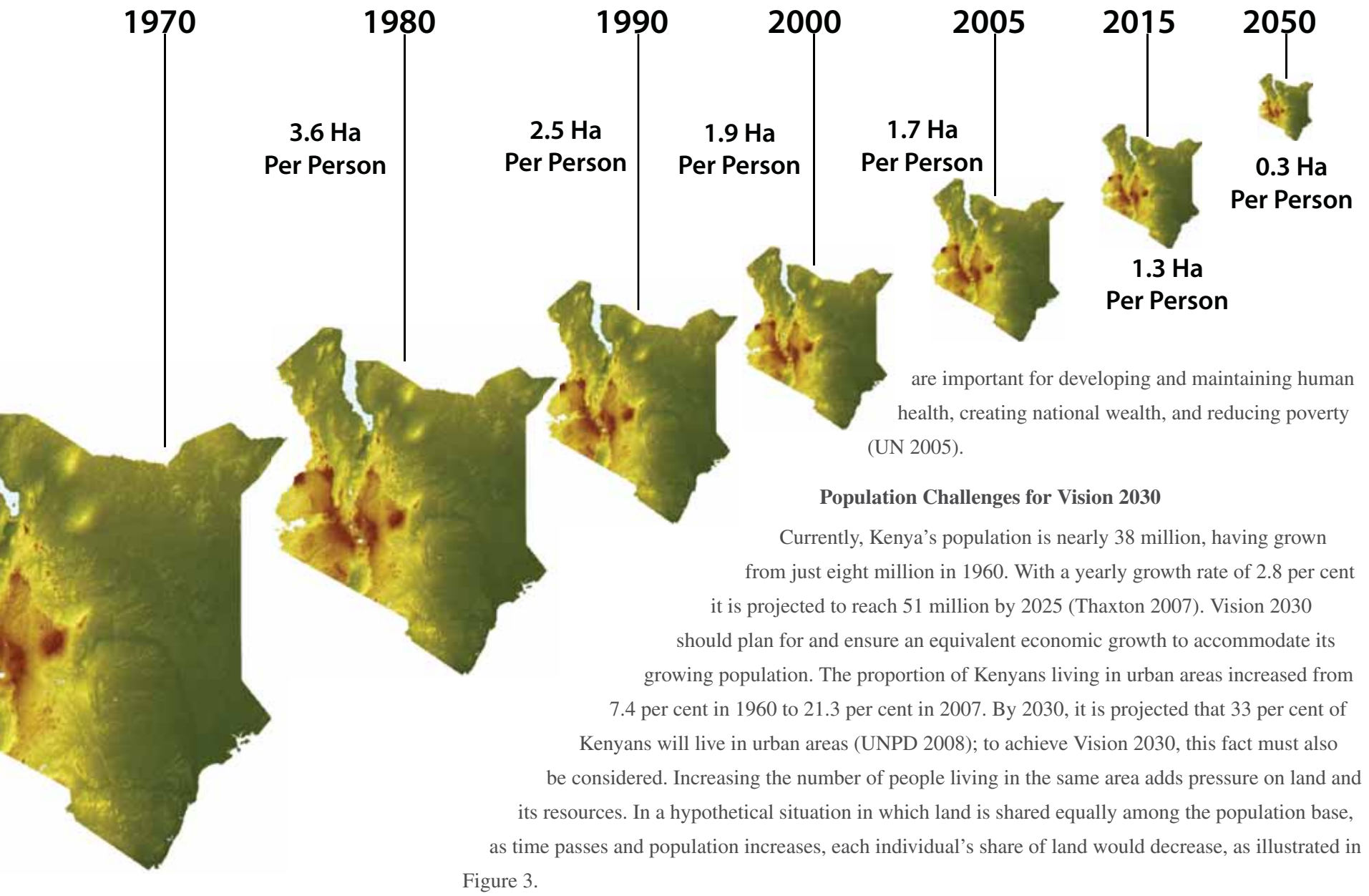


Figure 2: Kenya's projected rural and urban population, 1950-2050 (Source: UNPD 2008)



are important for developing and maintaining human health, creating national wealth, and reducing poverty (UN 2005).

Population Challenges for Vision 2030

Currently, Kenya's population is nearly 38 million, having grown from just eight million in 1960. With a yearly growth rate of 2.8 per cent it is projected to reach 51 million by 2025 (Thaxton 2007). Vision 2030 should plan for and ensure an equivalent economic growth to accommodate its growing population. The proportion of Kenyans living in urban areas increased from 7.4 per cent in 1960 to 21.3 per cent in 2007. By 2030, it is projected that 33 per cent of Kenyans will live in urban areas (UNPD 2008); to achieve Vision 2030, this fact must also be considered. Increasing the number of people living in the same area adds pressure on land and its resources. In a hypothetical situation in which land is shared equally among the population base, as time passes and population increases, each individual's share of land would decrease, as illustrated in Figure 3.

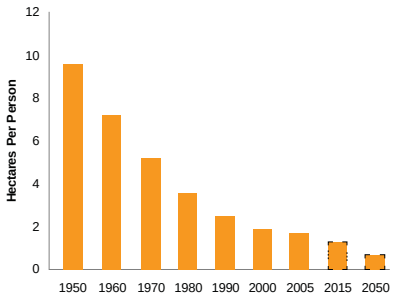


Figure 3: Kenya's shrinking land base (Source: UNPD 2008)

The amount of land available to each person in Kenya has decreased from 9.6 ha in 1950 to 1.7 ha in 2005. It is projected that available land will further decline to 0.3 ha per person by 2050

Environmental Goals for 2012

The Government of Kenya understands and appreciates the important function that the environment plays in underpinning development. It is cognizant that achieving Vision 2030 depends on maintaining the natural systems that support agriculture, energy supplies, livelihood strategies, and tourism. Table 1 on the following page illustrates how the environment cuts across Vision 2030's pillars.

To support the social pillar, Kenya aims to provide its citizens with a clean, secure, and sustainable environment by the year 2030. To achieve this, the nation has set goals such as increasing forest cover from less than three per cent of its land base at present to four per cent by 2012 and to lessen by half all environment related diseases by the same time (GoK 2007).

Among the strategies for achieving these goals are the following: promoting environmental conservation to help achieve the Millennium Development Goals (MDGs); improving pollution and waste management through the design and application of economic incentives; and commissioning public-private partnerships (PPPs) for improved efficiency in water and sanitation delivery. Kenya will enhance disaster preparedness in all disaster-prone areas and improve the capacity for adaptation to the impacts of global climate change. In addition, the country will harmonize environment-related laws for better environmental planning and governance (GoK 2007).

Smoke rises from farmers clearing small patches of land

Pillars	Sectors	2012 Targets	Environmental Challenges and Benefits
Economic	Tourism	• Increase number of visitors from 1.8 million per year to 3 million	• Develop tourism infrastructure (accommodation, transport) with light environmental footprint so as to preserve the natural assets
	Agriculture	• Add value to crop, livestock, and fish products by processing domestically • Cultivate idle land and open up new agricultural lands	• Plan processing plants to avoid environmental impacts • Ensure lands, weather conditions and water availability are suitable for cultivation; plan ahead to adapt to climate change in these areas • Avoid encroachment on sensitive ecosystems and marginal lands
Social	Health, water, and sanitation	• Lessen by half all environment related diseases • Improve access to safe water and sanitation • Increase irrigation and drainage levels to promote agricultural productivity	• Be proactive in preventing disease (instead of end-of-pipe solutions) by protecting and improving access to water sources and providing adequate sanitation facilities • Conserve water sources • Introduce innovative water harvesting and drainage schemes
	Environment	• Increase forest cover from less than three per cent to four per cent	• Increase forest cover, which will help sustain water catchments for hydropower, agriculture, municipalities, wildlife and tourism, etc • prevent erosion • increase biodiversity • sequester carbon • provide timber to local people, among other environmental, social, and economic benefits
	Housing and urbanization	• Increase annual housing unit production from 35 000 to 200 000	• Ensure urban plans are environmentally sustainable in terms of building materials, location, transport options, etc.
	Equity and poverty elimination	• Reduce the number of people living in poverty to a tiny proportion of the total population	• Ensure the equitable access of all people to the environmental resources they need to sustain their livelihoods, and that these resources are managed sustainably

Table 1: The crosscutting nature of the environment that underlies Vision 2030's pillars

Kenya's Forests and the Economic and Social Pillars

Forests cover only about three per cent of Kenya's land area, yet they provide crucial direct and indirect goods and services to its people and make a significant contribution to the national economy. About 70 per cent of Kenya's domestic energy comes from wood, for example, and out of the 20 million m^3 of fuelwood consumed annually, 95 per cent is collected from forests and rangelands (MENR 1994). In addition to providing a variety of wood and non-timber products, Kenya's forests provide the following ecosystem services: they trap and store rain water; regulate river flows and prevent flooding; help recharge ground-water tables; improve soil fertility; reduce soil erosion and sediment loads in river water; help regulate local climate conditions; and act as carbon reservoirs and sinks.

Many forests serve as essential wildlife habitats, and are traditionally important for cultural ceremonies and as sacred sites to local communities. It is estimated that 530 000 forest-adjacent households (which amount to 2.9 million people living within five kilometres from forests) derive direct benefits from indigenous closed-canopy forests. This amounts to about eight per cent of Kenya's population. Estimates indicate that in some areas, the forestry sector contributes about 70 per cent of the cash income of forest adjacent households (Wass 1995).

Forests play a critical role as water catchments. In addition to retaining and filtering water for human uses, forests contribute to the availability of water for hydro power, which supplies Kenya with close to 60 per cent of its electricity generation. Forests also help to reduce siltation in hydroelectric empoundments.

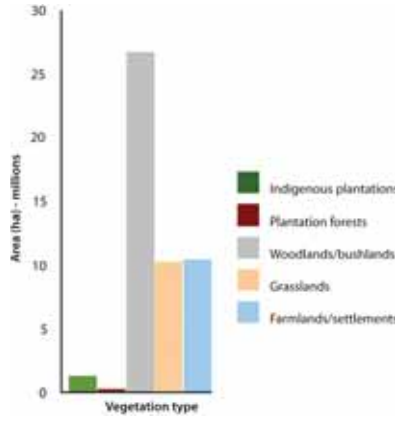


Figure 4: Land use area, 2005 (Source: KFS 2006)

Kenya's land cover is dominated by woodlands, grasslands, and farmlands

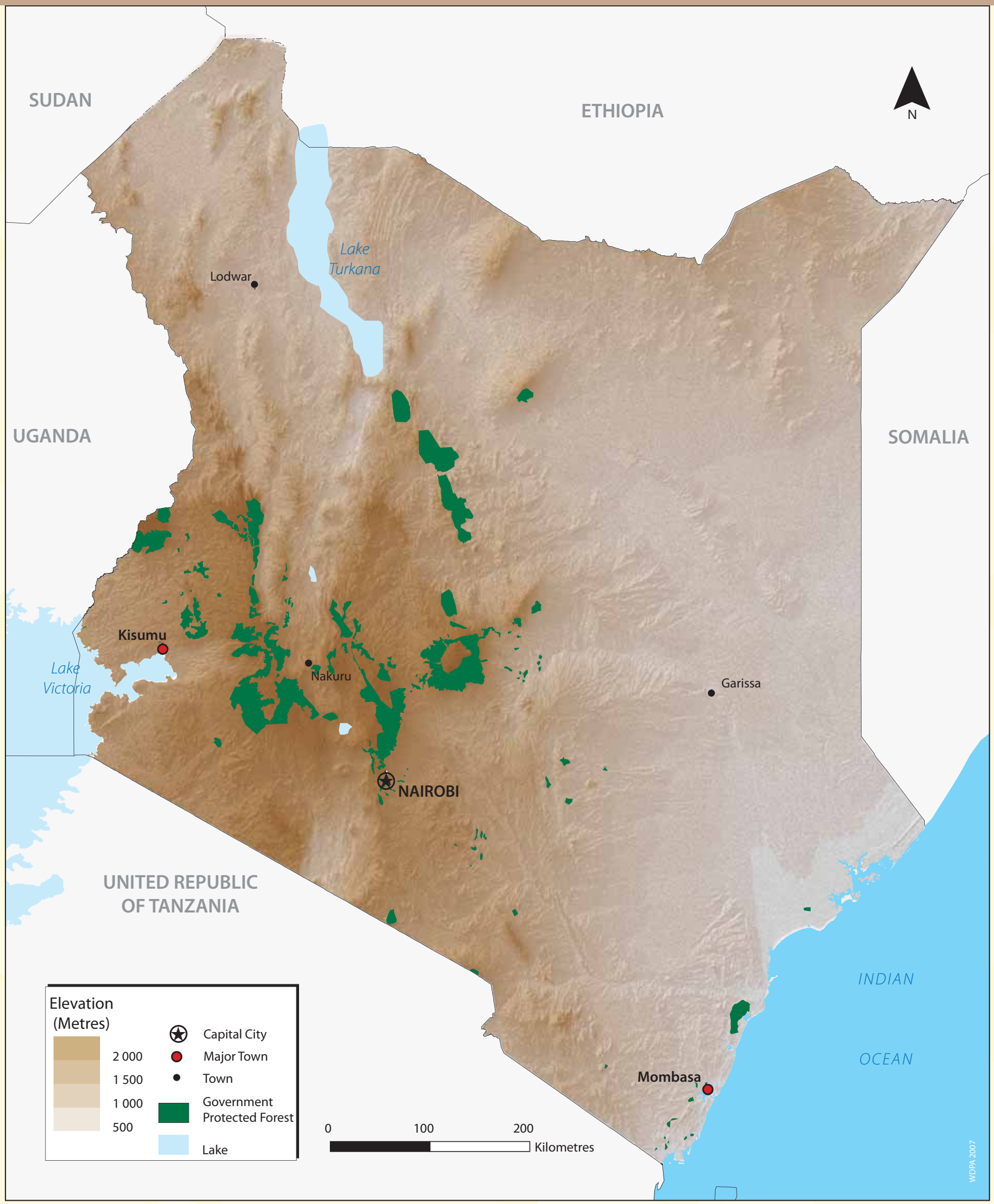


Figure 5: Forests are concentrated in Kenya's moist highlands where human populations and agricultural production are also concentrated. In the extensive semi-arid regions, forests are mainly found on isolated hills and in discontinuous narrow bands along riverbeds. Kenya has 258 forest reserves.

