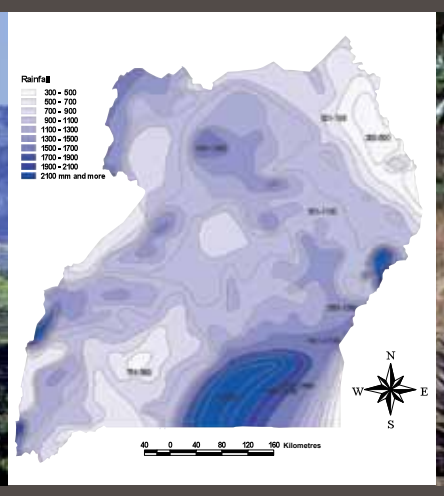
UGANDA

Atlas of Our Changing Environment

FOR GOD AND MY COUNTRY

THE REPUBLIC OF UGANDA



NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE REPUBLIC OF UGANDA

UGANDA

Atlas of Our Changing Environment

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We regret any errors or omissions that may have been unknowingly made.

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Foreword

Hon. Maria Mutagamba
MINISTER OF WATER AND ENVIRONMENT
THE REPUBLIC OF UGANDA

Uganda is a landlocked country in Eastern Africa. Our country is rich in natural resources and in the recent years we have been blessed with the discovery of oil in the Albertine Graben. It is now common knowledge that development of any society should not be at the cost of future generations. Many people especially in rural areas, are dependent on natural resources for their livelihood, and hence mainstreaming the sustainable use of these resources into Government plans and programs at all levels has been a priority of the NRM Government since it came to power in 1986. This Atlas seeks to highlight changes that have arisen from the effects of local activities and global phenomena. It also demonstrates the capacity Uganda has built over the last twelve years in using new technologies to provide information to aid decision making processes. Tracking environmental changes is not new because warnings have been issued bi-ennially in the National State of Environment Reports (NSOER) since 1994. However, the uniqueness of this publication is the evidence based information from multi-temporal satellite images, ground photographs and graphics to confirm some of the negative and positive changes in our environment.

This Atlas presents some positive changes in some areas which decision makers and other readers will find useful. However, allow me to highlight some key findings which need to be integrated in development plans in order to reverse the negative effects. The siltation of our lakes due to uncontrolled activities on land especially for Lakes Albert and Victoria needs urgent attention. The shrinkage in area of some lakes especially for Wamala affecting the fish catch requires urgent intervention measures. Loss of woody biomass due to charcoal burning and enchroachment of forested ecosystems especially in Nakasongola, Nakaseke and Kiboga Districts will have big consequences on the water regime and needs urgent intervention at both national and local government levels. Finally unplanned settlements in drainage channels especially in urban areas resulting in floods should be halted immediately.

I hope that this Atlas will make all the people of Uganda believe in the wealth of our natural resources and also threats that we face as a country because of human activities. There is a saying that “seeing is believing” and this Atlas provides visual information of our changing environment.

I wish you all good reading.

Acknowledgement

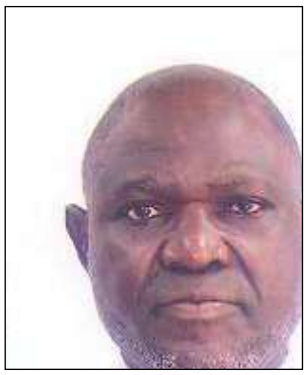
The National Environment Management Authority is pleased to present the atlas for Uganda's changing environment. This publication uses remotely sensed data, ground photographs and graphics to provide evidence on both positive and negative environmental changes over the years.

I sincerely thank the Government Departments and all Local Governments under the umbrella of the Environment Information Network (EIN) for contributing data and committing time to produce this atlas. This has demonstrated the level of collaboration that exists and capacity built among institutions in Uganda. This collaboration is a good building block for enhanced environmental management in the country.

Special thanks go to UNEP-GRID Arendal in Norway who provided the main finances and technical support that enabled preparation of this Atlas. I also wish to extend my gratitude to the United Nations Environment Programme (UNEP) office in Nairobi and Sioux Falls (USA) who provided financial, technical support and satellite imagery for this atlas. The Regional Centre for Mapping of Resources for Development (RCMRD) in Nairobi is recognized and appreciated for providing the useful satellite images.

Finally, I do appreciate the commitment of my staff who were involved in the technical preparation, review and production of this invaluable resource material. I can only urge them to continue with the good work.

This publication should serve as a tool for informing decision making processes in Uganda.



Aryamanya-Mugisha, Henry (Ph.D)
Executive Director
NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)
UGANDA

Sunset over Europe and Africa

A digital composite made by several Earth-orbiting satellites and ocean-faring ships, this image simulates the sun setting over Europe and Africa. The night side of the image, taken by DMSP satellites, is dotted with bright city lights and lighted road networks such as Paris, Barcelona, and cities in Holland.

The daylight side is composed of land images taken from the MODIS instruments on NASA's Terra satellite. In the daylight side, the vegetation shows green, non-vegetated areas are tan, and ice is white. The topography of the ocean floor is also visible with the Madeira, Canary, and Cape Verde islands showing clearly in the blue of the Atlantic Ocean.

The image taken by the crew on board the Columbia during its last mission before it crashed in space on the 01st February, 2003 at 4:36 pm shows Europe and Africa when the sun is setting. Half of the picture is in night and the bright dots you see are the lights in cities. The top part of Africa is the Sahara desert. Lights are already on in cities in Holland, Paris, and Barcelona, and it is still daylight in London, Lisbon, and Madrid.

The sun is still shining on the Straight of Gibraltar, and the Mediterranean Sea is already in darkness. In the middle of the Atlantic Ocean you can see the Azores Islands; below them to the right are the Madeira Islands; a bit below are the Canary Islands; and further south, close to the farthest western point of Africa, the Cape Verde Islands. The Sahara is huge and can be seen clearly both during daytime and night. To the left, on top, is Greenland, totally frozen.

NASA 01st February, 2003

Lobelia sp **in the Rwenzori mountains, Kasese District, Western Uganda**

Uganda Wildlife Authority (UWA) 2008

The beautiful ridges landscape in Kigezi highlands overlooking Lake Bunyonyi in Kabale District, Western Uganda

NEMA 2008

Wekesa George (S4. Seeta High School, Mukono Campus) Mikono District, Uganda 2008

Display of Jupiter, Venus and the moon triangle over Uganda on 1st December 2008

Source: **Wekesa George (S4. Seeta High School, Mukono Campus) Mikono District, Uganda 2008**

A Rare Meeting: Jupiter, Venus and the Moon

On 1st December 2008, the night-time skies over Uganda witnessed the seemingly meeting of three of four solar system's best known celestial objects. The moon, brightest of the three objects in the above photo, was 405 600 km away from Earth. Venus, to the left of the moon, was the second brightest object in the sky and 151 million kilometres away. Jupiter, the largest planet in the solar system, was a dimmer third and 869 kilometres away.

While the three celestial objects do come together from time to time, they are often too close to the sun or unite at a time when they are not so visible. The next time the three will be as close and visible, will be 18th November 2052.

Chapter 1

The Geography of Uganda

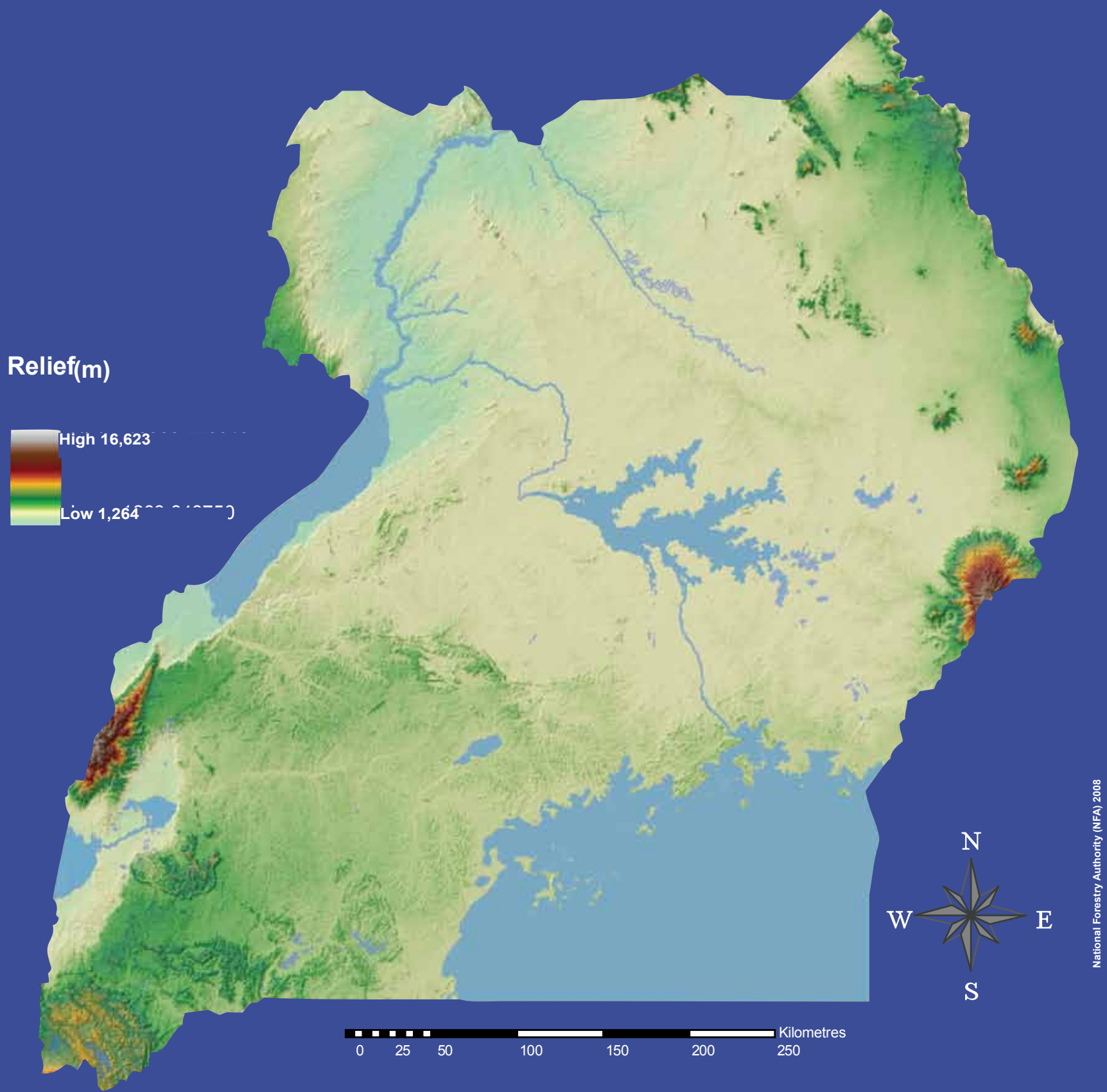


Figure 1: Uganda's Relief

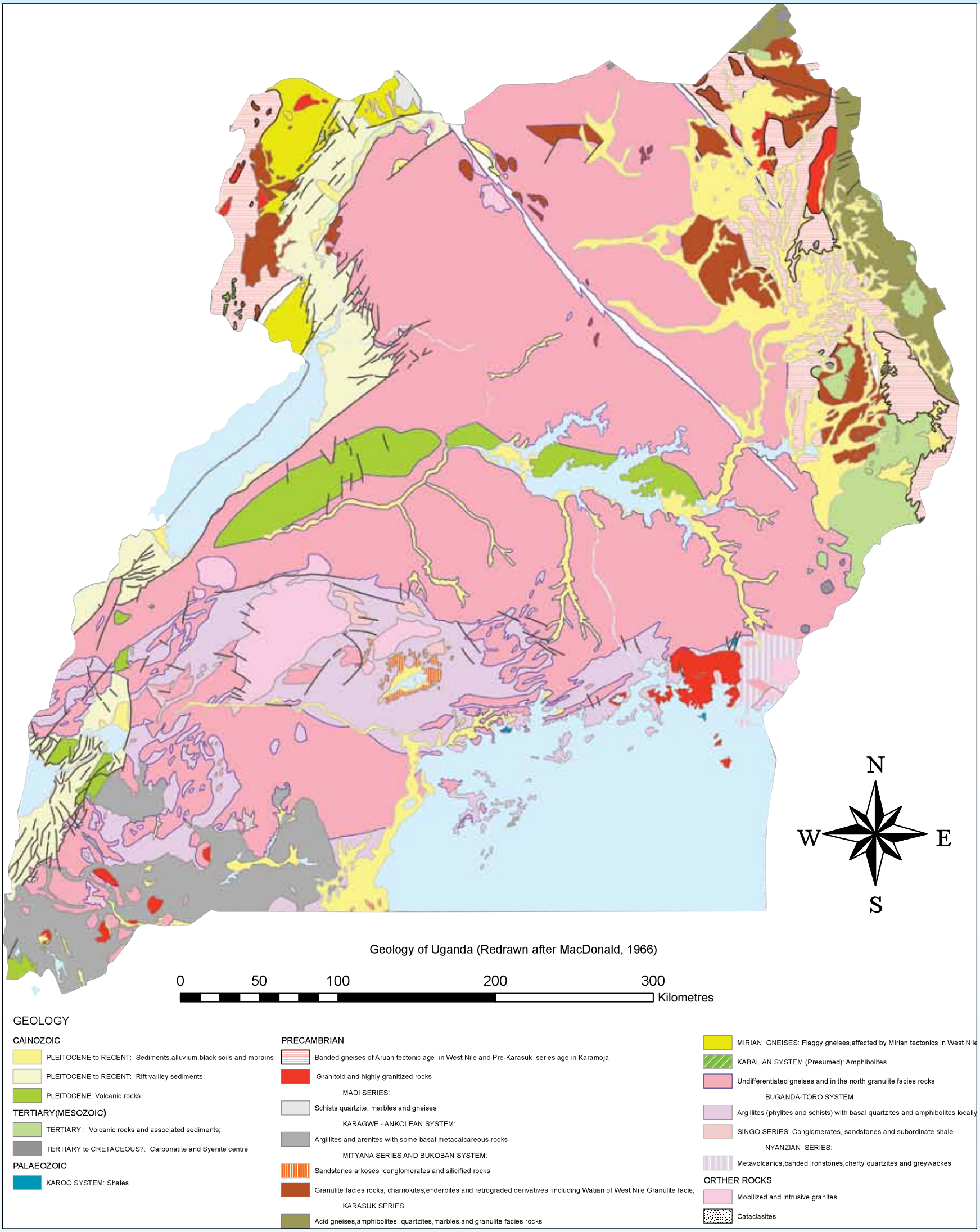


Figure 2: The Geology of Uganda

John Gibbons: Uganda At A Glance 2002

Sunset over Lake Albert in Western Uganda

Uganda lies astride the equator in the eastern region of Africa and is located on the raised part of the African plateau. Uganda is a landlocked country in East Africa and borders Kenya to the east, Sudan to the north, Tanzania to the south, the Democratic Republic of Congo to the west and Rwanda in the south-west. It lies within the latitude of 4°12'N and 1°29'S, longitude of 29°34'E and 35°0'W. The total surface area is 241,551 km² of which 199,807 km² fall under land and 41,743 km² under water and swamps. The annual temperature and rainfall range between 12°C to 32°C and 800 to 1,700 mm, respectively.

Uganda's landscape has a rich diversity of relief features with great contrasts bearing significant influence on the physical and biological environments.
The contrasts range from the great East African rift valley with the lowest elevation of about 620 m above mean sea level while the highest is about 5,111 m on Magherita peak in the Rwenzori Mountains.

The largest part of the country lies between 900-1,500 m but comprises of distinct landscape levels generally made up of plains, plateaus, and mountains.

These landscapes are a product of different cycles of erosion, and tectonic and volcanic activities that took place on the African plateau - surface. The African surface developed upon complex underlying geological structures of ancient basement rocks which are some of the oldest on earth (pre-Cambrian age), estimated to be between 3000 - 6000 million years of age.

The different landscapes bear great influence both direct and indirect, on the physical, biological, and human environments.
For example, Uganda has rich and diverse climatic conditions, ecosystems, and other natural resources which include fresh water lakes, rivers, wetlands, fisheries, forests, wildlife, minerals, and soils that support different agricultural systems. Gifted by nature, the country was once referred to by Sir Winston Churchill as the 'Pearl of Africa'.

Climate

Uganda experiences moderate temperatures throughout the year because of its location astride the equator and on a raised African plateau. The highest temperatures of over 30^0 C are experienced in the north and northeast of the country while temperatures as low as 4° C are experienced in the highlands of the southwest. Temperatures below 0°C are registered on the high mountains of Rwenzori and Elgon. The Rwenzori mountains have a permanent ice cap whose size is currently reducing, presumably due to global warming (Uganda Met. Department, 2000; UBOS Statistical Abstracts, 2006).

The high temperature records mean there is high potential for water evaporation, which in turn affects the water balance that influences the productivity of the environment, including agriculture, the back bone of Uganda's economy. Potential evaporation in excess of rainfall leads to water deficit and vice versa.

Temperature and rainfall are the most important parameters of climate in Uganda; temperatures are an important factor influencing rainfall and moisture, and in general play a major role in the determination of agro-ecological zones of the country.

Most areas experience high potential for water evaporation in excess of rainfall. Therefore, sustainable management of water resources is needed. Water balance analysis in Uganda indicates that both areas of water surplus and water deficit occur. Water surplus occurs only around the high rainfall and low temperature areas of Mt. Rwenzori and Mt. Elgon. The northern shores of Lake Victoria show a slight surplus or an almost even balance. Elsewhere, water deficits of varying degrees occur, generally increasing from south-west to north-east (Langlands 1974).

Because of its location around the equator, Uganda experiences equal hours of day light and night throughout the year, indicating that the country receives high solar radiation. However, periods of sunshine vary slightly during the day due to variations in cloud cover. The periods of high sunshine in the country are associated with lower relative humidity and a higher potential for evaporation. For example, the Lake Victoria basin experiences relatively low amounts of sunshine due to the usually cloudy skies while the south western highlands experience the lowest amounts of sunshine due to the unusually high cloud cover and prolonged light rains.

Favourable climate in Manafwa District: Young men carry maize to a grinding mill at the nearby market

Heavy rains in a Kampala surbub (December 2008) cause traffic jams, filth, diseases and incoveniences to road users and commercial establishments.
Inset: L-R: Floods in Bwaise-Kalerwe, Kampala (2007); women and children struggle to cross flooded Aswa river in northern Uganda; floods in Kyambogo, Kampala (2005)

Sunshine is an important environmental resource usually taken for granted in the country. Recently, through successful technological applications, solar energy has proved to be an important source of energy and is progressively being exploited by many to meet their energy needs.

Likewise, because of its equatorial position, high rainfall, and numerous lakes, the relative humidity is high in most parts of the country throughout the year especially in the southern and central parts of Uganda.
There are, however, spatial and temporal variations in humidity which are largely a reflection of rainfall and temperature variations.

Uganda experiences low wind speeds due to the lack of long wind-fetch environmental conditions such as expanses of flat lands and water bodies. The location of the country in the continental interior and the highly contrasting local relief features obstruct the development of high wind speeds. Consequently, the potential for development of wind-based energy in the country is limited, though still a possibility.

Although windspeeds of as low as 3m/sec can be used to generate energy for pumping water, utilisation of wind for energy generation involves initial high investment costs. However, this is a feasible innovation in irrigation and livestock agriculture and ideally suited for dry land areas such as Karamoja region and the rest of the cattle corridor.

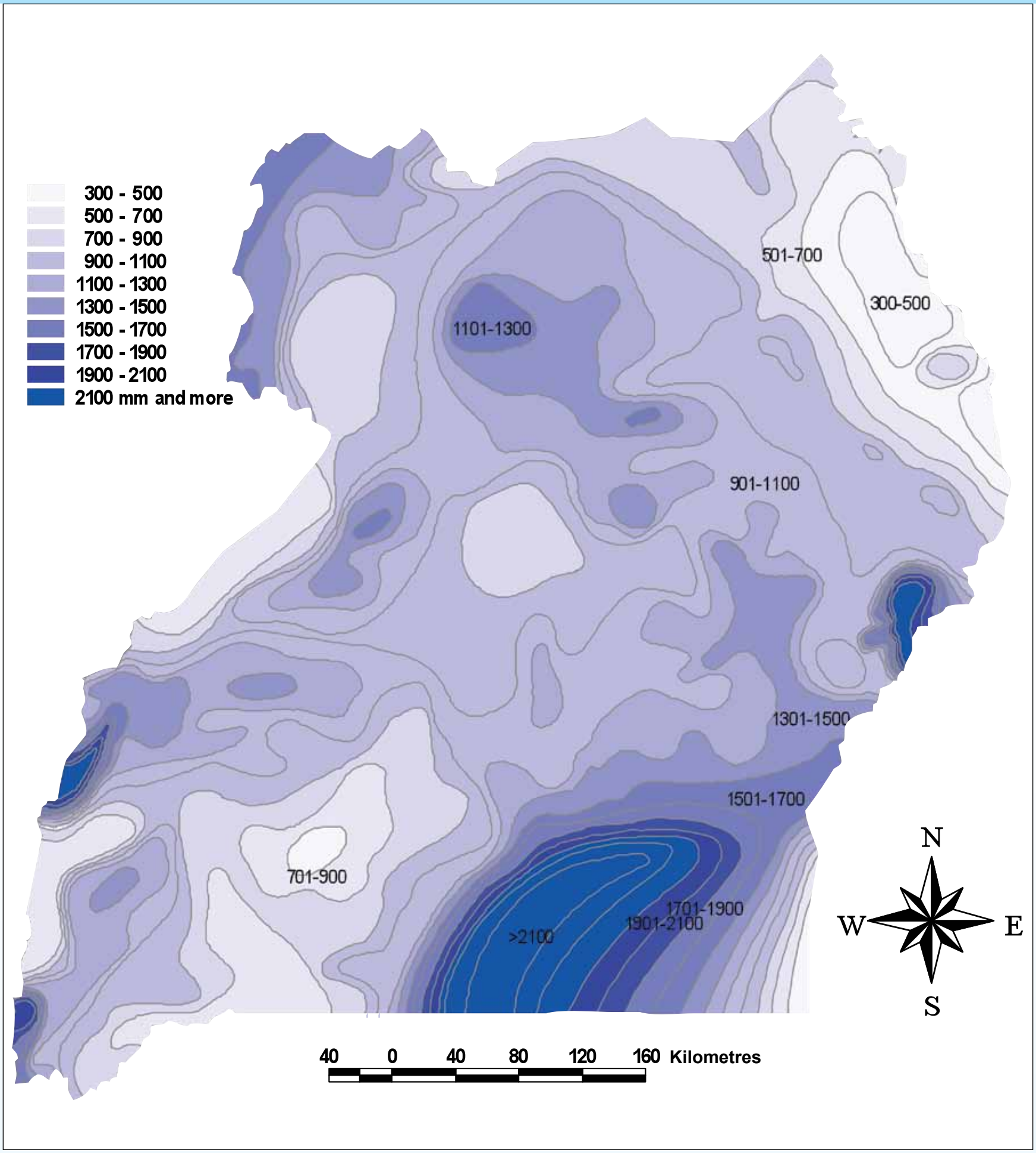


Figure 3: Uganda's Rainfall

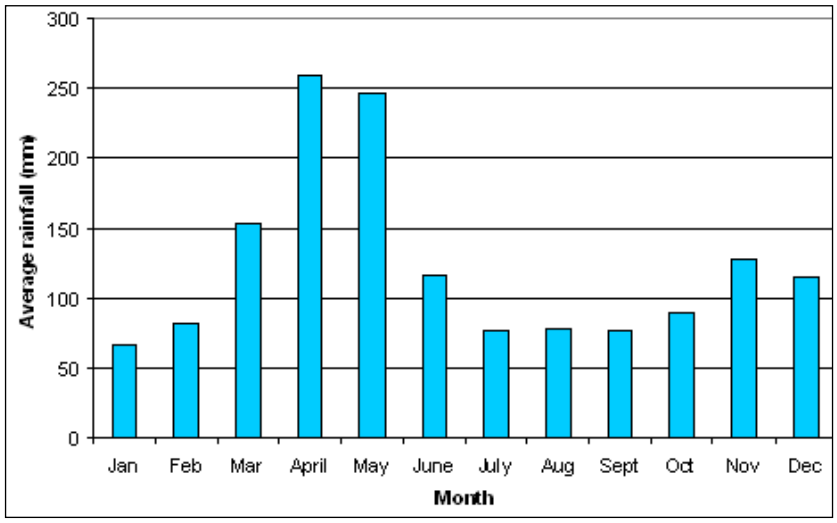
Climate disaster: Cattle trapped in a flooded Teso seasonal wetland after heavy rains. The wetland had been encroached on by massive rice growing (2007)

Uganda's rainfall and climatic patterns are influenced by variations in altitude, the Inter-Tropical Convergence Zone (ITCZ), and the air currents such as the South-East and North-East monsoons. In general, most parts of the country experience fairly well marked rainy and dry seasons. Furthermore, in areas adjacent to large water bodies such as Lake Victoria, maritime conditions tend to modify climate while in mountainous and highlands, climate is modified orographically (relief). The rainfall amounts vary over the country's regions.

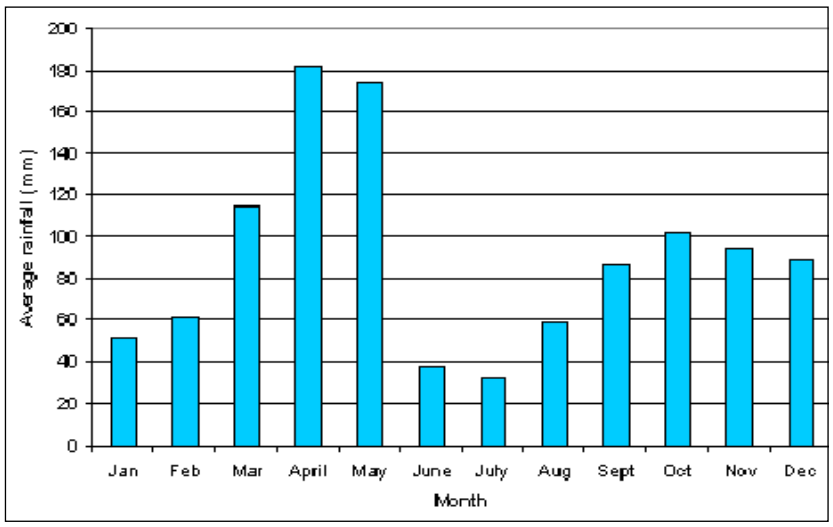
Areas around Lake Victoria receive the highest annual rainfall averages of between 1200-2000 mm. The Karamoja region in the north-eastern part of the country is characterized by an intense hot and dry season lasting from November to March. This is followed by a single rain reason that begins from April and ends around August. This region receives the lowest average annual rainfall in the range of 300-625 mm. The rainfall peaks in May and July while the driest months are December and January that are characterized by extensive burning of the dominantly shrub vegetation. In the western region the mean annual rainfall is between 875-1000 mm. However, on the higher plateaus of the region, the rainfall is over 1250 mm.

Uganda is divided into the following six climatic zones, mainly based on rainfall patterns (Figure 4).

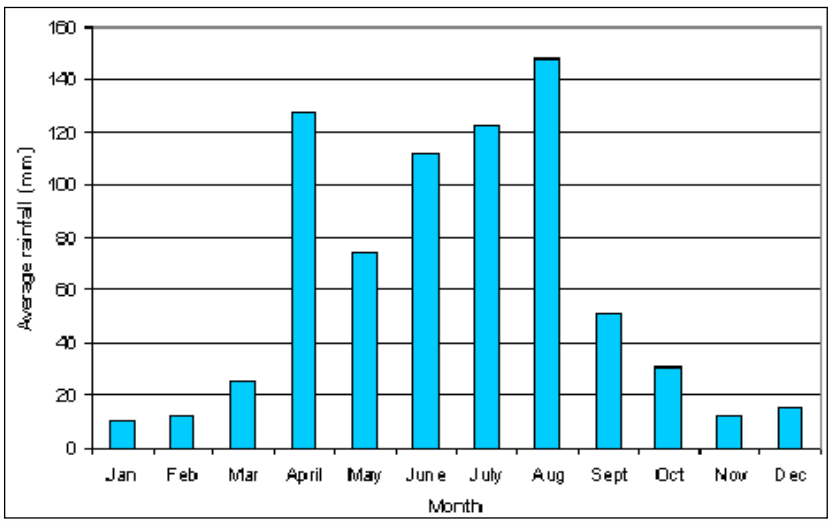
Floods caused by heavy rains in Aswa county (2007)



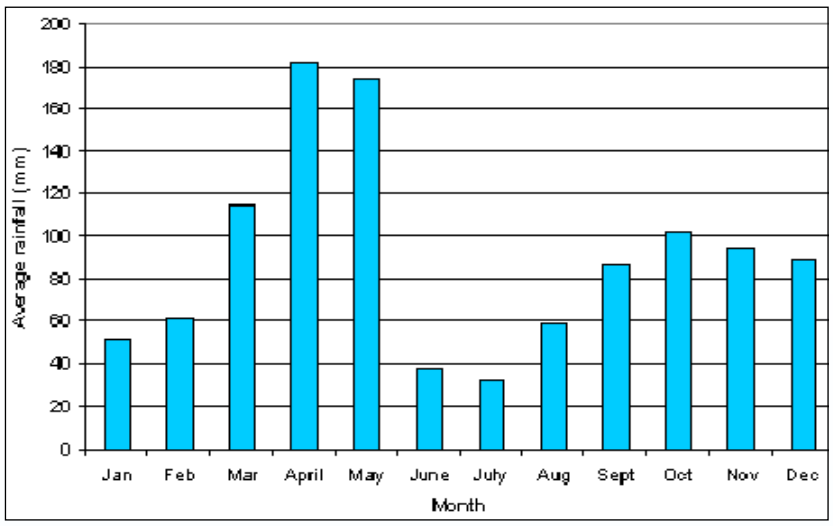
Zone 1: Lake Victoria Basin



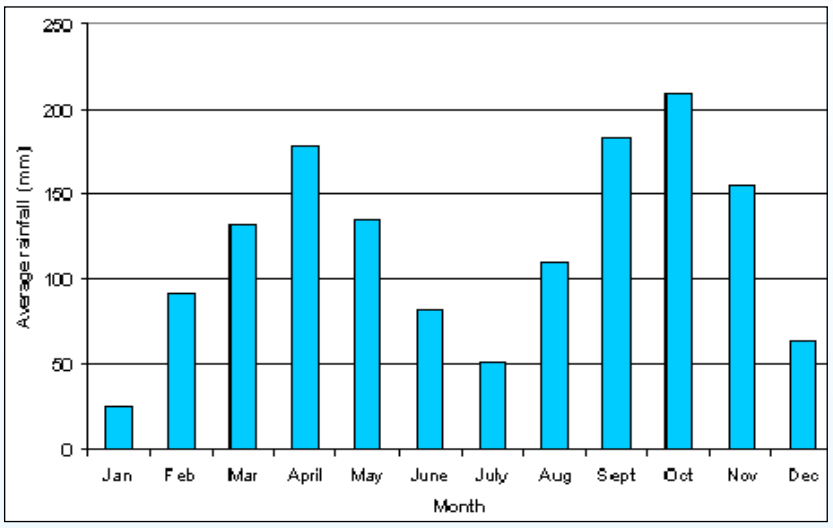
Zone 4: Acholi-Kyoga



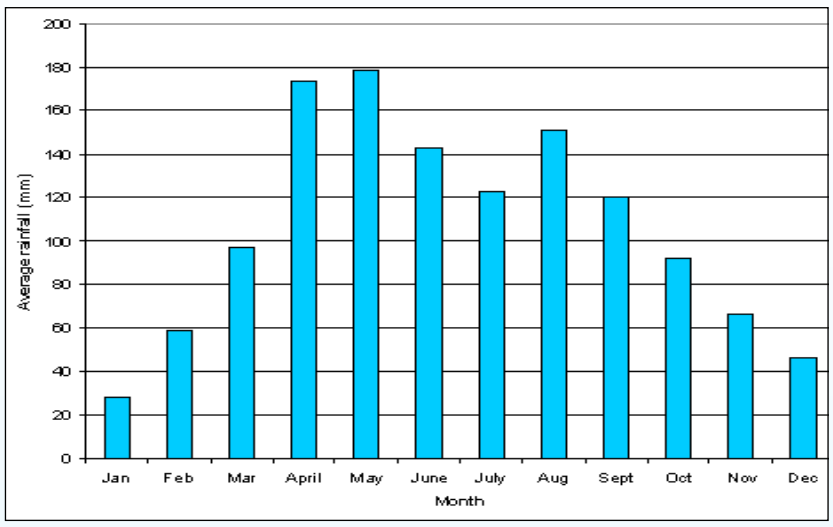
Zone 2: Karamoja



Zone 5: Southern Uganda



Zone 3: Western Uganda



Zone 6: Mount Elgon

Atlas of Uganda, 1967

Figure 4: Climatic zones of Uganda

Zone I Lake Victoria Basin

This zone is located around Lake Victoria and extends for a distance varying between 48-64 km inland from the lake shore. Rainfall varies from 1250 mm to over 2000 mm per annum. Rainfall is received throughout the year with two rainfall peaks in April-May and October-November; and two relatively low rainfall periods between December-March and June-July. The rainfall peaks are associated with the onset of southeast and northeast monsoon winds. Temperature, humidity, and wind patterns in this zone display comparatively small variations throughout the year.

Zone II Karamoja

This zone is characterized by a long and hot dry season lasting from November to March. It is the driest and hottest part of the country. There is a single rainy season from April to August. Average annual rainfall is between 300 mm and 600 mm, declining from west to east of the zone.

Zone III Western Uganda

This zone forms a relatively narrow belt along the entire western extremities of the country. The eastern limits of the zone are, however, difficult to determine. It includes the highland area of West Nile region, the escapement of the Albertine rift valley, the rift valley, the South Western highland region, and the mountains of Rwenzori and Muhavura. On the plateau, escarpment, and in the highlands rainfall is about 1250 mm, while in the mountains it increases to over 2000 mm. Generally, rainfall increases with altitude in the entire zone. The rift valley section experiences low rainfall, with averages of less than 875 mm. Temperature conditions vary widely from cold in the mountains, cool in the highlands to hot on the rift valley floor.

Zone IV Acholi-Kyoga

The zone includes much of the northern and part of eastern Uganda. The average rainfall is from 1250 mm to 1500 mm and mainly occurs between April and October (Wet season). The dry period usually extends from November to March. Rainfall is mainly convectional, characterized by afternoon and evening occurrences.

Zone V Southern Uganda

This zone extends from eastern to south-western Uganda, up to Rakai District. It experiences double maxima rainfall patterns with averages ranging from 875 mm to 1125 mm. The rainy seasons occur between April-May and September-November. The zone experiences two dry seasons, from June to July and December to January. The rainfall patterns in this zone are largely influenced by the maritime Lake Victoria conditions and the Inter-tropical Convergence Zone (ITCZ). The rainfall is dominated by thunderstorms of convectional nature.

Zone VI Mount Elgon

This zone experiences the main rains from March to September but with a sharp dry spell in June, and with a dry period from December to February. The rainfall patterns are influenced by both the orographic effects of the mountains and the proximity to Lake Victoria, through increasing total rainfall and decreasing the severity of the dry period. On the mountain foot hills and slopes, rainfall decreases from south (1250-1500 mm) to north (1000 mm) with the northern slopes falling within the rain shadow of the mountain.

Human settlements along the shores of Lake Victoria in Bugiri District. The trees planted by communities did not effectively ameliorate the effects of climatic extremes in the area as the regulations on managememt of the catchment zone were not adhered to (2005)

Dried Mubuku River during the dry season, Kasese District. In the background: Mt. Rwenzori ranges (2008)

Maritime climatically influenced Lake Victoria plains at Kakira in Jinja District (2008)

Heavy rainfall triggered landslides on Mt. Elgon at Busayi Bududa in November 1997; it destroyed 97 houses.

Water Resources

A degraded lake-shore catchment zone on Lake Albert, Nebbi District (2006)

Uganda is well endowed with water resources which consist of open water bodies (lakes and rivers), wetlands, groundwater, and rain water. Of the 241,500 km^2 total area of the country, fresh water lakes occupy 36,280 km^2 (15%), while 5,180 km^2 (2.2%) are covered by permanent wetlands. Lake Victoria is the largest lake in Uganda and the world's second largest fresh water lake. Several lakes are shared between Uganda and the neighbouring countries, while others are entirely located within the country.

This water is used in several ways: domestic consumption in rural and urban areas, for industry, agriculture, wildlife, transport and power generation. In addition, the open water bodies and wetlands are home to rich biodiversity including fisheries resources.

Furthermore, wetlands which occupy the transition between open water bodies and terrestrial eco-systems perform important regulatory functions such as filtration of pollutants from the mainland.