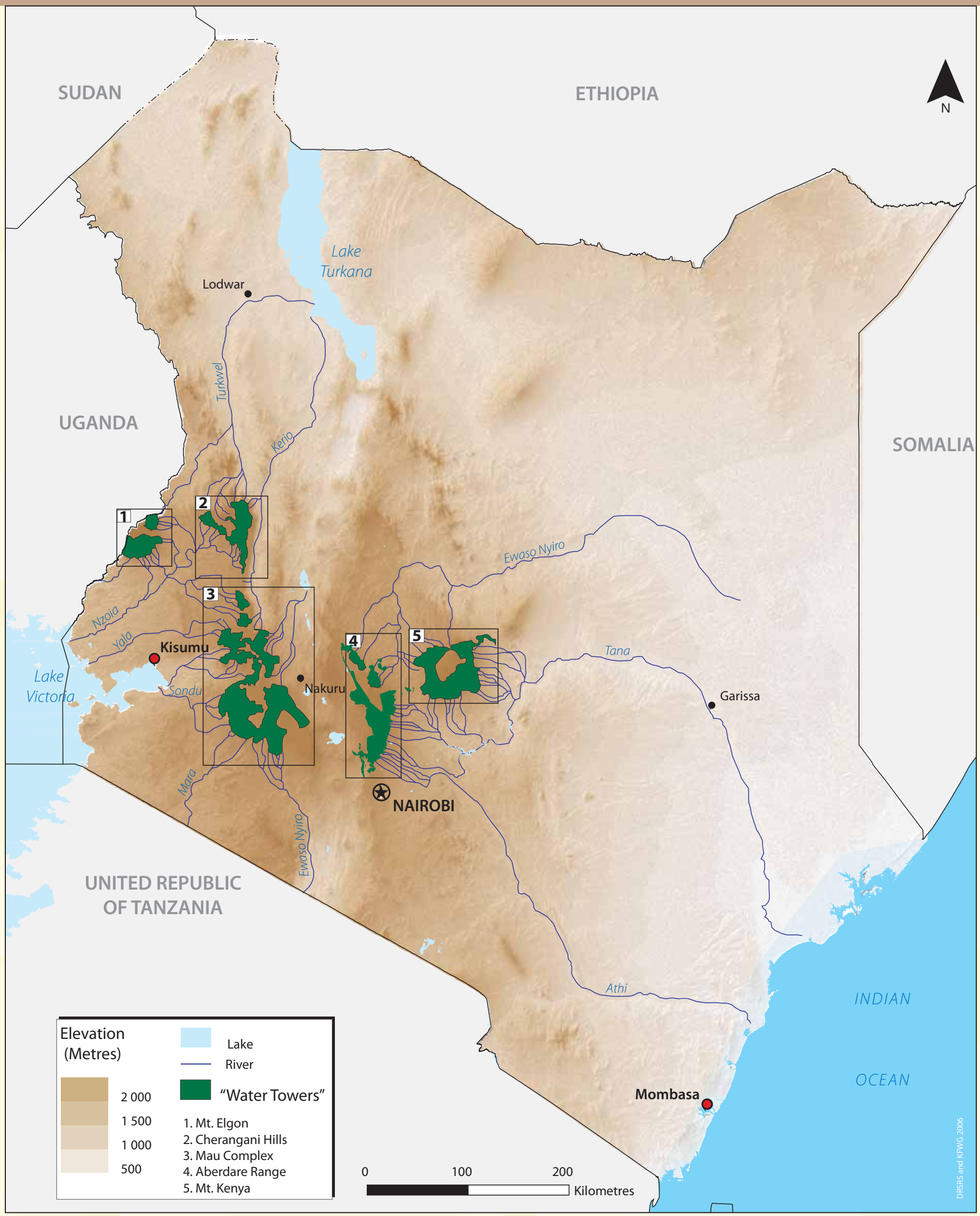


Figure 6: The five water towers of Kenya

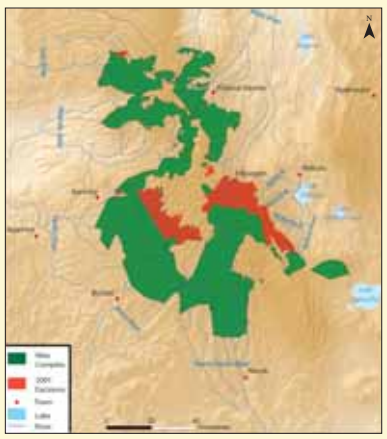

Christian Lambrechts/UNEP

Five water towers: Kenya's water catchments—a flagship project for 2012

The five "water towers" of Kenya—Mount Kenya, the Aberdare Range, the Mau Forest Complex, Mount Elgon, and the Cherangani Hills—are montane forests and the five largest forest blocks in the country. They form the upper catchments of all the main rivers in Kenya (except the Tsavo River originating from Mt. Kilimanjaro). The "water towers" are sources of water for irrigation, agriculture, industrial processes, as well as to all installed hydro-power plants, which produce about 60 per cent of Kenya's electricity output.

These montane forests are also surrounded by the most densely populated areas of Kenya, because they provide enough water for intensive agriculture and urban settlements (DRSRS and KFWG 2006). Their importance in the supply of timber and non-timber products to the communities living within their surroundings cannot be over emphasized. As such these forests are important and support livelihoods for all Kenyans in one way or another. At the same time, however, they are being lost or degraded by extensive illegal, irregular, and ill-planned settlements and illegal forest resource extraction. Such extensive and on-going destruction of the country's natural assets and their economic value is a matter of national concern.

This section presents each of the five "water towers" and describes their changing physical conditions over time. Assessing changes in these five regions is important not only for ensuring the livelihoods of millions of Kenyans, but also for preserving their intrinsic beauty and richness.



Mau Complex

The Mau Complex, the largest of the five water towers, feeds major water arteries that extend as far as lakes Turkana, Natron, and Victoria, and support critical economic activities including hydropower, tourism, and agriculture.

Mount Kenya

Mount Kenya was designated a UNESCO World Heritage Site in 1997 for its remarkable ecosystems and natural beauty. Its forests are critical water catchments for Kenya, delivering an estimated 40 per cent of the country's water needs.

Aberdare Range

Located on the eastern edge of the Rift Valley, the Aberdare Range forests cover over 250 000 ha and form part of the upper catchments of the Tana River, and the Sasumua and Ndakaini dams, which provide most of Nairobi's drinking water.

Mount Elgon

This 73 706 ha national park forms the upper catchment area for the Nzoia and Turkwel rivers, providing water to Malakisi River that crosses farming areas south of the mountain before entering Uganda.

Cherangani Hills

The Cherangani Hills forest, located on the western ridge of the Great Rift Valley, covers an area of some 120 000 ha and forms the upper catchments of the Nzoia, Kerio, and Turkwel rivers.

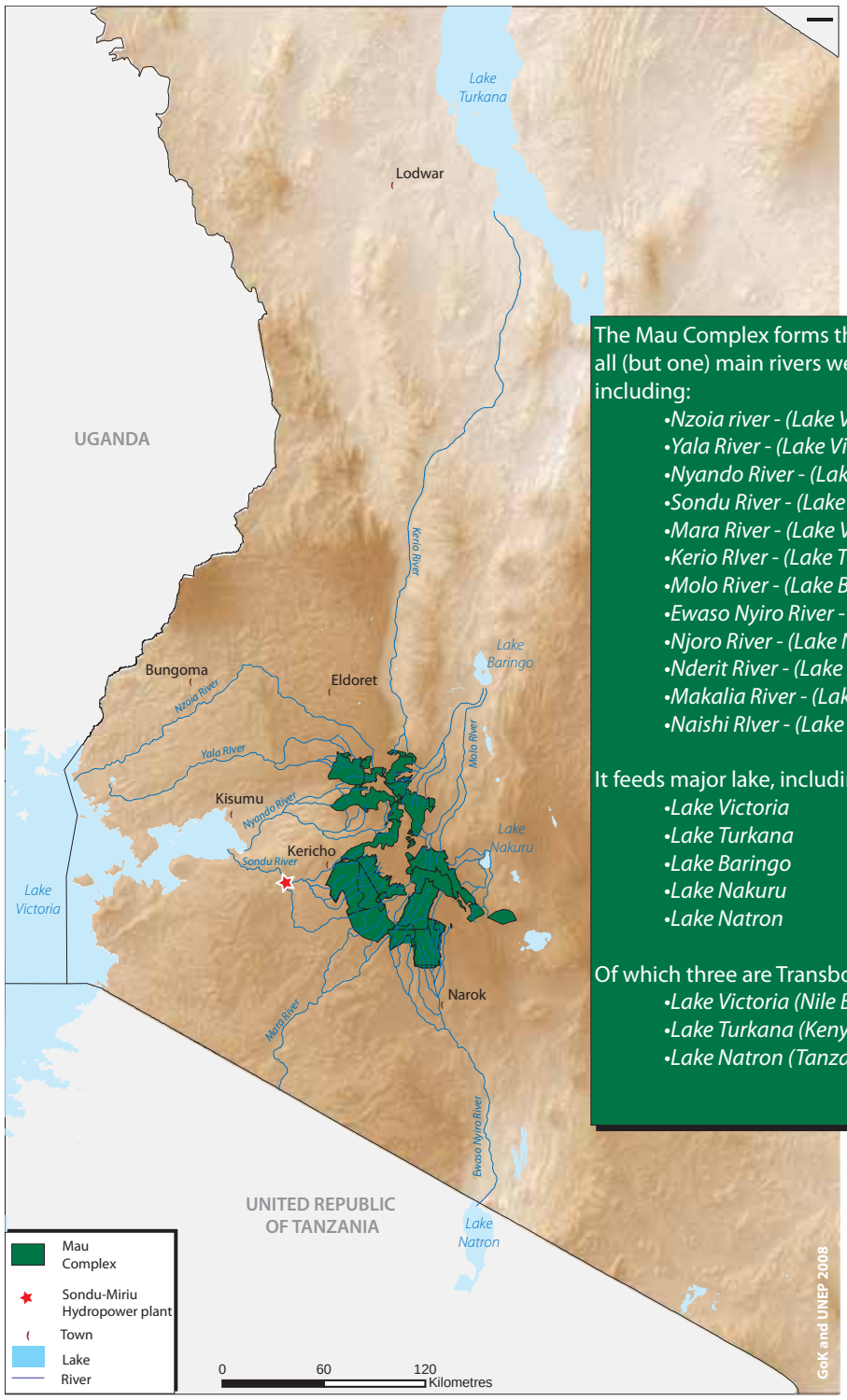


Figure 7: Critical water catchments, Mau Complex

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)*

The Mau Forest Complex

The Mau Forest Complex is Kenya's largest closed canopy forest ecosystem and the single most important water catchment in the Rift Valley and western Kenya. The Mau Complex forms part of the upper catchments of all but one of the main rivers on the west side of the Rift Valley. These rivers act as arteries carrying the Mau's waters throughout western Kenya—from Lake Turkana in the north to Lake Natron in the south as well as to Kenya's most populous rural areas in the Lake Victoria basin.

The Mau Complex covering over 400 000 ha, is the largest of the five "water towers" of Kenya. Its montane forests are an important part of water-flow regulation, flood mitigation, water storage, groundwater recharge, water purification, micro-climate regulation, and reduced soil erosion and siltation. The forests also provide other major environmental services, including nutrient cycling and soil formation. In addition, their role in storing carbon makes the Mau Forest globally important for mitigating climate change.

The Mau Complex supports key economic sectors in Kenya including energy, tourism, agriculture, and water supplies for settlements. The catchment's potential hydropower generation capacity is approximately 535 megawatts, which represents 57 per cent of Kenya's current total electricity generation. To date, projects that have already been developed, are under construction, or are proposed within the Mau catchment will generate only about 190 MW (GoK and UNEP 2008).

Tea estate

Woman picking tea leaves

The Mau Complex is particularly important for two of Kenya's largest foreign currency earners: tea and tourism. Kenya's most important tea-growing areas are located in the excellent growing conditions of the highlands adjacent to the forests of the five "water towers." In addition to approximately Kshs 12 billion in foreign currency, the tea sector brings 50 000 jobs and supports 645 000 dependants in western Kenya. It is estimated that two-thirds of the tea produced in western Kenya is grown in areas that benefit from the ecological functions of the Mau Complex, including the maintenance of favourable micro-climatic conditions.

In recent years, the tourism industry has been one of Kenya's three largest foreign currency earners. Kenya's wildlife and natural areas are the key attraction for most of those tourists. The rivers flowing from the Mau Complex are the lifeline for major tourism destination areas including: Maasai Mara National Reserve and Lake Nakuru National Park.