Water resources in Uganda are maintained through a dynamic balance between precipitation, evaporation and evapo-transpiration from open water, swamps and land in general. For example, of the estimated 118 billion cubic metres of water entering Lake Victoria from rivers and streams, 94.5 billion cubic metres (80%) evaporates, leaving only 23.5 cubic metres (20%) to flow into River Nile.

The actual evaporation ranges from 45% in dry areas to about 92% in humid areas.

Children at a hand-wash safe water point, Kamuli District (2006)

Water levels in major lakes

Lake Bunyonyi in Kabale District, Western Uganda (2008). The lake catchments are well managed.

Water levels

From 1948 Lake Edward highest water levels ever recorded is 2.68 meters in May 1978 and the lowest is 0.91 meters in July 2000. This is a difference of 1.77 meters between the highest and lowest water levels ever recorded on the lake. The lowest water levels can be attributed to the drought conditions from 1999 (La Niña).

From 1945 Lake George highest water level ever recorded is 5.19 meters in May 2002 and the lowest is 4.08 meters in march 1974. This is a difference of 1.11 meters between the highest and the lowest water levels ever recorded.

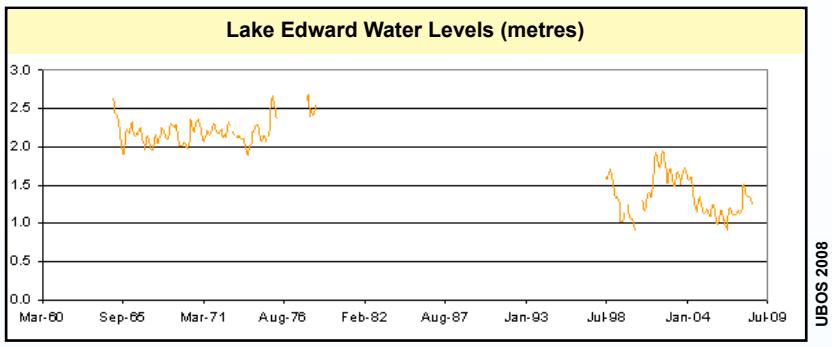


Figure 5: Lake Edward

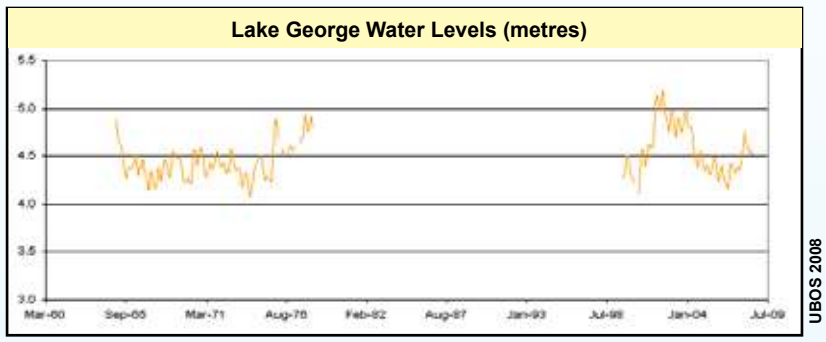


Figure 6: Lake George

Major Lakes Catchment Areas

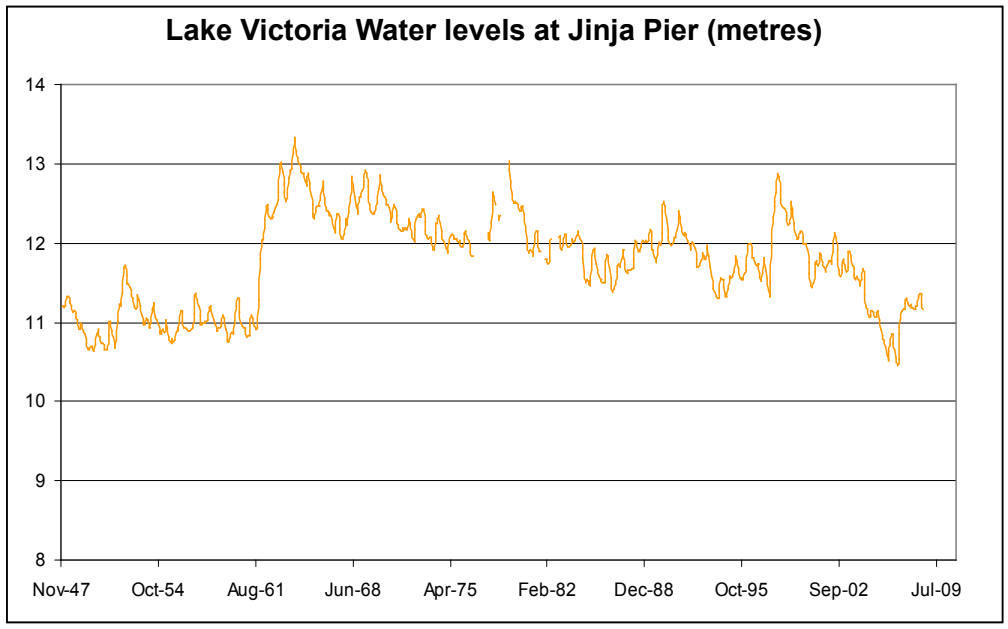
Nearly the entire country lies within the River Nile Basin save for a small portion in the north east that drains into Lake Turkana.

Most of the Lakes in Uganda may be classified as shallow; for example Victoria the largest lake has an average depth of only 82 m, while some of the lakes like Kyoga have average depths of less than 10m. The lakes, Edward and Albert and the volcanic lava dammed Lake Bunyonyi, have the greatest depths presumably due to deeper depressions created by intense warping and later filled with water.

The varying depths have an important bearing on the water storage capacity of the lakes and sensitivity to reduction in storage due to the increasing problem of silting as a result of environmental change.
Uganda is well endowed with drainage systems, with a large number of rivers and streams draining from eight river basins into River Nile.

Lake Water Levels

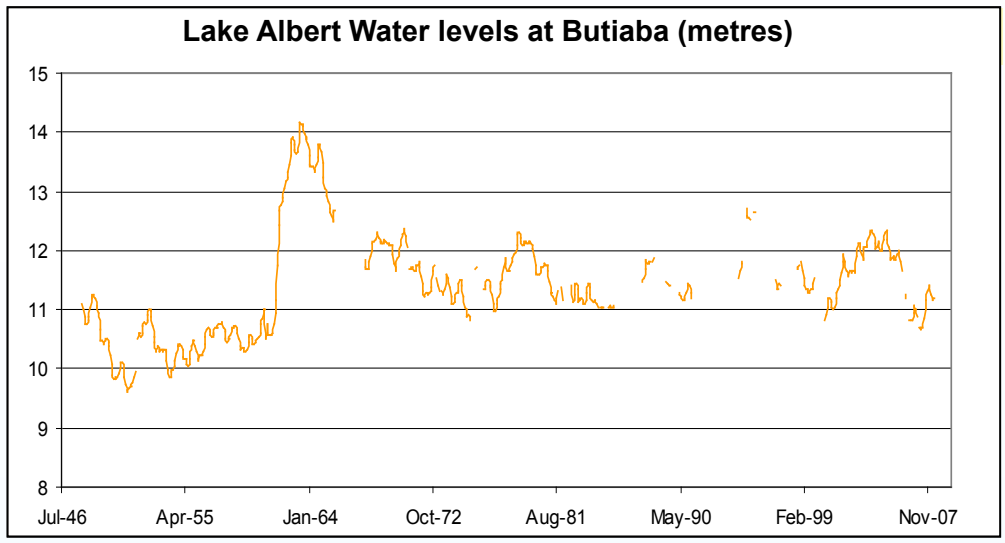
Lake Victoria highest water level ever recorded is 13.34 meters in May 1964 and the lowest is 10.46 meters in October 2006; a difference of 2.88 meters.
The highest water level was attributed to heavy rains (El Niño) that occurred in 1963, while the lowest level can be attributed to drought conditions over the lake basin (La Niña) from 1999.



Source: DWRM, MWE

From 1948 L. Albert highest water level recorded is 14.16 meters in June 1963 and the lowest is 9.61 meters in March 1951; a different of 4.55 meters.

The highest level was attributed to the 1963 heavy rains (El Niño)



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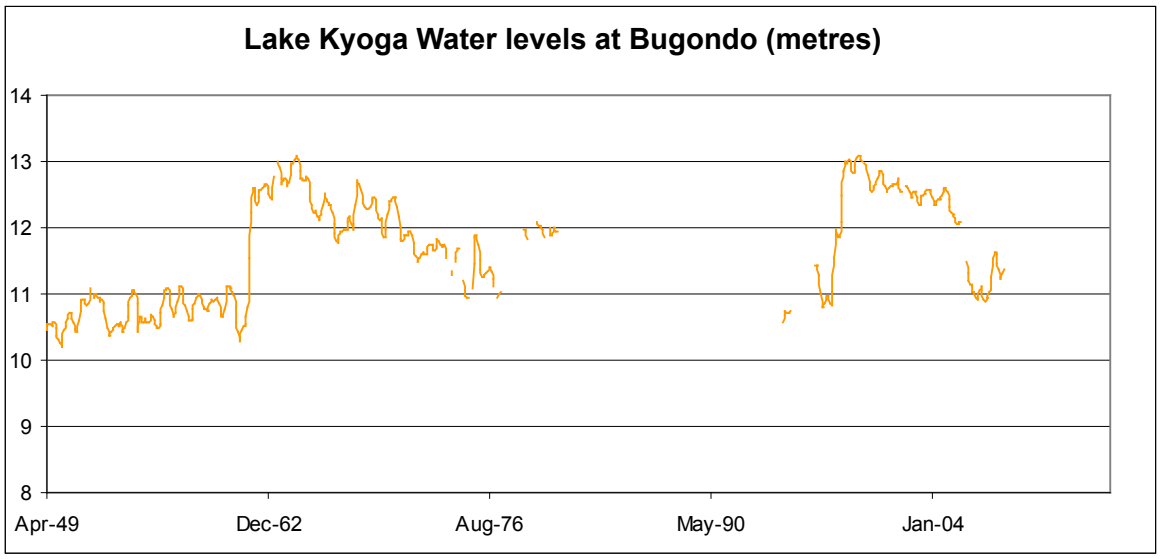

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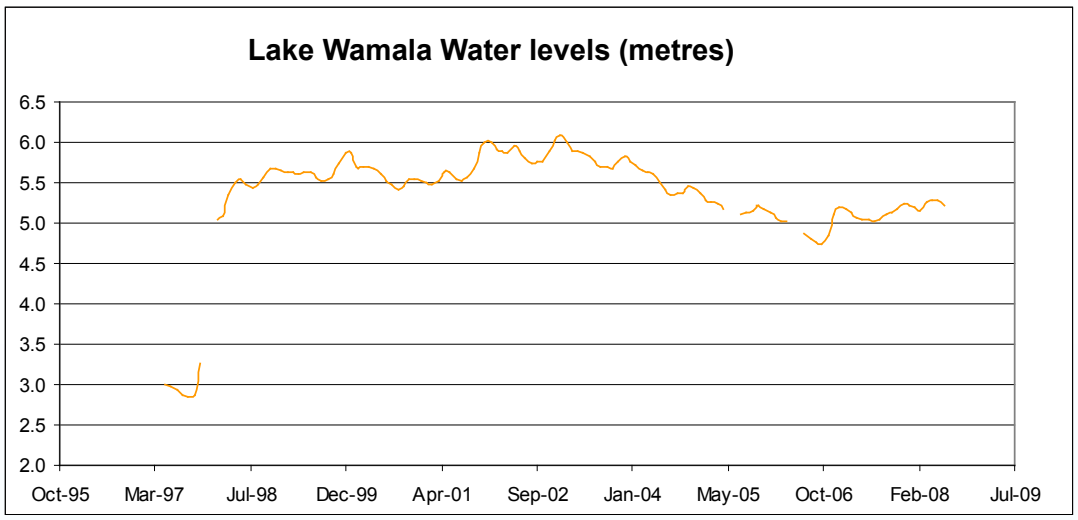

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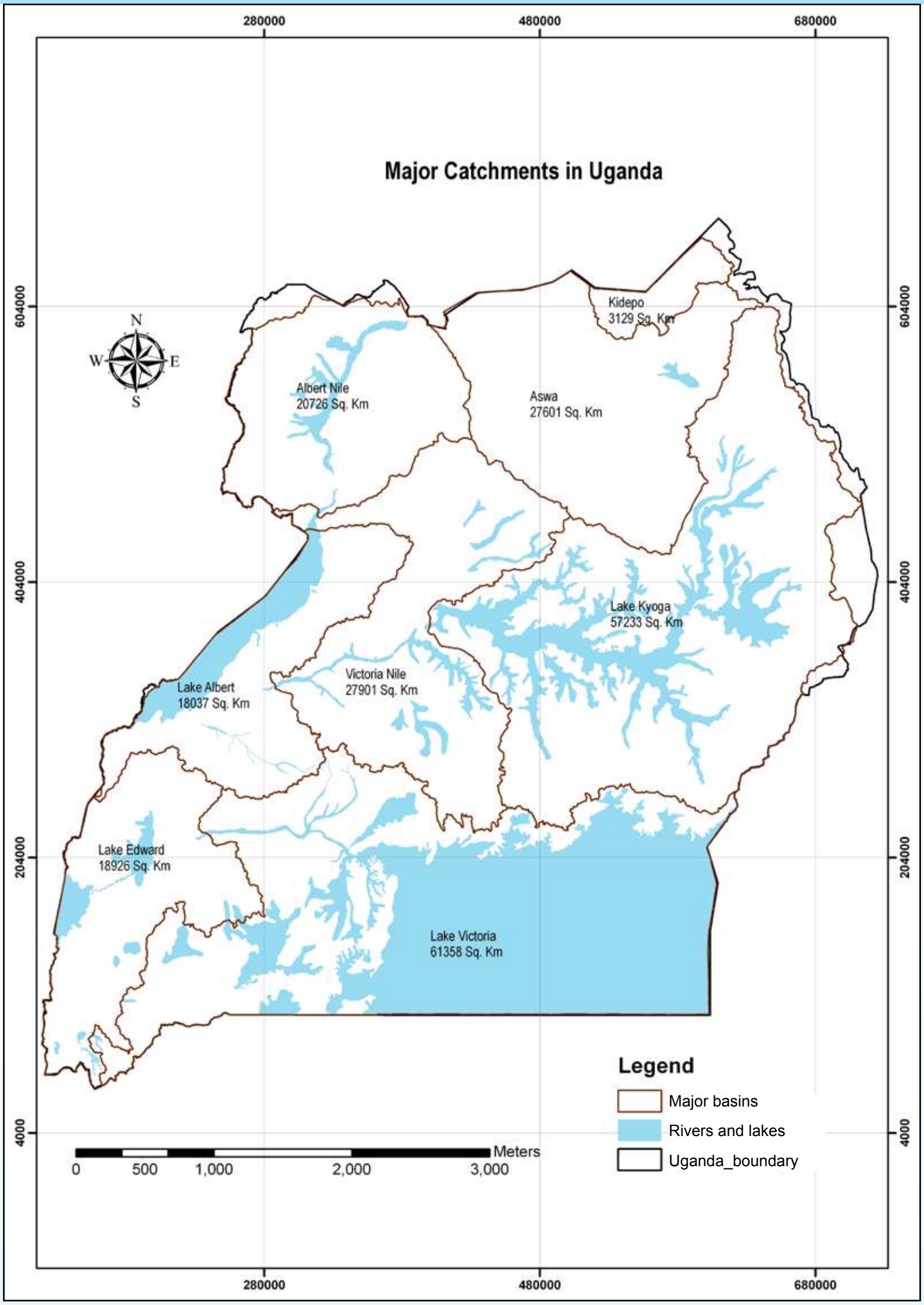

Figure 7: River Basins in Uganda

Edema Marice 2008

Aerial view of the River Nile at Moyo, West Nile region (2008)

Silted streams in Dufile (Laropi) sub-catchment that empties into the River Nile

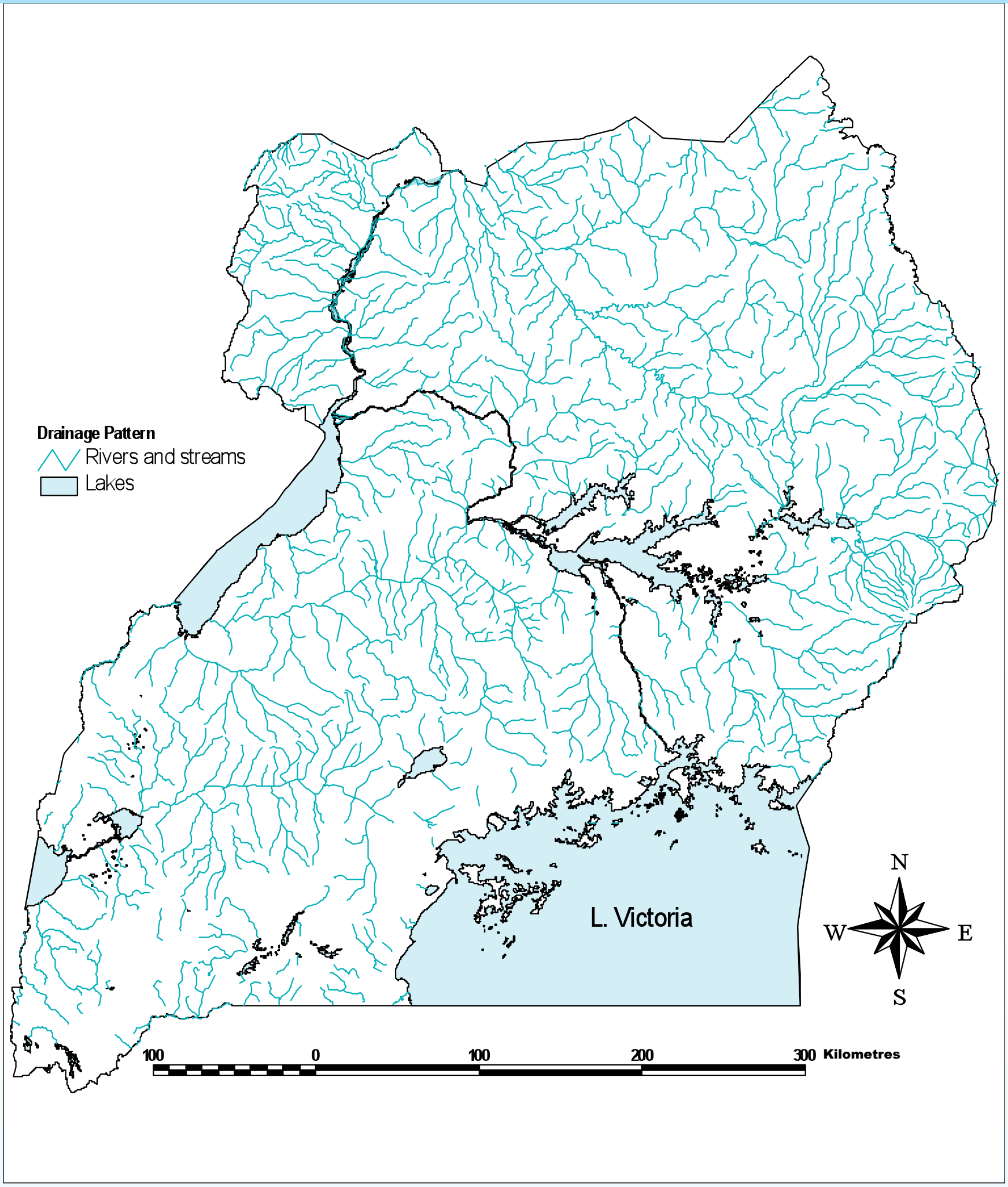

Figure 8: Uganda's water potential

Water transport at Port Bell on Lake Victoria. In the recent past, the port area has been infested with an algae bloom suspected to be a result of increased pollution from Kampala City in the immediate hinterland, through Nakivubo Channel, making the water dirty and smelly.

The drainage system of Uganda portrays a dense texture and is highly complex, especially in the western parts of the country. It is mainly influenced by landscape structure, as a result of the initial uplift of the African surface in this eastern part of the continent; and then the tectonic and volcanic activities that took place during the later geological times. As result of initial uplift of the African surface (plateau) the Uganda part of the plateau is thought to have experienced gradual tilt westwards. Consequently, most rivers were drained westwards into the River Congo in Central Africa. Later, with the formation of the uplifted shoulder of the Western Rift Valley, the rivers became reversed to flow along their courses into a down-warped axis to form lakes Victoria and Kyoga.

Many rivers flow through valleys with an imperceptible break in swamps from which water flows out in each direction.

Many of the rivers, especially those of the west, flow sluggishly in unusually wide valleys. The rivers of eastern Uganda generally flow in the old courses and in their original direction. The rivers of the rift escarpment became rejuvenated along their lines and flow in their original direction. Another effect on drainage is the formation of mountains from which arise, a clear radial pattern of drainage systems. The mountains serve as an important water tower and perennial source of water for the surrounding areas and beyond.

The combination of structure and rich drainage system has made Uganda's rivers to possess high potential for hydro-electric power production, as most of them pass through a series of falls and rapids. This provides opportunities for environmental sustainability and development since hydro power is a clean and cheap energy. Additionally, it is a potential substitute to some of the fossil fuel and fuel-wood energy sources to meet needs in the country.

Ground water

The water problem in Kamuli District, Eastern Uganda makes harnessing of ground water the best option: children collect water from a community ground water pump (borehole).

Children access water from a protected spring in Bugiri District (2005)

Although exploitation of surface water resources still accounts for more than 50% of the population needs, ground water resources are increasingly becoming important. However, its full potential is yet to be established, and it is believed that its development will go a long way in meeting the projected increased demand in future.

Ground water potential in the country is mainly determined by the geology and rainfall in a given area. Generally, areas underlain by fine grain rocks and soils have low ground water potential because of limited infiltration compared to those with coarse grain rocks and sandy soils. Similarly, low rainfall areas have low ground water because of low infiltration.
The geology of Uganda is not especially rich in ground water because of lack of true aquifers. Ground water is often readily available from fissures in the Gneissic Complex at about 100 m depth. The bulk of Uganda is under-lain by this Gneissic Complex which is of pre- Cambrian age. In the limited area of the country where ground water resources have been exploited, there is evidence of gradual decrease in the level of ground water which has been attributed to abstraction in access of yield. There is need for surveying and mapping of ground water resources potential in the country and assessing the sensitivity of this resource to excessive abstraction.

Communities in Northern Uganda access unsafe surface water for domestic use (2005)

Soroti Catholic Diocese Integrated Development Organisation (SOCADIDO) displays a borehole and its benefits during World Environment Day celebrations (2006) in Kumi District.

Environmental Education/Education for Sustainable Development. Children involvement in environment management: A pupil's drawing produced during the World Environment Day (2003) Uganda Primary Schools Art competitions under the theme "Water, we all need it, save and conserve it".

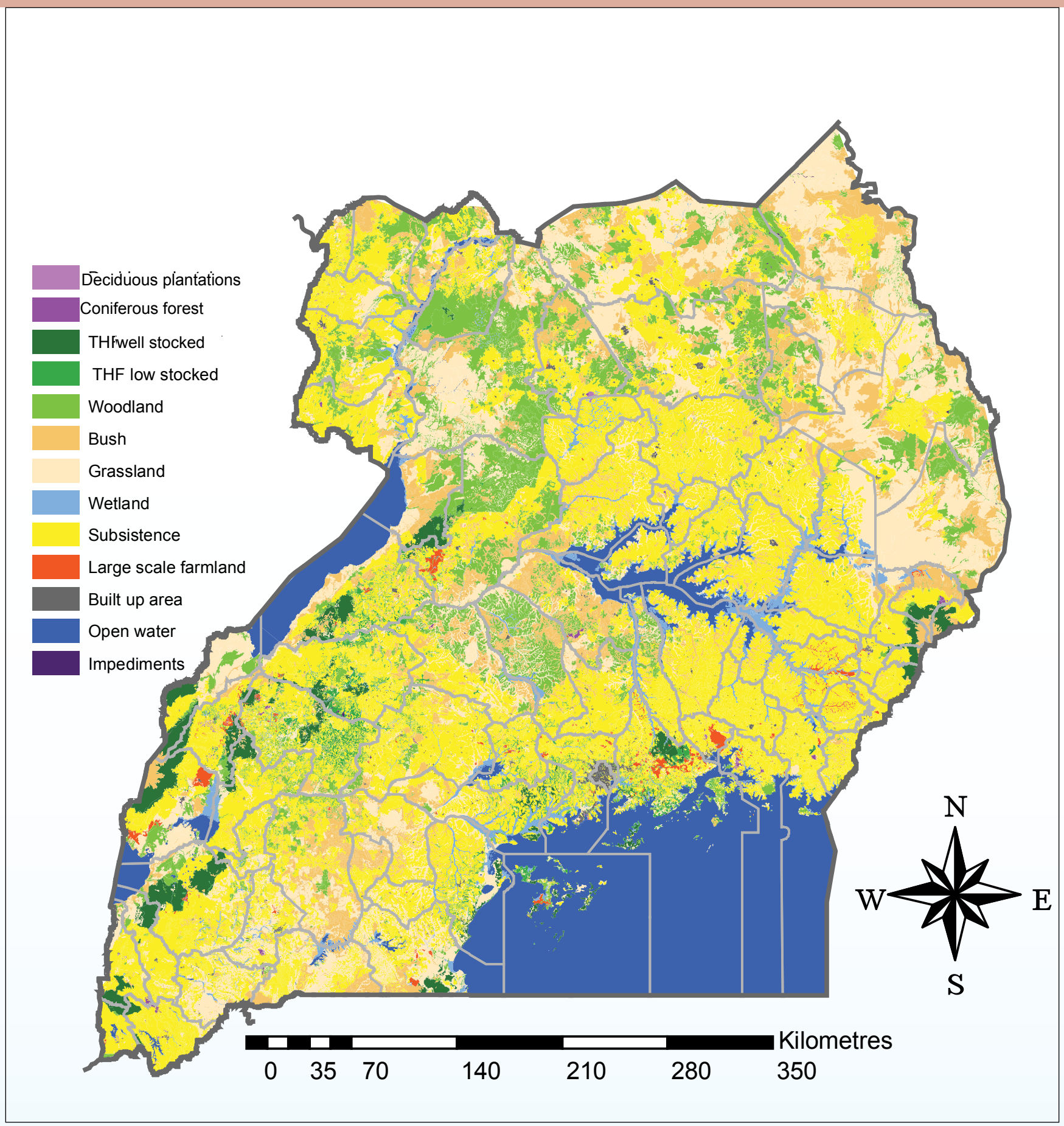

Figure 9: Uganda's Land Cover Classification

Land constitutes the main resource capital that is available to the people of Uganda. Specifically, land supports agriculture on which the country depends as an engine for economic growth and as a basis for rural livelihoods. The total area of Uganda is estimated at about 241,551 km^2, consisting of subsistence and commercial farmland, grassland, woodland, water bodies, bushlands, tropical high forest (THF)-normal and degraded, and others such as plantations and built-up areas. Land is therefore central to people's livelihoods and development, since it is the basis for all activities in the country.

Land in Uganda is distributed between families, gender, tribes, clans and economic classes, as well as between private and public ownership. This mosaic has affected the distribution of land and associated resources as well as their management practices since it is the most important factor of production in the country today.

Cattle grazing in demarcated paddocks to ensure sustainbale landuse in Ntungamo District, Western Uganda (2008)

According to Article 237 of the Constitution of the Republic of Uganda 1995, land belongs to the citizens of the country under the following tenure systems: customary, of the different types of ownership, utilization, freehold, mailo, and leasehold and the various degrees (GoU, 1995).

As a result of the different ownership types, utilisation and management systems, the ability of Uganda's land to support plant and animal life, preserve terrestrial biodiversity and regulate hydrological cycles and other ecosystem services has been affected to various degrees, especially under freehold land tenure. The various activities on land have resulted in reductions in productive capacities, leading to land degradation (NSOER. 2002)

Terraced gardens and intensive tree planting on farm plot boundaries and on marginal slopes in Kabale District, Western Uganda (2008). Kigezi highland is a productive region renowned for a temperate-like cool climate that support horticultural agriculture.

Mt. Rwenzori ranges in Kasese District , South-Western Uganda (2007). Intensive human activities on the ruggesd mountain slopes have led to destruction of vegetation cover and accelerated erosion.

Tororo Rock, a unique ecosystem in Tororo District, Eastern Uganda protected by the Local authorities (2007). Tororo is on the eastern border with Western Kenya.

NEMA sensitising communities in Ibanda District, Western Uganda on restoration and conseravtion of fragile ecosystems, including bare hills through afforestation and terracing (2006)

Clearing of forest in Mukono District, Central Uganda (2004). Most of the forest cover on private land in Mukono has been depleted for brickmaking and charcoal burning.

Degraded rangeland ecosystems: a boy tends cattle in poor pastures chocked with bushes dominated by thorny speciec (inset) in the cattle corridor drylands of Nakasongola District (2008)

Karamoja lean cattle and sorghum garden

Bush burning in Karamoja plains, North Eastern Uganda (2008). Karamoja is a dry pastoral-nomadic region that is facing problems of land degradation and severe shortages of pasture and water. Inset: Karamoja lean cattle and sorghum garden.

Kapchorwa terrain on the slopes of Mt. Elgon in Kapchorwa District, Eastern Uganda (2008). Kapchorwa suffers from recent deforestation that sparked off severe soil erosion and land degradation.

Pine trees planted by Kaharo Friends of the Environment Association in Kabale District, under the NEMA Districts Micro Projects Support Programme (2007). L-R: Mr. Paul Sabiti, District Environment Officer, Kabale, poses with the Chairman of the Association in front of the pine trees.

Drylands of Nakasongola in the cattle corridor (2008). The trees known for producing strong charcoal and firewood were recently depleted mainly for commercial charcoal burning.

Innovations in improved land productivity and nutrition: 'Basket gardening' is commonly used by communities as 'back-yard gardening' as well as an alternative to land scarcity situations to ensure sustainable nutrition.

Wetlands: about 33,000 km^2; 13% of country's total area

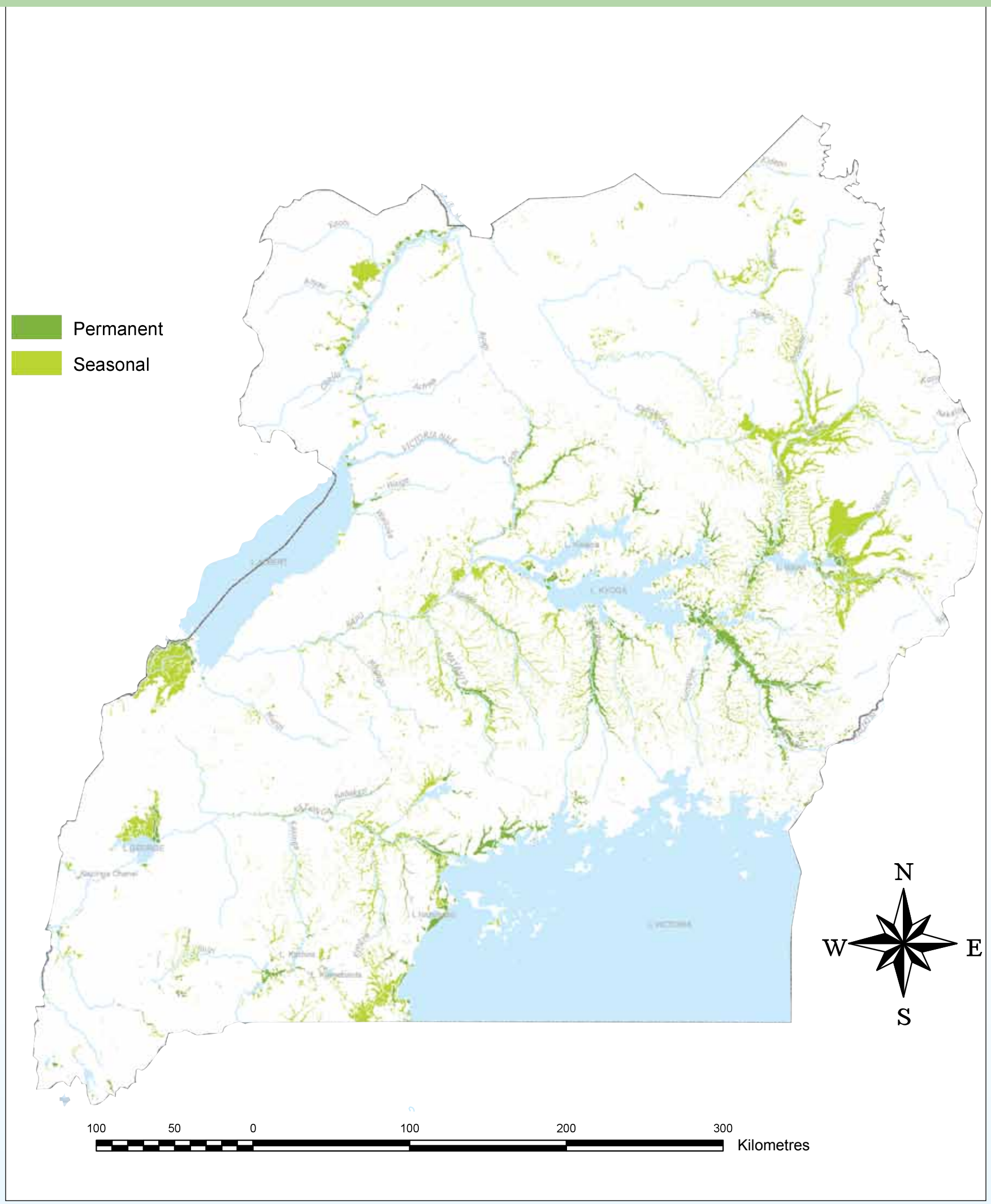

Figure 10: Distribution of wetlands in Uganda

A vibrant papyrus wetland in Gaba, Kampala District (2005)

Uganda has extensive wetland coverage, although the information about the exact size and distribution is yet to be established. Current estimates put the total area of wetlands at about 33,000 Km^2 covering about 13% of the country's total area. The wide coverage of wetlands in the country is influenced by a number of physical factors, especially the incidence of high rainfall and the nature of the landscape dominated by flat low land surfaces and, depressions which arose from past geological episodes leading to leveling of the African surface and later the teriary period tectonic activities associated with warping.

There is extensive occurrence of wetlands around most of Uganda's lakes and along most of the rivers especially the drowned river valleys that were affected by warping.

Name of Ramsar site	Year of designation	Site No.	Area (Ha.)	Conservation importance
Lake George System	4/03/1988	394	15,000	Flora and Fauna
Lake Nabugabo Wetland System	11/02/2004	1373	22,000	Bird and Acquatic
Sango Bay-Musambwa Island-Kagera	16/09/2005	1641	6,053	Flora and Bird
Lake Mburo-Nakivali Wetlands System	22/09/2005	1634	25,572	Flora and Fauna
Lake Opeta Wetland System	17/09/2005	1636	68,913	Bird
Mabamba Bay Wetlands System	18/09/2005	1638	2,424	Bird
Nabajjuzi Wetlands System	20/09/2005	1639	54,229	Bird
Lake Bisina Wetland System	15/09/2005	1633	91,150	Bird and Fauna
Lake Nakuwa Wetland System	16/09/2005	1635	108	Bird
Lutembe Bay Wetland System	18/09/2005	1637	20,163	Bird
Murchison Falls Wetlands System	20/09/2005	1640	22,400	Flora and Fauna
Rwenzori Mountains	Proposed		22,400	Flora and Fauna
Total area of Ramsar site			**307,756**	

Figure 10: Ramsar sites in Uganda

Guide to Ramsar sites: Mabamba Ramsar site, Mpigi District (2006)

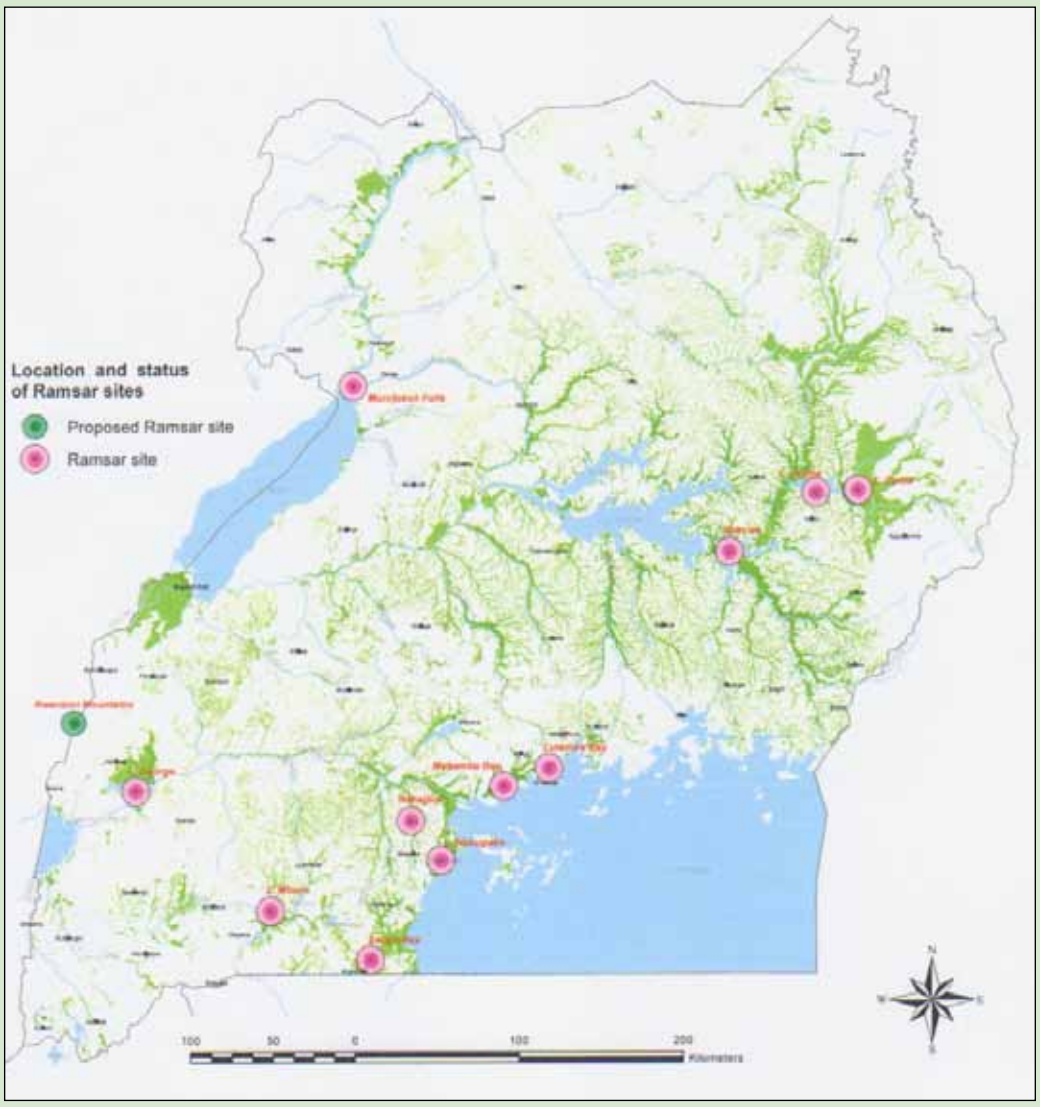

Figure 11: Locations of the Ramsar sites in Uganda

The Ramsar Convention, also known as the **Conservation on Wetlands**, is an international treaty on conservation and wise use of wetlands. Uganda, which joined the Convention in 1988, now has 11 Ramsar sites covering a surface area of 354,803 hectares. An additional site with a surface area of 22,400 hectares, named Rwenzori has been proposed for designation (Fig. 10). Globally, the Convention's 153 Contracting Parties have designated 1626 Ramsar sites, covering 145,594,013 hectares.

The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Uganda has provided an enabling environment for the conservation of wetlands through formulation of appropriate policies, legislation and a ten-year strategic plan (2000-2010). However, the country still requires more efforts in fostering sustainable use of wetlands as well as monitoring and research to inform the implementation of the convention.

To date the country has implemented several provisions of the Ramsar Convention which includes;

- Establishment of Wetlands Department in the Ministry of Water and Environment and existence of wetlands management institutions at both national and district levels
- Development of the National Wetlands Policy to support wetlands conservation
- Incorporation of a section on wetlands in the National Environment Act, Cap 153, and development of Environment Management Regulations (2000) thereunder, to specifically address wetlands management
- Incorporation of several clauses related to wetlands in several national legislations such as the Local Government Act (1997) and Land Act (1998)
- Preparation of Seventeen (17) guidelines for wetland policy implementation
- Awareness creation
- Launching and implementation of a 10-year Wetlands Strategic Plan

The Government is encouraging national and local governments and non governmental institutions to design and adopt wise use of wetlands with full participation of the local communities.

Challenges of Ramsar sites management in Uganda

A number of challenges still remain to realise fully the ability to, and benefits of, implementing the Convention which include, among others:

- Computing land use changes e.g oil exploration in Murchison Falls
- Government of Uganda still has the challenge of clearly demonstrating the benefits of the Ramsar sites to the stakeholders especially the surrounding local communities.

However, there are already visible benefits from these sites through increased tourism presumably resulting from the international publicity that attracts tourists to Uganda who make the sites as one of their destination.

Hon. Maria Mutagamba, Minister of Water and Environment

Uganda Wins Wetland Management Award (21/10/06)

Uganda has scooped an award for best African country in sustainable management of wetlands. Environment minister Maria Mutagamba received the award from African Union representative Dr. Abou Bamba at a conference for the African Ministers' Council on Water (AMCOW) at Speke Resort Munyonyo on Thursday.

She handed over the award to the First Lady, Mrs. Janet Museveni, who presided over the function. Mutagamba said Uganda was the only country in Africa with a Wetlands Inspection Division in addition to the 10 internationally recognised Ramsar sites.
She said Uganda was the only country in Africa which had hosted the Ramsar convention and the only country in Africa, which had held the presidency for the Ramsar convention.
Uganda hosted the convention last year in August 2006 at Munyonyo, Kampala.

"Our recognition on wetlands management was not by chance. There are a lot of things Uganda has done for sustainable management of wetlands," she said. Mutagamba added that Uganda had good policies on wetlands compared to other African countries.
She said due to increased industrialisation, population and environmental degradation, water levels for lakes and rivers were falling, causing what she termed as water stress.
She cited Mali, where she said a bottle of water is more expensive than a bottle of whiskey. She attributed depreciation of lake levels to the rising temperatures as a result of global warming and evaporation.

German Ambassador Dr. Alexander Muehlen said when one first comes to Uganda, the impression is that there is sufficient water for everybody.

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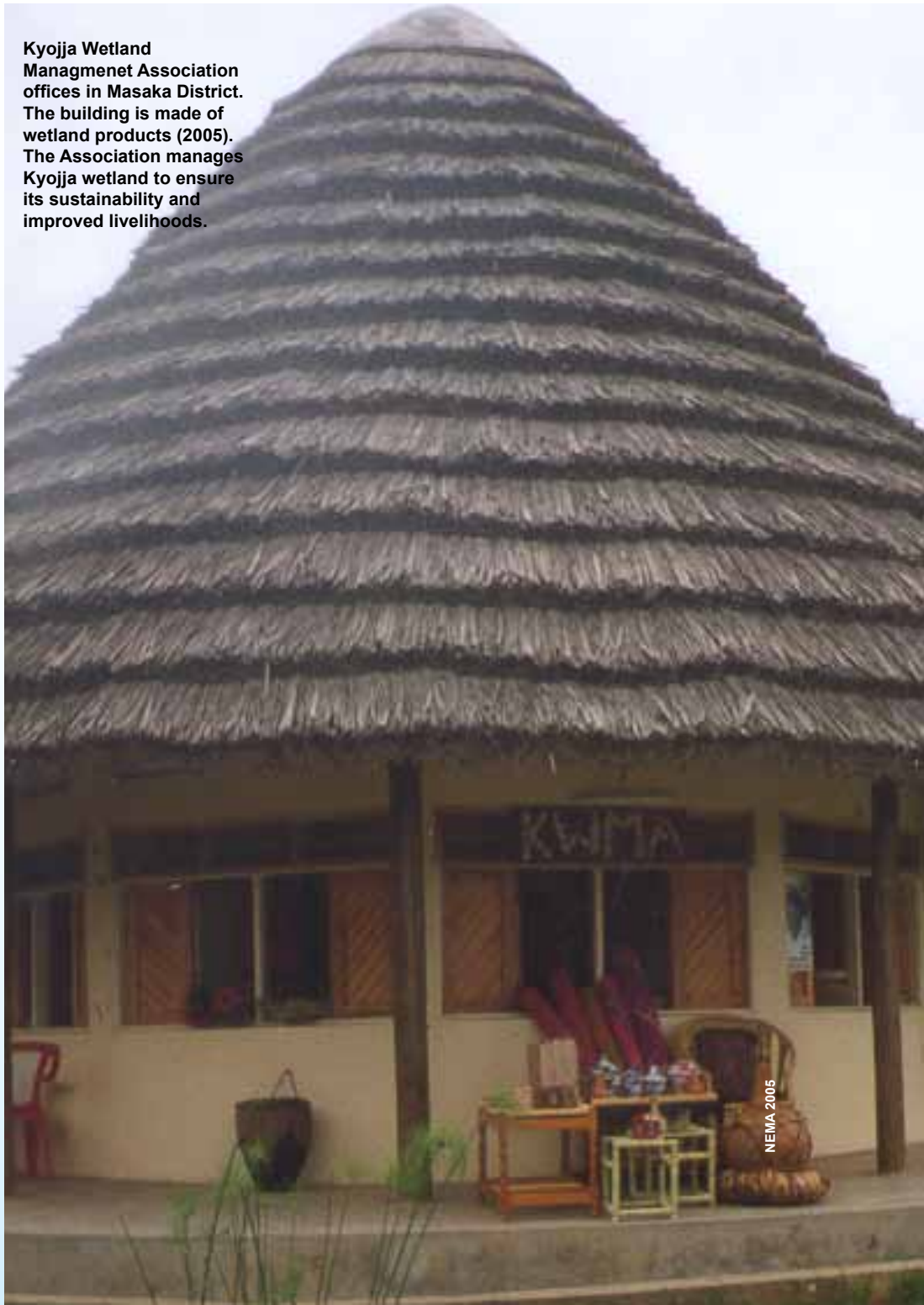
Below: Migratory birds at Lutembe Ramsar site on Lake Victoria

Uganda's wetlands can be categorized as papyrus swamp, swamp forests, lacustrine (lake edge), riverine, flood plains and damboos. These can be further categorized into permanent and seasonal wetlands. The most common type of wetland is papyrus swamp dominated by *Cyperus papyrus*. A bout 69% of the total area under wetlands is impeded drainage while seasonal swamps and swamp forests constitute 30% and 1 % respectively.

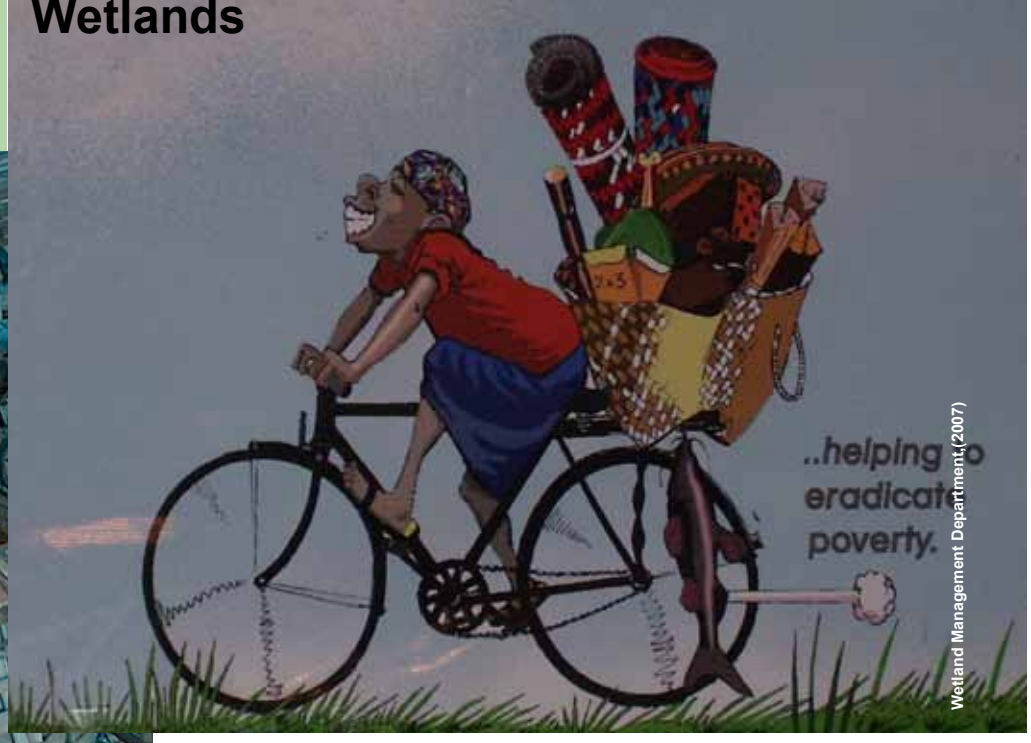
Wetlands in Uganda perform important chemical, hydrological, ecological and socio-economic functions. The major functions and values include; source of products such as water, fish, forage and grazing resources, wood fuel, building and craft materials, sand, clay and medicines; provision of services such as purification of water through filtering of both silt, and industrial and domestic effluent; regulate water flow and enhance ground water recharge; moderation of climate; retention of carbon; and provide landscape aesthetic resources for recreation and eco- tourism. Further more, wetlands have important attributes including habitat for aquatic life, biodiversity and genetic resources conservation. Therefore, a large proportion of Uganda's population directly or indirectly depends on wetlands for their livelihoods.

Uganda's wetlands are faced with a number of threats of degradation especially resulting from population pressure and economic development. Wetlands throughout the country are increasingly being encroached upon and reclaimed mainly for agriculture and settlements. Specifically, the main human activities that are leading to degradation of wetlands include drainage for agricultural purposes, sand and clay mining, over-harvesting of biomass, dumping of solid waste and pollution through release of industrial effluent and domestic waste. The impact of all these is far reaching, and is already threatening the integrity and sustainability of these vital resources. The current and potential impacts include increased floods, shortage of building and crafts materials, reduction in fish productivity (for example, disappearance of mud fish) decline in water quantity and quality, reduced ground water recharge and decline in the water table as exemplified by the disappearance of water springs.

Baskets made out of papyrus reeds



Kyojja Wetland Managmenet Association offices in Masaka District. The building is made of wetland products (2005). The Association manages Kyojja wetland to ensure its sustainability and improved livelihoods.



Wetland Management Department,(2007)

Poster on Poverty Eradication by the Wetland Management Department, Ministry of Water and Environment (2007)

NEMA 2007

Mud fish (Mamba) display during Wetlands Day Celebrations 2007 held at Mabamba, Mpigi District

NEMA 2007

Display of crafts and wetland products during the Commonwealth Heads of Government Meeting (CHOGM) Exhibitions 2007 in Kampala

NEMA 2007

Civil Society Organisations (CSOs) collaboration in national programmes and activities: Wetlands products (mats, baskets, bags and other crafts) display by MFACOI an NGO from Kamuli District, during exhibitions to mark World Environment Day Celebrations 2007 at Nkaiga, Kasese District.

NEMA 2008

Children fishing in a wetland in Iganga District

Indiscriminate dumping of solid waste in a papyrus swamp along Kireka valley (left) and on the shores of Lake Victoria in a Kampala surbub (right). Dumping of solid wastes in wetlands is a common practice in urban areas. Depositing substances in a wetland is a prohibited activity under the Environment Law (National Environment Act, Cap 153).

Prohibited: Dumping medical waste in a wetland in Adjumani District (2008)

Brickmaking is one of the regulated activities in a wetland (2007)

School field visit to Kinawataka wetland: Pupils of Kiswa Primary School, Kampala District, learn about regulated activities in a wetland (2006)

Environmental Education: Pupils learn about wetlands in rural Kangulumira, Kayunga District (2005)

Recovery of Nakayiba wetland in Masaka Municipality one year after restoration (2006)

Wetland restoration in progress: Demolition of illegal structures in the Nsooba-Lubigi wetland, a surbub on the outskirts of Kampala City (2009). Enforcement has been intensified in the wake of increased wetland degradation in Kampala and other parts of the country.

NEMA 2008

Hon. Jennifer Namuyangu, Minister of State for Water (front-right) prepares to plant a tree to mark World Wetlands Day celebrations held at Sezibwa Falls, Mukono District February 2008. Mr. Paul Mafabi (second from left), Commissioner for Wetlands explains to the Minister.

Plant a tree for the future: A girl plants a tree during national celebrations to mark World Environment Day, 5 June 2006 in Kumi District under the theme "Protect Drylands against Desertification"

NEMA 2006

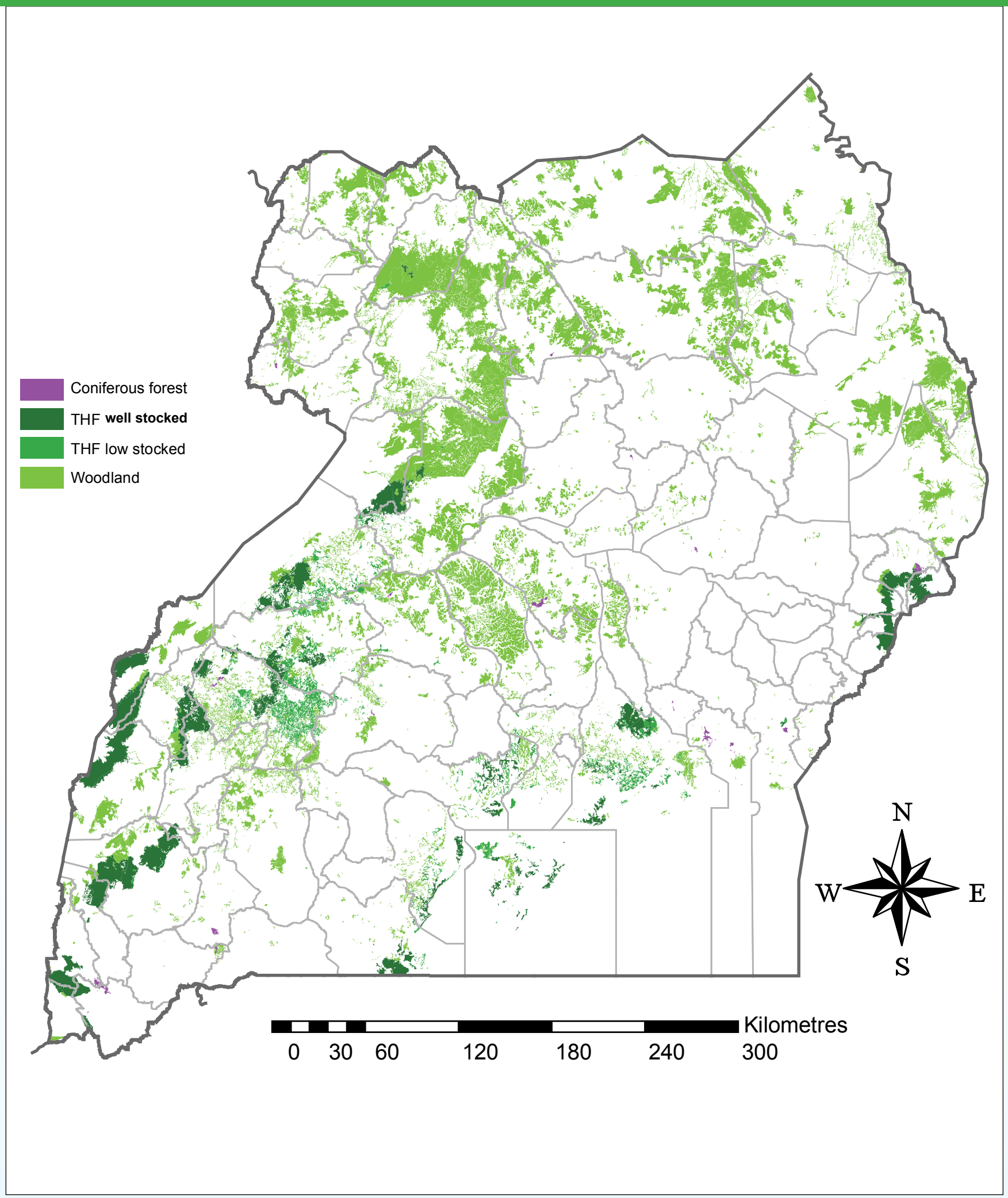
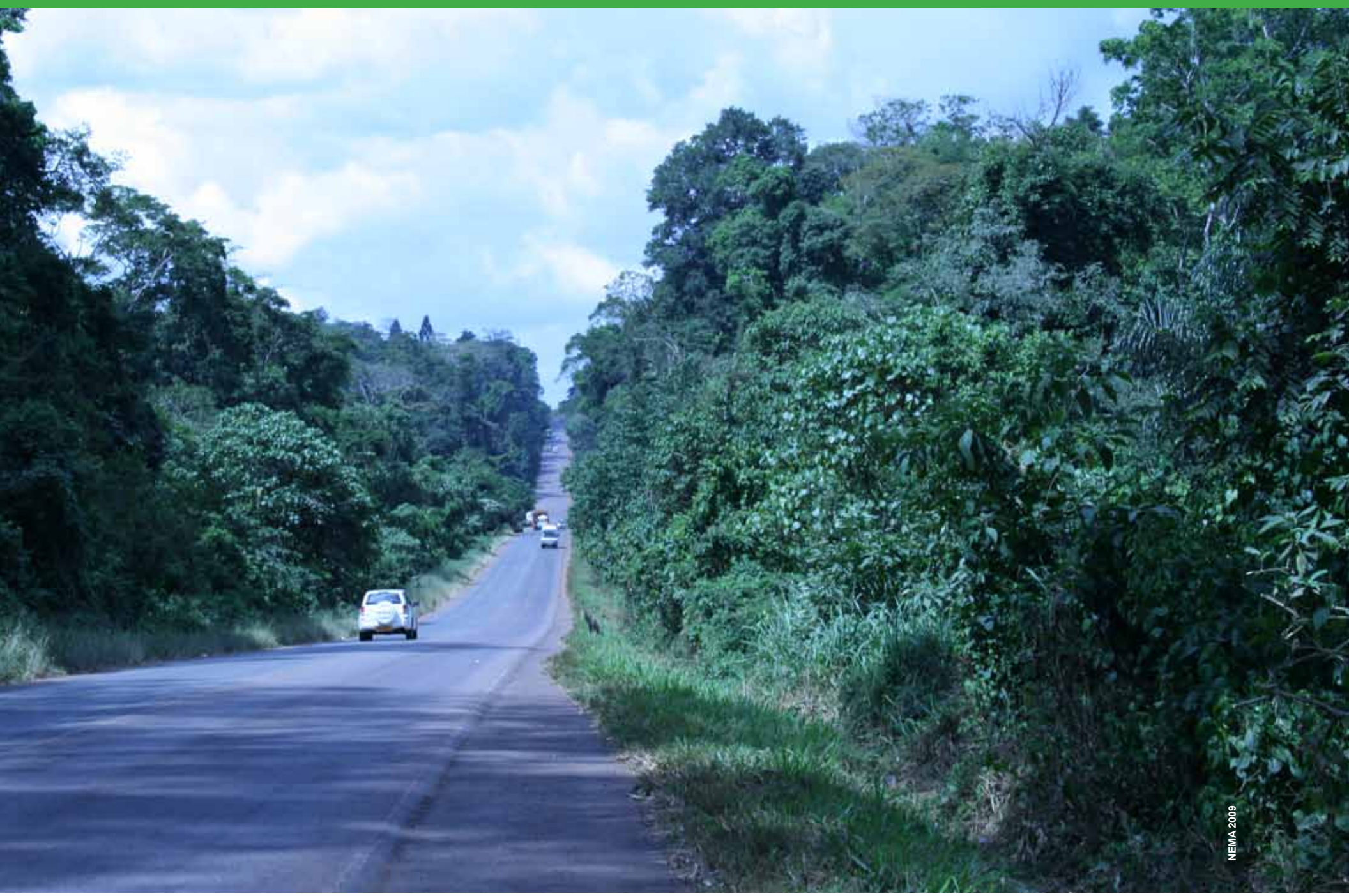


Figure 11: Forest Reserves in Uganda

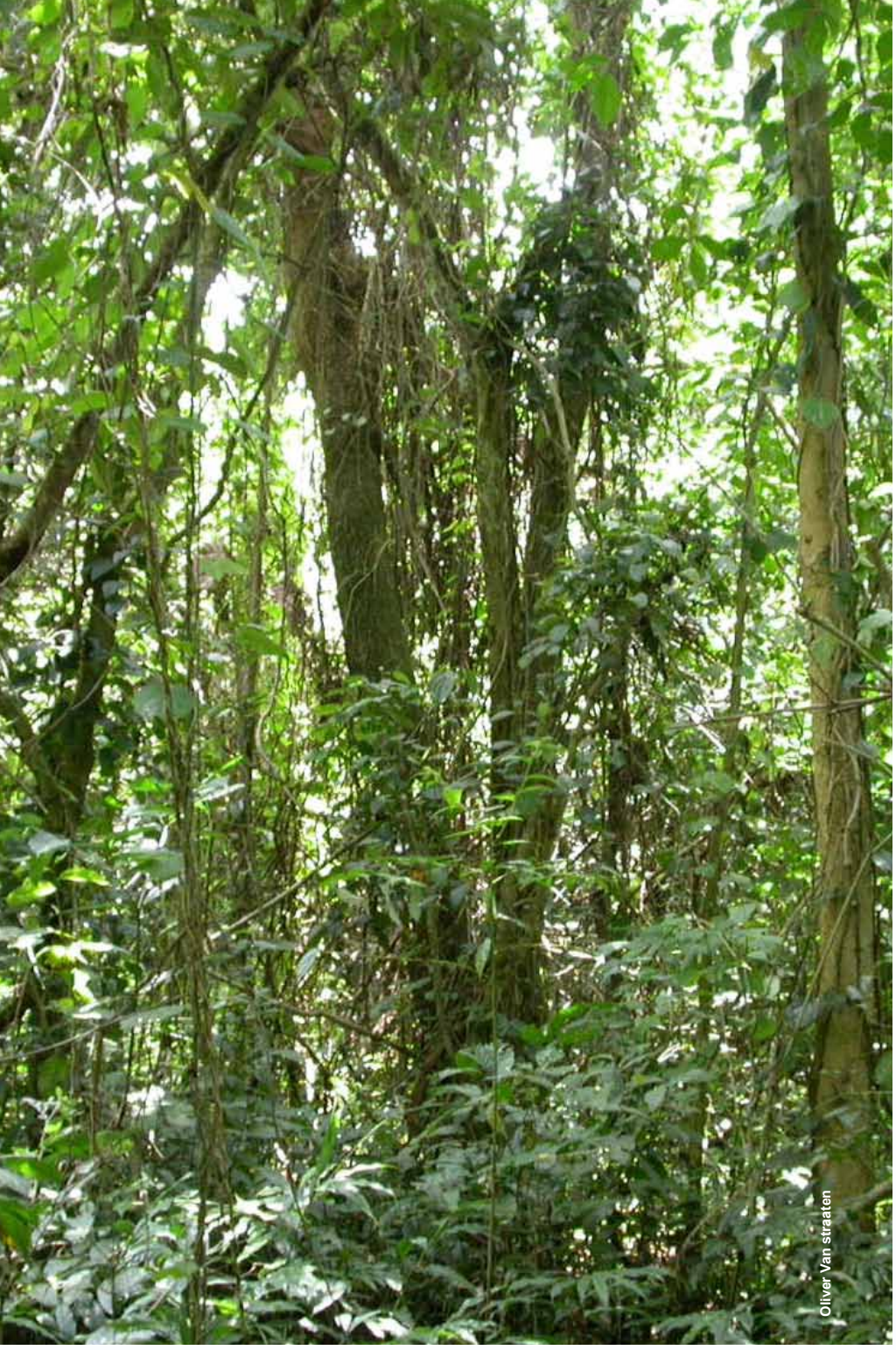
Forests



An early morning ride through a cool and refreshing Mabira (natural) forest along the Kampala-Jinja Highway (2008)

Forest resources in Uganda comprise of both natural forests and plantations. Natural forests include tropical high forests and woodlands while plantations comprise both pines and hardwoods. Forests and woodlands cover approximately 4.9 million hectares which is approximately 20% of the total country area. Of these, 924,000 ha are tropical high forests, 3,974,102 ha are woodlands while 35,066 ha are forest plantations. Forests in Uganda occur as gazetted areas (forest reserves), other protected areas (national parks) and as forests on private land. Forests and woodlands are estimated to have covered about 10,800,000 ha (45%) of Uganda's surface area in around 1890. Since then, the size of the forest estate has drastically shrunk. For example, at the beginning of the 20th century, Uganda's tropical high forests covered 3,090,000 ha or 12% of the country's area. Over the years the forests have been gradually cleared and today estimates indicate reduction to about 730,000 ha, which is only (3%) of Uganda's area.

Since the colonial era in Uganda, gazettement of forest resources has been undertaken under three main categories which still form the back borne of the current gazettement plans. The aim is to ensure continuous supply of forest goods and services to the people of Uganda in perpetuity. The categories therefore include supply of goods especially hardwood timber; protection of water catchments and control of erosion; and increased production of forest goods through establishment of forest plantations. Presently, most of the forest cover under protection is located on the upper slopes of mountains and highlands. Besides biodiversity conservation, the forests in these highland areas are for protection of important water catchments and for erosion control. In other parts of the country, forests were gazetted primarily for biodiversity conservation and supply of timber.



Budongo forest at "Mailo kumi", along the Masindi – Paraa Road via Kichumbanyobo Gate (2002)

Katuugo Forest Reserve planted by National Forestry Authority (NFA), Nakasongola District (2008)

Generally forest resources in Uganda offer a wide range of non- timber products and services; they provide various ecological functions such as watershed protection, erosion control, wind breaks, climate amelioration and carbon sequestration. Uganda's forests are a habitat to a diverse range of animal and plant species that are a potential for eco-tourism attraction. Some of these species are endemic; others are rare or threatened, while others are important as national heritage. Uganda's tropical high forests in particular are one of the most diverse ecosystems in the tropical world. About 20,000 plant species are known to exist. Due to their diversity in food and habitat, Uganda's forests are also rich in bird life. For example, over 1,000 bird species have been listed in the country of which 33% are entirely found in forest areas. Also Uganda's forests support such rare species as the mountain gorilla (*Gorilla gorrilla berengei*), found in Bwindi impenetrable and Mgahinga forests of which only about 600 are known to exist in the whole world, with this part of the world being their only habitat.

There are numerous threats to forests and consequently, the rapid shrinkage of forest estate and demise of the forest resources in Uganda. These include among others: rapid population growth leading to increased demand for land, food and energy, and hence rapid clearance of forests; unsustainable harvesting of the forest products and the degradation of the resource base; encroachment on gazetted forest reserves by surrounding communities; and urbanization, and industrial growth which are particularly putting pressure on peri- urban forests.

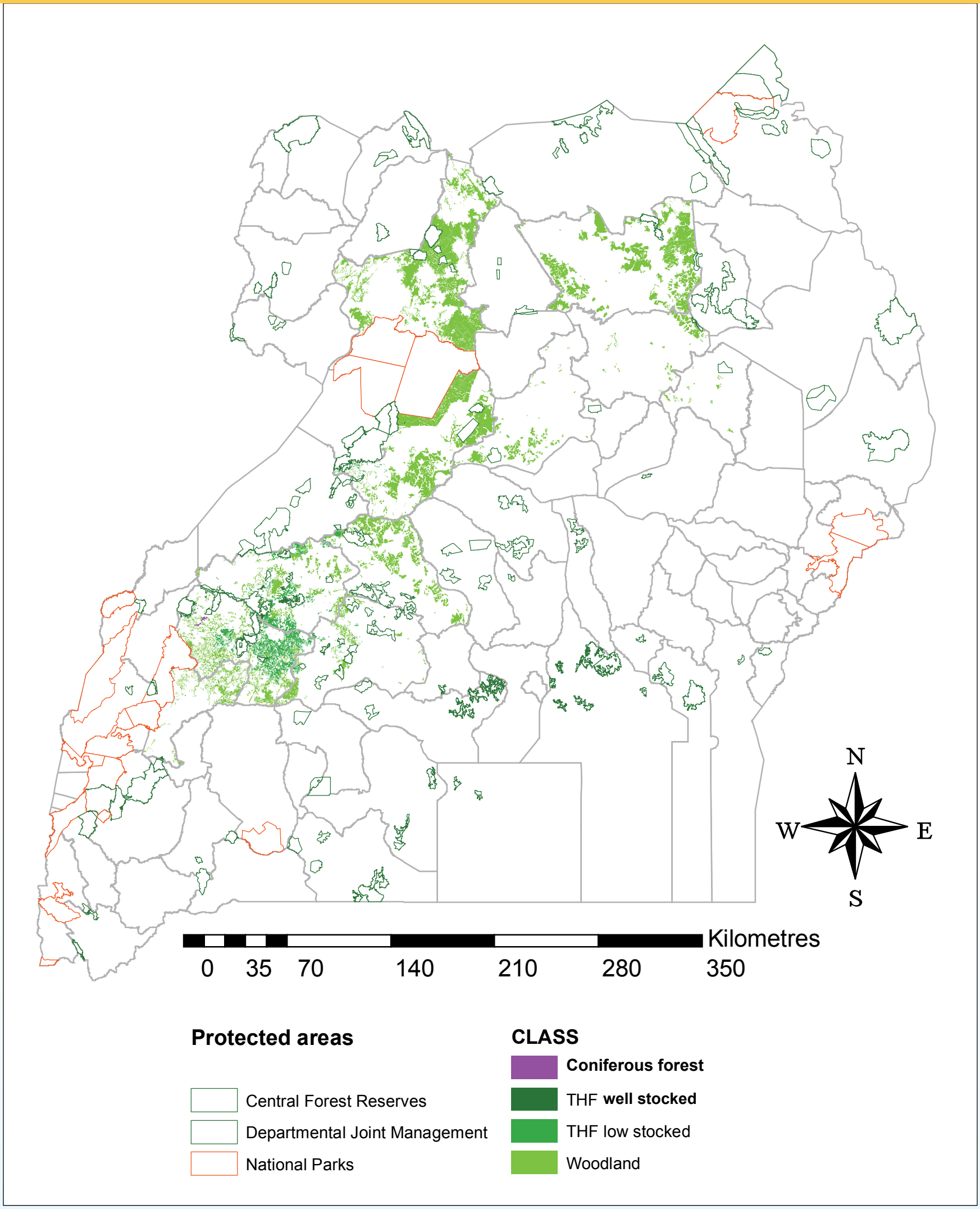
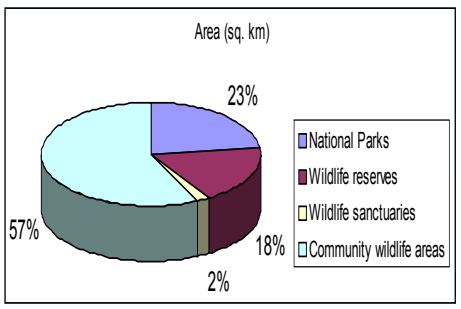


Figure 12: Protected areas in Uganda

Conservation areas: Wildlife

Gorillas in Bwindi Impenetrable National Park (2008)



Proportional area coverage of each of the conservation categories

Uganda is rich in wildlife resources that are located in both gazettted areas and on private lands. In addition to forest reserves, Uganda has four types of wildlife protected areas namely national parks, wildlife reserves, wildlife sanctuaries, and community wildlife areas; classified according to the degree of protection accorded. These areas are entirely for conservation of wildlife. There are six forest national parks namely Mgahinga, Bwindi impenetrable, Kibale, Semliki, Rwenzori Mountains and Mt. Elgon.
There are also four savannah ecosystem national parks namely Lake Mburo, Queen Elizabeth, Murchison Falls, and Kidepo.

The National parks occupy a total area of 11,150 km^2 (4% of the country's area). There are also ten wildlife reserves which occupy 8,760 km^2 (3.6% of the country's area) of the country's area, and consist primarily of grassland with patches of dry woodland and scrubland. In addition, there are seven wildlife sanctuaries and thirteen community wildlife areas. Overall, protected wildlife areas occupy about 20% of the area of Uganda, which is quite a significant proportion.

Uganda boasts of a diversity of wildlife both flora and fauna species; which are mainly due to a diversity of landscapes that lead to different ecosystems ranging from mountain, tropical forests to savannah grasslands. The conservation areas habour species of both national and global importance.
The main economic benefit from the wildlife estate has been revenue earnings from tourism. The other benefits include cultural and scientific. The conservation of Uganda's wildlife resources also has benefits of global significance. Sustainable use of these conservation areas faces many challenges such as increased population pressure leading to competition for land resources, and conflict between humans and wildlife. Wildlife conservation in Uganda faces a number of threats which include encroachment on the conservation areas for agriculture and settlements, poaching, destruction of wildlife considered to be vermin.