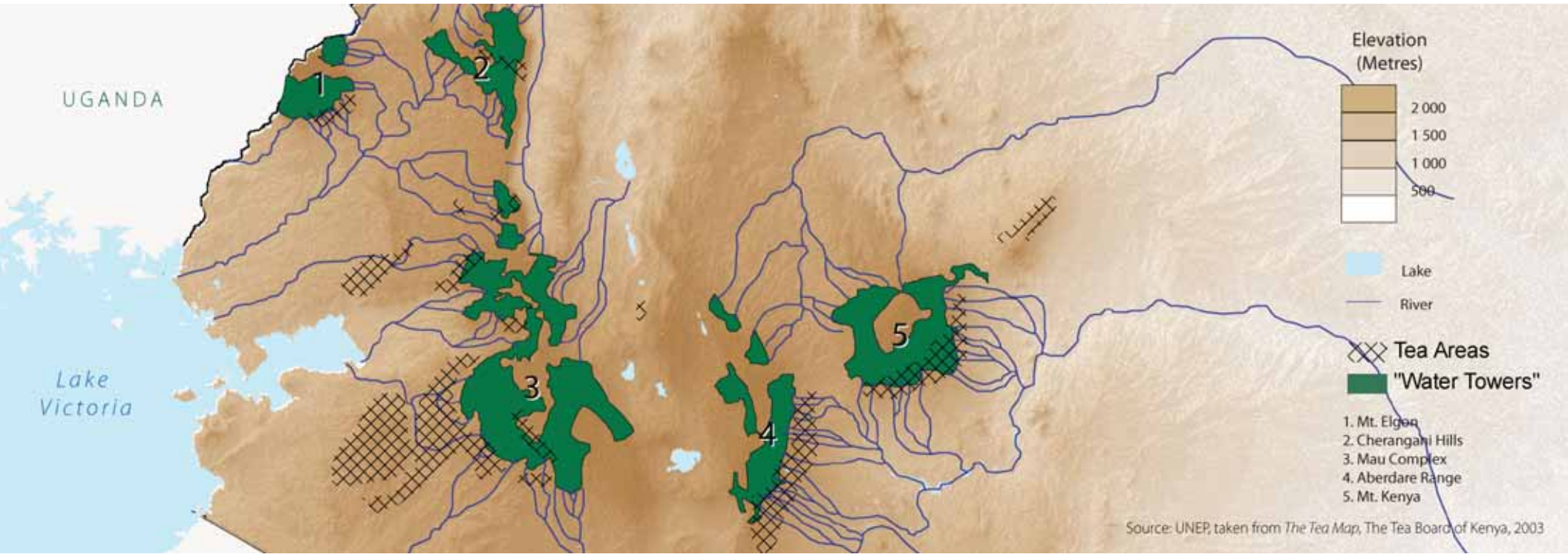


Figure 8: Kenya's tea growing areas and the five "water towers" (Source: UNEP, taken from The Tea Map, The Tea Board of Kenya, 2003)

The Mau Forest Complex: Degrading Forests

In spite of its national importance, many areas of the Mau Forest Complex have been deforested or degraded; much of this damage taking place in the past few decades. Degazettement of forest reserves and continuous widespread encroachment have led to the destruction of over 100 000 ha of forest since 2000, representing roughly one-quarter of the Mau Complex's area (yellow arrows). This series of satellite images documents 35 years of incremental destruction of forest area, punctuated by dramatic excisions.

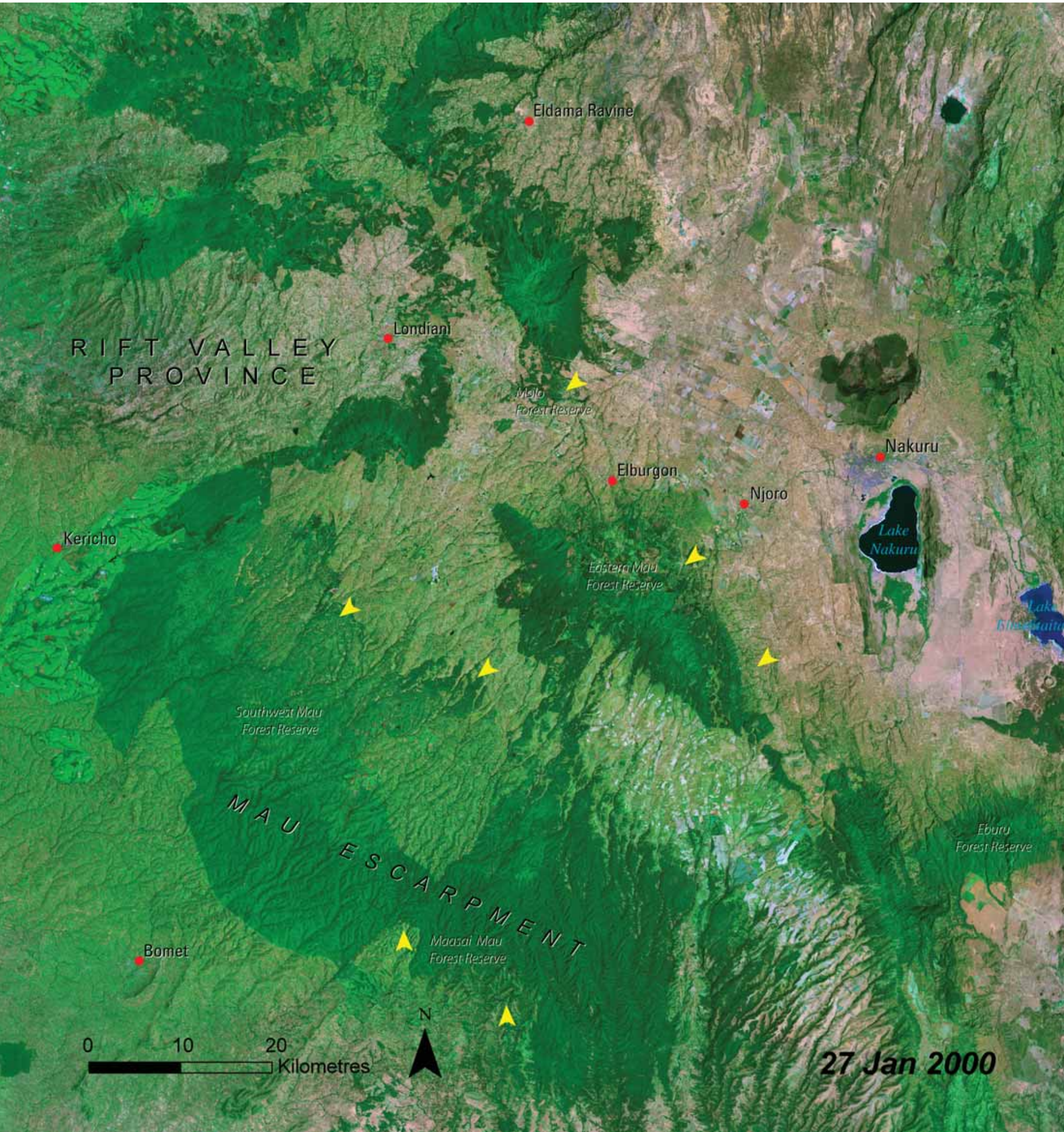
In 2001, 61 023 ha of forest in the Mau Complex were excised including over half of Eastern Mau Forest Reserve. Eastern Mau Forest is the headwaters for the Njoro River which drains its eastern slopes into Lake Nakuru, one of Kenya's prime tourist attractions. One quarter of South West Mau Forest Reserve was excised. The Southwest Mau Forest is the primary source of the Sondu River, site of the future Sondu-Miriu hydro-power plant. All of Molo Forest Reserve was excised.

Between 1973 and 2005, Maasai Mau Forest lost over 8 214 ha of forest within its official boundaries, which were established to protect the forest. Almost 43 per cent of that loss occurred in just two years from 2003 to 2005. Just outside the

Eldama Ravine
Londiani
RIFT VALLEY PROVINCE
Molo Forest Reserve
Nakuru
Elburgon
Njoro
Kericho
Lake Nakuru
Eastern Mau Forest Reserve
Southwest Mau Forest Reserve
MAU ESCARPMENT
Eburu Forest Reserve
Maasai Mau Forest Reserve
Bomet
N
0 10 20 Kilometres
28 Jan 1986

gazetted boundaries of Maasai Mau Forest nearly 32 000 ha were lost during the same time period. The eastern slopes of the Maasai Mau are a crucial catchment for the Ewaso Nyiro River, as the western slopes are for the Mara River. Forest loss in critical catchment areas for the Sondu, Mara, Molo, Naishi, Makalia Nderit, and Njoro Rivers will result in ecological and hydrological changes, which threaten the sustainable future of areas downstream.

In addition, people have encroached into some 43 700 ha in the Mau Complex's remaining protected forests. The desirability of many of these areas for agriculture attracts a rapidly growing population and has led to rapid conversion of large areas of forest to farmland. Extreme land cover changes such as these can have serious consequences both within the forest and downstream in the form of water shortages, health risks, desertification,



habitat destruction, sedimentation, erosion and even alteration of the micro-climate.

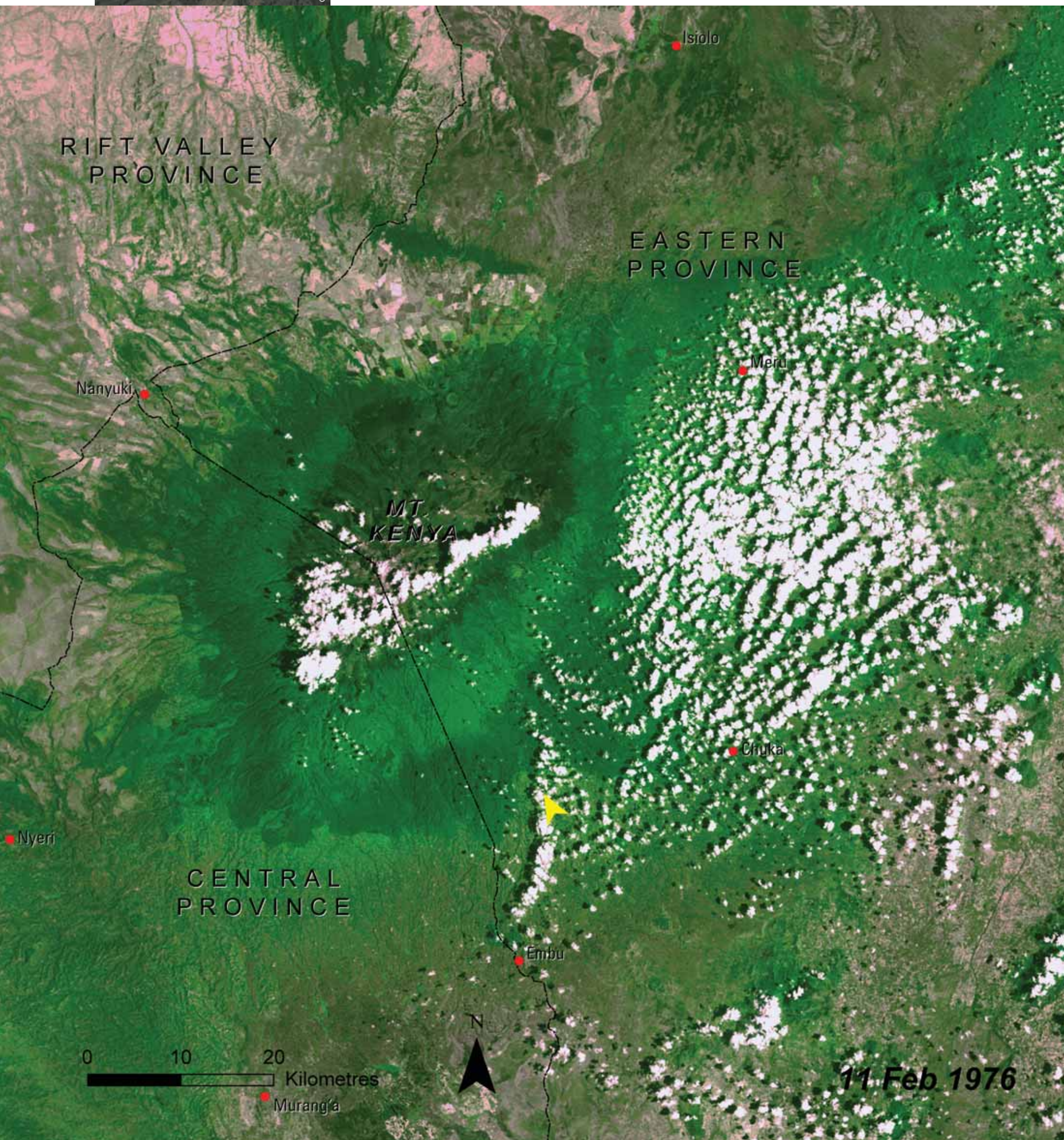
Loss of forest at this rate is unsustainable and threatens the security and future development of Kenya. Realizing the goals of Vision 2030 will depend in a very significant way upon the sustainable management of Kenya's natural assets. Kenya's five "water towers" are key among those assets.

In the mid-1980s, Kenya's Nyayo Tea Zones were created to form a clear boundary and a buffer between the indigenous forest and surrounding land uses. They have not been particularly successful in meeting that aim and many hectares of indigenous forest were cleared for their creation (Birdlife International 2008a, GEF 2008).