Uganda Wildlife Authority (UWA) 2008

The Delta in Murchison Falls National Park, Amuru District (2008)

Uganda Wildlife Authority (UWA) 2008

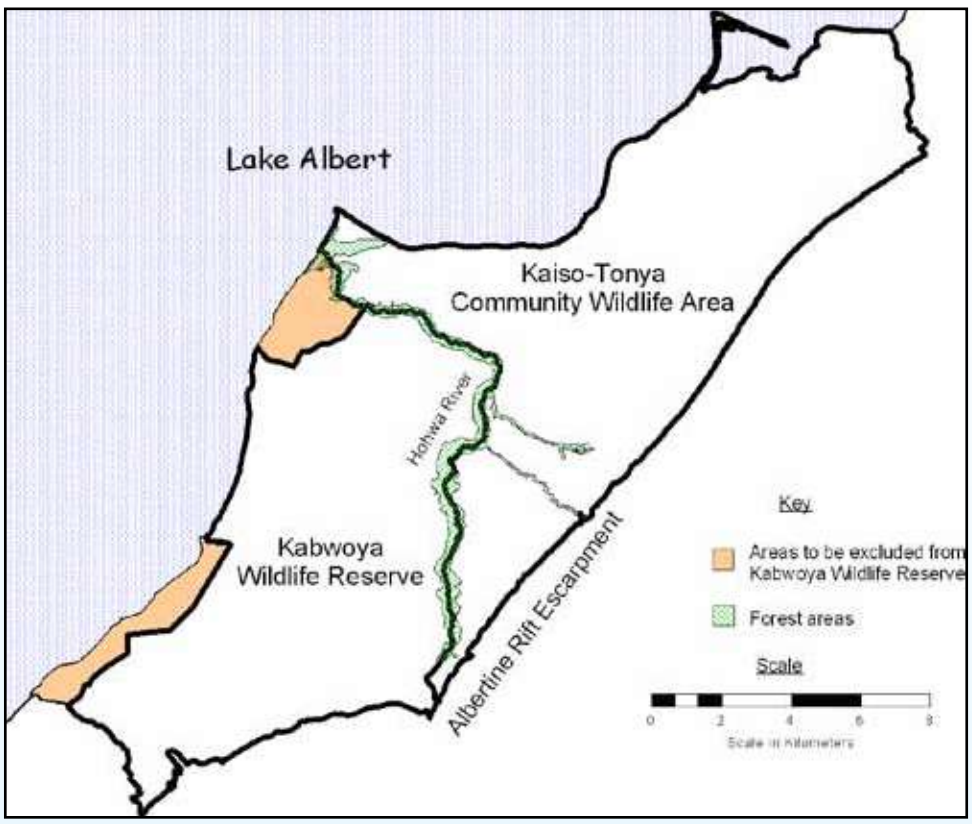
Pelicans in Queen Elizabeth National Park, Kasese District (2008)

An elephant in Queen Elizabeth National Park, Kasese District (2008)

Grey crowned cranes (2008)

Climbing lions in Ishasha, Kanungu District Western Uganda

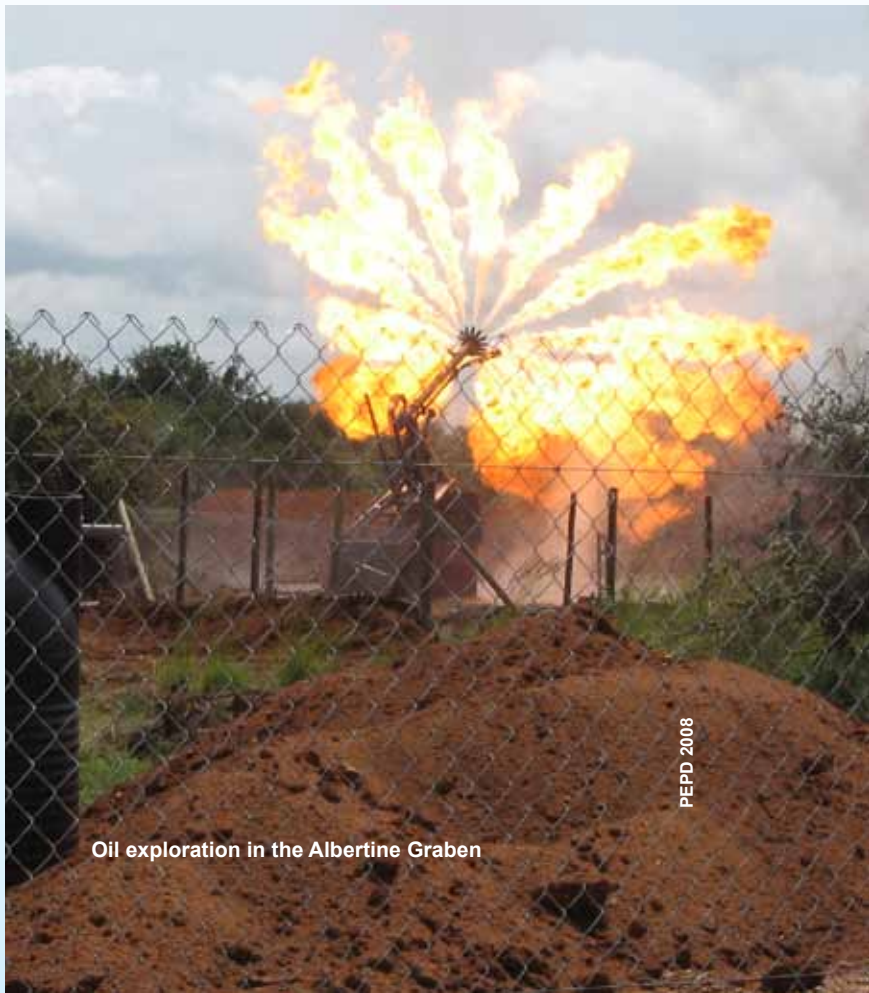
Uganda Wildlife Authority (UWA) 2007



Map of Kabwoya Wildlife Reserve and Kaiso-Tonya Community Wildlife Area.

Source: Uganda Wildlife Authority 2007.

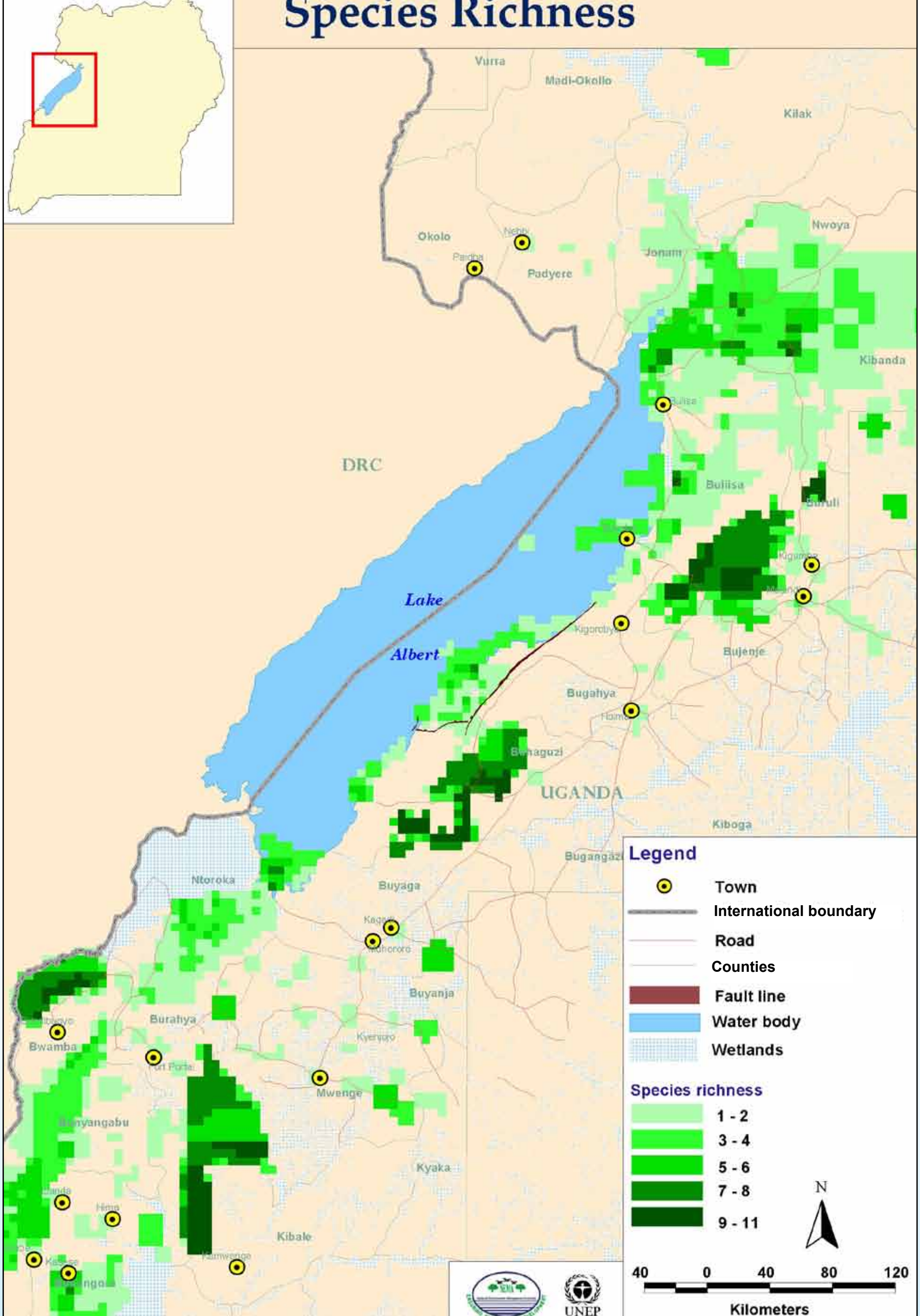
Kabwoya Wildlife Reserve is part of the Albertine Graben which is rich in biological species and oil. The map (opposite page) shows species richness.



PEPD 2008

Oil exploration in the Albertine Graben

Species Richness



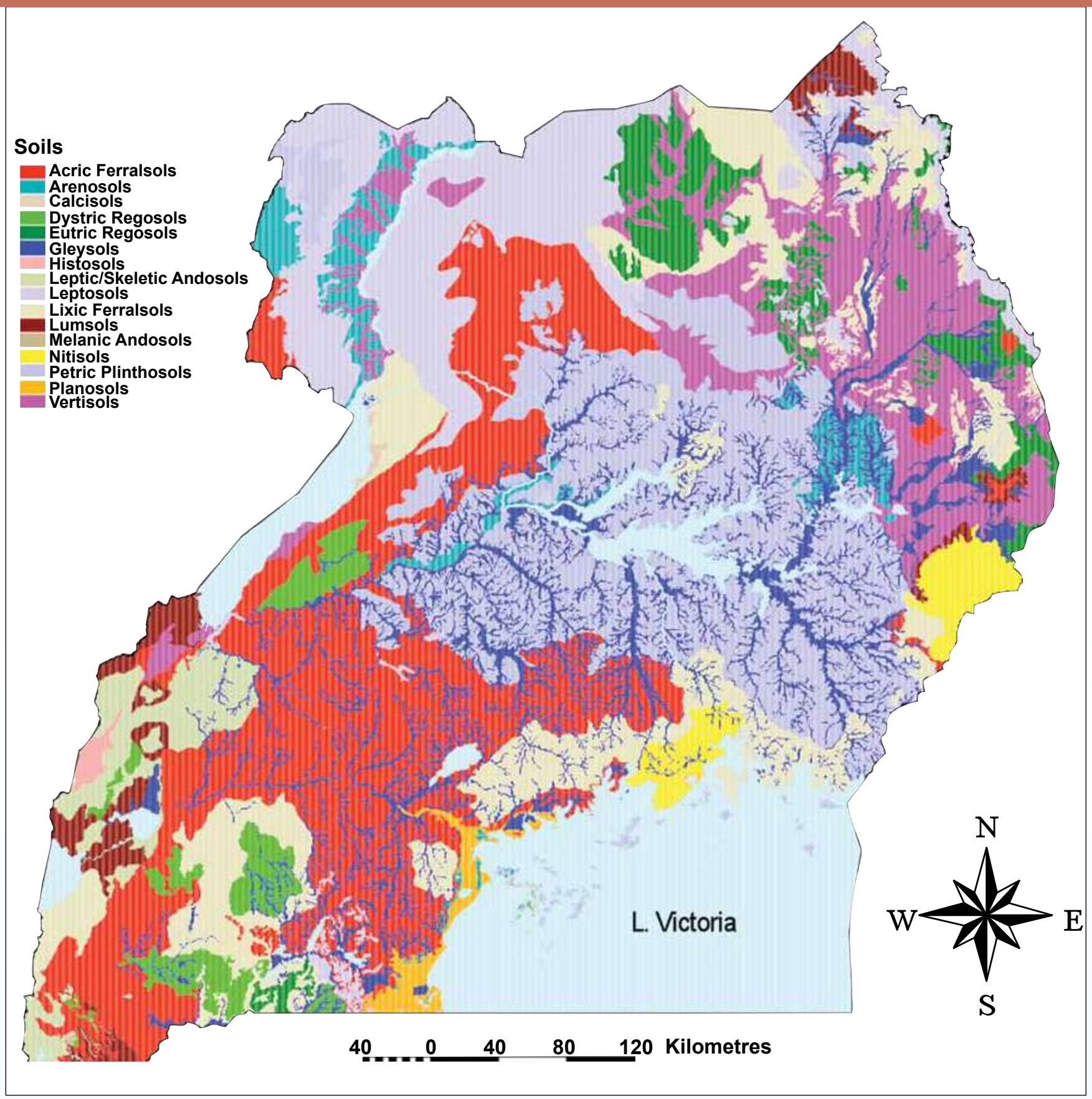


Figure 13: The major soils of Uganda

General Status

Apart from the volcanic soils in the East and South West, most soils in Uganda are older than 500 million years and are in their final stage of weathering with little mineral reserves remaining. The predominant minerals in the soils are quartz and kaolinite that do not directly supply nutrients to soils.

The soils are acidic and of low fertility with low Cation Exchange Capacity (CEC). Nutrients such as phosphorus occur in inorganic and organic forms that are not readily available to crops. Phosphorus is fixed by oxides of iron and aluminum. Nitrogen that is low in most mineral soils can only be naturally supplied to the soil from the atmosphere by symbiotic biological fixation and slowly from organic matter. Potassium, another essential element, is also limiting in these soils because there are no primary minerals that can supply it. Also, due to the low CEC, inorganic cations are easily leached out of the root-zone of most crops.

Soils Types		
Soil Type	**Sub Type**	**Area (Km²)**
Andosols	Leptic/Skeletic	5,751
	Melanic	63
Arenosols		5,579
Calcisols		204
Ferralsols	Acric	43,180
	Lixic	24,392
Gleysols		24,019
Histosols		580
Leptosols		22,086
Luvisols		5,275
Nitisols		3,907
Planosols		1,735
Plinthosols	Petric	35,205
Regosols	Dystric	5,072
	Eutric	8,085
Vertisols		19,066

Table 4: Soil Types and Productivity status in Uganda

Severe soil erosion on Mt. Elgon slopes in Kapchorwa District, resulting from loss of vegetation cover and leading to heavy siltation of River Ngenge (2005)

Changes

Over the years, food production has been characterized by subsistence farming. A subsistence production system usually focuses on maximizing short term profit which promotes consuming and depleting natural stocks of plant nutrients. Such a farming system has resulted in soil fertility degradation through nutrient mining. In the past, when Uganda's population was still low, lost soil fertility was restored through long periods of fallows. With an average land holding of about 2 ha per household today, fallows are no longer practical. Research has demonstrated that fertilizer inputs and appropriate land management practices are important components of technology required to maintain or improve soil fertility in Uganda (P. Ndeki et al).

Classification and Nomenclature

The major criteria in soil classification are the physical and chemical characteristics. Physical characteristics include factors such as parent rock, texture, structure, location, depth, colour, and topography, while chemical characteristics include pH, base composition, base saturation, and Cation Exchange Capacity (CEC). Going by those criteria, 13 major classes (some with sub classes) have been identified at national level (see Table 4).
The earlier nomenclature of soils in Uganda was based on the catena system, in which units were assigned names of the most prominent town or centre in the area. This Atlas however uses reclassified soils based on the standard FAO nomenclature.

The high productivity soils cover only 8% of the area of Uganda. This is indeed a small area. Therefore, moderate and fair productivity categories form the bulk of the soils and must be effectively managed in order to sustain Uganda's agriculture. Furthermore, through intensive but sustainable agricultural practices, yields on low productivity soils can be enhanced.

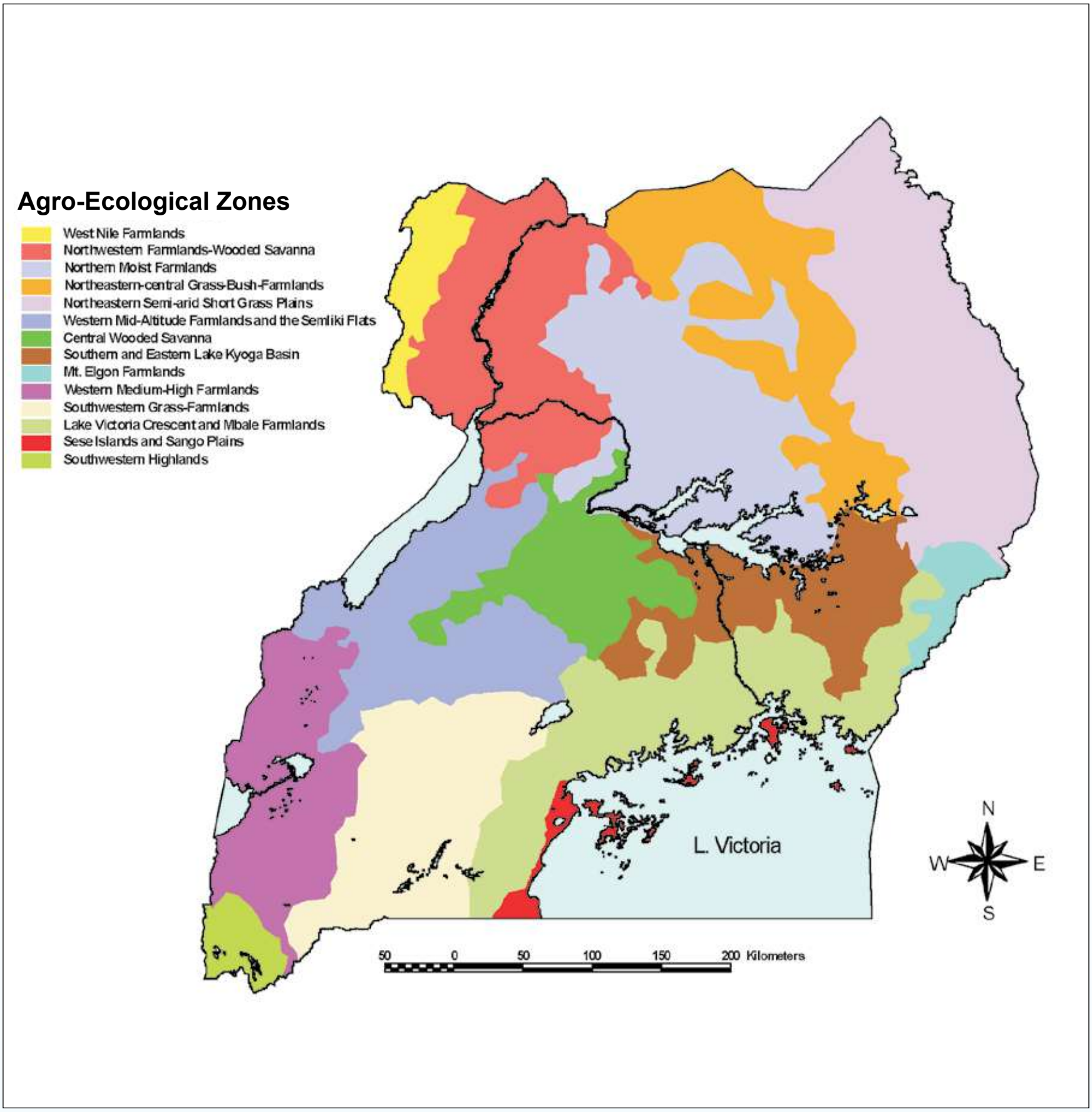


Figure 14: Agro-ecological zones of Uganda

Agro-Ecological Zones

Agro-ecological Zoning (AEZ) refers to the division of an area of land into smaller units which have similar characteristics related to land suitability, potential production and environmental sensitivity (see Figures 15a and 15b).

An Agro-ecological Zone is a land resource mapping unit, defined in terms of climate, landform and soils, and/or land cover, and having a specific range of potentials and constraints for land use. The priority given to each of these factors may vary from region to region. The country has been delineated into 14 Agro-Ecological Zones (Wortman and Eledu (1999).

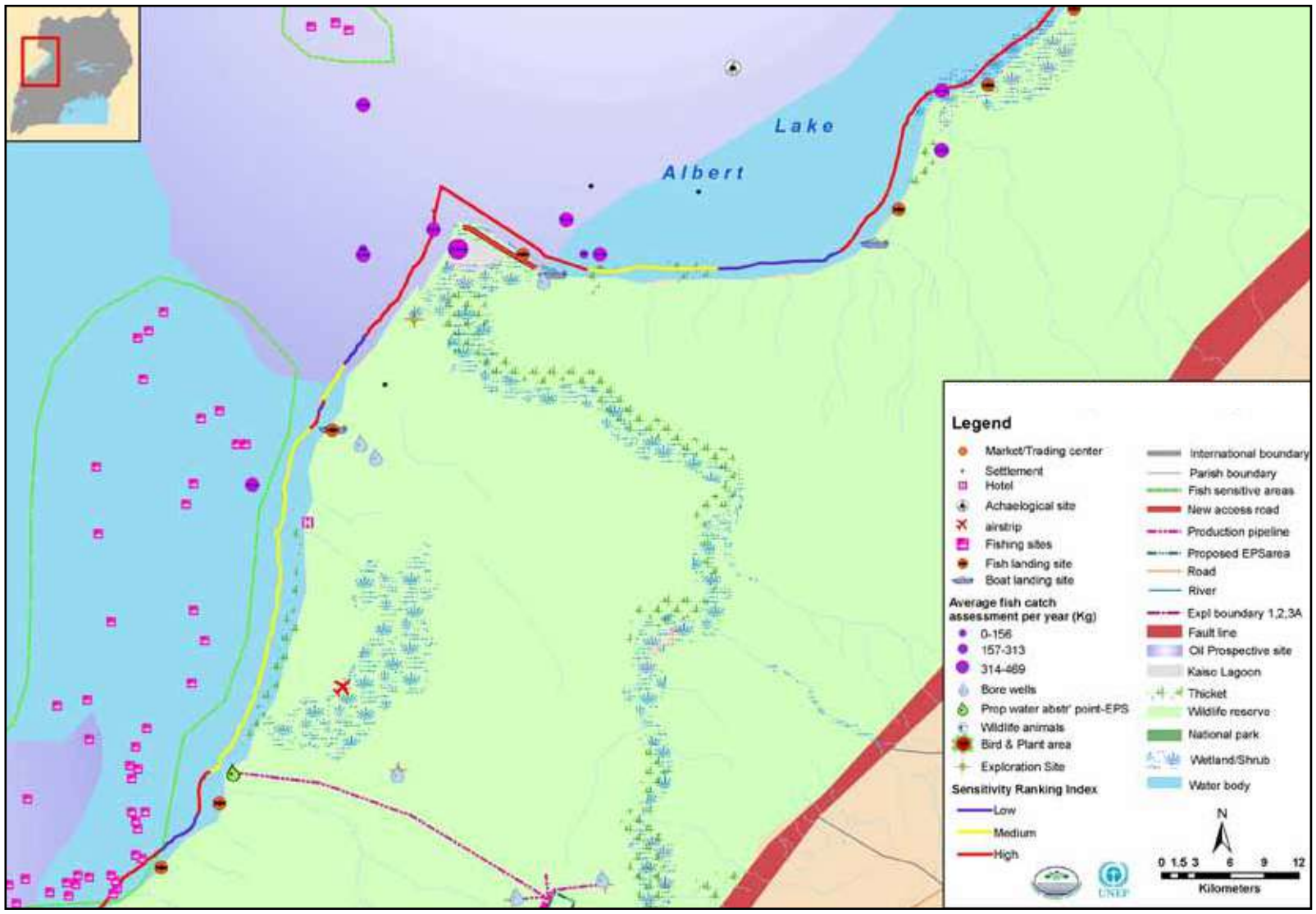
	Agro-Ecological Zone	Rainfall (mm)	Minimum Temp ^{0}C	Altitude (M)	Dominant Soils	Farming system	Photograph
1	West Nile Farmlands	900-1500	10	800-1800	Acric Ferralsols (696) Leptosols (2470) Petric Plinthosols (1157)	Annual crops and cattle	
2	Northwestern Farmlands-Wooded Savannah	700-1700	10	500-1500	Acric Ferralsols (3043) Arenosols (2260) Calcisols (116) Gleysols (51) Leptosols (11238) Lixic Ferralsols (1588) Petric Plinthosols (567) Vertisols (1560)	Annual crops and cattle	
3	Northern Moist Farmlands	700-1700	15	1000-1200	Acric Ferralsols (5580) Arenosols (285) Eutric Regosols (961) Gleysols (3113) Leptosols (1614) Lixic Ferralsols (982) Petric Plinthosols (10689) Vertisols (2718)	Annual crops and cattle	
4	Northeastern-Central Grass-Bush-Farmlands	700-1500	15	900-2500	Arenosols (1120) Eutric Regosols (4023) Gleysols (1217) Leptosols (3971) Lixic Ferralsols (2577) Petric Plinthosols (3883) Vertisols (2058)	Annual crops and cattle	
5	Northeastern Semi-arid Short Grass Plain	300-1300	12	900-3000	Acric Ferralsols (424) Arenosols (127) Eutric Regosols (2,661) Gleysols (3,409) Leptosols (2,721) Lixic Ferralsols (5,354) Luvisols (1,481) Nitisols (283) Petric Plinthosols (1,028) Vertisols (12,001)	Mainly pastoral with a few annual crops	
6	Western Mid-Altitude Farmlands and Semliki Flats	500-1700	10	700-1600	Acric Ferralsols (10706) Arenosols (50) Calcisols (89) Dystric Regosols (1369) Gleysols (1907) Leptic/Skeletic Andosols (1167) Leptosols (178) Lixic Ferralsols (181) Luvisols (771) Petric Plinthosols (978) Vertisols (595)	Banana, millet, cotton, coffee, and cattle	
7	Central Wooded Savannah	700-1300	15	900-1300	Acric Ferralsols (1591) Arenosols (375) Gleysols (3398) Leptosols (6) Petric Plinthosols (5751)	Banana, millet, cotton, coffee, and cattle	

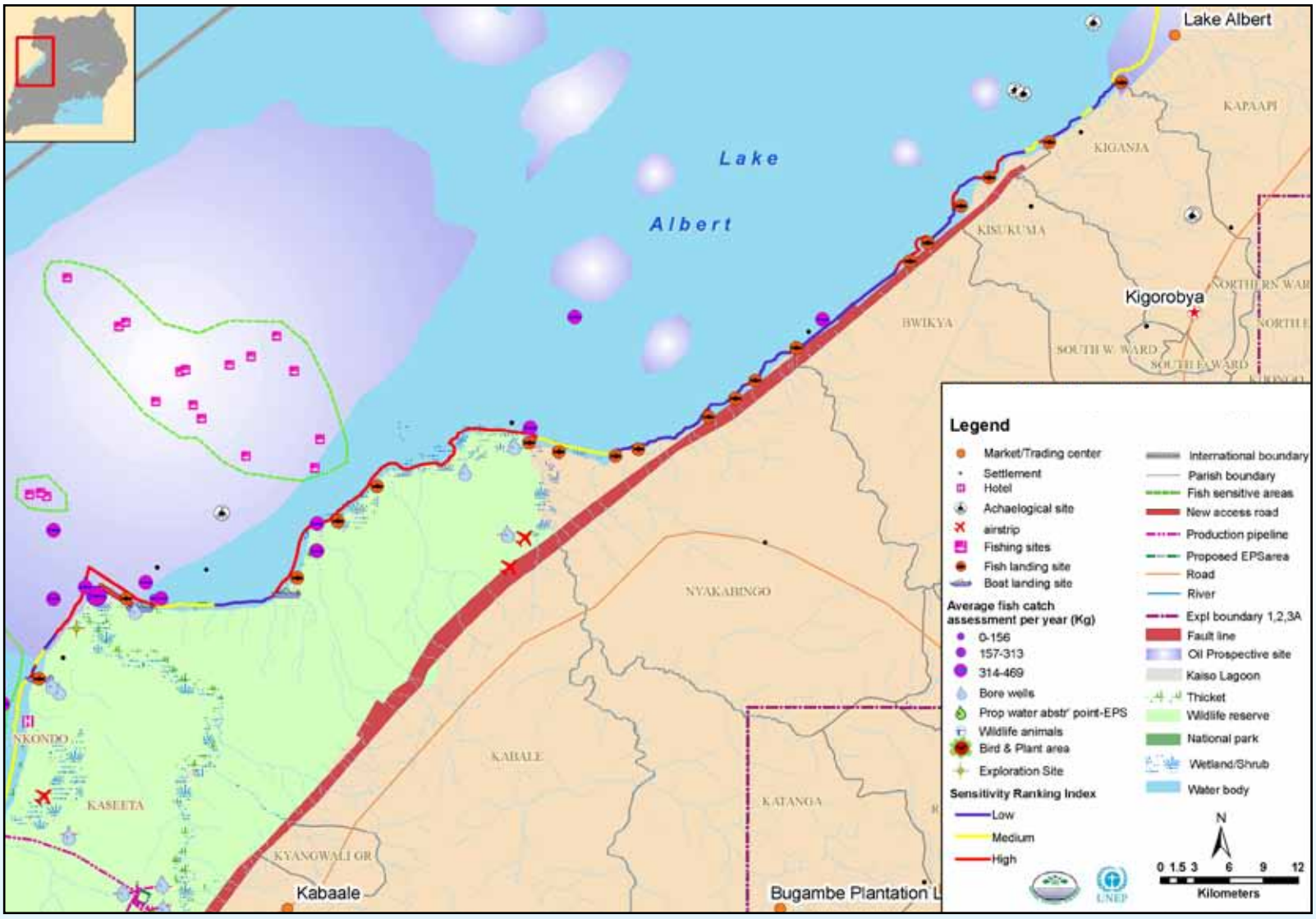
Figure 15a: Table showing Agro-ecological zones of Uganda (continued to next page)

	Agro-Ecological Zone	Rainfall (mm)	Minimum Temp ^{0}C	Altitude (M)	Dominant Soils	Farming system	Photograph
8	Southern and Eastern Lake Kyoga Basin	700-1700	15	900-1300	Acric Ferralsols (1364) Arenosols (27) Gleysols (3972) Leptosols (1) Lixic Ferralsols (71) Petric Plinthosols (7895) Vertisols (42)	Banana, millet, cotton, cattle, and a few annual crops	
9	Mount Elgon Farmlands	900 – over 2100	7.5	1000-4000	Acric Ferralsols (62) Gleysols (81) Lixic Ferralsols (461) Luvisols (52) Nitisols (1846) Petric Plinthosols (189) Vertisols (28)	Intensive banana and coffee, forest(higher altitudes), and a few annual crops	
10	Western Medium-High Farmlands	500 - >2100	7.5	600-4500	Acric Ferralsols (840) Dystric Regosols (81) Histosols (93) Leptic/Skeletic Andosols (975) Lixic Ferralsols (43) Luvisols (701) Melanic Andosols (62)	Banana, coffee, cattle, and forest (higher altitudes)	
11	Southwestern Grass - Farmlands	300-1100	10	1100-2000	Acric Ferralsols (8365) Dystric Regosols (2553) Eutric Regosols (436) Gleysols (2484) Leptosols (522) Lixic Ferralsols (4027) Planosols (32)	Banana, coffee, cattle, and some annual crops	
12	Lake Victoria Crescent & Mbale Farmlands	700 - >2100	12.5	1100-2400	Acric Ferralsols (5554) Arenosols (129) Gleysols (3869) Leptosols (230) Lixic Ferralsols (6452) Luvisols (59) Nitisols (1776) Petric Plinthosols (2561) Planosols (797) Vertisols (5)	Banana, coffee, millet, cotton, and annual crops	
13	Ssese Islands Sango Plains	700 - >2100	15	1100-1300	Acric Ferralsols (47) Arenosols (237) Gleysols (55) Leptosols (47) Lixic Ferralsols (346) Petric Plinthosols (476) Planosols (1003)	Intensive banana, coffee, and annual crops	
14	Southwestern Highlands	700-2100	7.5	1100-4000	Acric Ferralsols (840) Dystric Regosols (81) Histosols (93) Leptic/Skeletic Andosols (975) Lixic Ferralsols (43) Luvisols (701) Melanic Andosols (62)	Annual crops and Forest	
	Lake	700 - >2100	17.5	1100	-	- -	

Figure 15a: Table showing Agro-ecological zones in Uganda (continued from previous page)

Oil potential in the Albertine Graben





Oil prospecting sites in Lake Albert (2008). The maps also show the sensitivity of the shoreline.

Energy: Hydro electric power

NEMA (2009)

Above: Kampala at night
Below: Owen Falls Hydro Electric Power dam at Jinja: Construction was completed in 1954.
The dam is the source of hydro electric power for Uganda and neighbouring Kenya.

Uganda Museum (2009)

Energy: Upcoming Hydro power plants

NEMA 2008

Bujagali Falls in Jinja District (2002): Construction of a second hydro electric plant, the Bujagali Hydropower Project is underway at the falls.

NEMA 2002

Karuma falls in Masindi District (2007), site for a proposed new hydro electric power plant

Odipio Edward Adraku 2008

Selling charcoal by the Nebbi-Arua highway (2008). There has been rampant depletion of tree cover in Arua District that borders the Sudan to the north and the Democratic Republic of Congo (DRC) to the west.

JEEP 2009

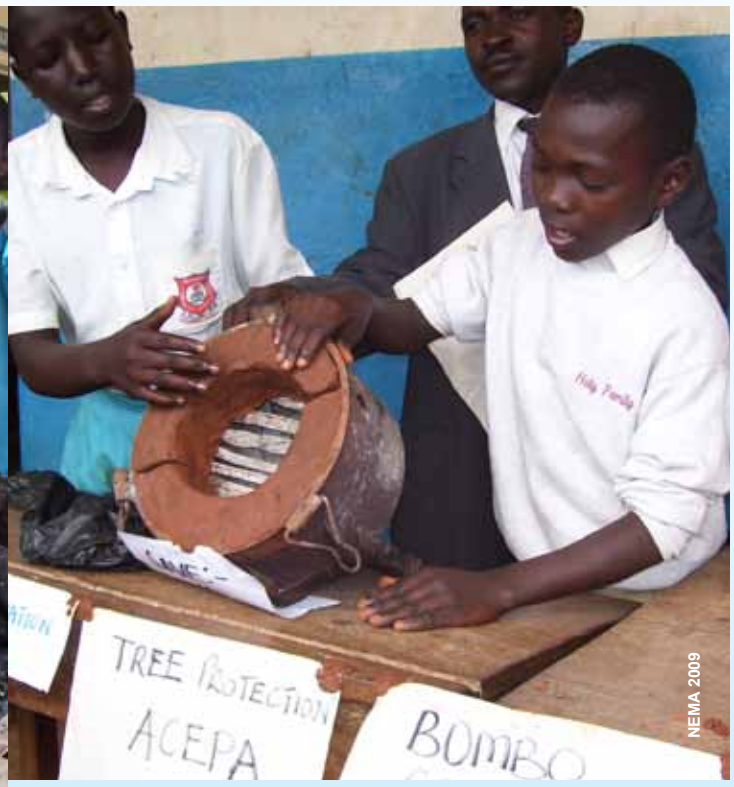
Solar power: Phone, battery and lantern charging in rural Wobutungulu by a solar project implemented by Joint Energy and Environment Projects (JEEP), a local NGO.

NEMA 2001

Women participate in the Community Training of Trainers programme by NEMA in Arua District.

NEMA 2005

Firewood is the main source of energy for domestic cooking across the country



NEMA 2009

Children of Bombo display fuel saving technologies: saw dust, charcoal briquettes and a charcoal stove during celebrations organised by ACEPA to celebrate World Environment Day 2009 in Bombo, Luwero District

52

Industry

Hima Cement Factory, Kasese District in Western Uganda (2008)

Tororo Cement Factory, Tororo District in Eastern Uganda (2002)

Impact of mining

Effects of pollution (from cement dust) from Hima Cement factory in the neighbourhood before NEMA's interevention (1996)

One year later in the same neighbourhood after Hima's compliance to the intervention (1997)

Kasese Cobalt 2005

Image ©2009 Digital Globe

Kasese Cobalt

Trail left by acidic waters from the cobalt stock pile left unprotected in the 1970s and 1980s. This area is currently under rehabilitation by the Kasese Cobalt Company.

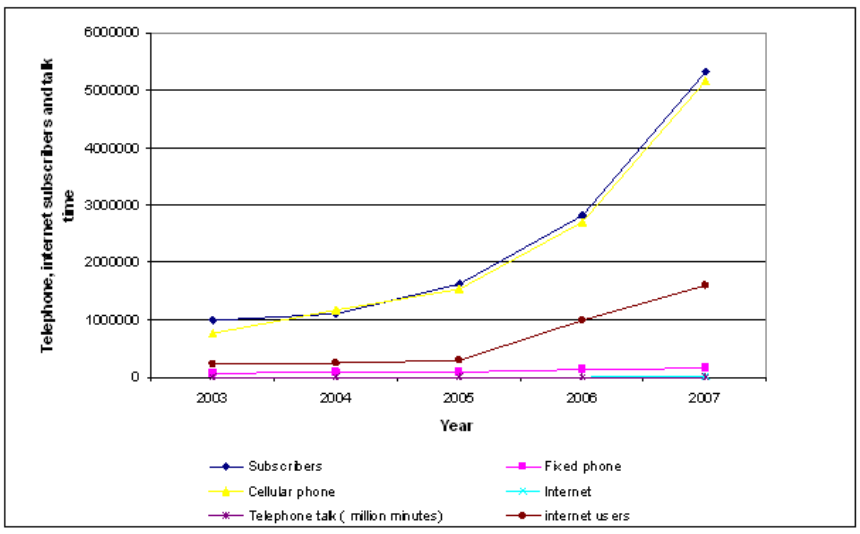
NEMA 2007

Rwenzori Mountain ranges in the vicinity of Kasese Cobalt

Science and Technology

NEMA 2008

Makerere University Faculty of Computer and Information Technology



Uganda Communication Commission in the NSOER 2008 in the press

Telephone and internet subscribers 2003 - 2007

Uganda's new focus on science, technology and innovation is founded in the Poverty Eradication Action Plan (PEAP) and the National Development Plan (NDP) which together emphasize the need for increased investment in industrialization, research and development, and technology transfer for increased productivity and economic growth.

The 'Ivory Tower': Makerere University Main Building, still going strong.

NEMA 2009

John Gibbons: Uganda At A Glance 2002

Above: Kampala, Uganda's capital city (2002). Inset: Kampala at dawn (2009).

Below: River Nile at Owen Falls Dam, Jinja, source of Hydro-electric power Uganda's and second largest town after Kampala (2008)

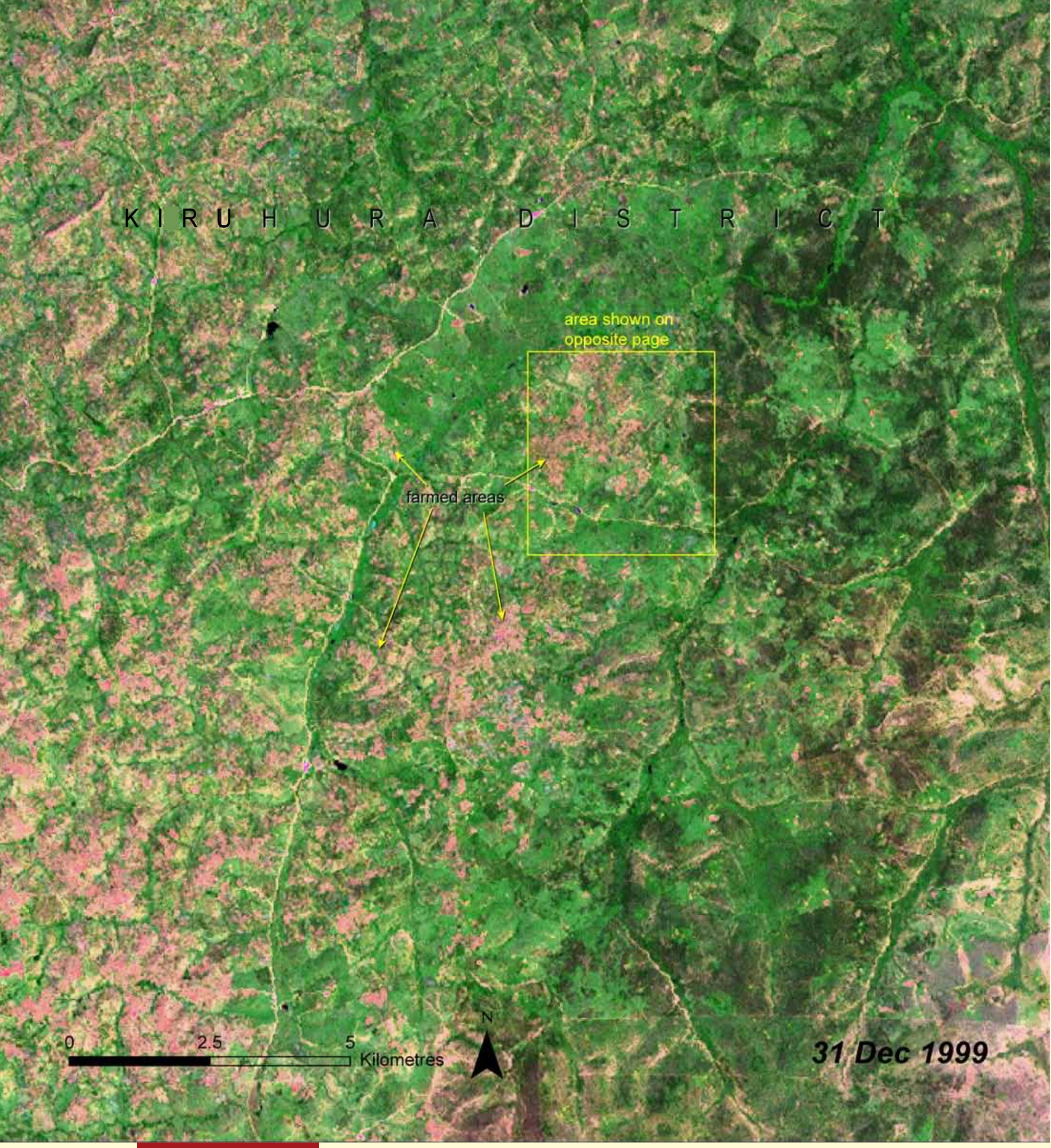
NEMA 2008

Chapter 2

Uganda's Changing Environment

Part of the Northern By-pass under construction (2009)

NEMA 2009



Kiruhura
Increase in agriculture

Kiruhura District was created in July 2005 by an Act of Parliament. The district that borders with seven districts lies in the cattle corridor in South-Western Uganda. The cattle corridor stretches from the Karamoja region, through Teso, into parts of Eastern Uganda, across the Lake Kyoga region, to Nakasongola and further down to Mbarara and Rakai. The communities of Kiruhura were pastoralists living nomadic life and the animals reared were

Mixed farming and permanent homesteads in Kiruhura

K I R U H U R A D I S T R I C T

High resolution imagery of area makred with yellow box on previous page.

farmed areas

0 0.4 0.8 Kilometres

N

Image © 2009 TerraMetrics
Image © 2009 DigitalGlobe
© 2009 Google
© 2009 AND

13 Oct 2003

cattle, goats, and sheep. However, over the years conditions have changed, and as land has become scarce, the people have settled down and taken on cultivation as an additional activity. Evidence of farming can be seen in the 1990's satellite image and larger farming areas can be seen in the zoomed image of October 2003. The major cash crops are Banana and coffee. Food crops include maize, millet, beans, potatoes and ground nuts.

Karamoja
Increase in agriculture

Karamoja region comprises of the districts of Kaabong, Kotido, Moroto, Nakapiripirit and Abim. These form part of the cattle corridor and the farming systems are agro-pastrolism and the cereal-cotton-cattle farming systems. The satellite images of September 1984 and August 2002 which is a harvest season show increase in areas

KAABONG DISTRICT

KITGUM DISTRICT

KOTIDO DISTRICT

N

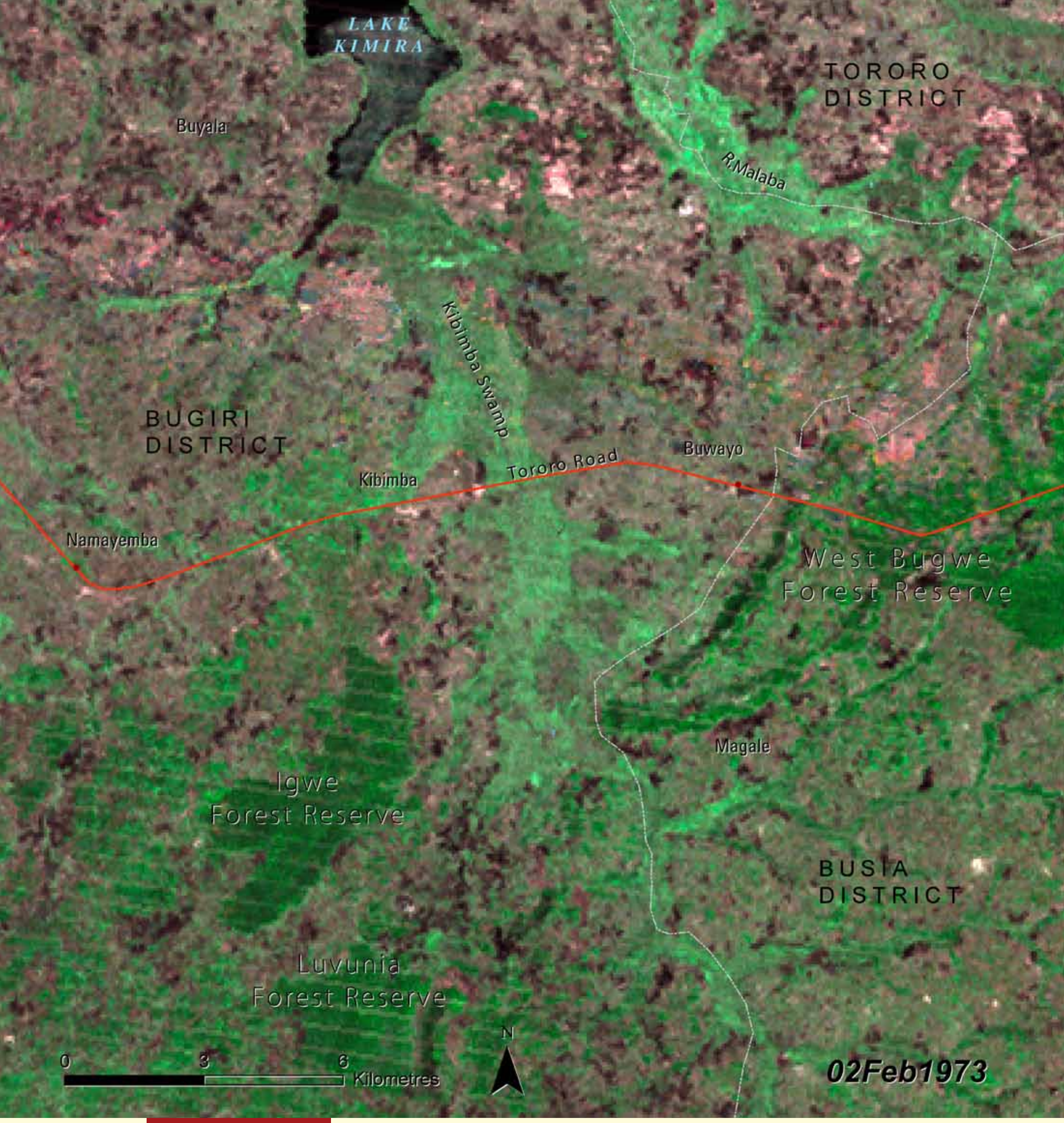
0 8 16 Kilometres

26 Aug 2002

ABIM DISTRICT

MOROTO DISTRICT

under agriculture. The main crops grown are cereals especially sorghum, cotton, cassava, maize, simsim, sunflower and groundnuts. Although there is an increase in agriculture frequent droughts have made these areas to be food insecure.

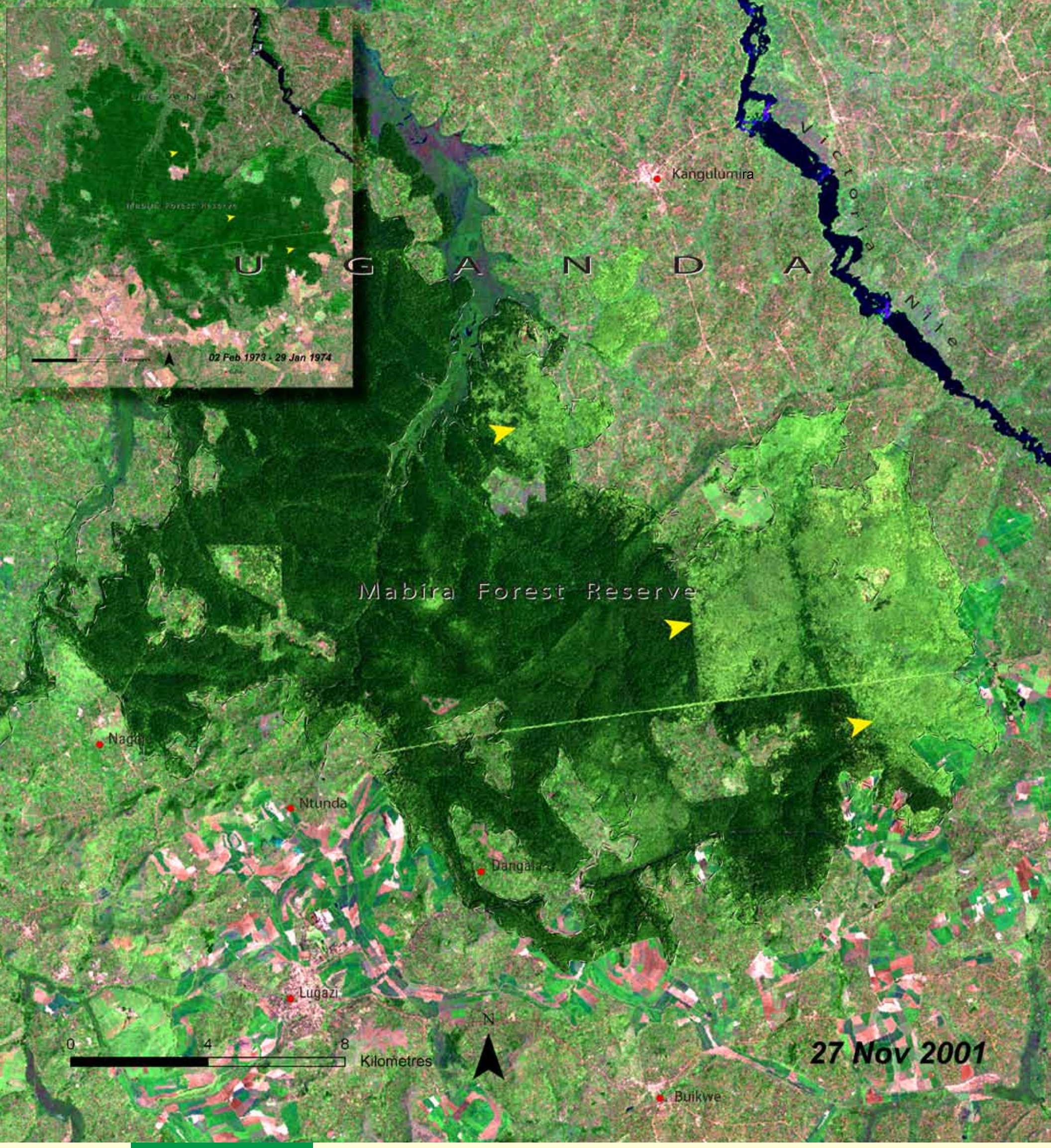


Kibimba
Rice Scheme

Ten years ago, Uganda was hardly known among rice producing countries, but recent successes in rice production have earned the country a respectable place among rice producers that it could quickly turn into the regional supplier of rice. Uganda's total area under rice cultivation is now 300 per cent of what it was a decade ago. The area has increased from less than 60,000 hectares and is now about 180,000 hectares, indicating a high rate uptake in rice production. As Uganda positions itself to be among the leading rice producers in the region, the general feeling among rice

LAKE KIMIRA
TORORO DISTRICT
Buyala
R.Malaba
Rice Harvester
Kibimba Swamp
BUGIRI DISTRICT
Buwayo
Tororo Road
Kibimba
Namayemba
Kibimba Rice Scheme
West Bugwe Forest Reserve
Magale
Igwe Forest Reserve
BUSIA DISTRICT
Luvunia Forest Reserve
N
0 3 6 Kilometres
10Sep1984

producers is that the government must sustain the current level of support because the industry is not yet fully consolidated. With the continued support of the Agricultural Ministry and our government, Uganda will be able to also supply neighbouring countries, generating valuable foreign exchange and leading to greater food security for the East African region. The satellite images of 1973 and 1984 show Kibimba Rice Scheme in Bugiri District. The scheme was non-existent in 1973.



Mabira
Recovery of forest

Mabira forest was heavily encroached upon in the 1970s and early 1980s. In the 1990s, encroachers were evicted and the forest is now on the road to recovery.
Note: Enclaves inside Mabira forests are not part of the reserve but public land.
The 1974 image shows a dense forest with a few pockets of possible clearing. The

Mabira forest

UGANDA

Nile

Mabira Forest Reserve

Nagoji

Ntunda

Dangala

Lugazi

N

0 4 8 Kilometres

25 Jan 2006

Buikwe

2001 image shows that a large part on the eastern side had been cleared and was recovering. Five years later in 2006, the image shows evidence of a dense forest on its way to recovery.

Part of the Mabira Tropical High Forest

The Mabira forest reserve, on the shores of Lake Victoria hosts valuable wildlife, serves as a timber resource, provides ecosystem services for water balance, and the rainforest represents a tourist destination. Following a proposed plan for clearing a third of the reserve for agricultural use, the values of the forest were calculated by local researchers (Yakobo Moyini, 2008). This economic evaluation of the forest shows that from a short-term perspective, growing sugarcane would lead to more economic benefits than maintaining the forest

reserve, with a return of 3.6 million USD/year in contrast to 1.1 million USD/year for conservation. However, sugar cane production is only optimal during a short time span of five years. When comparing both land use alternatives over the lifetime of the timber stock of 60 years, the benefits from the forest, and the ecosystem services it provides, exceed those of sugarcane planting.

Nakasongola

Loss of woodlands due to charcoal burning

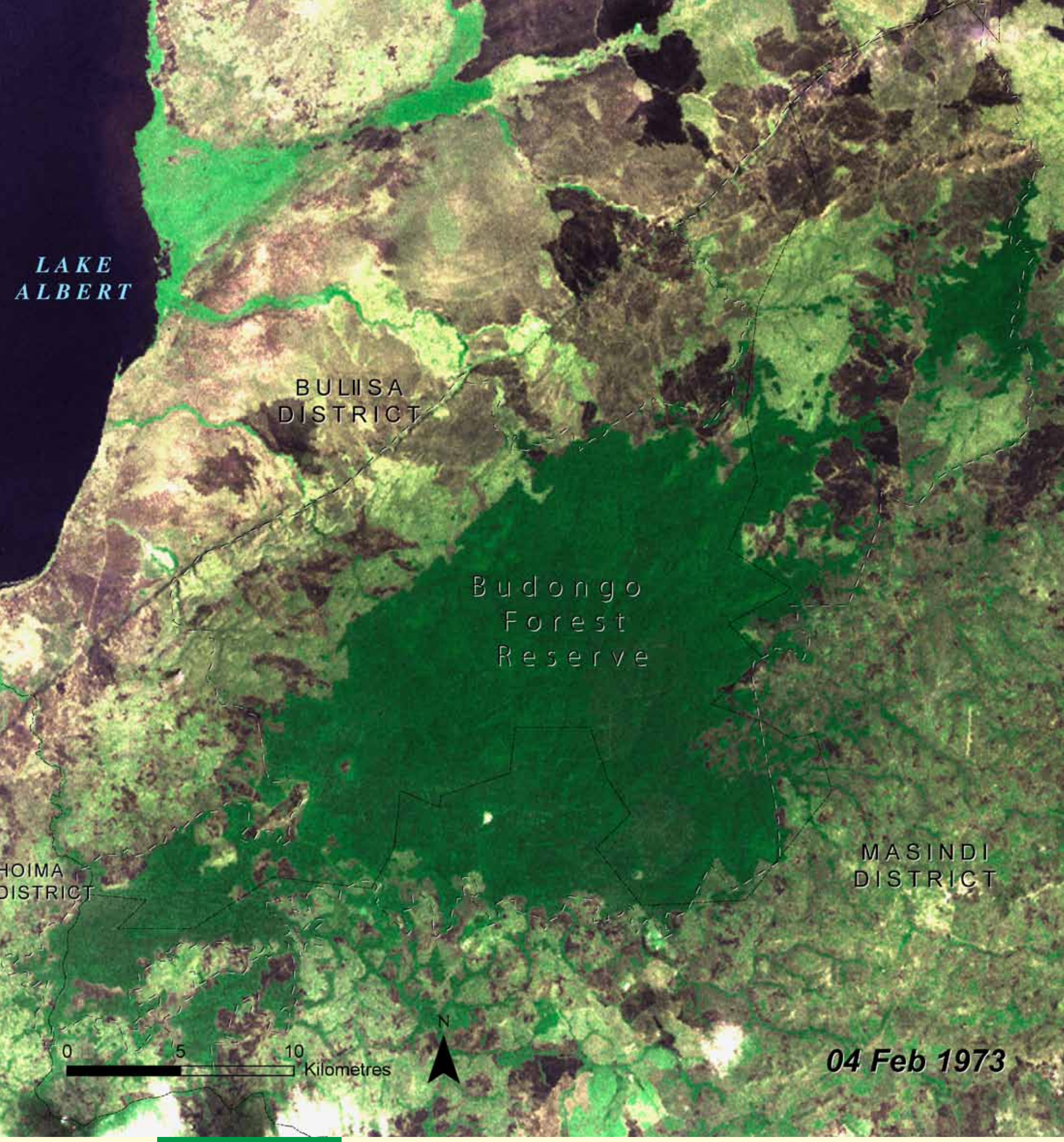
Desertification is a silent grabber of land. The existence of bare ground in Nakasongola District is a sign of serious land degradation. The areas worstaffected have become less productive and residents of Nakasongola attribute it to termites that forage on the vegetation (Stephen Muwaya, 2008). However, termites have devastated Nakasongola because the organic matter which they feed on has been destroyed (Swidiq Mugerwa,

Bare ground and drought resistant thorny trees in Nakasongola

NEMA 2008

Katugo Forest 2007, Nakasongola District

2008). Human activities such as overstocking, charcoal burning and bush burning are some of the contributors to this problem (Mpairwe, 2007). As a management tool, bush burning should only be done once in four years. Better land management practices, control of stock and enforcement of bye-laws would improve the situation.



Budongo Forest Reserve

Decreased Fire fronts and increased vegetation

A study in the Budongo forest –Murchison falls National Park landscape shows that there has been both woody cover decrease and increase. In areas where there has been continuous burning, woody cover species have changed from those that are less resistant to fire to those that are more resistant. Signs of fire are evident in such landscapes (see pictures on next pages). In areas where there has been a higher control of burning, increase in woody cover has been observed.

Large tree greater than 30cm dbh that had been destroyed by the recurrent fires on the southern bank of Murchison Falls National Park near Wairingo ranger post.

LAKE ALBERT

BULIISA DISTRICT

Budongo Forest Reserve

HOIMA DISTRICT

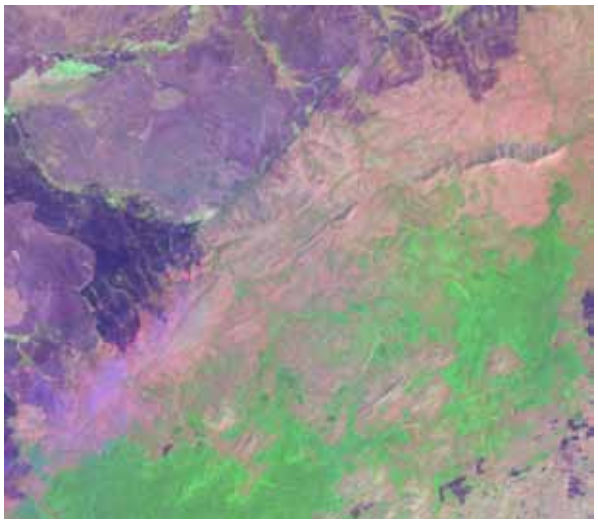
MASINDI DISTRICT

0 5 10 Kilometres

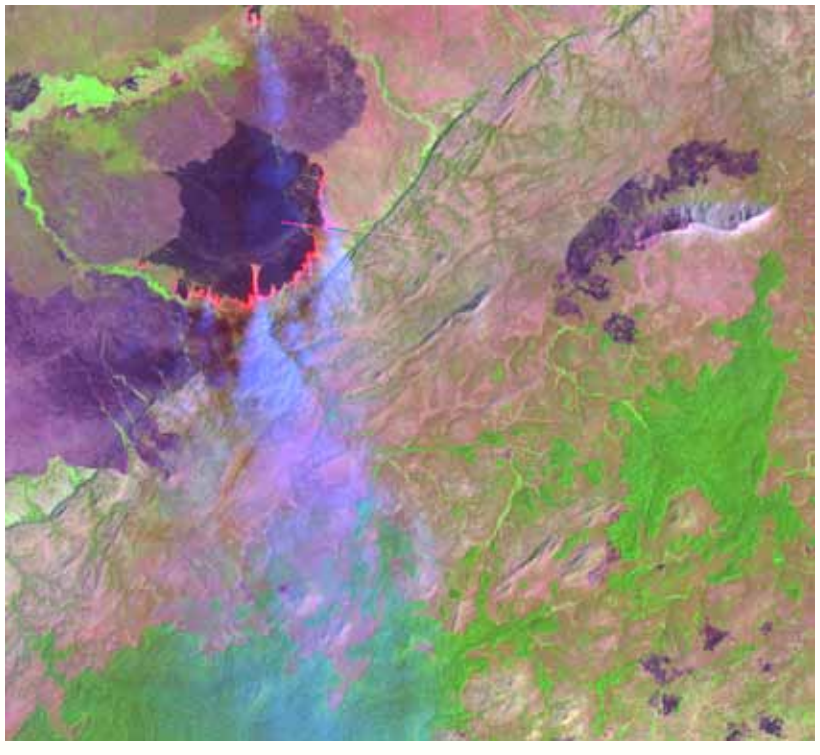
N

07 Dec 2008

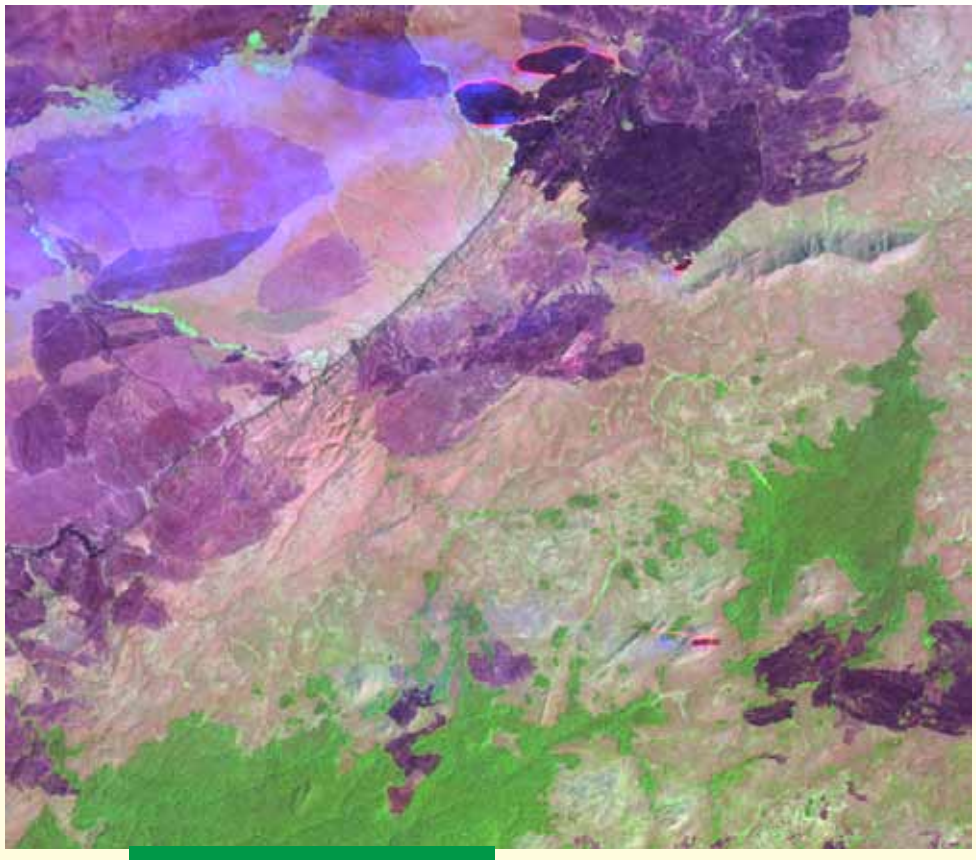
For northern Budongo, increase in policing of the forest area and the presence of the park entry gate at the southern end of the only through road has resulted in observable decrease in burning. The burning was mainly carried out by the local communities bordering the forest. Fire scars were evident on the 1973 image of northern Budongo. There are no fire scars on the one of 2008 due to recovery.



Budongo fire fronts 2002



Budongo fire fronts 1995



Budongo fire fronts 1985

Dr. Grace Nangendo (2008)

The figures show Landsat satellite images taken in 1985, 1995 and 2002. All three images were taken in February of the respective years. Active fires with fire fronts are visible in the rift valley area and close to the escarpment. Fire scars are evident between main Budongo and Kaniyo Pabidi forested areas in 1985, but in 2002 there is less fire and more regrowth between the two forested areas. The regrowth is also evidenced in the photographic comparison shown on the opposite page.

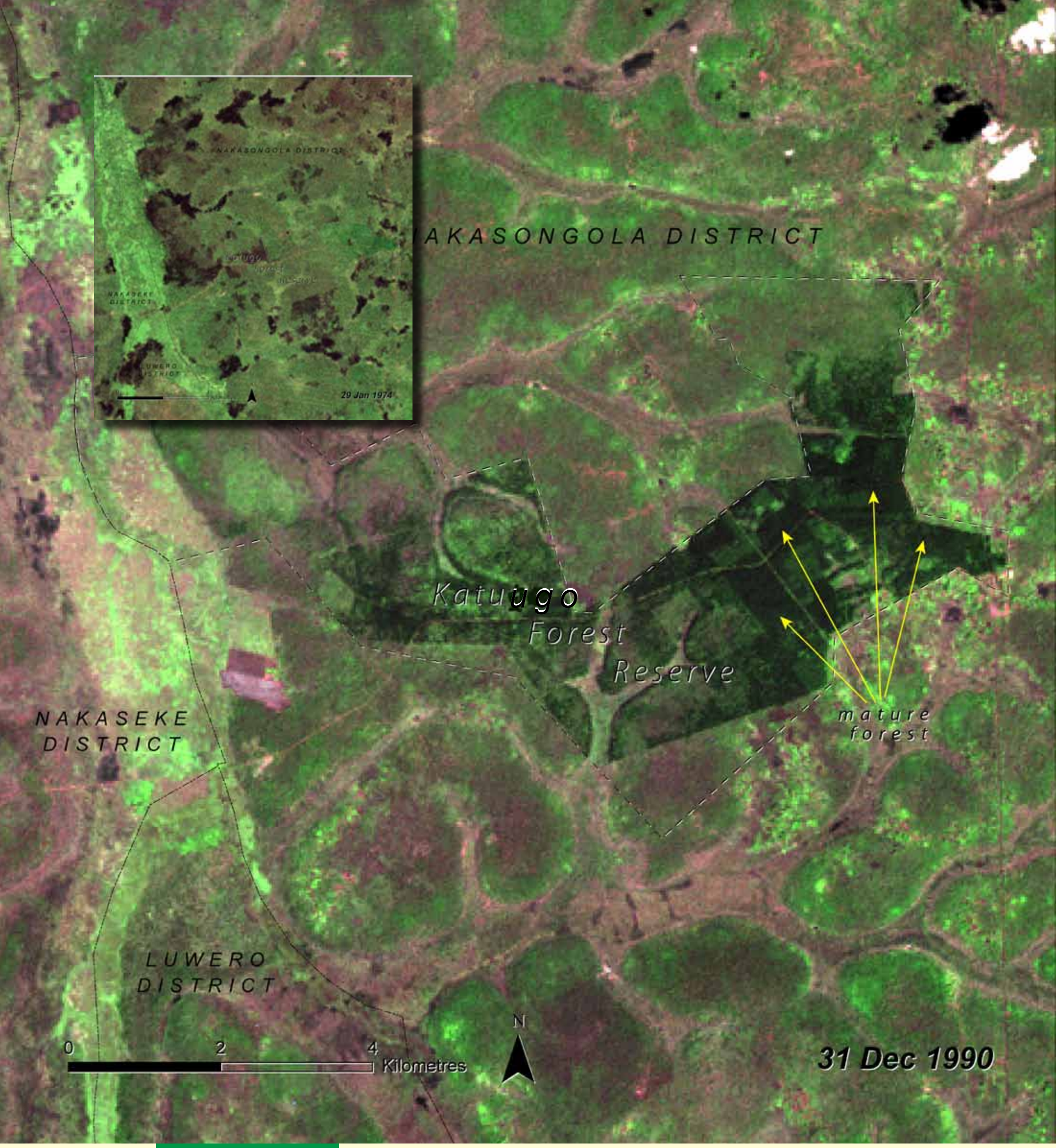
Budongo Forest Reserve

Decreased Fire fronts and increased vegetation

Large trees greater than 30cm dbh that had been destroyed by the recurrent fires on the southern bank of Murchison Falls National Park near Wairingo ranger post.

A campsite of a research team that was located at "Mailo kumi", along the Masindi – Paraa Road via Kichumbanyobo gate, in 1974. Photograph was taken by Professor Van Straaten who was then carrying out his PhD research.

Photograph of the same location taken by Oliver Van straaten (son of Prof. Van Straaten) 2002.