Christian Lambrechts/UNEP

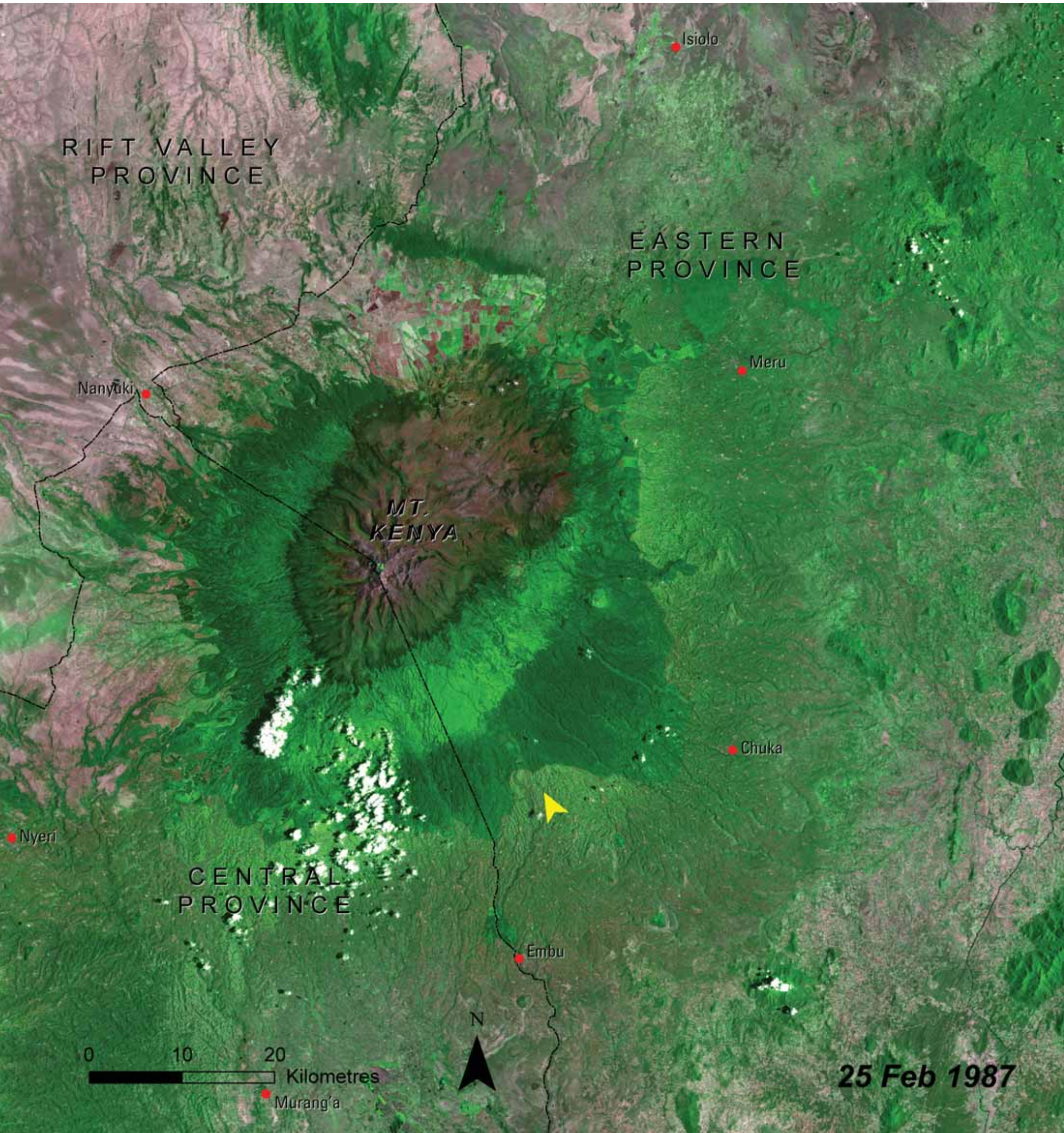
Mount Kenya: Disappearing Glaciers

Mount Kenya lies directly on the equator, 180 km north of Nairobi. Its scenic snow-cap, rising above the surrounding savanna, can be seen for hundreds of kilometres. It is an iconic symbol of Kenya known around the world. In addition to its beauty, Mt. Kenya's slopes are valuable for timber, farmland, and tourism and as a critical water catchment for much of the country. From the forest belt growing between 3 000 and 4 000 m to the



glacial summit at 5 199 m, Mt. Kenya receives over 2 000 mm of precipitation annually. This water feeds the Ewaso Nyiro River and the Tana—Kenya's largest rivers. Mount Kenya's contribution to the Tana provides roughly half the water needed for its crucial hydropower facilities.

Its wide range of altitude and rainfall gives rise to eight ecological zones ranging from a cultivated zone below 1 800 m to the Afro-alpine (areas above 3 800 m) and the Nival zone, found above most vegetation. Some of these zones can be seen in distinctly different shades of green in the satellite images.



Only 11 of the 18 glaciers that covered Mount Kenya's summit a century ago remain, leaving less than one third of the previous ice cover. The ice on Mount Kenya has also become thinner. While this trend dates to the late 1800s, emerging evidence suggests that it has accelerated since the 1970s.

Intense population growth around Mount Kenya between the 1960s and 1990s, along with unsustainable exploitation of forest resources, further threatened its integrity. Large areas of indigenous forest have been cleared for tree plantations, extensive illegal logging of valuable species, and small-

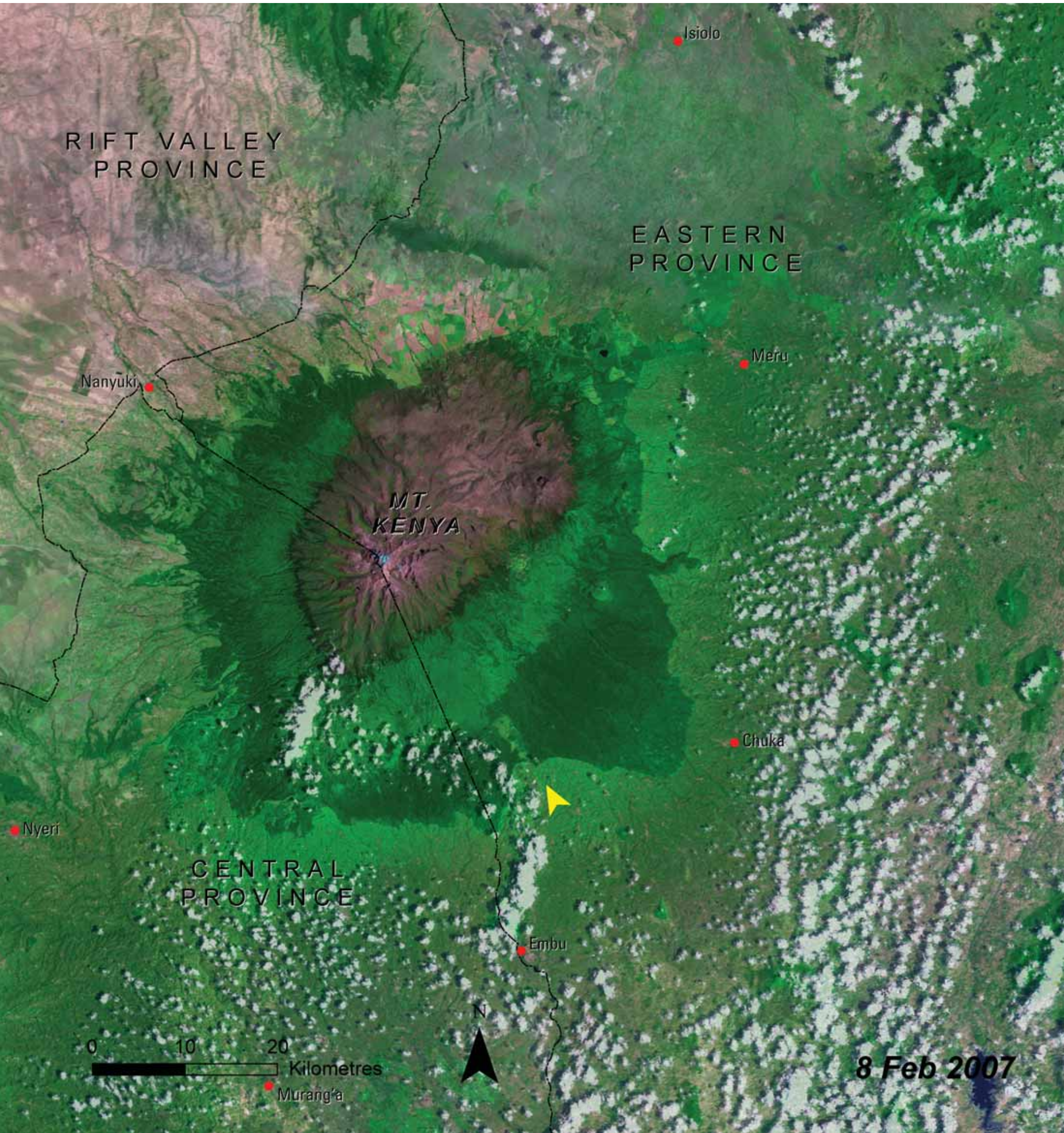
Boy relaxing at the base of a very large tree

Christian Lambrechts/UNEP

scale illegal activities such as charcoal production, marijuana growing, and unauthorized farming. These activities have degraded many areas of natural forest, new management policies and practices, and improved enforcement put in place since 2000 have significantly reduced these threats.


Mount Kenya vegetation

Thadk/Flickr.com




Christian Lambrechts/UNEP

The Aberdare Range: Forest Devastation

The Aberdare Range spans the equator west of Nairobi rising over 4 000 m at its highest peak, Oldonyo Lesatima. Its western escarpments drop dramatically toward the Rift Valley. To the east it slopes gradually, carrying water into the Tana River and to the Seven Forks hydropower plants where over half of Kenya's electricity is generated. On their way into the Tana, the Chania River flows into Sasumua Dam and the Thika River into Ndakaini Dam, from which Nairobi's more than three million people obtain most of their water. The Aberdares also form part of the upper catchments of the Athi, Ewaso Nyiro, and Malewa Rivers.


Ndakaini Dam
Nation Media Group

RIFT VALLEY PROVINCE
Nanyuki
EASTERN PROVINCE
MT. KENYA
ABERDARE RANGES
Nyeri
CENTRAL PROVINCE
Murang'a
Naivasha
Lake Naivasha
RIFT VALLEY PROVINCE
0 10 20 Kilometres
N
25 Feb 1987

Reserves protect the forest belt of the Aberdare Range, including Aberdare, Kikuyu Escarpment, Kijabe Hill, Kipipiri, and Nyamweru and 760 km^2 of the forest falls under the protection of Aberdare National Park. The forests cover over 250 000 ha. The Range is characterized by a high diversity of forest types due to the wide altitudinal range (1 800 to 3 600 metres) and climatic differences between slopes.

The forests are being devastated by large-scale, uncontrolled, irregular, or illegal human activities, in particular charcoal production, logging, encroachment and settlements, cultivation of marijuana and other crops, and livestock grazing. The assault on these forests poses a grave threat to Kenya's water security, biodiversity conservation, and economic development.

RIFT VALLEY PROVINCE

Nanyuki

EASTERN PROVINCE

MT. KENYA

ABERDARE RANGES

Nyeri

CENTRAL PROVINCE

Naivasha

RIFT VALLEY PROVINCE

0 10 20 Kilometres

N

27 Jan 2006

Thika


Christian Lambrechts/UNEP

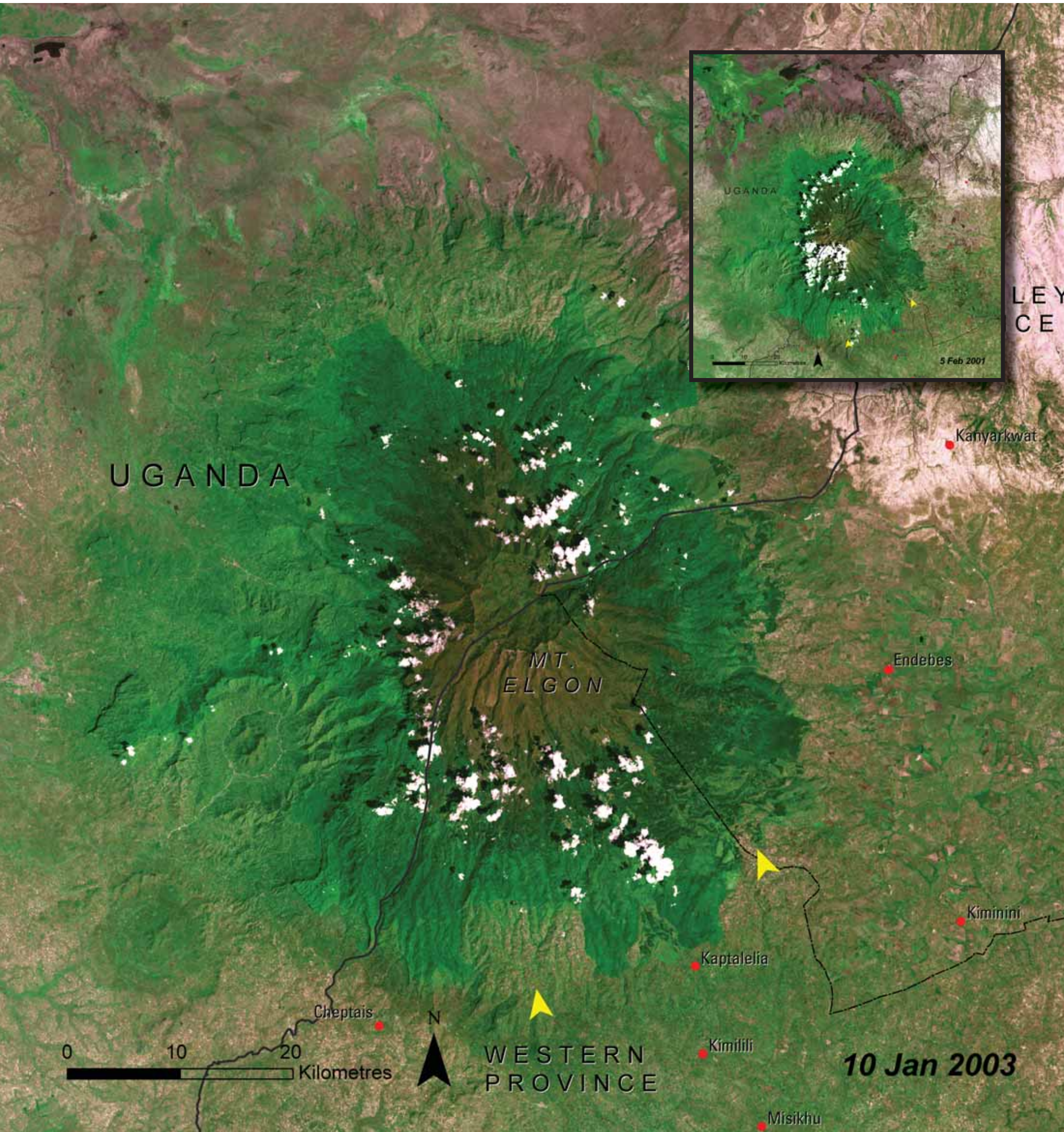
Mount Elgon: Legal Logging

Mt. Elgon lies north of Lake Victoria on the Kenya-Uganda border. Its Kenyan side is protected by Mt. Elgon National Park, Chepkitale National Reserve, and Mt. Elgon Forest Reserve; the latter covers 73 706 ha. Mt. Elgon forms the upper catchment area for two major rivers, the Nzoia and Turkwel. The forest contains globally threatened species, including some endemic to the Afro-montane region and others endemic to Mt. Elgon alone, making the area a priority for species conservation and a major attraction for tourists. A rapidly growing population of around two


Christian Lambrechts/UNEP

Landscape surrounding Mt. Elgon

million people in the area around the mountain puts very high pressure on this unique ecosystem. Authorized logging has been practiced in Mt. Elgon since at least the 1930s. In the 1970s, land was excised from the Mt. Elgon Forest around Chebyuk where 600 families were settled to make way for a national game reserve. While a 1986 Presidential Decree banned all logging in Kenya's natural forests, it excluded Mt. Elgon where legal logging continues. Agricultural encroachment and charcoal production are degrading the forest in many areas as well. In many cases forest has been cleared for crops on slopes that are not suitable, making them susceptible to erosion and landslides. Continued degradation and forest loss on Mt. Elgon threatens to undermine the area's crucial role as a water catchment for the surrounding region and will reduce the viability of the ecosystem itself.




Christian Lambrechts/UNEP

The Cherangani Hills: Indigenous Forests

The Cherangani Hills, an ancient fault-block formation of non-volcanic origin, are a series of gently rolling hills that form an undulating upland plateau on the western edge of Kenya's Rift Valley. They lie between the Elgeyo Escarpment to the east and Mt. Elgon to the west, rising to 3 365 m above sea level at Cheptoket Peak in the north-central section. Located on the Cherangani escarpment, the hills are largely covered by a series of gazetted indigenous Forest Reserves. River Nzoia has its source in these Hills. Over the last 20 years, local inhabitants have encroached on the forest land converting it to farmlands.

RIFT VALLEY PROVINCE
Sigor
Chepararia
CHERENGANI HILLS
Kapenguria
Cherengani
Chebiemit
Moiben
Marewet
Cheboret
N
0 10 20 Kilometres
1 Feb 1973
28 Jan 1986

Because the Cherangani Hills are one of the five most important water catchment areas in Kenya, a joint project of UNEP and the Department of Resource Survey and Remote Sensing monitored the change in forested area between 2000 and 2003. It found that the Cherangani Hills were the least affected of the five forested water towers, with 174.3 ha deforested. Since this forest cover is indigenous, however, it was recommended that the area be closely watched to prevent further destruction.

The forests of the Cherangani Hills bear scenic features suitable for ecotourism and are home to the rare De Brazza's Monkey. The Hills are also classified as an Important Bird Area (IBA) with over 73 forest-dependent species recorded of which four species are regionally threatened.

Deforestation in the Cherangani Hills

Christian Lambrechts/UNEP

RIFT VALLEY PROVINCE

Sigor

Chepararia

CHERENGANI HILLS

Kapenguria

Cherengani

Chebiemit

Moiben

Marewet

Cheboret

N

0 10 20 Kilometres

5 Feb 2001

Arshia Chander/SGT/UNEP

Tourists on safari view a large herd of African elephants

Tourism

Since 2002, the tourism industry has been one of Kenya's three largest foreign exchange earners. In 2007, consolidated earnings from tourism amounted to Ksh. 65.4 billion. Tourism is also a major source of employment, providing at least 400 000 jobs in the formal sector and over 600 000 in the informal sector (GoK and UNEP 2008). Tourism is targeted as the leading sector in achieving the goals of the Vision 2030. The Vision's economic pillar aims for the country to be among the top 10 long-haul tourist destinations in the world, offering high-end, diverse, and distinctive visitor experiences that few competitors can offer. Preserving the environment is essential if this goal is to be realized.

Kenya will need to improve the infrastructure in and around its tourist attraction sights, including airports/airstrips and road networks, in order to achieve its goals of quadrupling tourism's annual GDP contribution to over Ksh. 80 billion, raise international visitors from 1.8 million in 2006 to three million in 2012, increase hotel beds from 40 000 to about 65 000, and provide high quality service. The challenge is to do this without destroying the very environment that visitors come to see. As can be seen in Figure 9, there are already many airstrips within protected areas and some parks have high densities of these strips. Building more of them in such sensitive areas will destroy wildlife habitat and endanger the animals that attract tourists to Kenya.

Wildife conservation

Kenya's game parks and spectacular wildlife attract nearly two million tourists each year (UN-Water 2006). Wildlife conservation is thus a high priority. Formed in 1946, Nairobi National Park, just outside the city, was the country's first protected area (Chapter 5). By 2008, 75 237.9 km^2 of the nation's land area had been set aside as national parks and game reserves (WDPA 2007).

Airstrip Location and Density

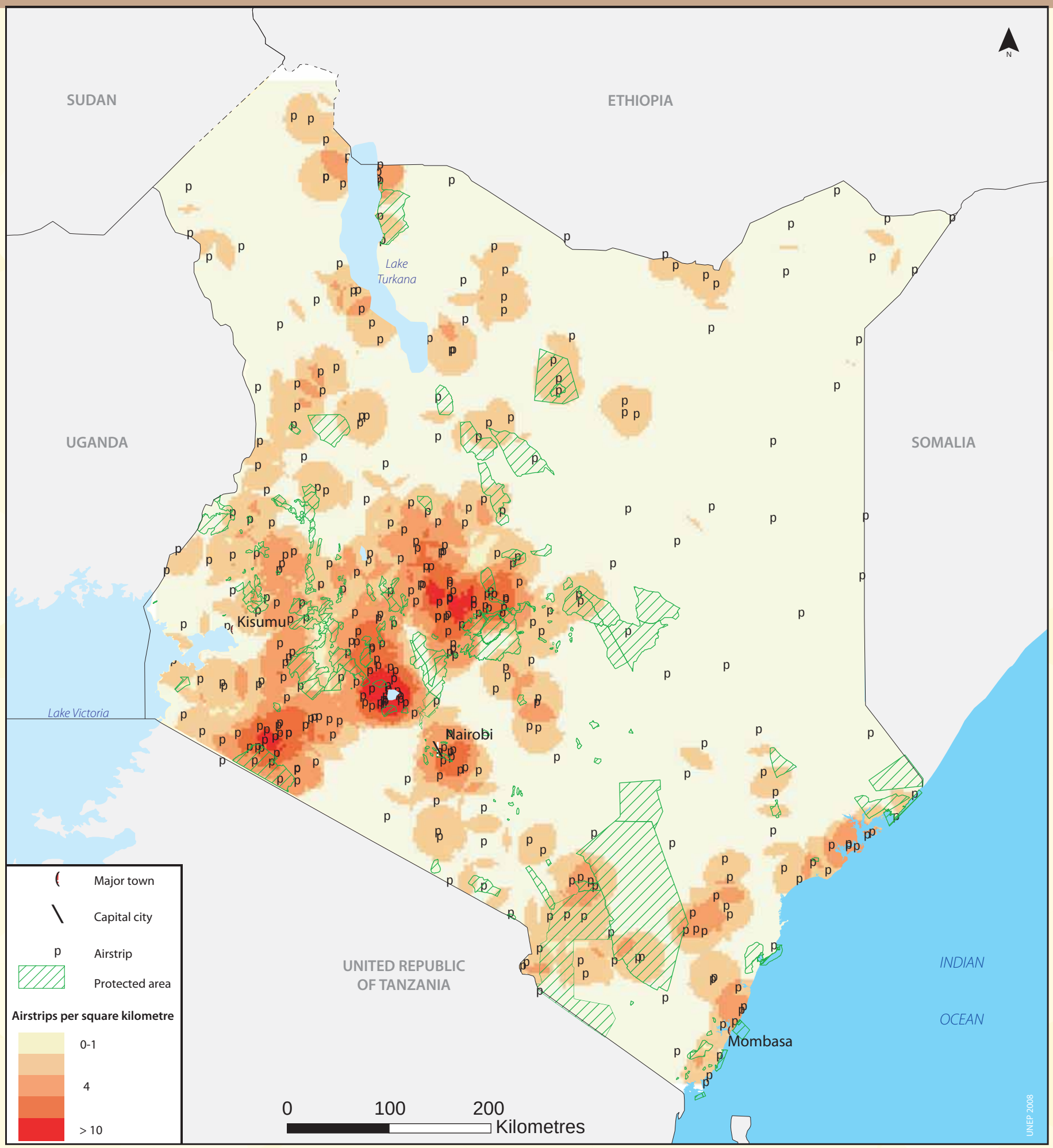


Figure 9: Most airstrips, with the exception of those within or close to the capital city, are located within or very close to protected areas, especially those of international repute like the Maasai Mara Game Reserve

Christian Lambrechts/UNEP

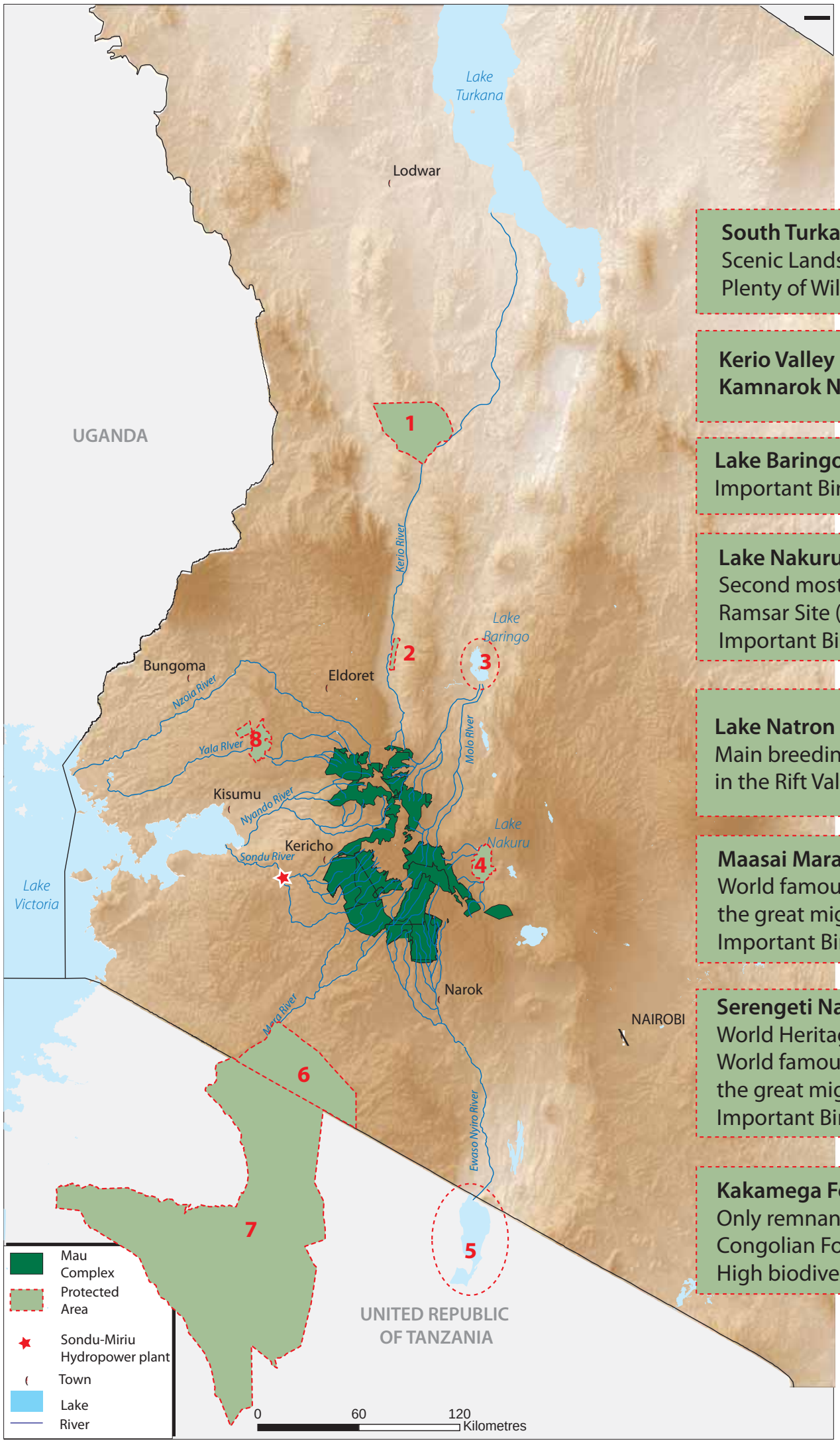
Flamingos and other birds wade in the shallow water along the northwest shores of Lake Nakuru

The environment underpins economic vitality, including future tourism growth. For example, 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 (Figure 10). In 2007, revenues from entry fees alone amounted to Ksh. 650 million and Ksh. 513 million for the Maasai Mara and Lake Nakuru respectively (GoK and UNEP 2008). The annual indirect revenues from tourism in these two conservation areas are estimated to be in excess of Ksh. 5 billion. The rivers are also the lifeline for a number of other conservation areas where tourism potential is not yet fully developed, including Kakamega National Reserve, Kerio Valley National Reserve, South Turkana National Reserve, Lake Baringo, and Lake Natron.