Katuugo Forest Reserve

Loss of vegetation cover

Since the 1940's the Ugandan Government has promoted a policy of planting forests on gazetted land to supply cheap softwoods for the country's growing domestic demand. Uganda's overall population growth rate of 2.6% and urban growth rate of 5.4% puts enormous pressure on these forests (Ministry of Finance, 2000). This pressure is likely to worsen because 6% of forest on private land and 6.1% of forest

NAKASONGOLA DISTRI

Katuugo Forest Reserve

NEMA 2008

Katuugo Forest Reserve

harvested forest

NAKASEKE DISTRICT

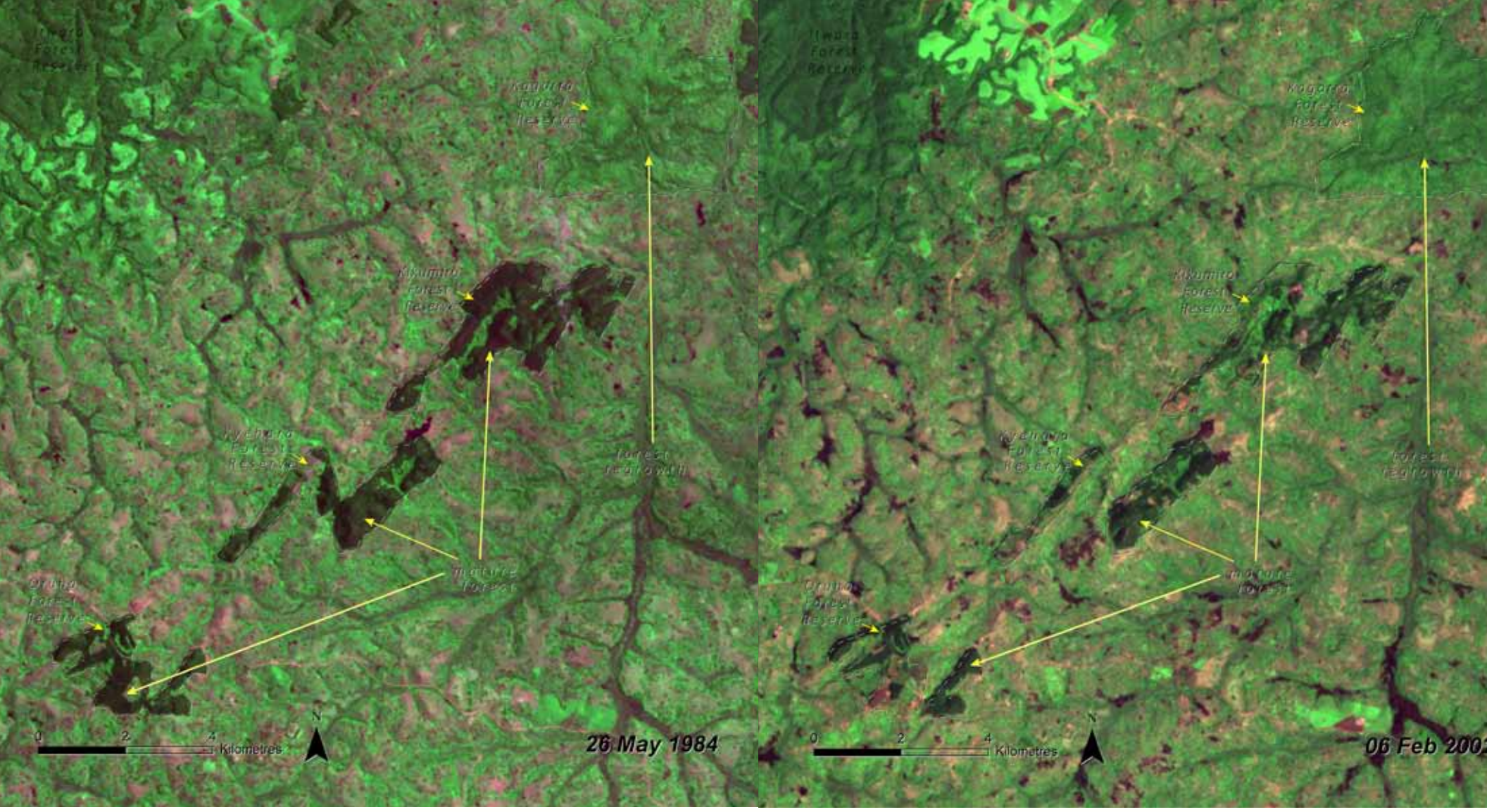
LUWERO DISTRICT

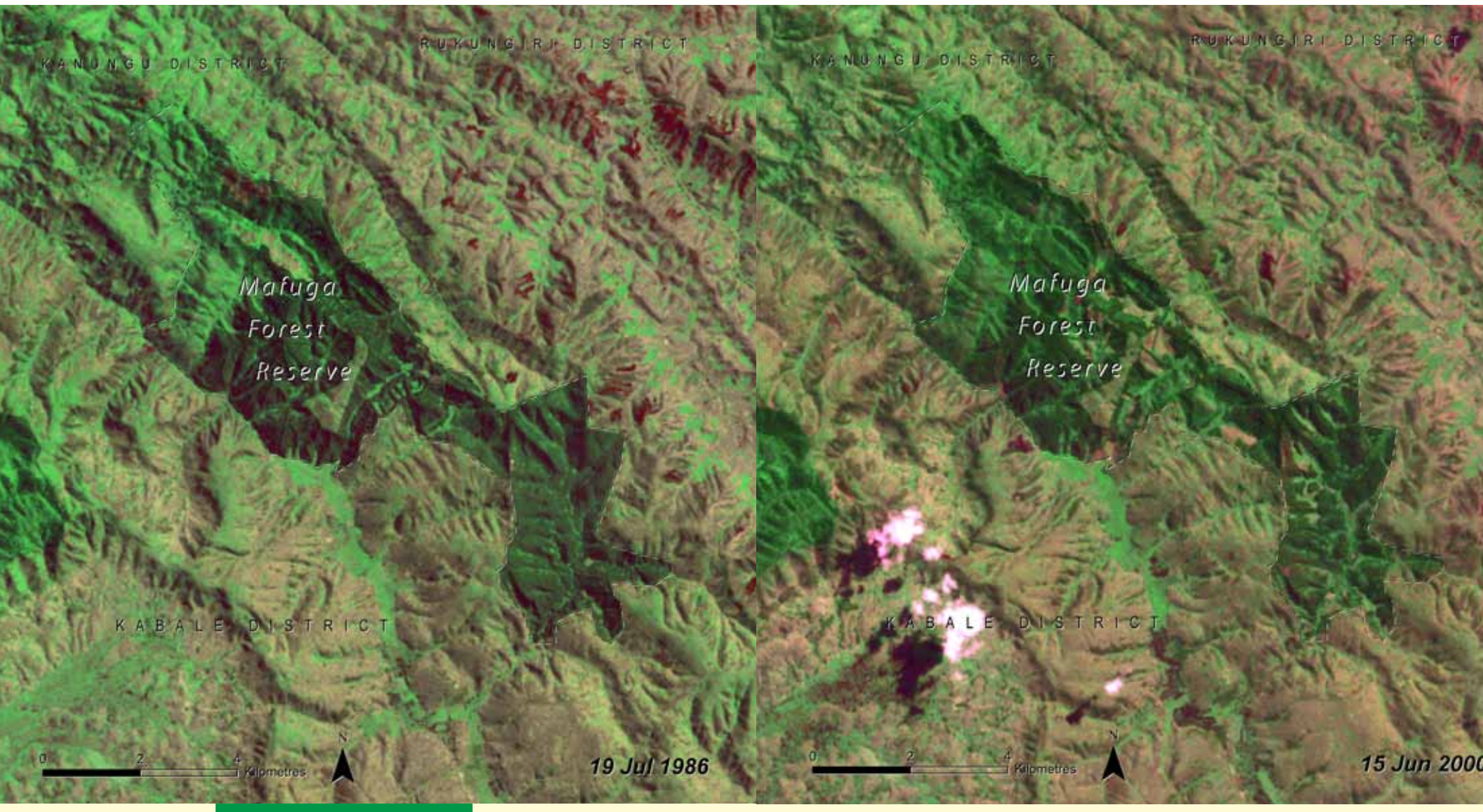
0 2 4 Kilometres

N

21 Jun 2007

in protected areas has been lost since 1990 (NEMA, 2008).
Katuugo, Mafuga and Mwenge Forest reserves are fplanted on gazetted land to supply cheap softwoods for the country's growing domestic wood demand. Mafuga in Kabale District covers an area of 3,699 ha and was gazetted in 1946.

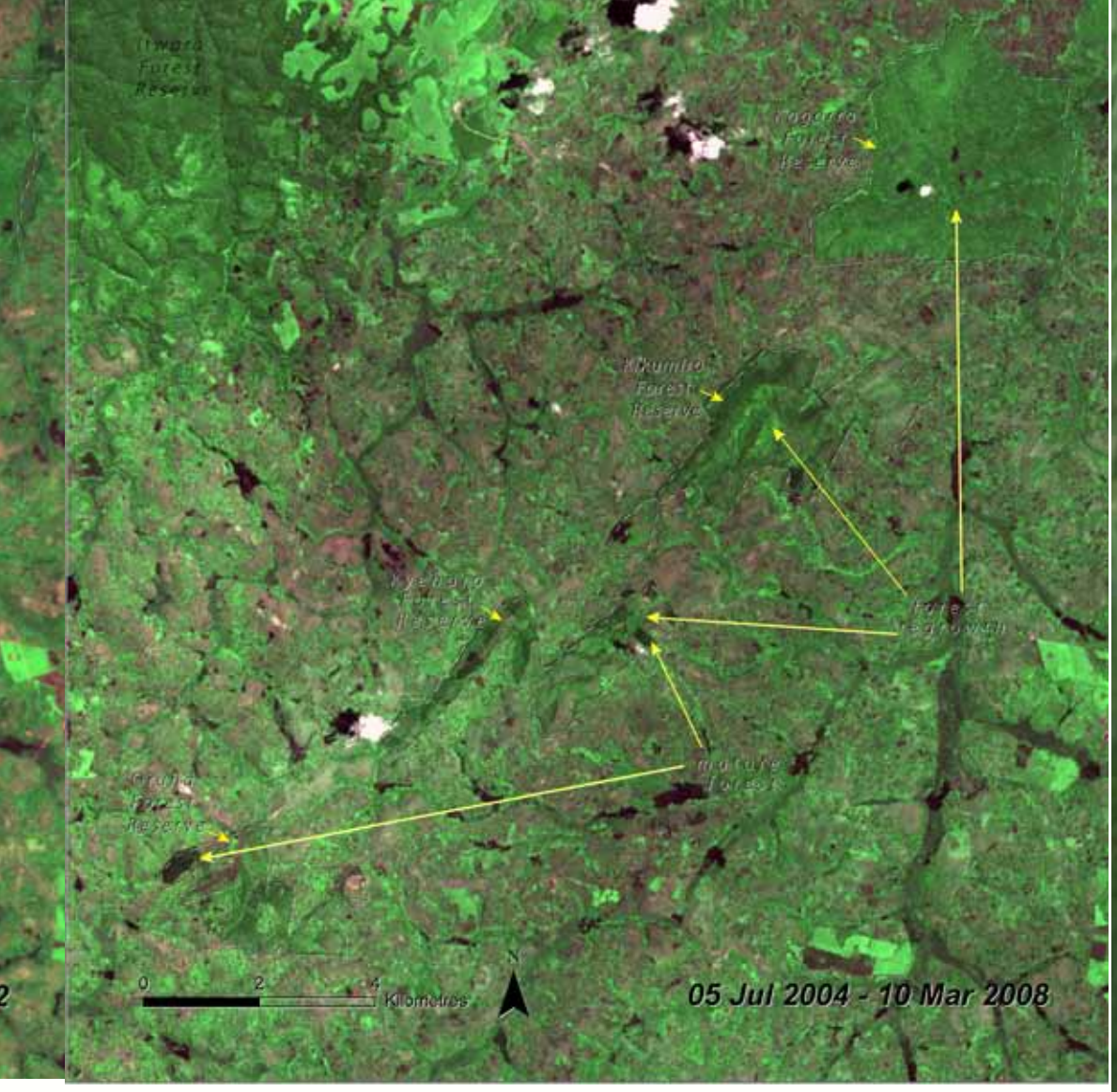


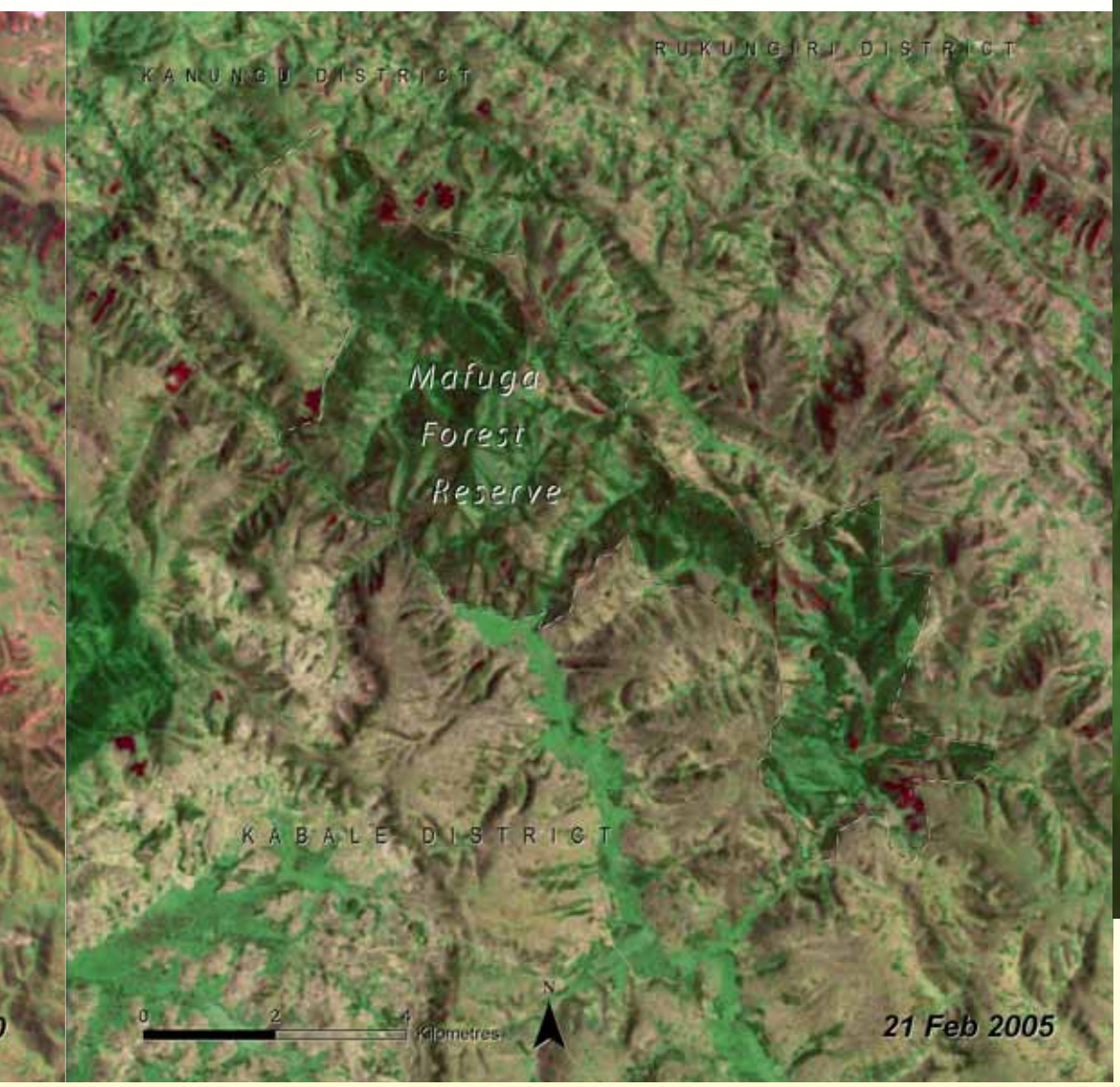


Mwenge - Mafuga Forest Reserves

Lack of willingness to replant

The main trees planted were Pine, Eucalyptus and other non-conifers in fire lines (Gombya, 2004). Katuugo in Nakasongola District was gazetted in 1963 and covers an area of 3,318 ha while Mwenge in Kabarole covers an area of 6,278 ha and was gazetted in 1948. The annual harvesting rate from these three reserves was 16.2 ha

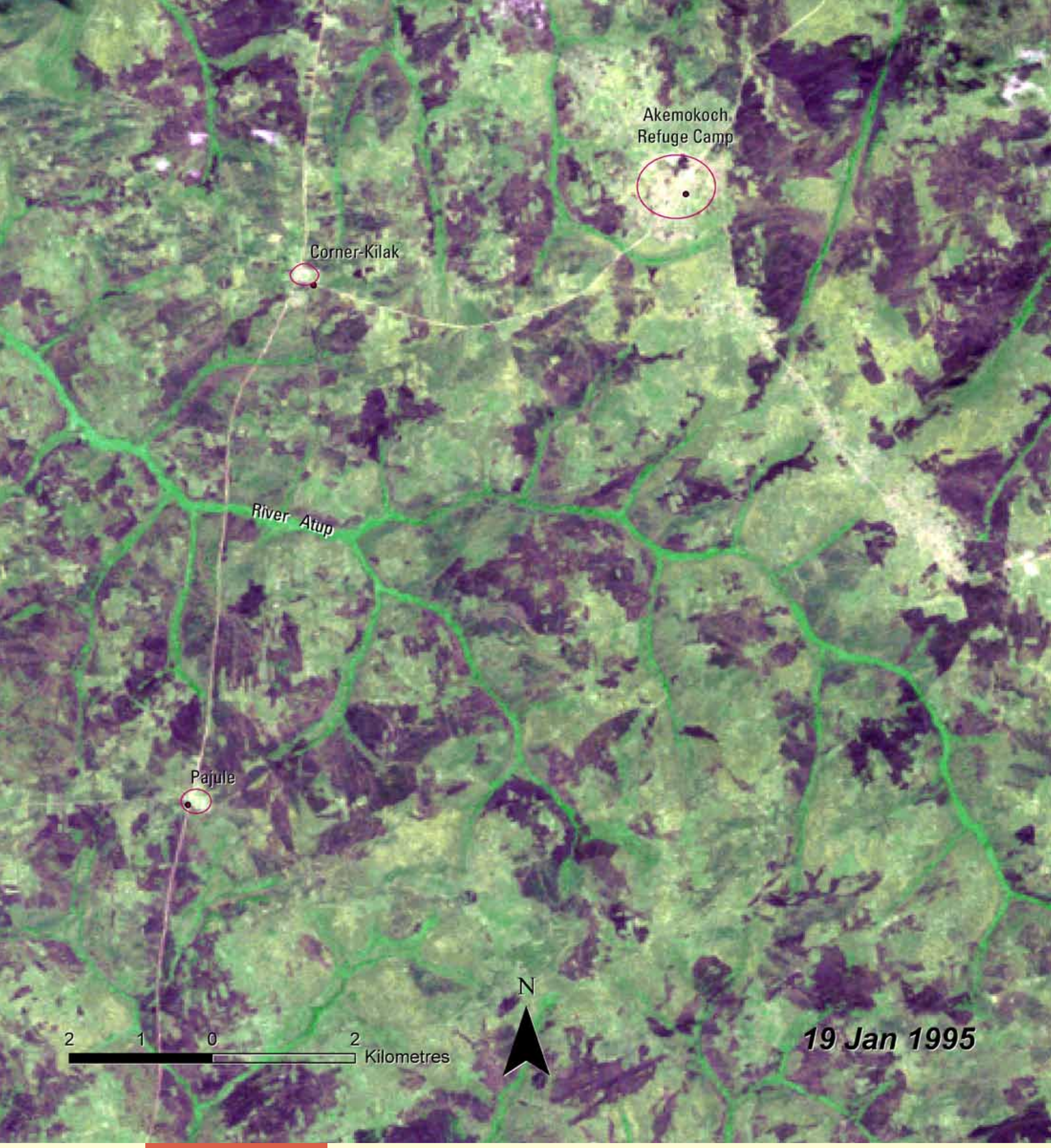




and replanting was 0.3 ha because the concessionaires were not willing to replant. This means the level of management of these planted forest reserves is unsustainable (Gombya,2004).

Mwenge (top) Forest Reserves

Mafuga (bottom)



Pader Refugee camps

Impact of the war and concentration camps; vegetation loss

From the Landsat color composite of 1990, most of the land in Pader District was under cultivation. However during the war all people moved into Internall Displaced People's camps as seen on the Landsat TM image of 1995. The areas that used to be under agriculture regenerated into bush but there was more vegetation loss around

Akemokoch
Refuge Camp

Corner-Kilak

River Atup

Pajule

N

2 1 0 2 Kilometres

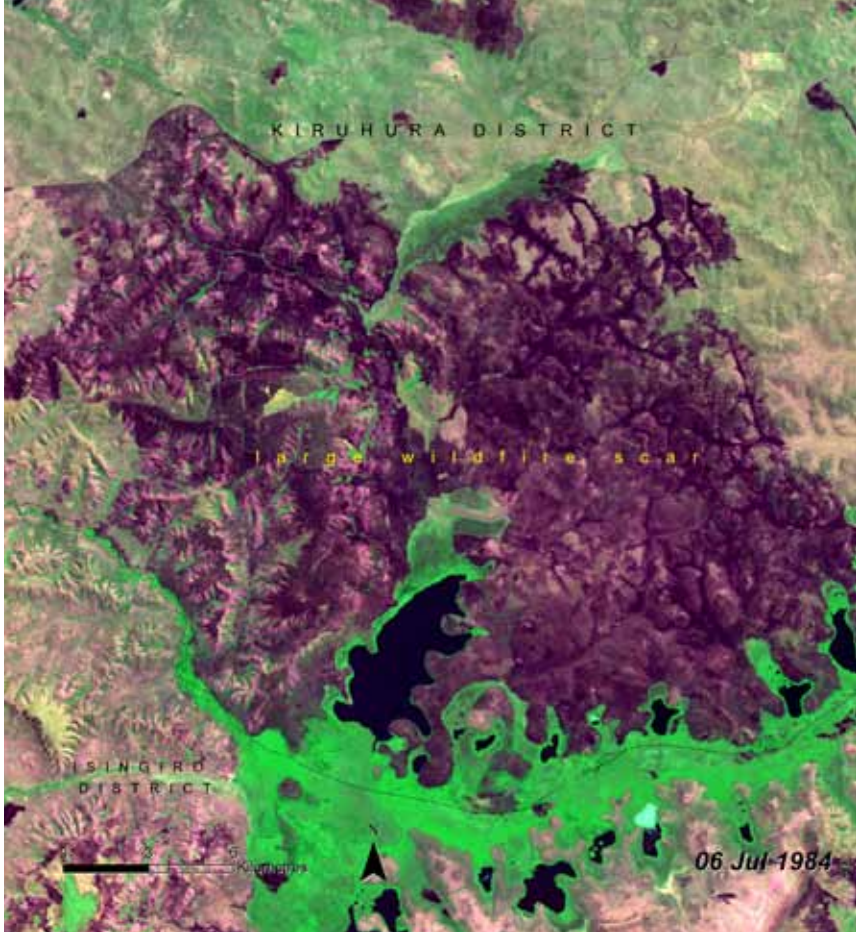
17 Jan 2009

Bush burning is very rampant in the month of January as evidenced in the satellite images of 1995 and 2009. If this is not regulated, it will result in land degradation and low productivity of soils.

Kooki Hills Area

Degraded hills

The Kooki Hills in Kooki County, Rakai District are part of the south-western highlands, although not as conspicuous. Their summits range from smooth rounded to flattish surfaces, with moderate to long steep flanking slopes, fluted by minor valleys and short pediments on the lower ends. In some cases hills occur singularly, while in other cases they occur as ridges (for example in Kibanda sub-county), with slope lengths of about 0.5 to 1.0km. Kooki hills are underlain by Karagwe-Ankolean



Bare hills in Kagamba sub county, Rakai District

phyllite, mudstone and shale rock systems. The Karagwe-Ankolean phyllites cover a wide stretch (ridges, and represent the climax of the Kooki hills, presumably due to being more resistant than shale and mudstone. The climax is representative of Katabaluka and Katiarizo hills in Kibanda, which rise to 1,542 m and 1,540 m above sea level, respectively. These bare hills as seen in the image of 1984 are constantly burnt in the dry seasons.

Kooki hills in Kibaale-Bukoora, Rakai District

The degraded hills of Kooki in Rakai District

The most common morphology of the hills comprise of round to flat summits that abruptly descend on steep convex and straight slopes, ending in relatively gentle and moderately concave pediments. The pediment slopes show an abrupt steepening in their lower sections adjacent to valley floors which are often swampy.

Gemorphologically, Kooki hills are thought to result from an upwarped Buganda plateau during early Tertiary, after a long quiescence from the Karoo era and subsequent reduction of the plateau landscape by denudation process to a very low relief, the African Surface in this Buganda part of Uganda which, therefore, is sometimes called Buganda surface. The uplift resulted in an elevated and dissected plateau consisting of a series of flat-topped hills or their remnants and intervening valleys. Thus, the landscape was dissected by the rejuvenated drainage system, leading to a dissected plateau in form of the present ridges and hills. In some cases, the Kooki hills are related to the Kigezi-Ankole surfaces (highlands), but generally, Rakai hills are regarded as an upwarping of the Buganda surface.

The soils in the Kooki area are dominantly of Ferralsols type and its associations. This is the most dominant soil type in Uganda, covering about 2/3 of the country. This is a class of soils considered to be the oldest on earth; the soils are characterized by low fertility levels and are deeply weathered and leached with little mineral reserves remaining. Generally, soil distribution varies with slope morphology, in that at the summits, moderately deep to shallow soils often occur; but on the steep convex and straight slopes, soils become very thin with depths varying from bare rocky or weathered regolith surfaces to only a few centimeters deep. Further down on the concave and pediment slopes, respectively, soil depths increase appreciably often reaching depths of over 150 cm.

On the hill summits and steep upper and middle slopes, the soils are Plinthic Ferralsols and Hyperskeletic Leptosols. These associations are dominantly shallow, loose and skeleteral, with high proneness to erosion. Most of the former summit laterite capping has been removed leaving behind disintegrating boulders and relics

Kooki hills in Kacheera sub county, Rakai District

of deeply weathered regolith, on mudstones and shale rocks. Ferralic Acrisols (well drained) occur on the upland pediment slopes and support moderate crop production, while at the footslopes and valley bottoms, halpic luvisols are a common feature. In the valley bottoms and river valleys, a variation of deposition related soils occur, both arenosols and luvisols (for example, Ferralic arenosols, Halpic arenosols, Halpic gleysols and Arenic gleysols). Most of these soils are of medium productivity and tend to be of higher moisture content during the dry season.

Kooki hills are located in the relatively dry zone of Uganda (the cattle corridor) with climatic conditions classified as dry sub-humid to semi-arid. Rainfall records at Kibanda indicate that the area receives about 880 mm annually (Climatology Statistics for East Africa Part II - Uganda; East Africa Meteorological Department, Nairobi 1975). Occasionally, the area experiences periods of prolonged droughts which sometimes lead to severe moisture deficit. During this dry season, extensive and uncontrolled bush burning, a traditional practice mainly used as a means of land clearing for agriculture and for rejuvenation of young and tender grasses for livestock grazing.

Rakai has over 20,000 head of cattle. During the periods of drought and pasture and water deficits, about 70,000 more heads of cattle come from other areas in search of pasture and water leading to a swelling cattle population of over 90,000 which, in turn, put tremendous pressure on land, exacerbating the problem of overgrazing.

A combination of low soil fertility and poor structure, steep slopes, low available plant moisture, as well as poor grazing and crop growing practices, is thought to be the main cause of extensive occurrence of patches of bare ground on the Kooki hills. The rate of expansion of these bare patches is reported to have recently increased dramatically, which indicates rapid environmental change in the area. Consequences of this process are far reaching, especially with regard to reduction of grazing land, increased runoff and erosion and, increased sedimentation problems in the valleys below and in water systems.

With increased degradation to bare ground in upland areas, people are turning to the valley bottoms and dry plains, wetlands, river banks, and fragile ecosystems for both crop cultivation and grazing, leading to yet new threats of degradation and environmental change.

Rainy season: Kooki hills in the background overlooking Lake Kijanebarola, Rakai District (NEMA 2008)

Origin of Lake Kijanebarola and River Rwizi-Kibare-Bukora system

During the formation of the Western Rift valley system, landscape was tilted eastwards which led to rivers and streams being reversed to flow through new routes on a down warped landscape and drowned valleys. Consequently, a fairly long river system of Rwizi-Kibare-Bukora developed. The system originates from its uppermost catchment in the south-western highlands of Itojo, Rwampara, and Buhweju in Ntungamo, Mbarara and Bushenyi districts, respectively. Due to the down warping effects, depressions were formed along its course, which were filled with water both from the river flow and from micro-catchments to form lakes Kacheera, Mburo and Kijanebarola. On its long course from the highlands to Lake Victoria, the river flows out of lakes, Kacheera and Mburo, through Kanagisa wetlands - a poorly defined valley system with numerous shallow depressions choked by wetlands; and then into Kijanebalola, a rather streak valley that was filled by water from the river and flanking cathments to form the lake. From Lake Kejanebarola, the system changes into Kibare-Bukora Rivers, which drain the Kooki hills through the Sango Bay plains, and then into Lake Victoria via the western shores.

The Lake Kijanebalola feature is itself a recent formation, which is a result of drowning of part of Rwizi-Kibare river course. It is a very shallow lake with an average depth of 5 m; and occupies a wide and streak valley, covering a surface area of 35 km^2 and with a circumference of about 88 km. The name of the lake itself implies that it was formed when people were there seeing. Although the age of the lake is not readily known, it is a recent formation and could be traced and estimated through both scientific and folklore means.

The water catchments of the rivers and lakes are experiencing heavy population pressures, which become the key driver of environmental change in the area. Due to population pressure, land degradation has increased to unprecedented magnitudes, especially through loss of vegetation cover and soil erosion. This is thought to have reduced the hydrological potential of the catchments and consequently the volumes of water flowing through the river to the lakes. In addition, heavy silting of the river valleys and the lakes has the effect of reduced the water holding capacity of these water systems; and worse still, the shallow nature of the lakes and the high potential evaporation rates in the area may augment the problem.

Environmental change

Of recent both the river system and the lakes through which it drains have experienced heavy silting and this has affected the water quality to the extent that

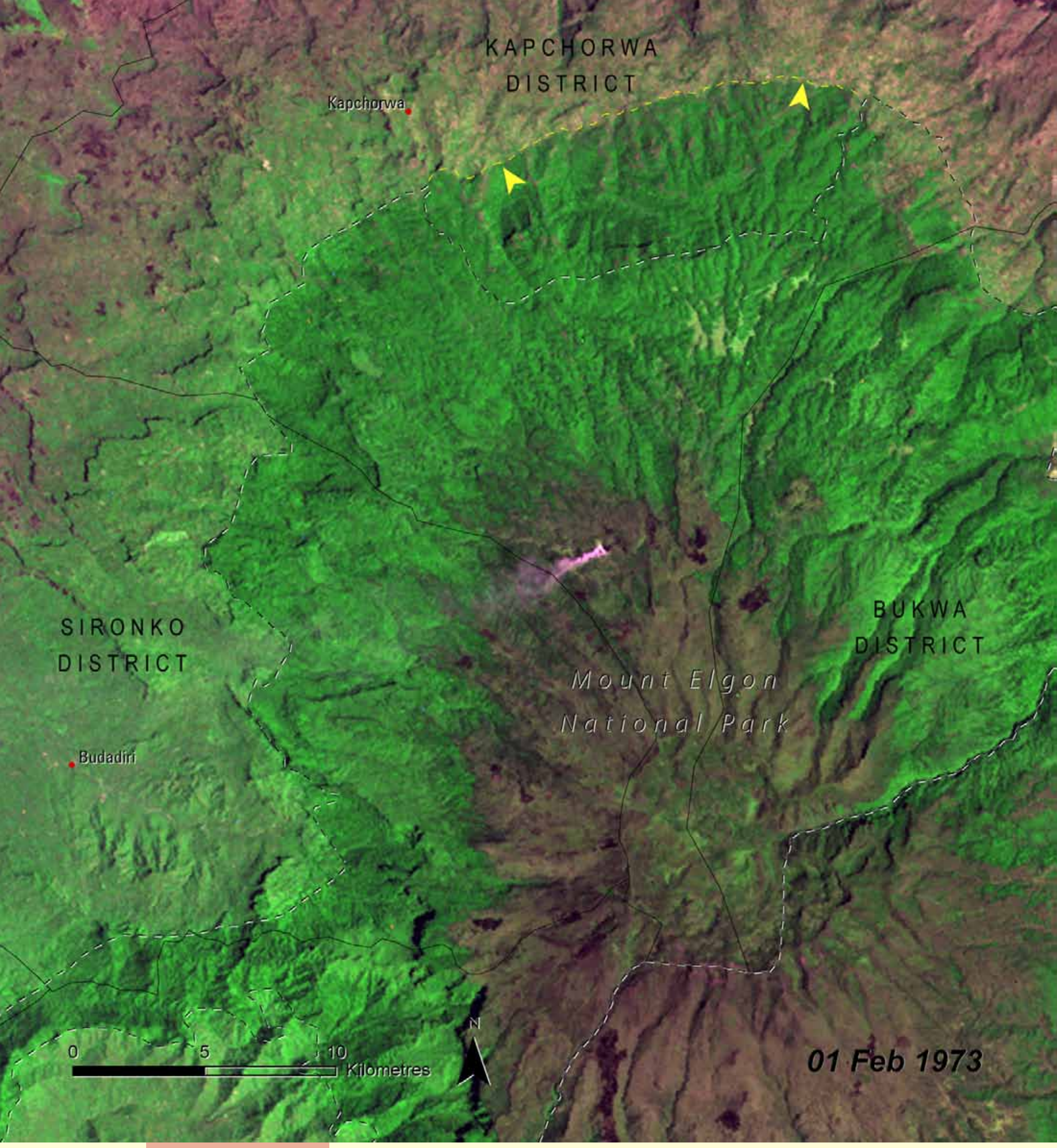
Execution of the Kibale-Bukora eco-system Restoration plan 2007, Rakai District.

it requires heavy investment to make it suitable for domestic use. As such, the lake water is mainly used for livestock while the population prefer water from rivers, wetlands, shallow wells and bore holes, but these are not adequately available, leading to water shortage problems. Recent trends indicate continued shrinkage of the size of the lake, and numerous islands formerly non-existent are emerging, attributed to silting and reduction in the lake level. It is predicted that if this trend continues unchecked, and due to the eminent threats of climate change, the river flow may be demised and lakes dried, leading to a water crisis.

A further and new dimension of environmental change is being experienced in the river valley and Lake Kijanebarola. Due to land degradation and productivity decline on land flanking the river, people have turned to the river banks and dry river beds, encroached on them and reclaimed them for crop cultivation, taking advantage of the relatively still fertile soils due to silt eroded from the hills and deposited in these valleys. The magnitude of the problem became so high that, in 2001 government embarked on the development of a strategy and action plan to restore the degraded wetlands, river banks and lake shores in the area, by removing farmers and facilitating recovery of both vegetation and water eco-systems in these fragile areas. Execution of the action plan was undertaken in 2007, and within a period of just one year, impressive recovery has been realised especially with respect to aquatic vegetation and water levels which have improved significantly.

Many people who have been to and still live on the shores of Lake Kijanebarola complain that the water causes their bodies to itch, when they bath it. The lake waters have developed a blue-greenish weed in powder form that is drawn in water from the lake for domestic use. The presence of this weed encourages accumulation of bacterial communities, which in turn leads to depletion of oxygen in the water body. This may be what underlies the local belief that Lake Kijanebarola has no fish and its water causes itching to the body when used for bathing. The situation is made worse by the high rate of fungal infection in the district and the entire region. Unguided cultivation, reclamation of wetlands, river banks and lake shores, bush burning has resulted into the bare hills of Kooki and “eutrophication” of lakes, and the attendant effects on human well-being.

To the local communities, the blame is being directed to those people in positions of responsibility who have not made any serious efforts to halt these trends.



Mt. Elgon National Park

Conservation issues

Mount Elgon has been controlled by the Forest Department since 1929. It became Mount Elgon Crown Forest in 1940, and a Forest Reserve in 1951. The main objective of the working plan for 1968-1978 (Synott, 1968) was to protect the forest, with secondary objectives of extraction of timber. Since the restoration of civil stability in Uganda, the government has been increasingly aware of the need to promote conservation, and in 1988, a forest rehabilitation project was initiated on Mount Elgon.The upper reaches of

KAPCHORWA DISTRICT

Kapchorwa

SIRONKO DISTRICT

BUKWA DISTRICT

Mount Elgon National Park

Budadiri

0 5 10 Kilometres

N

28 Sep 2005

Mount Elgon received the protected status of a National Park in 1992. Prior to this, the area had been a Forest Reserve (gazetted in 1951) with objectives of forest protection and timber extraction (Synnott, 1968). The Mount Elgon Conservation and Development Project has been assisting the National Park authorities with forest and community issues since 1987.