These conservation areas host a high diversity of fauna and flora. For example, three of them — Kakamega, Baringo, and Natron — are classified as Important Bird Areas, with Kakamega and Baringo each hosting over 450 bird species, while Natron is the main breeding area for the Lesser Flamingoes in the Rift Valley. Other Important Bird Areas (IBA) that depend on rivers flowing from the Mau Complex include: Koguta Swamp (Kenya–Sondu River); Kusa Swamp (Kenya–Nyando River); Serengeti National Park (Tanzania–Mara River), Mara Bay, and Masirori Swamp (Tanzania–Mara River).

Lip Kee/Flickr.com

Flamingoes in Lake Nakuru



South Turkana National Reserve 1
Scenic Landscape
Plenty of Wildlife

Kerio Valley National Reserve
Kamnarok National Reserve 2

Lake Baringo 3
Important Bird Area (over 470 species)

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

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

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

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

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

Source: UNEP 2008

Figure 10: Major tourism destinations
The rivers flowing from the Mau Complex are the lifeline for major tourism destinations.

Goliath heron, Lake Baringo

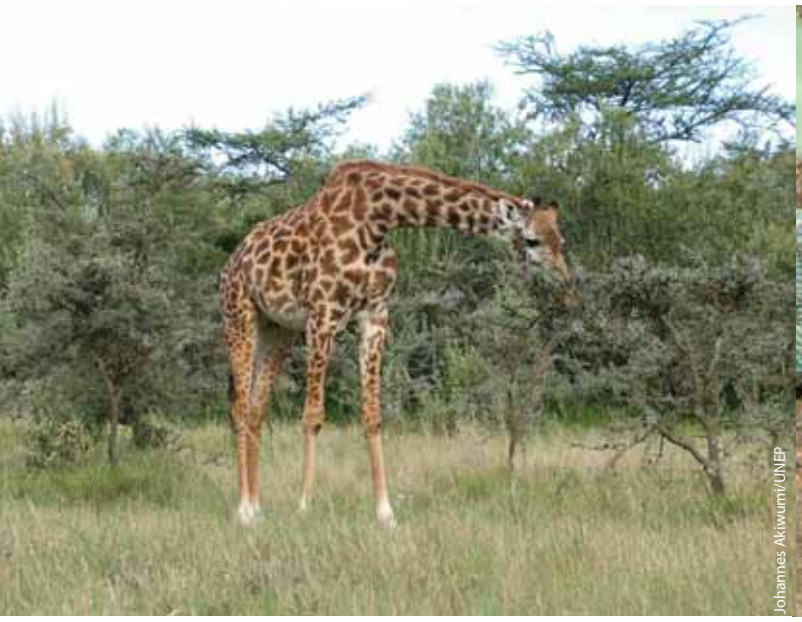
Located in the Rift Valley, Lake Baringo is a critical habitat and refuge for a variety of birds and fish species. Today, fish stocks in the lake have decreased, and so have water levels as a results of droughts and over-irrigation.

The Aberdare National Park receives an average 50 000 visitors annually. The scenery is spectacular and the high upland waterfalls are a special attraction. The north and southeast of the park are as yet undeveloped but have unique attractions. Kenya Wildlife Service (KWS) has identified sites in the south with potential for forest walks and hiking routes to Kinangop peak. In the north, areas for fishing, hiking, and horse riding have been identified. Thus, the tourism potential of the Aberdares remains largely untapped.

The rivers flowing from the Marmanet forests provide water to five major conservation areas: Lake Baringo, Lake Bogoria National Reserve, Samburu National Reserve, Buffalo Springs National Reserve, and Shaba National Reserve (Figure 11). In 2007, the entry fees alone in these five conservation areas generated revenues in the range of Ksh. 100 - 200 million (GoK and UNEP 2008).

Biodiversity attractions and threats

Kenya ranks second highest among African countries in bird and mammal species richness. It has an estimated 6 506 higher plant species, 359 mammals, 1 079 birds (of which 344 are breeding birds), 61 reptiles, 63 amphibians, and 34 fish species (Survey of Kenya 2003, WRI 2003). In addition, there are an estimated 21 575 insect species for a total of 29 673 species excluding molluscs and other invertebrates (Survey of Kenya 2003).



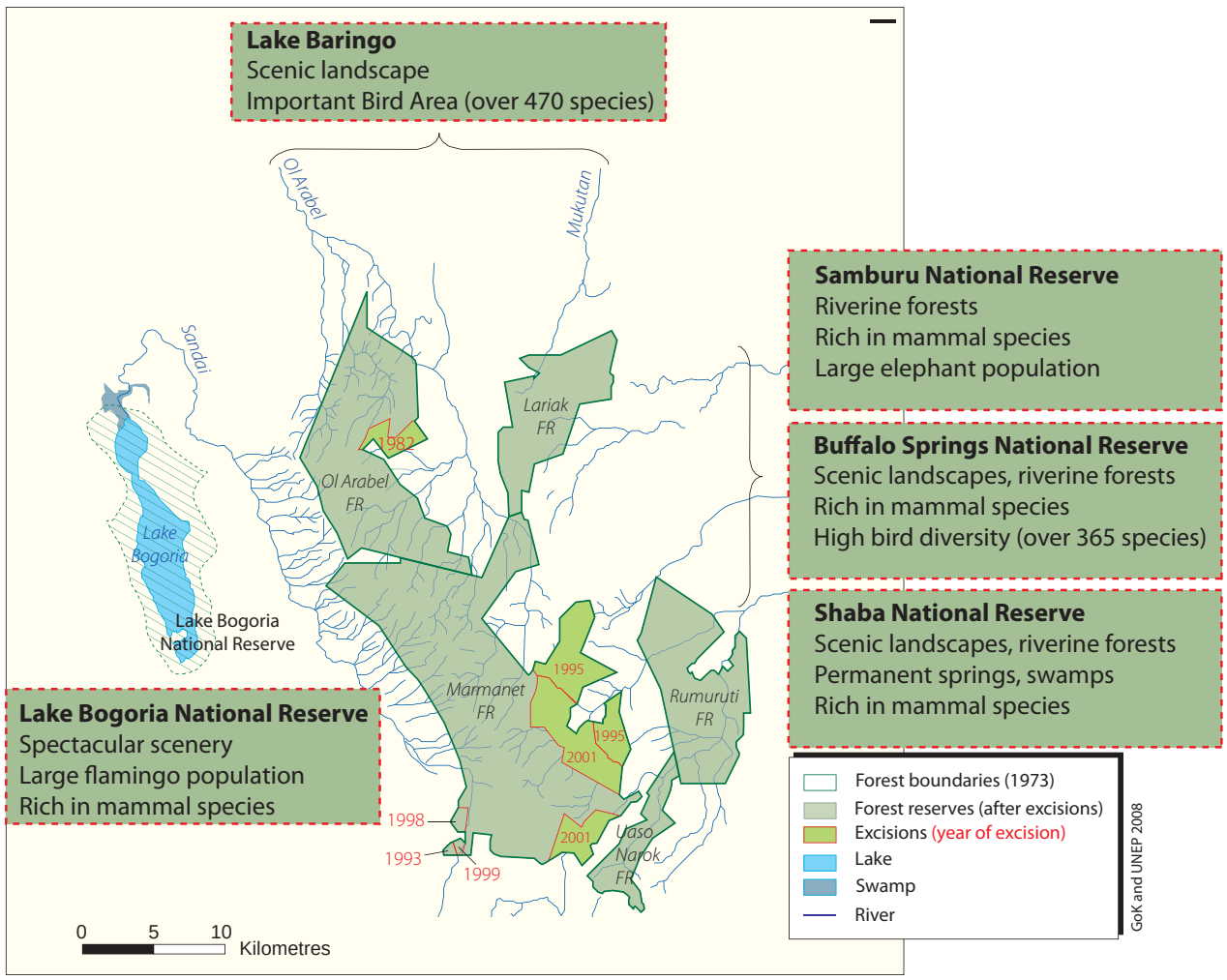


Figure 11: Marmanet forests are critical to major conservation areas

Threatened Species

The closed canopy forests are major habitats for a disproportionately large percentage of the country's wildlife and other biodiversity. Though forests cover about three per cent of Kenya's area, they contain 50 per cent of the nation's tree species, and it is estimated that they harbour 40 per cent of the larger mammals, 30 per cent of birds, and 35 per cent of the nation's butterflies. The indigenous forests have both endemic and threatened species (KFWG 2008).

About half of Kenya's threatened mammals and birds are found in its forests (Survey of Kenya 2003). According to the 2006 International Union for Conservation of Nature and Natural Resources (IUCN) report, Kenya's threatened species include 33 species of mammals, 28 breeding bird species, five species of reptiles, four of amphibians, 29 of fish, 16 molluscs species, 11 species of other invertebrates, and 103 plant species.

Endangered *species* of Kenya


Lukas Vermeer / Flickr.com

African Elephant

(Loxodonta africana)

The African elephant is the largest land animal on Earth. It is listed as Endangered under IUCN. African elephants are threatened by poaching and habitat loss. Their tusks have been used in jewelry, piano keys, hanko (personalized signature seal used in Japan), and other items. Local people consume their meat and trade their hides and other parts, which are highly prized among big game hunters. From 1979 to 1989, Kenya's elephant population declined from about 130 000 to less than 17 000. Management and anti-poaching measures implemented through the ivory ban in 1989 has helped to increase and stabilize their population.


Tiswango/ Flickr.com

Grevy's Zebra

(Equus grevyi)

Grevy's zebras have suffered one of the most substantial reductions of range of any African mammal. A few decades ago, more than 15 000 Grevy's zebra inhabited Africa. Today in Kenya alone, the population estimates are between 1 838 and 2 319. The Grevy's Zebra is listed as Endangered under the IUCN. The greatest threats facing the species today are habitat fragmentation and loss as more land is converted to agricultural use. Overgrazing by livestock is leading to significant environmental degradation. Grevy's zebra compete with the ever-increasing livestock population and agricultural crops for water.


Ryan Harvey / Flickr.com

Black Rhino

(Diceros bicornis)

The black rhinoceros population was nearly wiped out by poachers in the 1970s and 80s. Today its population stands at 540 in Kenya (AWF 2008). Poaching activities for horn trade, believed to have medicinal value, along with habitat loss, have put the black rhinoceros on the Critically Endangered list of the IUCN.


birdfinders.co.uk

Sokoke Scops Owl

(Otus ireneae)

The Sokoke Scops owl's population is estimated at about 1 000 pairs over about 220 km^2 of forest in the Arabuko-Sokoke forest. Unsustainable (and often illegal) deforestation for wood-carving and firewood may substantially reduce the species breeding success. Government owned forest reserves suffer from pit-sawing of timber and pole-cutting. The Sokoke Scops is listed as Endangered under the IUCN.


alukaorg

Gigasiphon

(Gigasiphon macrosiphon)

The gigasiphon is listed as Endangered under the IUCN. Native of the tropical forest, this plant is threatened by anthropogenic activities. Threats originate from habitat destruction or loss, deforestation — where land is cleared for agriculture, development, and population resettlement — competition from introduced species, pollution, global warming, and plant hunting, collecting, and harvesting.

Mangabey

(*Cercocebus galeritus)*

As one of the world's top 25 most endangered primates, the Tana mangabey inhabits the lower Tana River where its decreasing population is estimated between 1 000 and 1 200 according to old data. There is no current accurate estimate of the mangabey population. Their survival is directly correlated to the tree density and the forest area, which decreased by a third since the latest population census. Moreover, mangabey-human conflicts, such as crop raiding and traps, continue to threaten their survival (Wieczkowski 2005).