Dawn at the Mt. Elgon Ranges (2008)

Mt. Elgon Benet Area

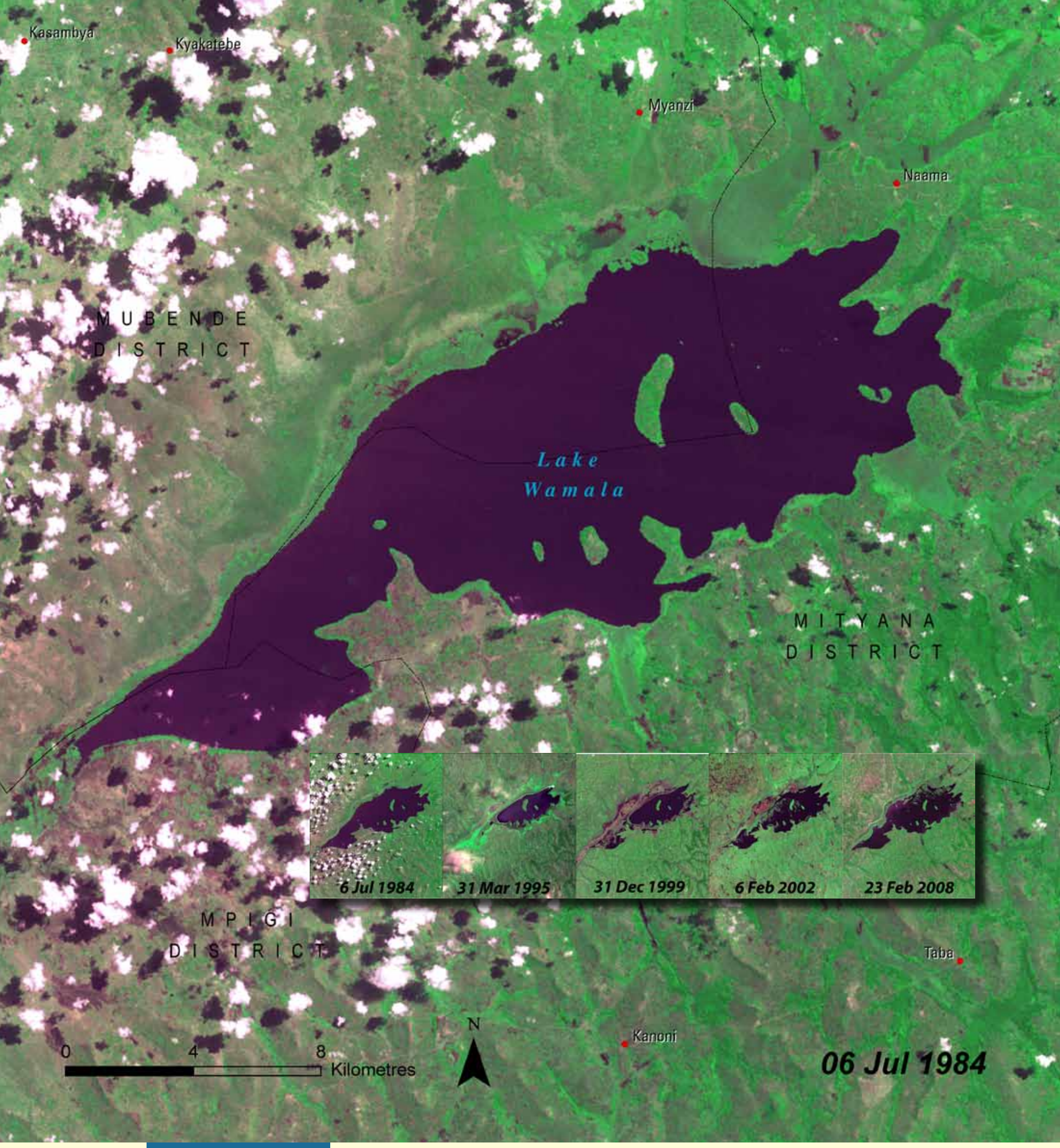
The current aim of the project is to "promote community development and conserve Mount Elgon's ecosystem for present and future use" using a "community based resource management approach" involving the participation and empowerment of local communities in the development process (MECDP, 1995). Working in conjunction with MENP, park regulations have been formulated with reference to the needs of local people and their resource use levels, and enforced in conjunction with a comprehensive extension programme. Collaborative management was piloted in two parishes, with the aim of extending it to all forest-adjacent parishes before the project ends in 2000.

IUCN have commissioned a number of resource inventories and assessments. Katende et al. (1990) carried out a biodiversity inventory for woody perennials and birds. A Land Mapping and Biodiversity Survey of Mount Elgon National Park was carried out in 1993 to assist the development of a long term management plan (van Heist, 1994). The survey described numerous aspects of the mountain with an emphasis on plant biodiversity. A "resource use assessment" was commissioned for the same purpose detailing resource use by people groups across the mountain through a series of semi-structured interviews and group discussions (Scott, 1994).

A number of forest dwellers still live in the park. They are primarily pastoralists, practising subsistence agriculture in gardens next to their houses. Prior to cultivation, the areas are burnt and cow dung is added to the soil to fertilise it. The gardens are then planted for two or three years. The high altitude prohibits the production of maize, but potatoes (*Solanum tuberosum*) and matoke (*Musa sapientum*) are widely grown. When the evictions occurred, many of these gardens and grazing areas around them were abandoned. Immediately after the 1990 evictions the forest was lacking the dense shrub layer characteristic of East African upper montane forests (Richards, 1996) and extensive areas of top-soil were exposed due to the activity of cattle (Katende, A. pers. comm.). The current pastoralists concentrate grazing activity on the Benet grasslands which meander through the forest at an altitude of approximately 2,500 - 2,800 m. It is not certain whether the Benet grasslands have always been open grassy areas (van Heist, 1994) but they are maintained as artificial climax by heavy grazing. A number of cattle graze in the forest, but they are fewer in number than before the evictions. Although the Ndorobos live illegally in the area they are tolerated by the National Park authorites who are currently deciding whether to relocate them.

Sunrise at the Mt. Elgon Ranges (2008)

Donkeys are commonly used as a means of transporting produce and goods in the Mt. Elgon areas of Kapchorwa and Nbale Districts (2008)

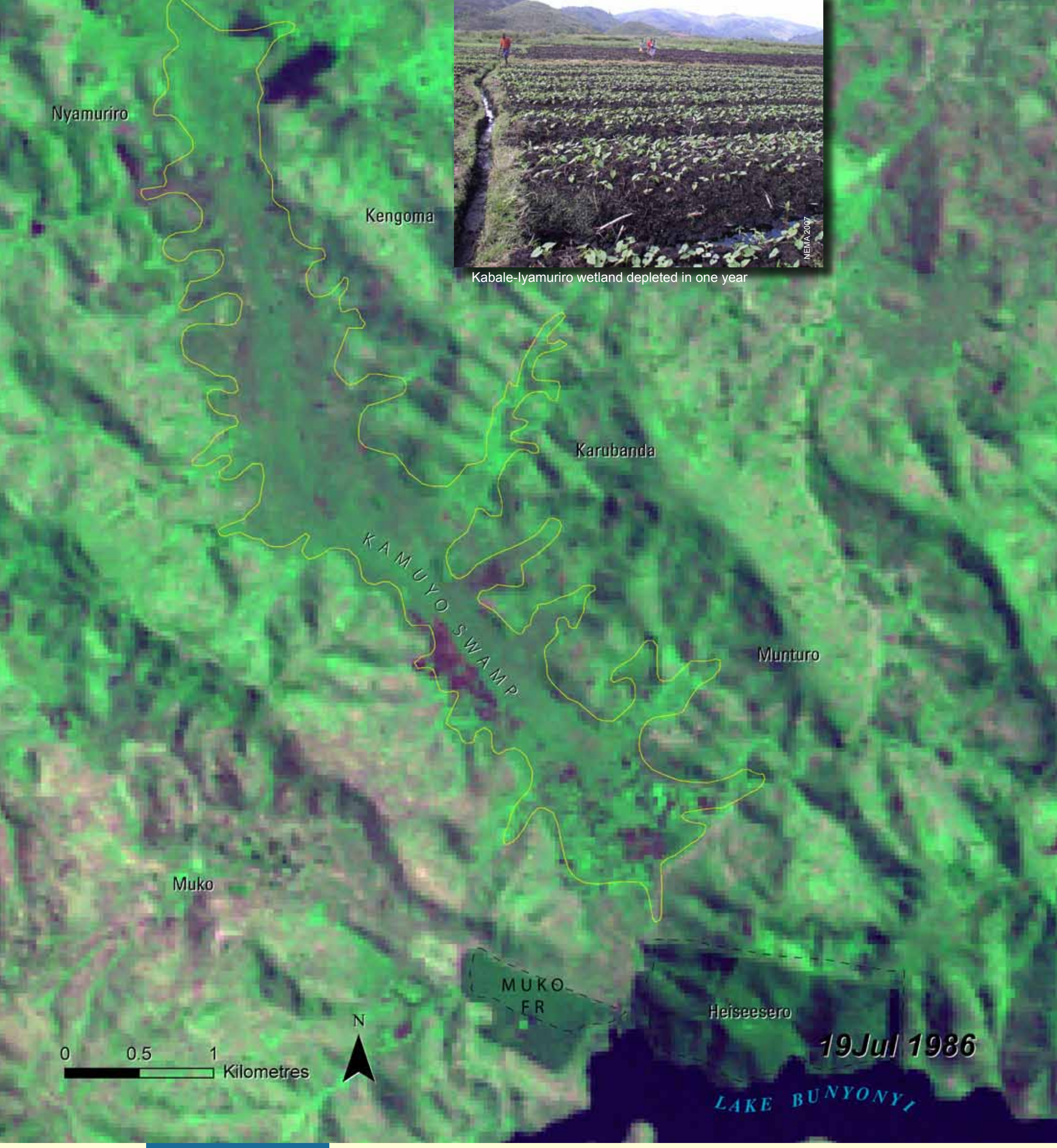


Lake Wamala

Wetland degradation

Lake Wamala is situated in Mityana District. The system receives numerous minor affluent watercourses and drains via the Kibimba River to the Katonga River. The Kibimba is almost permanently dry and only occasionally does it carry overspill from Lake Wamala, and when it does, this may not be sufficient to reach the Katonga. The Wamala Basin (2,654 km^2) is therefore usually quite separate from the Katonga Basin. Direct precipitation over the lake is estimated as 1,200 mm/yr and the largest inflow the

Mpamujugu, contributes 97 million m3/yr. The area of the lake has been shrinking over the years. The lake had an area of 164 km^2 in 1990 and by 2000 the area had reduced to 87 km^2 which is 50% reduction. The fish catch from Lake Wamala has declined since the lake was stocked in 1956 and opened to fishing during the 1960s. Changing levels of the lake is a function of rainfall and not as a result of other environmental causes.



Kabale-Iyamuriro wetland depleted in one year

Lake Bunyonyi - Iyamuriro Wetland

Effects of wetland degradation

By 1990 the Iyamuriro wetland was intact, performing hydrological and ecological functions. From the year 2005 to date, the whole eco-system has been converted to Agricultural cultivation land.

Nyamuriro

Kengoma

Karubanda

KAMUYO SWAMP

Munturo

Muko

MUKO FR

Heiseesero

N

0 0.5 1 Kilometres

05Jul 2004

LAKE BUNYONYI

Effects:
- Loss of biodiversity including endemic birds e.g the Papyrus yellow warbler. This wetland is one of the Important Bird Areas (IBAs) in Uganda.
- Change in micro-climate (fog and mist formation greatly altered)
- Change in hydrology in the area. The conversion happened “instantly” and impacts are highly significant.

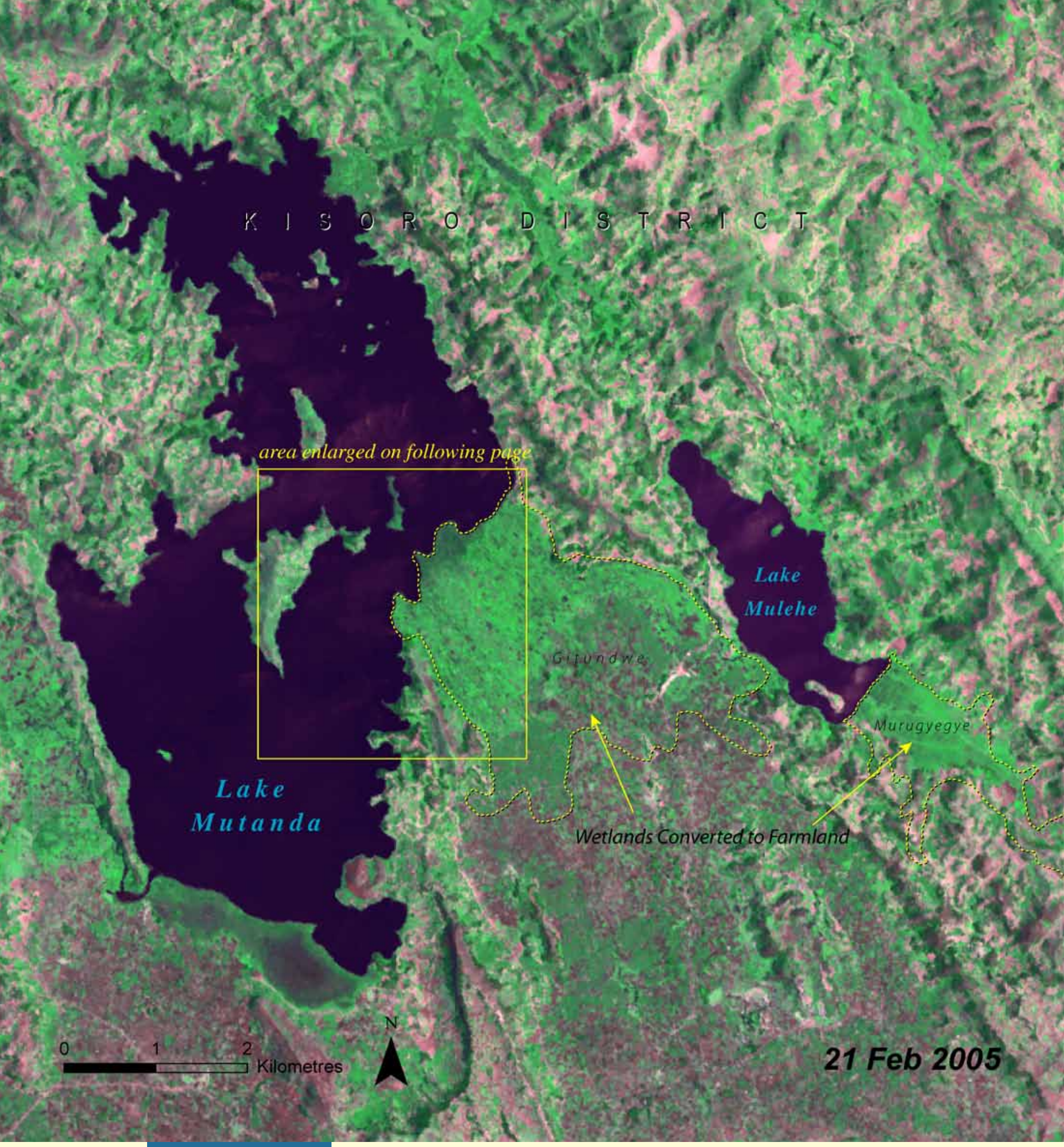
Aerial view of Kabale-Iyamuriro wetland

Lake Bunyonyi

The lake was formed due to a combination of intense rifting and back tilting of the landscape by earth movements that occurred in this area during the Tertiary times, in association with formation of the Western Rift valley in East Africa; and later the volcanic lava damming of rivers flowing on the raised and tilted landscape. As a result, Lake Bunyonyi occupies one of the deepest and long winding narrow valleys, characteristic of this Kigezi region and a reminiscent of the intense Tertiary rifting in this part of the country. The entire lake is encircled by towering ridges and hills, with very steep slopes that abruptly drop to the very narrow lake shores. Water from rivers filled a drowned deep and moderately wide streak valley which was then dammed by lava to form one of the deepest lakes in Africa. The lake covers an area of 46 km^2 and has an average depth of 39m (Langlands 1974).

Lake Bunyonyi, in Kabale District, Western Uganda (2008)

The streak nature of the lake gives it a long shoreline relative to its size, with a circumference of 186 km (Langlands 1974). The lake gradient is tilted towards north-west, in accordance with the orientation of the former main valley, and the water in the lake is held back by a small band of lava flow near Muko. Water from the lake escapes through a breach in this lava band in form of a mini-rapid, and marks the beginning of a river flowing through the formerly vast and deep Iyamuriro wetland system into the Ruhuuma and from there through a narrow valley across the Kabale-Kisoro border into lake Mutanda in Kisoro District. Because of its great depth and narrow shores, and due to characteristically low temperatures of the highland region, the lake productivity in terms of fish is low.



Lake Mutanda

Rapid silting and wetland depletion

Like Lake Bunyonyi, Lake Mutanda was formed due to river valley drowning and lava damming on the arena-like Kisoro plain; but the valley was not so deep in comparison with the case of Lake Bunyonyi, and hence, the resulting lake is not so deep. The lake covers 22 km^2 in area, with an average depth of 22 m. The lake shore line is more regular and shorter compared to Lake Bunyoyi, with a circumference of only 60 km. The shallow nature of the lake puts it at a higher risk of demise through rapid silting compared to the deeper Lake

Bunyonyi. There are other lava dammed lakes in this same area of Kisoro District namely Murehe, Chahafi and Kayumba, but these are smaller and even shallower, and are at the verge of being killed by heavy silting. Out of Lake Mutanda, flows River Kaku, which crosses the Uganda-Democratic Republic of Congo (DRC) boundary to form part of the upper River Semliki system, a major tributary of the River Nile (Langlands 1974).

Lake Mutanda: Heavily converted Gitundwe wetland in Nyundo and Nyakabande sub countries (2008)

Lake Mutanda

This emphasizes the local, regional and international importance of lakes Bunyonyi and Mutanda and, their catchments and the various wetland systems fringing these water systems, as one whole ecosystem whose degradation will have serious on-site and off-site implications.

Environmental Change and effects

Population pressure on land and poor land management practices have led to clearance of every bit of vegetation cover in the lake catchments leading to grave accelerated erosion. In the past, efforts were made by Government to institute and enforce soil and water conservation measures, and by 1950s this region was graded to attained soil and water conservation standards, particularly bunding and terracing on farmlands, easily unsurpassed anywhere else in Africa. However, the ever mounting challenges of rapid population growth coupled with later relaxation in enforcement of conservation measures has left the lake catchments and the rest of the highland region in a desperate state, with conservation structures on farmlands and hillslopes in general disintegration from hyper-accelerated erosion (Bagoora, 1993).

In the areas surrounding Lake Bunyonyi and Mutanda, the population is estimated to be beyond 350 persons/km^2 making it one of the world's most densely populated rural areas; with projections of continued high growth rates of more than 3% per annum, which does not in any way point to a rosy future.

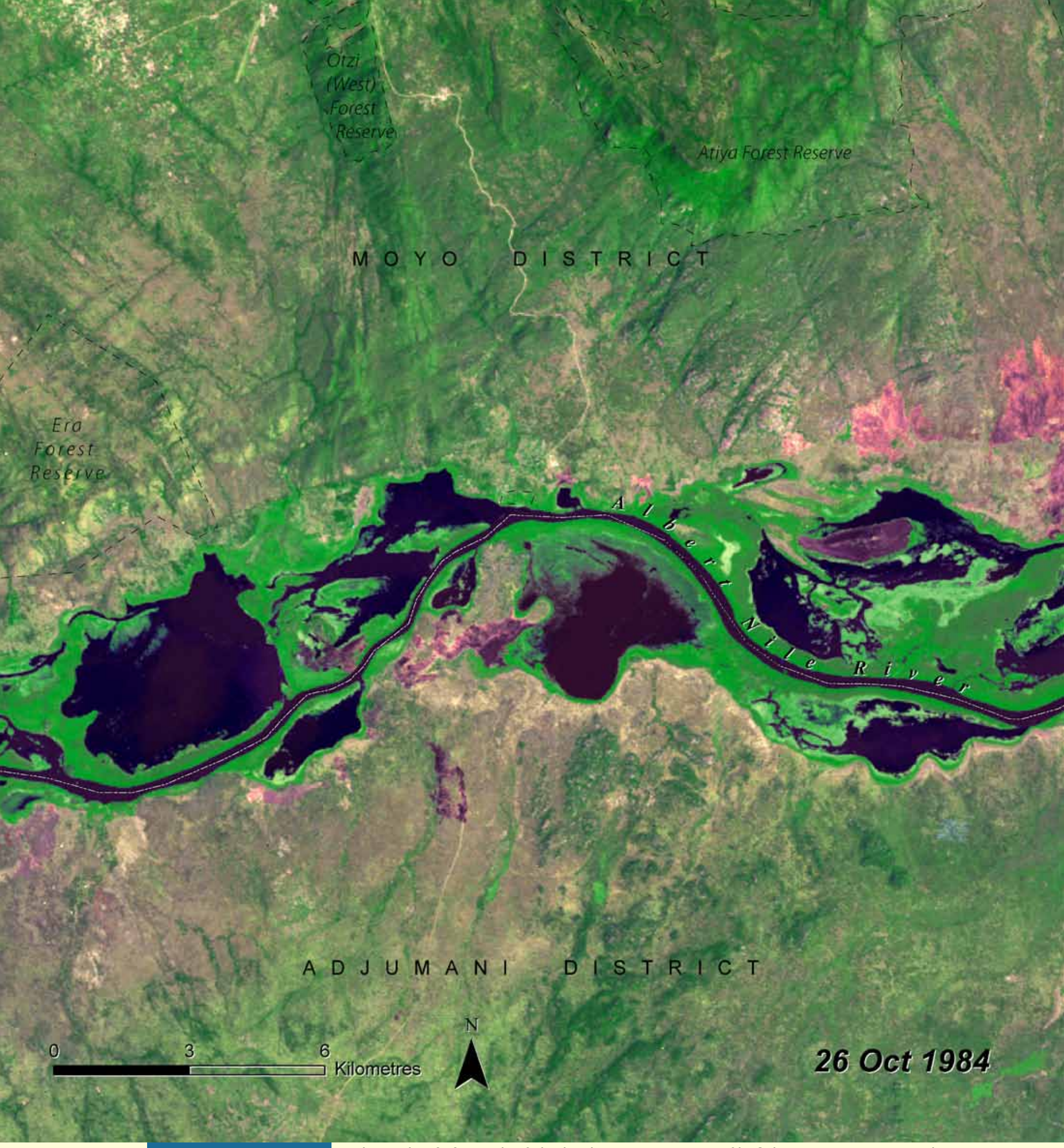
Landuse is dominated by peasant farming based on annual crops dominated by sorghum, potatoes and legumes, which leads to disturbance of the soil continuously and provide poor cover and protection to soil from erosion. Although soil loss from these slopes has not yet been properly quantified, it could be within the magnitude of 155 tons/ha/year on

NEMA community sensitisation on proper wetland management in the Iyamuriro-Mutanda wetland area

the middle and upper slopes as measured on such cultivated steep slopes. This is similar to the soil loss measured on cultivated slopes in nearby Rukiga highlands (Bagoora, 1997). Such rates of soil loss is intolerable by world standards.

Consequently, the lakes are increasingly facing threats of demise due to silting from rapidly eroding soils on the slopes flanking them. Therefore, the lakes are in danger of being lost through silting and reduction of water storage capacity, which will have serious implications on the water resources in this area, both in terms of quantity and quality, and given the added threats of climate change. Current trends indicate progressive shrinkage of the lake sizes through stages, beginning with silting of the immediate shores that are later occupied by swamps which, in turn, are encroached on and reclaimed for cultivation; a good example being the expanse swamp fringing Lake Mutanda.

Both silting and encroachment on the lakeshores are thought to interfere with fish breeding and aquatic biodiversity in general and has been partly blamed for the low productivity of these lakes. Government in the year 1995 declared the lakeshores and riverbanks as fragile ecosystems and accorded them special protection through designation of protection zones around lakeshores and along riverbanks. For example, lakes Bunyonyi and Mutanda have a protection zone of 200 m from the lowest water mark, where no active landuse practices are allowed without permission and regulation. There have been daunting challenges, however, in enforcing this regulation in such an area with severe land shortage and due other shortcomings in enforcement. The smaller lakes of Murehe, Chahafi and Kayumba, in order of decreasing size, are more vulnerable to demise from silting due to their size, making their near future even more grim.



Laropi-Moyo lakes/ lagoons

Floods and siltation

In the early 1950s much of the land area in Laropi (Dufile Sub county) was covered by adequate tree cover such as Acacia, combrentum and fig species. Because of this, some landing sites were named after the abundance of the vegetation (for example Congo). From 1979 to 1986 the local population was driven into exile and when they returned, their way of life had changed. Between 1990 and 2000, there was a boom in fish catches and fish trade. The most traded fish was smoked using traditional kilns

that consume vast quantities of fuel wood. As a result, the communities along the Nile lost over 70% of forest cover to this booming trade and the Increased populations of the landing sites. Human activity has continued to increase, reducing vegetation cover and encouraging siltation of River Nile. The lakes along the river have increased since 1960 due to climatic changes and could it could be worsened by land degradation.

Shifted bridge as result of flooding on Ebemi stream along the Laropi-Dufile Road

Rivers/streams

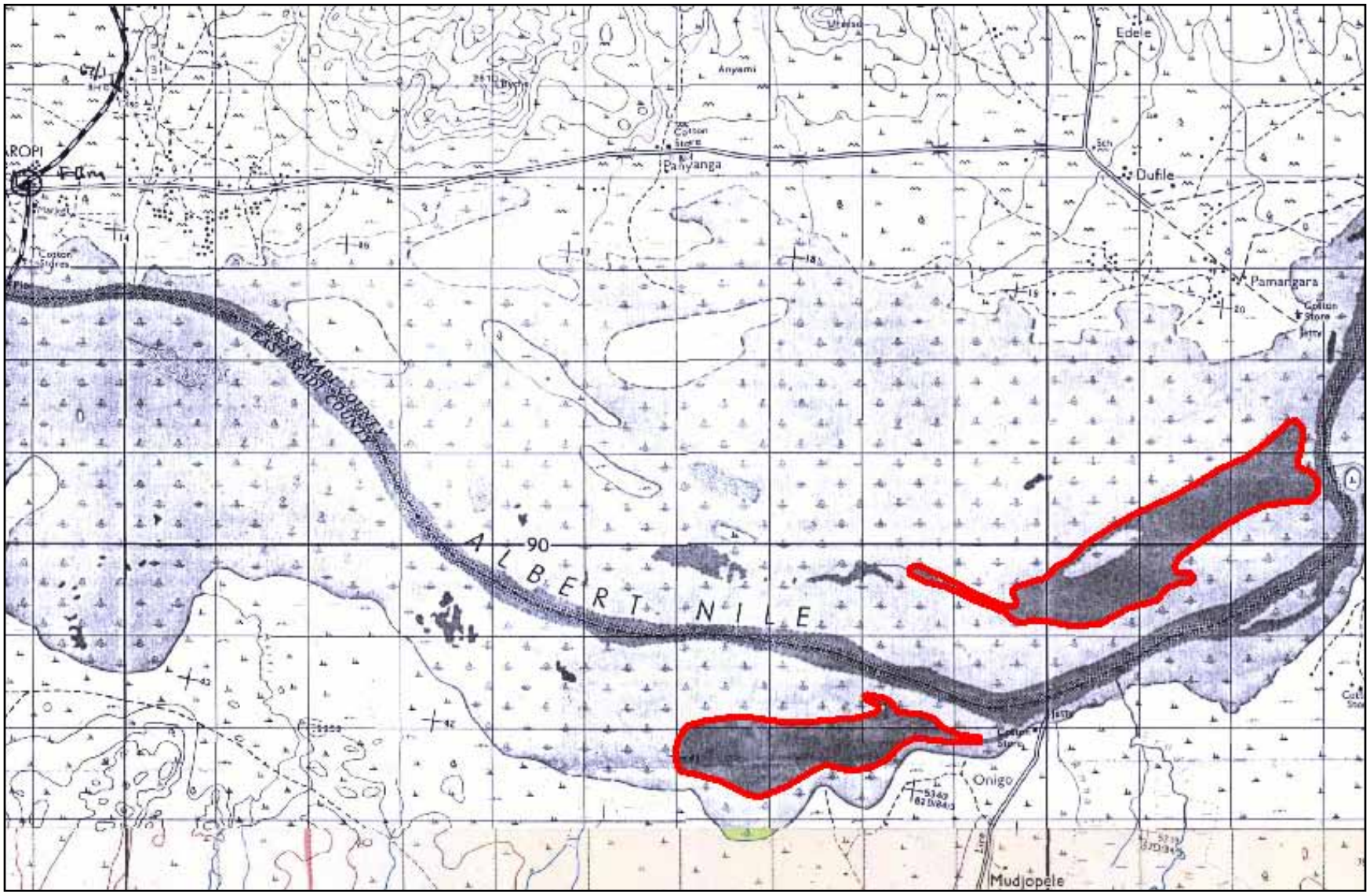
The River Nile is fed by several perennial/seasonal streams such as Amua, Chala, Ebemi, Aburiji and Oyo. However, from 1980s to date many of the streams experienced siltation as result of changes in the livelihood of the local population, including from small scale fishing and animal rearing, to farming and extensive fishing. This is evidenced by cultivation of fragile ecosystems such as river banks, and opening up of new lands for agriculture by the local communities.

Major flooding occurred in 1962 and 1998

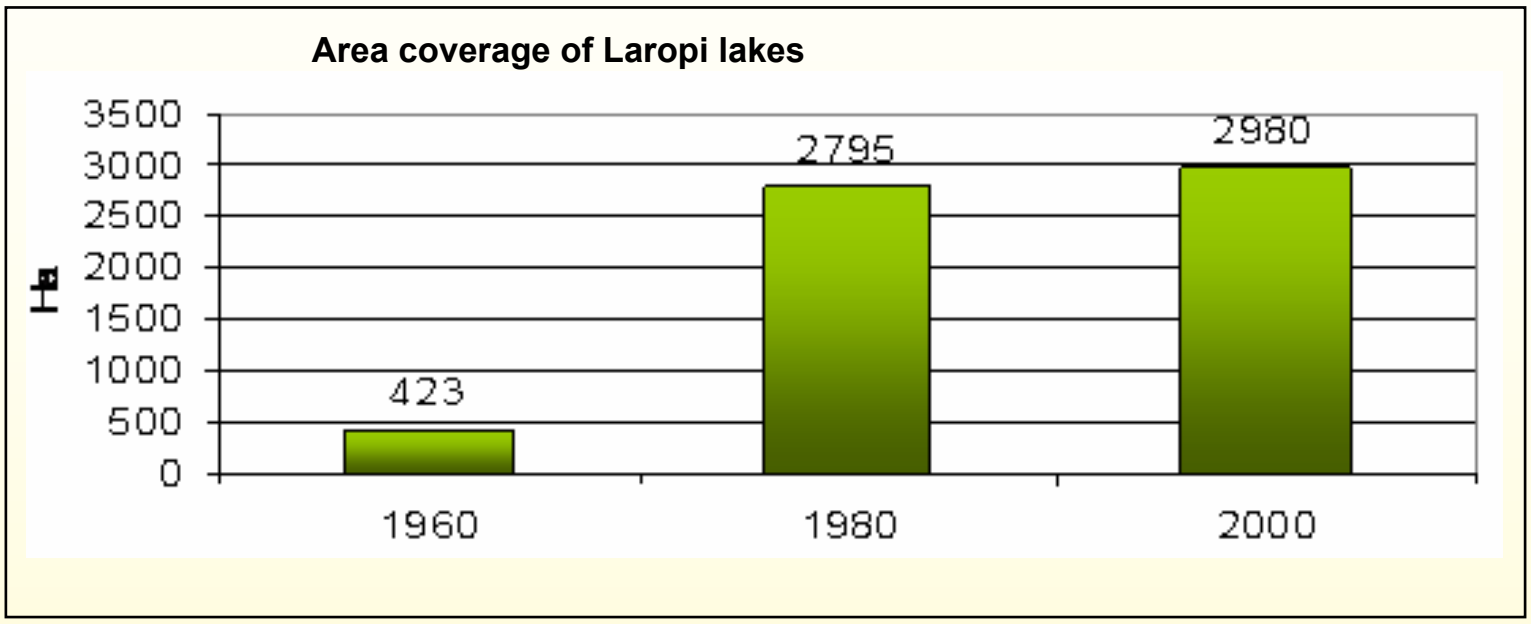
Laropi/Dufile experienced frequent flooding during 1962 and 1998 and as a result several bridges on the rivers/ streams were shifted three times. In addition, a portion of the road along Laropi to Dufile trading centre was also shifted northwards.

Laropi lakes/Lagoons

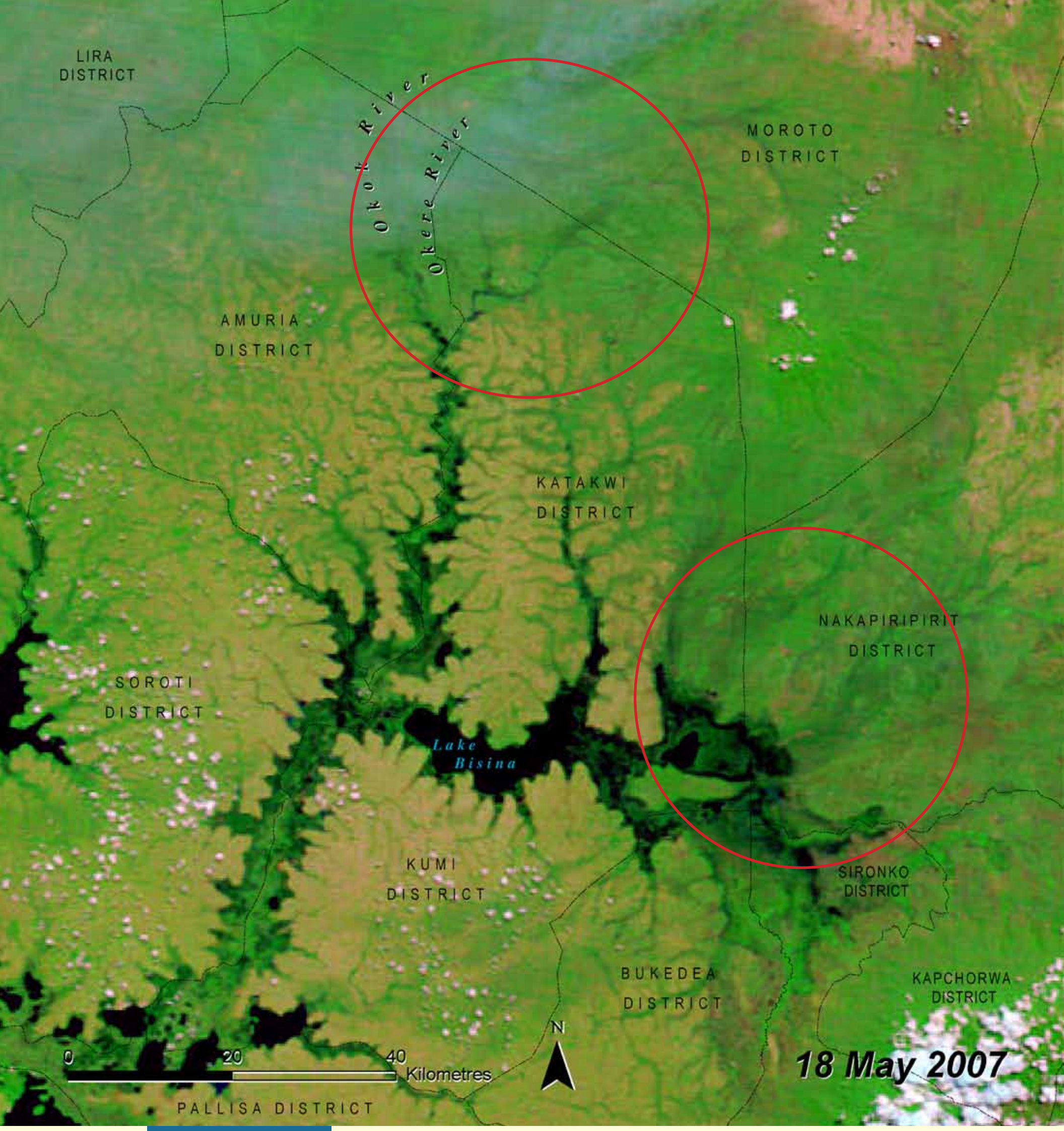
River Nile is one of the major rivers found in Uganda, and it forms the south eastern border of Moyo District. Over the past years it has been noticed that several small lakes (lagoons) have formed along the Nile (here referred to as Laropi lakes). In 1960s there were only two noticeable lagoons/lakes whereas in 1980 the number of lakes increased to five and in 2000 some of lakes merged. Only four new ones can now be observed. This could have been due to the heavy rainfall in 1962 and the apparent El Niño of 1997/98. This implies that the open water areas are increasing (see graph and the combined map of extent of lakes on the opposite page respectively). The trend shows that the lagoon/lake areas have been increasing over the years.



Laropi lakes in 1960



Laropi lakes



Teso region

Flooding

The northern part of the wetland increased due to heavy rains that caused flooding. Usually these places are seasonal wetlands and should be left intact. On 19th September 2009 the Ugandan Government declared a State of Emergency in the northern and eastern parts of the country due to severe floods. About 30 people were killed, an estimated 8,500 acres of crops were destroyed, and a number of animals drowned in the floods. 300,000 people were in need of food aid and thousands of school children were forced to stay at home. Floods washed away buildings, roads and homes. The districts mostly affected were Amuria, Katakwi, Bukedea, Pader and Kitgum. According to the rainfall forecast for the

LIRA DISTRICT
Okok River
Okere River
MOROTO DISTRICT
AMURIA DISTRICT
Flooded fields
NEMA 2007
KATAKWI DISTRICT
NAKAPIRIPIRIT DISTRICT
SOROTI DISTRICT
Lake Bisina
KUMI DISTRICT
SIRONKO DISTRICT
BUKEDEA DISTRICT
KAPCHORWA DISTRICT
N
0 20 40 Kilometres
18 Sep 2007
PALLISA DISTRICT

region, the area received above normal rains (NEMA 2008). These floods hit again in August 2008 before the areas could recover; and the areas most affected were those near Lake Bisina. The causes of floods were above normal rains but the situation was worsened by loss of vegetation cover in the water catchment areas of Kapchorwa and Sironko. This led to increased run-off to the low lands of Ngenge plains into the Teso region. Water logging has lead to new activities such as rice growing which used not to be the case in the early 1960s. In addition, overgrazing in the Teso wetlands has interfered with the wetlands not to perform their function as water reservoirs.