Cheetah

(*Acinonyx jubatus)*

Already extinct in most of Asia, there are now only two remaining cheetah population strongholds: Namibia/Botswana in southern Africa, and Kenya/ Tanzania in East Africa. The cheetah population in Kenya is not well-known, but is approximately 1 000 individuals. Cheetahs are endangered because of decline in prey, loss of habitat and poaching. They are often disliked because of their predatory lifestyle. Also, predation of cheetahs by both lion and hyenas in protected game reserves is forcing larger numbers of cheetahs to live outside protected areas where they come into contact with humans. Other threats facing cheetahs include diseases and low genetic diversity. The cheetah is classified as an endangered species, and listed in Appendix I of the Convention of International Trade in Endangered Species (CITES).

Green Sea Turtle

(*Chelonia mydas)*

The Green Turtle is listed as Endangered under the IUCN. Despite the protection of the Green Sea Turtle under Kenyan law, their survival is still precarious. The harvesting of turtle eggs, demands for its meat and oil, habitat destruction of nesting and foraging grounds by human encroachment (coastal and tourism development), pollution and beach erosion are all disturbances affecting their already fragile survival. Another threat is posed by fishing trawlers and drift nets, which accidentally catch sea turtles and drown them in fishing gear. One of the most worrying threats in recent years has been an increase in fibropapillomas, which are fibrous tumours that can grow on almost any part of the turtle's body, impeding movement or sight, and often leading to death. Kenya created a Turtle Conservation Committee to generate public support for this endangered turtle.

Hawksbill Turtle

(*Eretmochelys imbricata)*

Classified as Critically Endangered under the IUCN, Hawksbill turtles have been commercially exploited for thousands of years for their particularly attractive shell (tortoiseshell). Other major threats to their survival come from a substantial market for eggs, meat and even stuffed juveniles as exotic gifts in some parts of the world. Additional pressure on the global population comes from the loss of nesting sites, accidental entanglement in fishing lines and the deterioration of coral reef systems, which act as feeding sites for these turtles.

Tana River Red Colobus

(*Procolobus rufomitratus)*

The Tana River red colobus population decline was fuelled by bushmeat hunting and habitat degradation. Today, protected by only a few square kilometres of riverside forest, the red colobus is now threatened by a new sugar-cane plantation and the flood of settlers it will bring (IUCN 2008). It is listed as Endangered under the IUCN.

African Lion

(Panthera leo)

The lion is listed as vulnerable under the IUCN. In Africa, a population reduction of 30 to 50 per cent is suspected to have occurred over the last 20 years mainly due to hunting, poisoning and habitat loss. Kenya's lion population is estimated at 2 280.

Christian Lambrechts/UNEP

Women carrying fuelwood

Energy

Adequate and reliable sources of energy are essential for any country's security and economic development. To achieve a ten per cent annual GDP growth rate for the next 25 years as outlined in Vision 2030, Kenya needs to secure and maintain sustainable supplies of energy. Kenya's energy sources are broadly classified into traditional biomass-based energy sources such as fuel wood and charcoal, and conventional sources such as petroleum products and electricity. The former is mainly used in rural areas and to some extent in poor urban situations, while the latter are viewed as "modern" energy forms.

Kenyan energy sources have been typically derived from the domestic environment rather than from imports. Fuelwood accounts for 70 per cent of all energy consumed (in rural areas, it accounts for as much as 90 per cent of energy use) while electricity supplies six per cent of the country's energy, of which hydropower sources represent more than 64 per cent (Figure 12) (GoK and UNEP 2002, GoK 2002). Figure 16 shows the location of power stations and illustrates the environmental base of power supplies. Hydropower, for example, is derived directly from the forested catchments of Kenya's five "water towers." Deforestation of their slopes has a direct impact on the amount of water available to generate power.

Kenya's energy supply needs to continue growing as the population increases. At the same time, the environmental sources of power are diminishing as forests are felled and water catchments threatened. In addition, as poverty levels grow, so increasing numbers of people can ill afford conventional forms of energy and turn to wood for fuel (GoK 2002).

When energy supply is inadequate and poor populations have limited access to energy, hardship sets in and meaningful social and economic development is hampered. Electricity power rationing due to prolonged droughts, for example, often leads to the closure of several industries with negative consequences on employment and Gross Domestic Product (GDP).

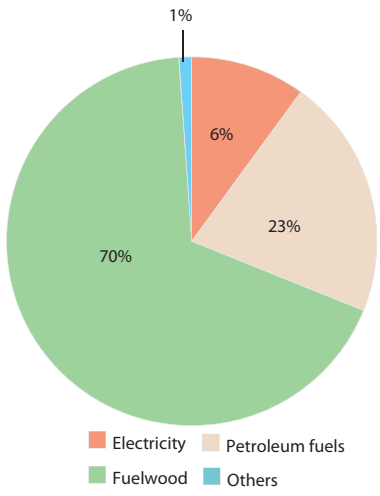


Figure 12: Sources of national energy (Source: Economic Survey 2000/2008)

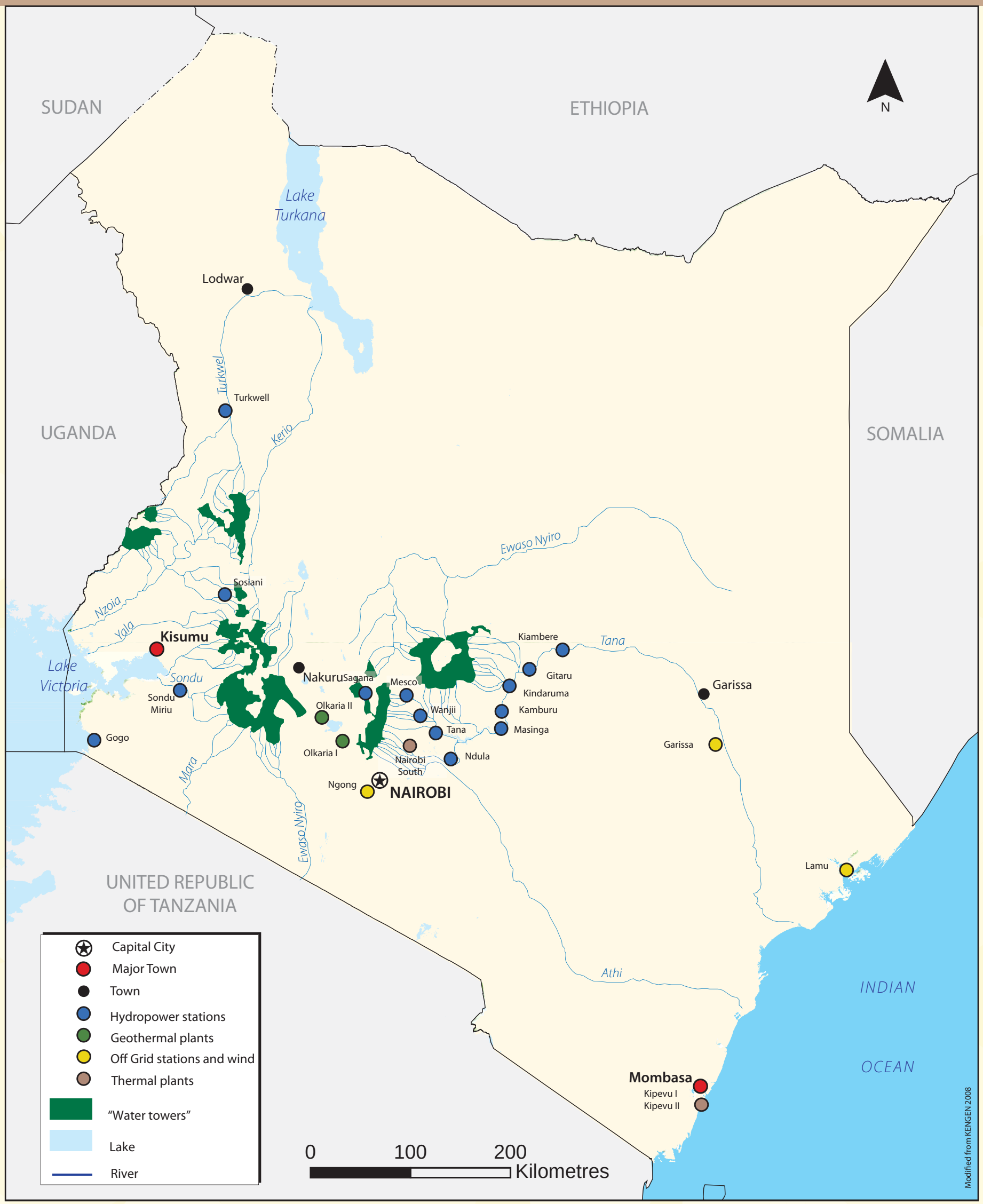


Figure 13: Location of power stations

Conventional Energy: Petroleum

Petroleum fuel is the most important conventional energy source accounting for 23 per cent of total national energy consumption. Kenya imports all its petroleum requirements either in the form of crude oil or finished petroleum products and they account for a significant proportion of national importation costs. Most of the petroleum fuels are consumed in the transport sector and in electricity production. Road tankers, rail, or oil pipelines transport petroleum products from the port of Mombasa to other parts of the country. The oil pipeline network extends to the cities and towns of Nairobi, Nakuru, Eldoret, and Kisumu. Plans are underway to extend the pipeline to Uganda.

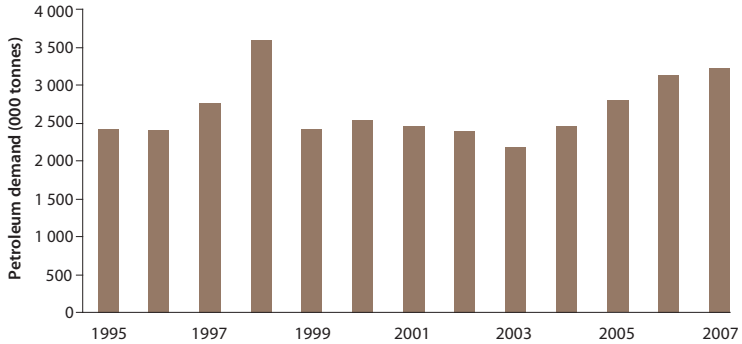


Figure 14: National petroleum energy demand, 1995 – 2007 (Source: CBS 2001)

In recent years, Kenya has geared up petroleum exploration as a major step towards providing the energy needed to attain Vision 2030. To this end, several inland and offshore blocks have been leased to petroleum exploration companies (Figure 16). Adherence to high environmental standards during the exploration and production process is essential, especially since some of these blocks overlap with existing protected areas.

It is important to note that demand for petroleum sometimes increases with drought events and that petroleum consumption is a major source of the greenhouse gases that contribute to climate change. On the other hand, traditional domestic energy sources such as fuelwood and hydropower could be managed on a sustainable basis, while other renewable energy sources, such as solar, geothermal, wind, and biogas, could be developed to increase their contribution to the nation's energy needs.

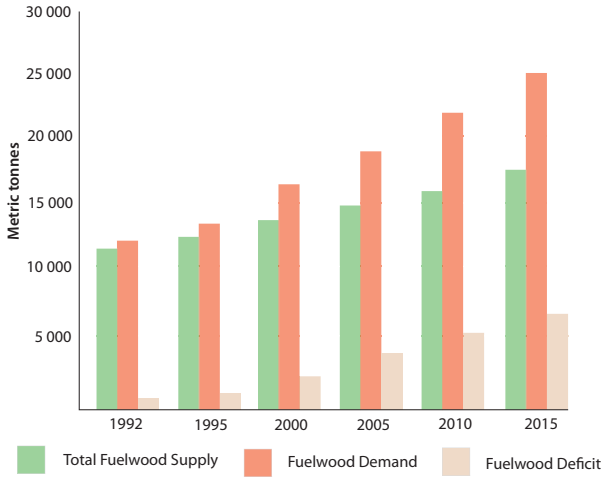


Figure 15: Fuelwood supply, demand, and deficit (Source: MENR 1994)

Traditional Energy: Fuelwood

Fuelwood is the nation's major source of energy, especially for rural people who make up 80 per cent of the total population. Although it constitutes the most significant energy source, the resource base is rapidly shrinking as demand outstrips the sources of local firewood and charcoal (Figure 15). Furthermore, the use of inefficient methods of burning is widespread, including traditional three-stone fireplaces for firewood and earth-mound charcoal kilns. Excessive reliance on fuelwood and the supply/demand imbalance are the cause of much deforestation and forest fragmentation, which in turn accelerates land degradation and threatens water catchments (GoK 2008). In addition to hampering the achievement of Vision 2030's economic goals, the fuelwood crisis undermines progress towards the MDG goal of increasing the land area covered by forest. Another impact of burning fuelwood and charcoal is respiratory illness among women who are exposed to indoor smoke from kitchen fires. There is, therefore, a great need for the adoption of improved efficiency and energy-saving stoves and kilns and for the nation to shift away from a reliance on fuelwood, or excessive demand will increase pressures on already vulnerable forest resources.

Bundle of fuelwood

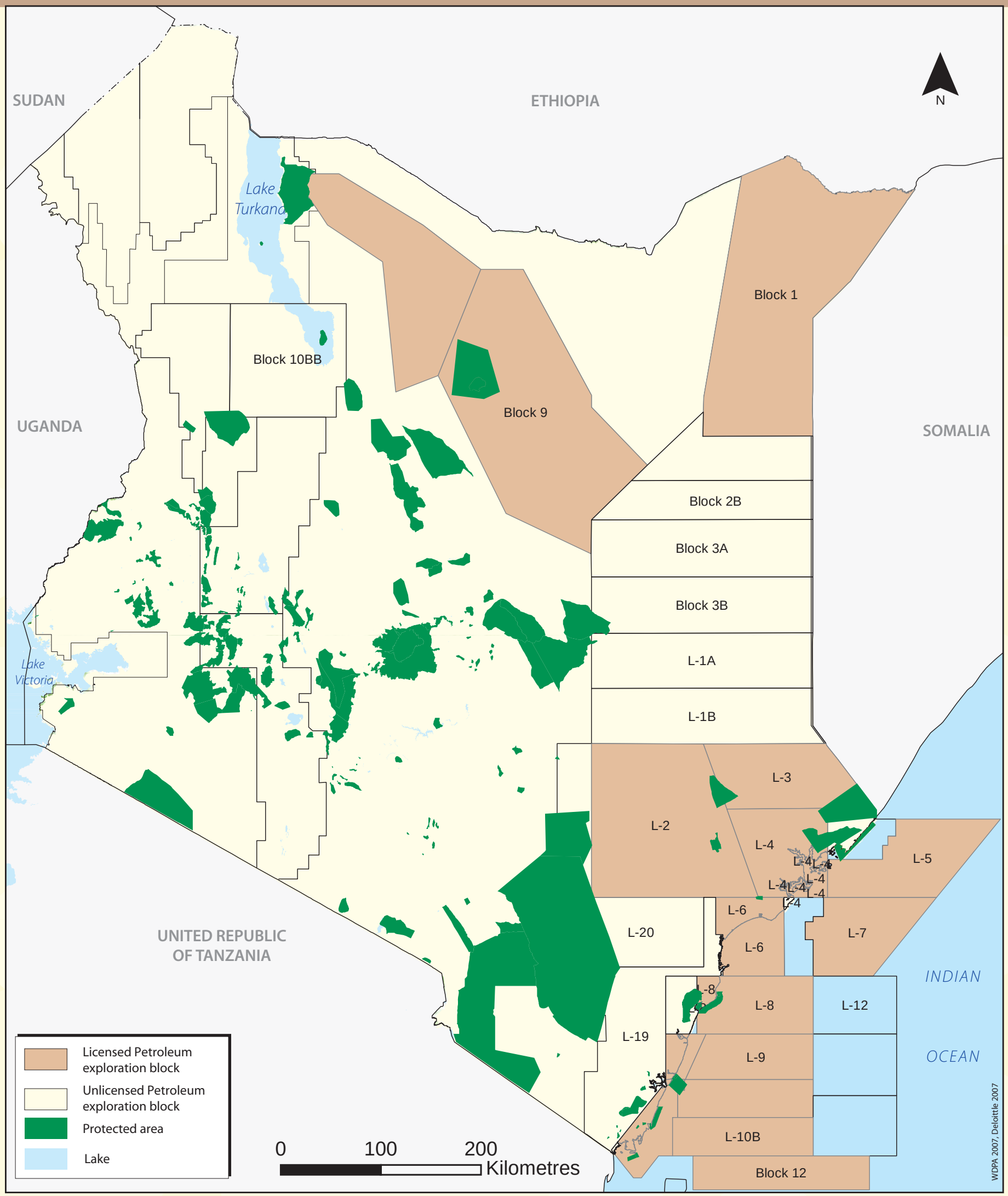


Figure 16: Inland and offshore licensed and unlicensed petroleum exploration blocks and protected areas overlap in various instances

Renewable Energy

Eighty-one per cent of the energy used in Kenya is from renewable sources, including solid biomass (fuelwood) (REN21 2008). Geothermal energy is by far the most developed renewable energy form, accounting for about 11 per cent of all the electricity produced in the country (GoK 2008). It is produced at three sites in the Rift Valley and a new plant is being built in Hell's Gate National Park to increase capacity. Kenya's geothermal potential is very large and it has several advantages — it is generated domestically so doesn't rely on expensive oil imports and it doesn't emit greenhouse gases. Future development, however, must avoid damaging the environment for local people, wildlife, and tourism.

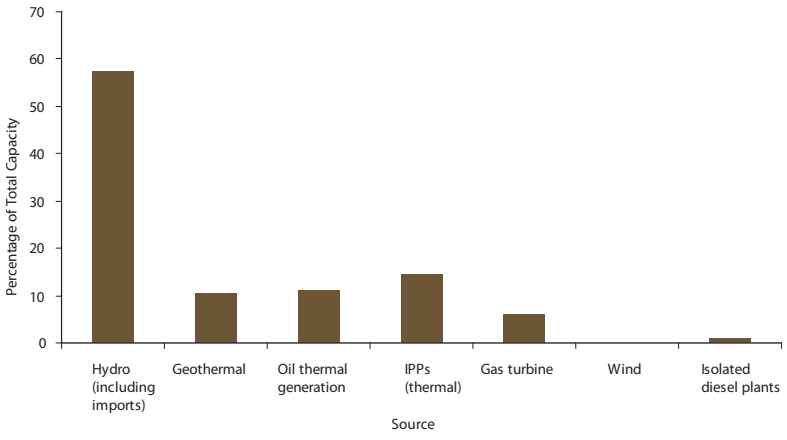


Figure 17: Electricity power generation capacity from various sources, 2000 (Source: GoK 2008)


Ambrose Oroda

Steam rises from a geothermal plant

Kenya's electric power generation capacity in the year 2005 was 5.5 billion kWh (EIA 2008). In 2000, hydropower accounted for about 57 per cent of the total. Petroleum based, geothermal, and wind account for 31 per cent, 11 per cent, and less than 0.1 per cent respectively (GoK 2008) (Figure 17).

The water used in hydropower generation comes from dams on major rivers flowing from Kenya's five water towers (page 6). Deforestation, land cover conversion, or any other activity that degrades these water towers will in turn lead to a reduction in the amount of electricity generated hence directly affecting the attainment of Vision 2030.

The exploitation of solar, wind, and biogas energy is still very low in spite of the country's enormous potential for these environmentally sound energy sources and the need for sustainable and affordable energy sources to reduce reliance on fuelwood (GoK 2008). Solar energy is currently under-exploited although it widely regarded as a plausible option to stimulate rural electrification. To date, it is being exploited in Kenya for lighting (photovoltaic), water pumping (mechanical), refrigeration, and water heating (solar water heaters). The solar market is currently estimated to be worth over Ksh. 300 million per year. A solar photovoltaic policy framework and strategy is being developed under the power sector reorganization programme.

Wind energy also remains largely under-developed and under-exploited. A study in 2002 found there is the potential for about 0.6 per cent of total energy to come from community wind energy (GoK 2002). Wind energy applications, especially those related to mechanical functions, have a long history in Kenya. In 1986, there were over 200 working windmills, of which about 100 were in Lamu and Mombasa districts. Local expertise for building windmills, especially for water pumping, is still available in the private sector. The Ministry of Energy created a national wind atlas for Kenya in 2003. It provides useful information to facilitate both public and private sector investment in this important energy sub-sector.

Biogas technology for cooking and lighting gained momentum in the mid-1980s during the German-funded Special Energy Project. Active promotion of biogas resulted in an estimated 1 000 biogas plants being constructed and in use by 1995. Most of these plants are found in areas of high agricultural potential.


International Rivers

Young man selling a solar panel

Flash floods wash out a section of a road in Baringo District

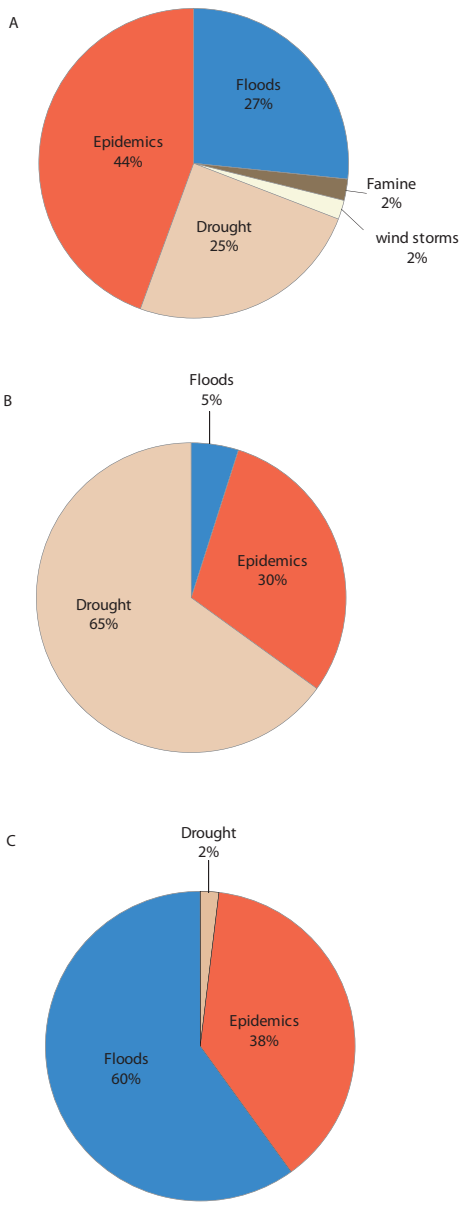


Figure 18: Types of hazards in Kenya (Source: Mutua 2005)

Key: a) Prevalence b) People affected c) People killed or affected adversely (disasters)

Environmental Disasters and Challenges to Vision 2030

Kenya has always been plagued by natural, weather-related disasters that cause diseases, deaths, and suffering throughout the nation. Figure 18 illustrates the prevalence of various types of hazards and the proportion of Kenyans affected by each of them.

Especially prevalent are the twin weather-related hazards of drought (Figure 19) and flooding (Figure 20). As the nation strives to achieve its development goals, including targets under the MDGs and those related to Vision 2030, it needs to effectively plan and manage its environmental, as well as its economic and human resources, to avoid allowing recurring natural phenomenon to turn into human and economic disasters.

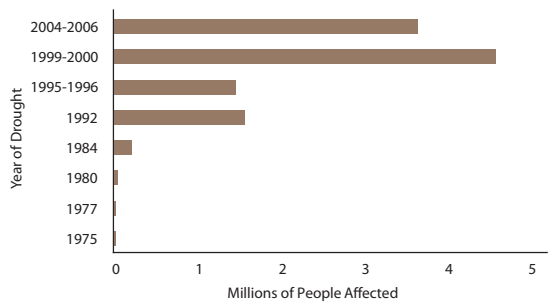


Figure 19: Number of Kenyans (million) affected by drought, 1975-2006 (Source: KMD 2008)

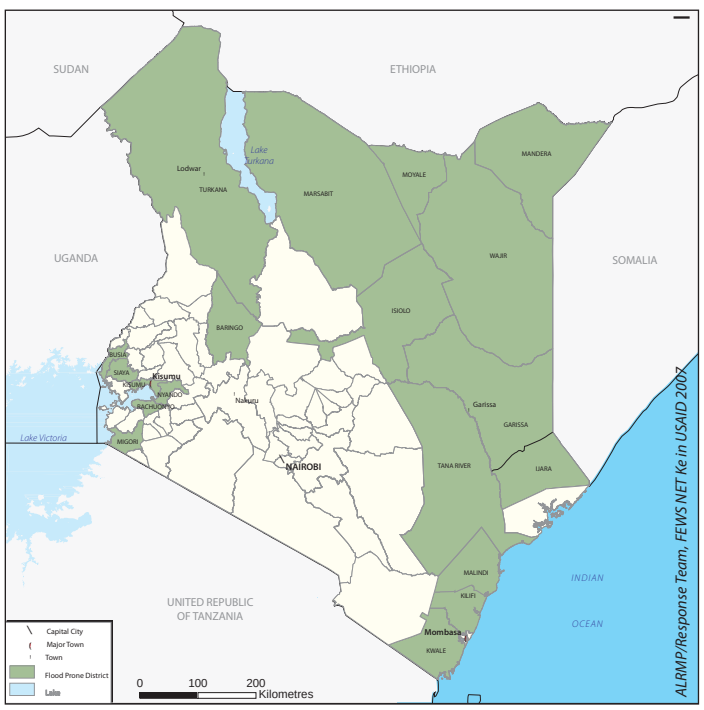


Figure 20: Areas affected by floods

Many areas, especially in the northeast, along the coast, and in western Kenya, are susceptible to floods and the country's rangeland districts generally experience flashfloods during the rainy seasons.

Although these events are natural in origin, the impacts of human-induced climate change are predicted to exacerbate them. It is already evident that the frequency and occurrence of floods in many parts of the country have increased significantly since the 1990s, for example. In addition, environmental changes brought by human activity, such as those highlighted in this Atlas, including deforestation; desertification; coastal modification, such as the removal of mangroves; and agricultural practices in fragile ecosystems, contribute to an increase in the disastrous consequences of what were once purely natural weather hazards. Protecting and restoring these environmental assets will help make Vision 2030's economic and social goals a reality.

DEPHA

Floods in the Tana River District

The Tana River Delta is among Kenya's top three largest and most important freshwater wetland systems. Local people live by the seasons, adapting to the regular floods that keep the area fertile through the year.

Floods in Bundalangi

Budalangi division lies to the north of Lake Victoria near the Kenya-Uganda border's Busia District. Floods are characteristic in the region. Between 1977 and 1984, dykes were built along the river to prevent the worst floods. Large areas of forests upstream from the source near the rivers have been cleared mainly for settlements and farmland. This has led to erosion and inevitable soil slippage and landslides when yearly floods occur. Without recourse to other options, when the dry season returns, survivors go back to their land and rebuild their homes in areas susceptible to recurring flooding disasters. A lasting solution has yet to be found.

DEPHA

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