Kampala

Urbanisation and industrialisation

Kampala's changing environment

Kampala has expanded since 1974, and its area is currently estimated at 197 km^2. Land use is mixed throughout the district, consisting of the built up areas, agricultural land, rangelands and conservation areas. There are essentially three broad land use categories: agricultural land, built-up areas, and those reserved for conservation.

However, these land use categories are not entirely exclusive of one another, and are inter-related (SOE, 2002).

Kampala City (2007). Inset: Kampala City (2007)

Kampala's Changing Environment

Uganda is experiencing rapid urbanization estimated at an annual population growth rate of 5.5%. Kampala has remained the capital city since 1969 with equally a high annual population growth rate of 5.61%. With this growth rate, Kampala absorbs 40% of the national urban population and 4.9% of the national population (UBOS, 2002).

Kampala has also experienced an increase in population, from 774,241 in 1991 to 1.2 million in 2002 (UBOS 2002). The population figures reflect the night populations but the estimates show that these numbers double during the day, as many people travel to the City for work and business and return to their homes outside the City at the end of the day. The population increase in Kampala metropolitan area is responsible for increased demand for employment, land for housing, social services and infrastructure that have stimulated spatial urban development and industrialization, leading to rapid environmental changes.

The Kampala suburbs are also experiencing rapid urbanization leading to development of satellite towns around the City. Their activities have a strong linkage with those in the City, which results in additional pressure on the City resources. Current trends indicate that these satellite towns may be merged into the present Kampala to form the Metropolitan Kampala. Towns likely to be absorbed include Mukono, Entebbe, Wakiso, Kira, Namungoona, Bweyogere, Kyengera, etc. This development will act as a catalyst to additional dynamics of environmental change of the City, particularly in these outer satellite towns.

NEMA 2009

The poorly planned and ever congested old taxi park in Kampala City

NEMA 2009

The beautiful and spacious environment of Serena Hotel, Kampala, away from the hectic environs of Kampala city centre.

Jinja-Kaloli
Nsoba_Lubigi
Namanve
Kyambogo
Kitintale
Kampala
Busega
Nakivubo Channel
Clock-Tower
Kyegera
Namasuba
Kajjansi
N
0
2.5
5
Kilometres
16 Feb 2009 - 03 Apr 2008

Flooding in Nsooba Lubigi drainage channel. Houses and a school are submerged in the water in 2007.

Floods at Kyambogo junction: construction of industries in wetlands which are drainage channels interferes with the flow of water causing constant flooding at this junction. Traffic is blocked for hours in many cases.

Dumping of solid waste in Nakivubo channel is choking the Nakivubo wetland. Nakivubo channel cleans waste water from Kampala before it is discharged into Lake Victoria. This wetland is under threat due to cultivation of yams and illegal settlements.

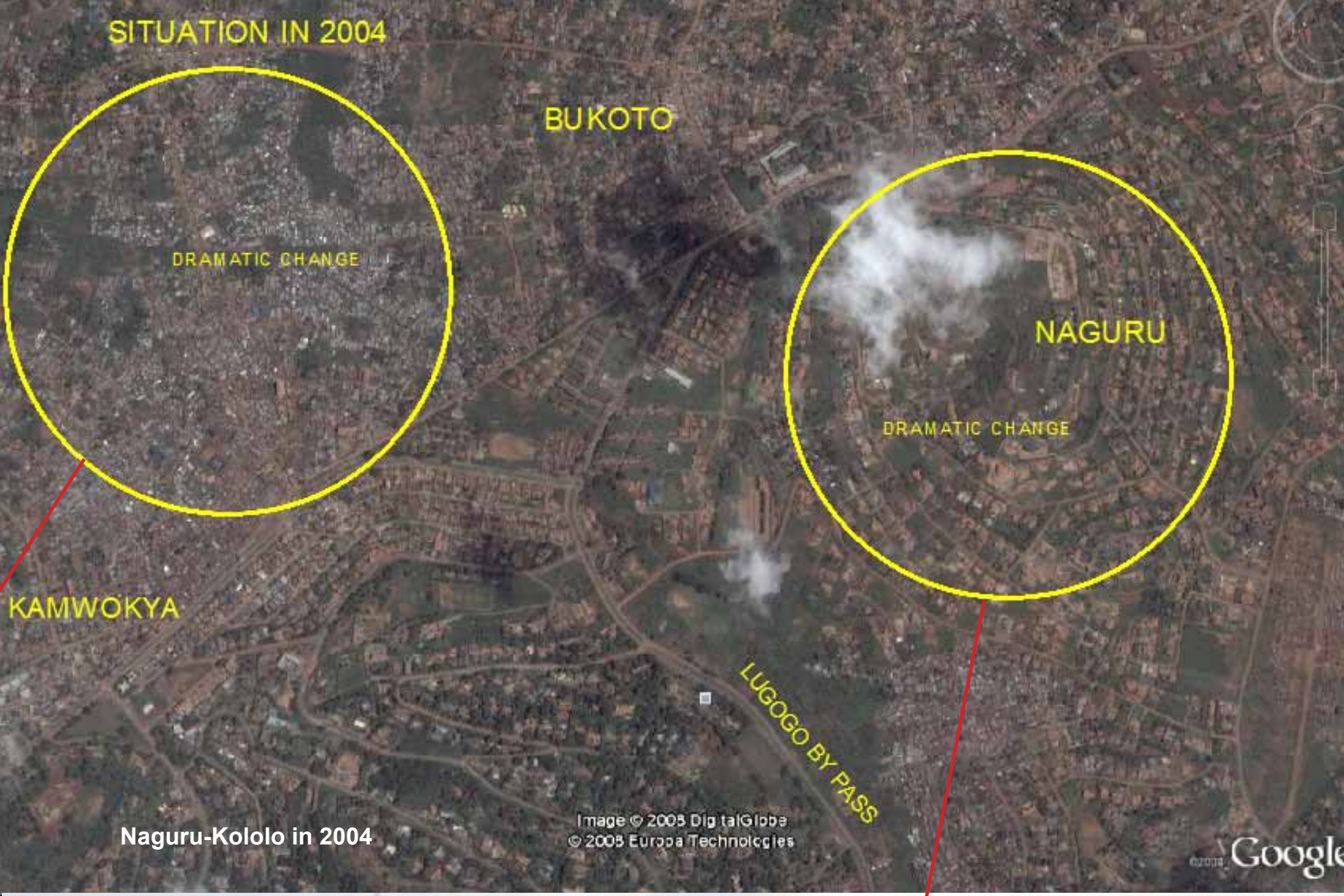
The *Kaawa* Boat, one of the main transport vessels between Uganda and Tanzania docks at Port-Bell in Luzira. The water is currently infested with an algae bloom and a smelly stench hovers over the area. The main cause is pollution of Lake Victoria waters by pollutants from Nakivubo Channel.

These buildings were constructed in wetlands which are the water ways for drainage into Lake Victoria. The houses were flooded in 2007 temporarily interfering with traffic and business along the Kampala-Entebbe highway.

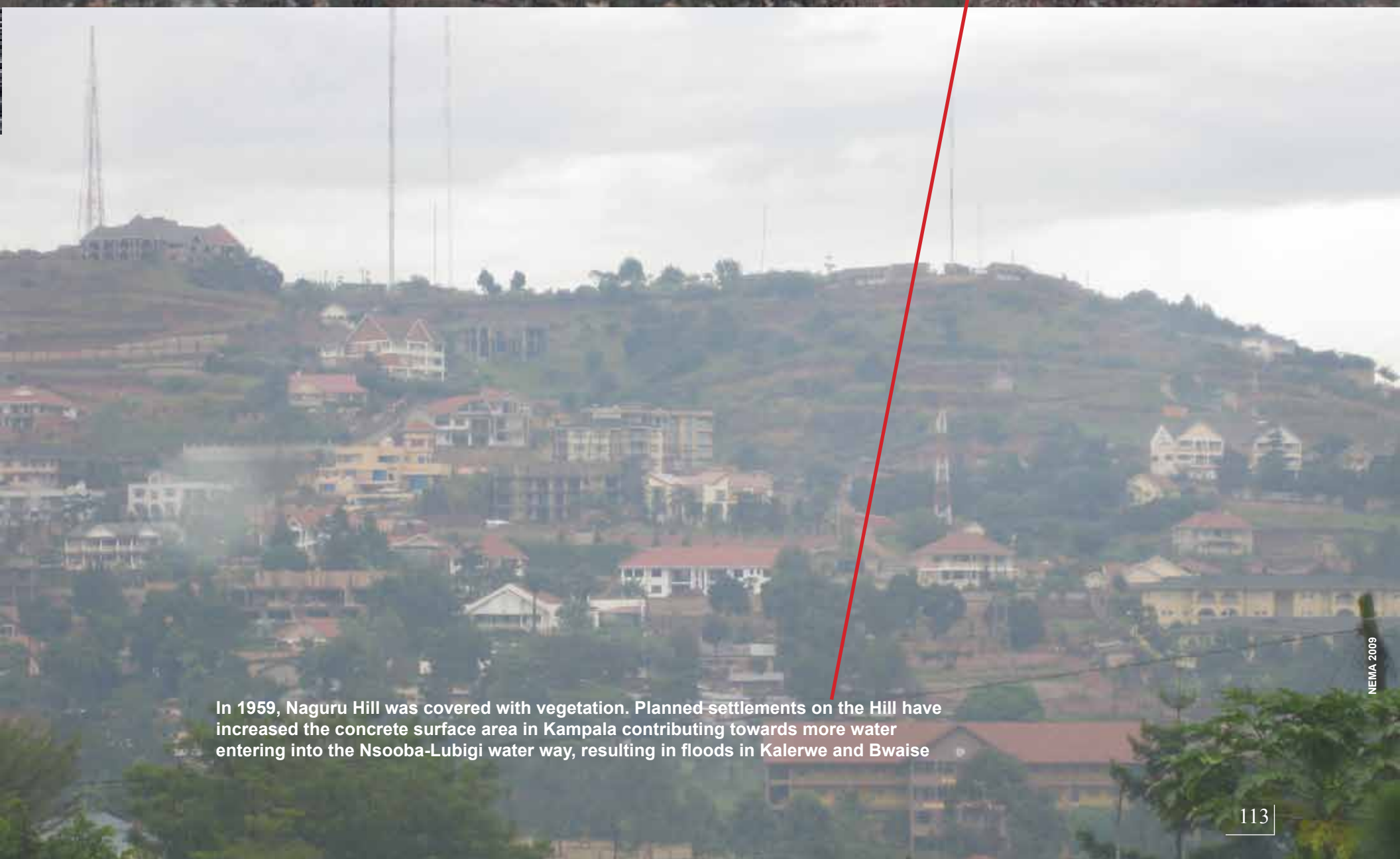
Naguru-Kololo in 1959

In 1959, Kamwokya valley was covered with vegetation. Presently, unplanned settlements in the water way are part of the problem causing floods

NEMA 2009



Naguru-Kololo in 2004



In 1959, Naguru Hill was covered with vegetation. Planned settlements on the Hill have increased the concrete surface area in Kampala contributing towards more water entering into the Nsooba-Lubigi water way, resulting in floods in Kalerwe and Bwaise

NEMA 2009

Bugolobi in 1959

Unplanned settlements at Namuwongo interfering with the functions of Nakivubo wetland

Situation in 2004

Nakivubo

Bugolobi

Kiwuliriza

Nakivubo channel

Muyenga

Image © 2008 DigitalGlobe
© 2008 Europa Technologies

0°18'15.81" N 32°37'19.51" E elev 3727 ft Mar 13, 2004

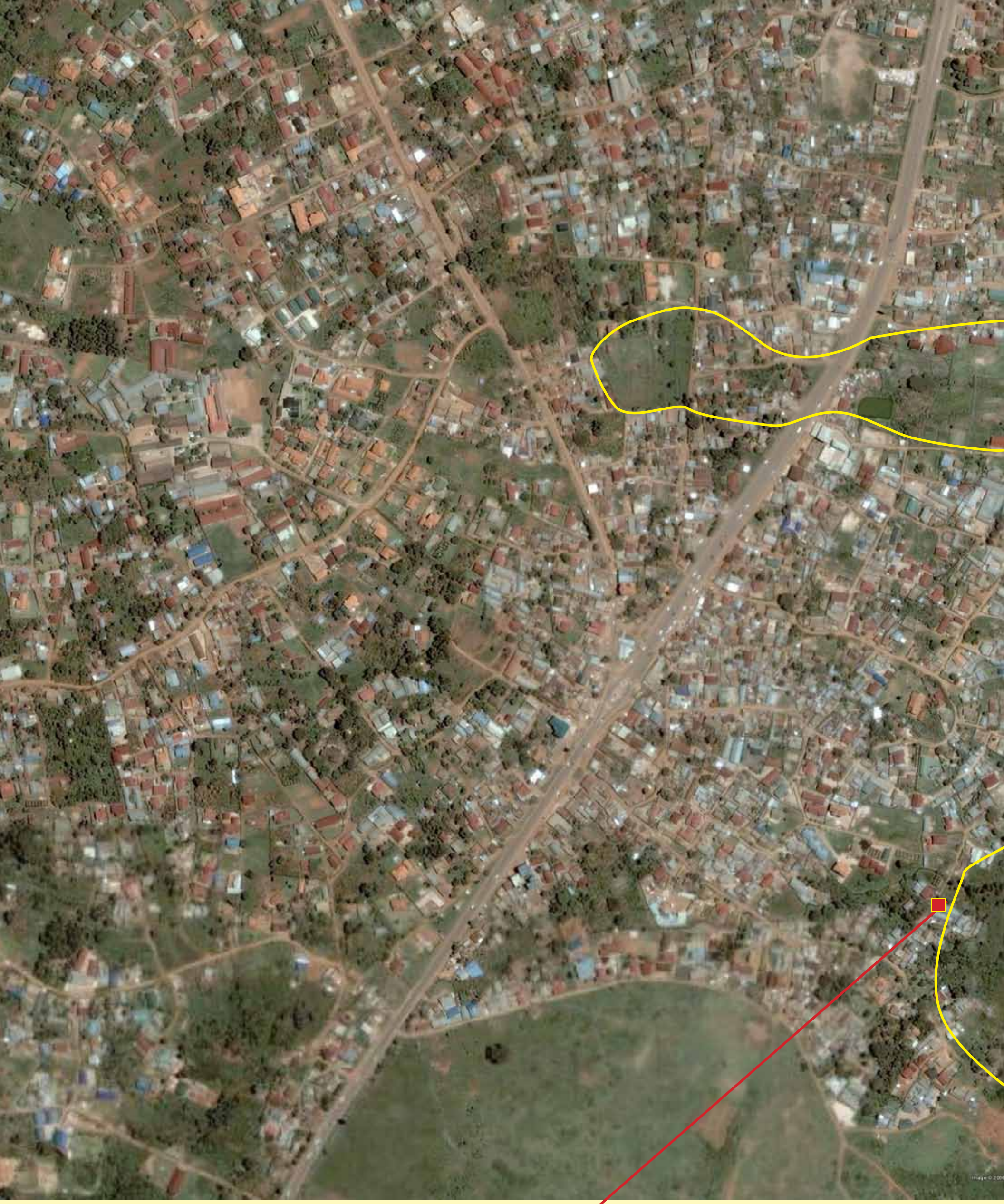
Bugolobi Housing Estate. In 1959, this area was a forest

Flood prone area at Clock Tower junction, Kampala (2009)

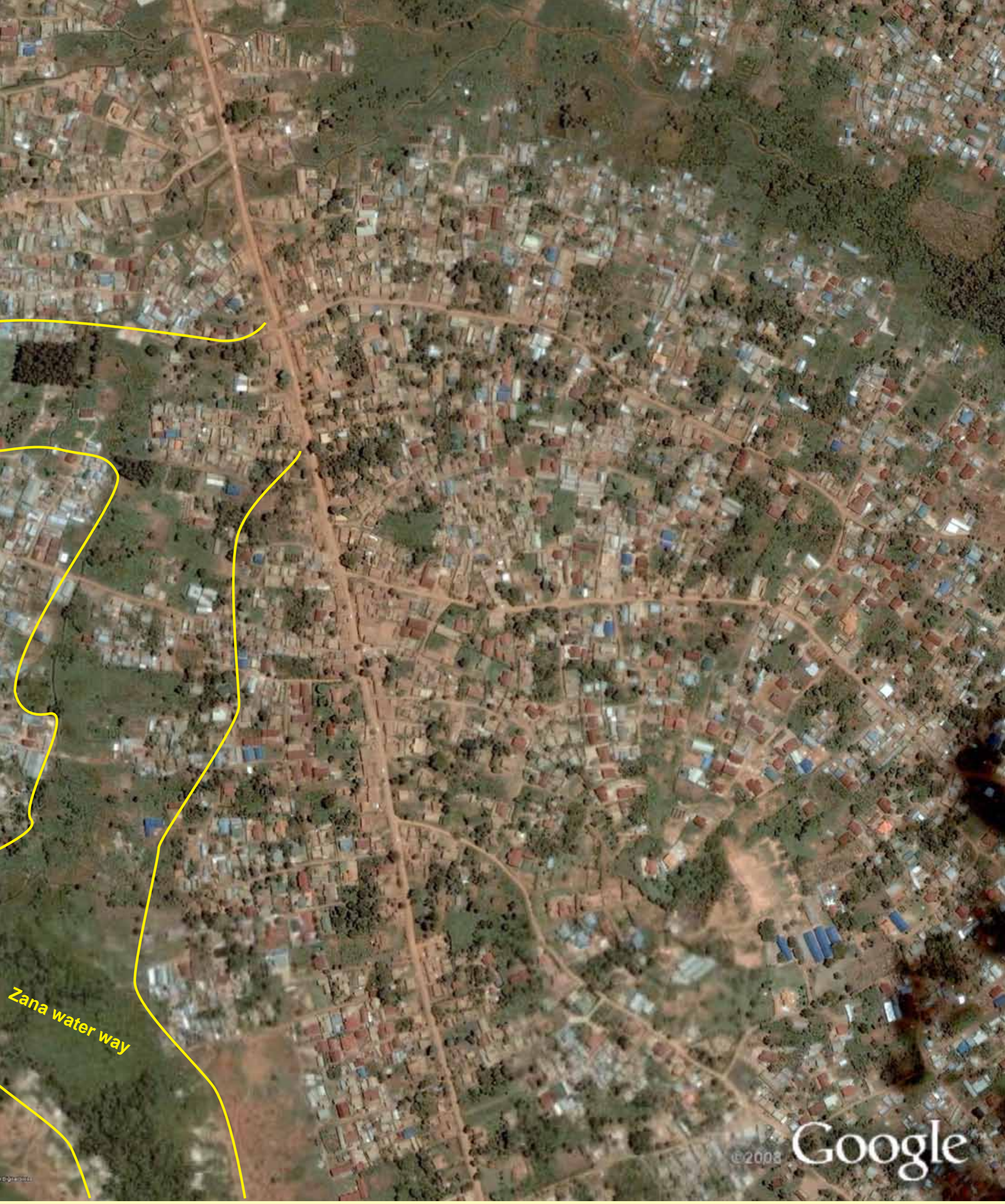
Tower
©2008
Google

Construction in the Nsooba-Lubigi waterway, Kampala (2009)

Kalerwe
Nsooba
Nsooba-Lubigi
Google



Construction in waterways at Zana, Kampala (2007)


Zana water way
©2008 Google

Construction of houses in Nakivubo wetland, Kampala (2007)

Bugolobi
Kitintale
Nakivubo channel
©2008 Google

Unplanned settlements at Nakawa, Kampala (2007). It is difficult to access such settlements in event of an emergency.

Nakawa
Makerere University Business
School (MUBS)
©2008 Google

Biomass	Land use/land cover km²	Land use/land cover %
Hardwood Plantations	0.31	0.16
Softwood Plantation	-	-
Tropical High Forest (Normal)	4.90	2.49
Woodlands	0.30	0.15
Bush lands	7.40	3.74
Grasslands	0.80	0.41
Wetlands	14.50	7.36
Subsistence Farmlands	69.00	35.05
Commercial Farmlands	1.22	0.62
Built up areas	81.50	41.37
Open water	16.80	8.55
Impediments	0.19	0.10
Total	**197.00**	**100.00**

Uganda National Bureau of Statistics (UNBS) 2008

Table 1: Land use and land cover, Kampala District

Indiscriminate solid waste disposal in the Nsooba-Lubigi water channel near Kalerwe market

Impact of the Changing Environment

Kampala City natural environment faces continued degradation. The Biomass dynamics show a decline in tree resources. There has been an increasing demand for charcoal, with increasing pressure on neighboring district tree resources. The wetlands also face degradation for industrial and housing developments, agricultural use, as well as pollution from industrial and domestic waste.

Recent developments have seen the clearing of the buffer zones of forests and open spaces, as well as encroachment on the wetlands. Buildings and other forms of infrastructure have replaced the forests, open spaces and the wetland vegetation. The impacts of this change have been far reaching. Most of Kampala's land surface in the built up areas is highly paved leading to reduced water infiltration and hence to generation of high storm waters. The storm water has of late caused flooding in Bwaise and most low-lying areas of Kampala City.

In a bid to fight the floods, a lot of drainage channels have been placed and several widened to alleviate the problem. The efforts have hardly solved the problem as the constructed drainage channels have failed to contain the heavy run off leading to continued floods.

The problem has been exacerbated by heavy silt and solid waste carried by run off from construction sites and homesteads, respectively.
Government and Kampala City Council in particular, should make efforts to solve the problem of floods in the City. One of the options would be to identify and gazette all critical wetlands and drainage systems that serve to absorb and regulate storm waters.

Kampala is served by two major wetland systems namely the Nsooba–Lubigi and Nakivubo Wetland systems. The ongoing process of gazetting Nakivubo wetland system for water attenuation and purification needs to be finalised. A similar process should be undertaken for the Nsooba – Lubigi wetland system to serve as a storm water attenuation area. The long term interventions therefore, would be to resettle people from the flood attenuation areas and safe guard the natural drain pattern of the City.

Causes of environment changes in Kampala

- Urbanisation
- Wetland encroachment
- Deforestion

This has resulted into increased runoff during the downpours causing frequent flooding that are so rampant in several places in Kampala.

Effects of the Northern By-pass during the rainy season (2007)

Flooding in Bwaise, a Kampala surbub after a heavy down pour (2008)

Prior to the peak of urbanisation being experienced now, these two systems had a wide coverage of wetlands and around them a buffer of thick forests. Citizens in 1960s would use boats to cross over from Kamwokya along the stream through the present Centenary Park to Luzira. The streams even had a lot of water then.
This has seen most of the water in these places drained and lowering the water tables temporailiry during the dry seasons.

The shrinkage of Nsooba-Lubigi wetland system in the upper catchments due to settlements has increased the retention time of the water in the lower reaches during rains resulting into flooding. It should be noted that the gradient of this system is quite low making the water meander at a slow rate as it finds its level. This process has greatly increased on the wetland coverage down-stream around the Kampala-Wakiso border and beyond. Areas of Namungoona have seen land that was dry being reclaimed by the wetland overtime.

There has been contionous shrinkage of the Nakivubo wetland system. The gradient of this drainage system is a bit steeper than that of Nsooba-Lubigi wetland system and so water in this system has less time to reticulate and claim some areas. The situation was worsened by the widening of Nakivubo Channel which saw a lot of water being drained from these areas. This has greatly lowered the water table in these areas leading to further encroachment of the remaing strectches for agriculture.

Water Quality

In the 1960s Kampala had clear water in the streams and good drinking water in the natural springs.
Overtime, the city has had the water quality deteriorating due to:

- Contamination of water from pit latrines and poorly constructed ‘hanging’ latrines that are opened into the channels during rains
- Frequent flooding that ends up draining the pit latrines directly into the water tables

Currently, more than 85% of the spring wells in Kampala are polluted with *E-coli*- a sign of faecal contamination.

- Industries that have been constructed close to water ways, releasing their effluents into the water.
- The silt which is being eroded from the opened up areas and during the rains is swept down into the water sources. Overtime, Lake Victoria has become more turbid and this has a negative impact on the fish industry since it leads to silting up of the breeding grounds for fish.

Hon. Maria Mutagamba, Minister of Water and Environment (middle-front) launches the URA-NEMA-Celtel "Keep the Pearl Clean" Waste Wise campaign (2008) at Nakawa Trading Centre, Kampala. Ms. Allen Kagina, Commissioner-General URA (first-left), Dr. Aryamanya-Mugisha-Henry, Executive Director NEMA; stakeholders and the general public participated in the lauch.

Below: Part of the day's collection of garbage during the Waste Wise campaign lauch.

Hon. Jesca Eriyo, Minister of State for Environment inspects the exhibition stall mounted by the Ministry of Water and Environment during the CHOGM meet, held in Kampala, November 2007; all sectors under the Ministry collaborated to exhibit in one stall. Inset: the CHOGM Monument near the Parliamentary Building and the President's Office.

NEMA 2008

NEMA 2007

George Lubega of NEMA (third from left-front) takes District Environment Officers through initiation of wetland management

Nile Basin Initiative (NBI) 2006

NEMA 2005

Partnerships in environment management: (*Left-Right*) Nile Basin Initiative (NBI) Community clean-up campaign in Makindye, Kampala District as part of the environment week activities to mark World Environment Day 2006; Enhanced Environmental Education: Pupils of Green Hill Academy, Kampala District display environmental messages and activities during the school's Open Day (2005)

Some of the landmarks in the middle of Kampala City

A. Uganda Houses of Parliament, kept orderly and still going strong (2008)

B. CHOGM Monument

C. Indepenedence Monument

Luwum Street: *Boda-boda* cyclists increasingly create confusion to pedestrians and motorists on Kampala streets (2008)

NEMA 2009

Below: Down town Kampala near Mini Price junction (2008)

NEMA 2009

THIS AREA
MARKS THE PLACE FROM WHERE
THE NILE STARTS ITS LONG JOURNEY
TO THE MEDITERRANEAN SEA THROUGH
CENTRAL AND NORTHERN UGANDA
SUDAN AND EGYPT
NEMA 2008

Chapter 3

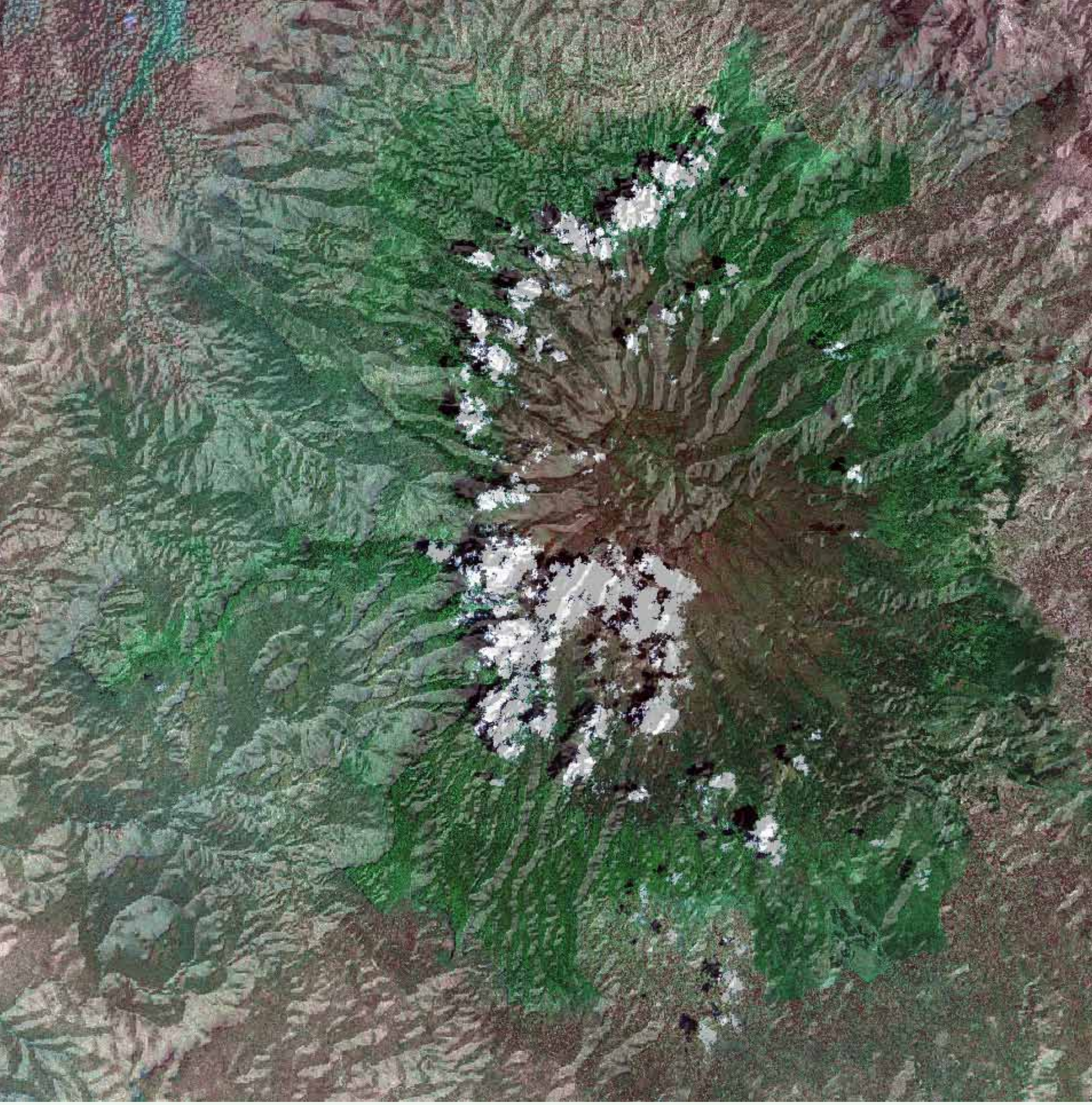
Transboundary and cross-border environmental issues in Uganda

The source of River Nile at Jinja. The River Nile leaves Lake Victoria at Jinja. The tributaries of the Nile flow through nine countries in Africa into the Mediterranean Sea.

Distribution of natural resources and biodiversity does not respect boundaries, which makes their management of transboundary in character. Uganda shares boundaries with Kenya, Tanzania, Democratic Republic of Congo, Rwanda and Sudan. Many protected areas, rivers, lakes in Uganda are shared with these countries. For example one of the longest river in Africa, the Nile and is shared by many countries has its source in Uganda. Furthermore, Uganda now has 80 districts and many ecosystems are shared among districts which calls for increased collaborative efforts to manage these resources. Uganda has signed several agreements with its neighbors to manage some of these resources. The Nile Basin Initiative (NBI) is a partnership initiated and led by the riparian states of the Nile River through the Council of Ministers of Water Affairs of the Nile Basin states (Nile Council of Ministers, or Nile-COM). The NBI seeks to develop the river in a cooperative manner, share substantial socioeconomic benefits, and promote regional peace and security.

Lake Victoria is also another resource where Uganda has gone into partnership with its neighbors to manage it sustainably. The East African Community has designated Lake Victoria and its Basin as an “area of common economic interest” and a “regional economic growth zone” to be developed jointly by the Partner States. And Lake Victoria is the focus of new attention following the declaration by the East African Community Heads of State that a joint programme be developed for the overall management and rational utilization of the shared resources of the lake.

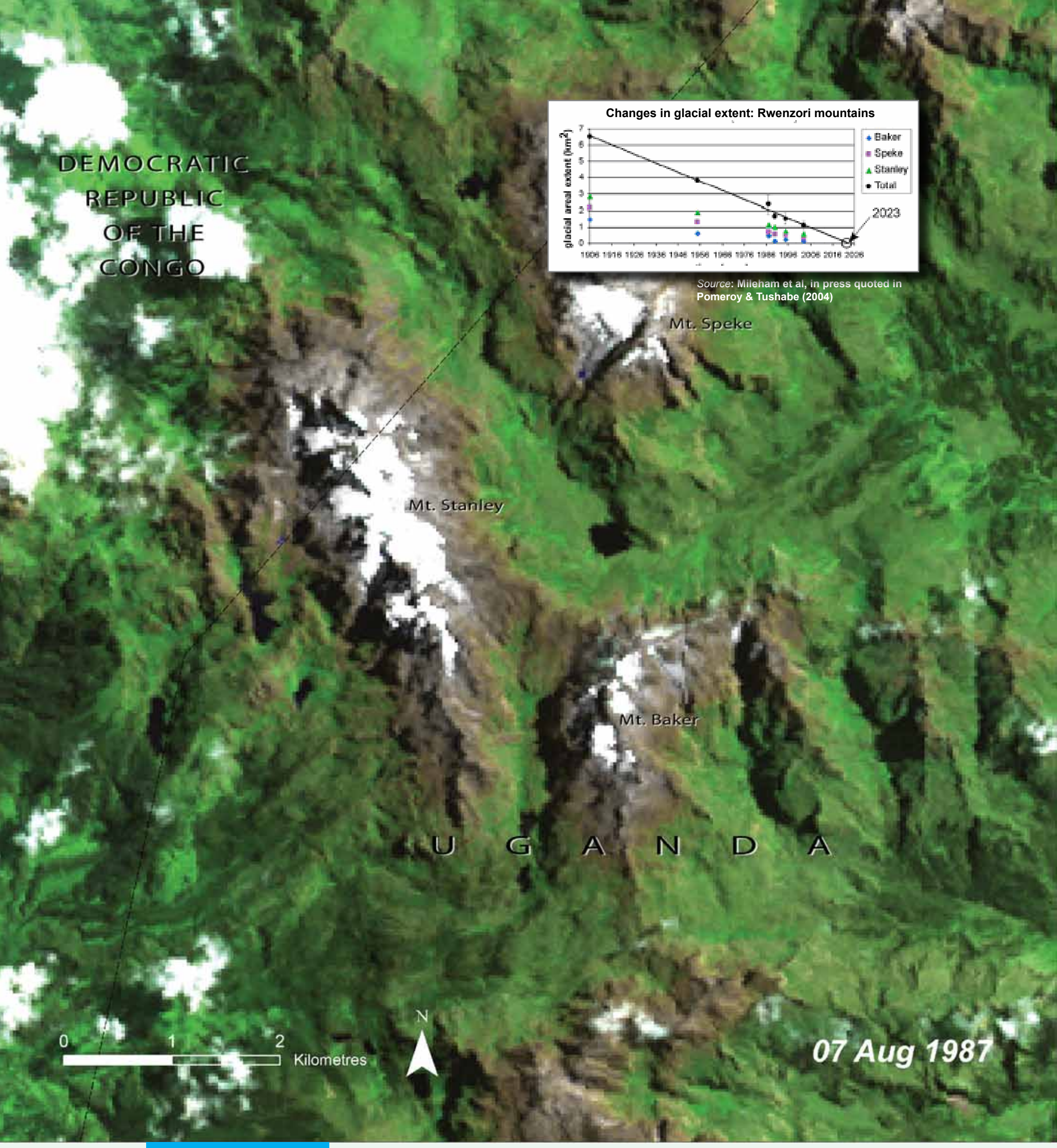
The East African Community established the Lake Victoria Development Programme in 2001, as a mechanism for coordinating the various interventions on the Lake and its Basin; and serving as a centre for promotion of investments and information sharing among the various stakeholders. Currently there is the Lake Victoria commission that became effective in 2005 with its headquaters at Kisumu. It is the apex institution of EAC mandated with overall coordination.



Mt. Elgon borders Uganda and Kenya in the east

The Mount Elgon National Park straddles the international boundary between Kenya and Uganda and is a watershed of international importance, feeding the waters of Lake Victoria, the Nile River system, and Lake Turkana. The core ecosystem in the Mt Elgon area is characterized by large montane forest landscapes; it comprises several protected areas. Adjacent is a vast, heavily populated agricultural landscape supporting up to 2 million people, whose livelihoods and economic activities are largely dependent on the ecosystem goods and services of the highlands. The mountain ecosystem of Mt Elgon is thus vital to the social and economic functioning of the surrounding areas, both in the highlands and in the lowlands.

A Mutuku herdsman tends his cattle near Mt. Rwenzori ranges at the border of Uganda and the Democratic Republic of Congo (2006)



Source: Mileham et al, in press quoted in Pomeroy & Tushabe (2004)

Mt. Rwenzori Glaciers

Global warming, disappearing ice caps, reduced stream water

If global warming persists, ice cover on the peaks of the Rwenzoris (Baker, Speke and Stanley) will disappear altogether by 2023 (Mileham et al in press). In 1987 there was more snow on the Stanely, Baker and Speke peaks but by 2005 there are strong signs of reduction in snow. The disappearance of the ice cover will mean reduced water

DEMOCRATIC REPUBLIC OF THE CONGO

Mt. Rwenzori ranges, Kasese District

NEMA 2007

Mt. Speke

Mt. Stanley

Mt. Baker

U G A N D A

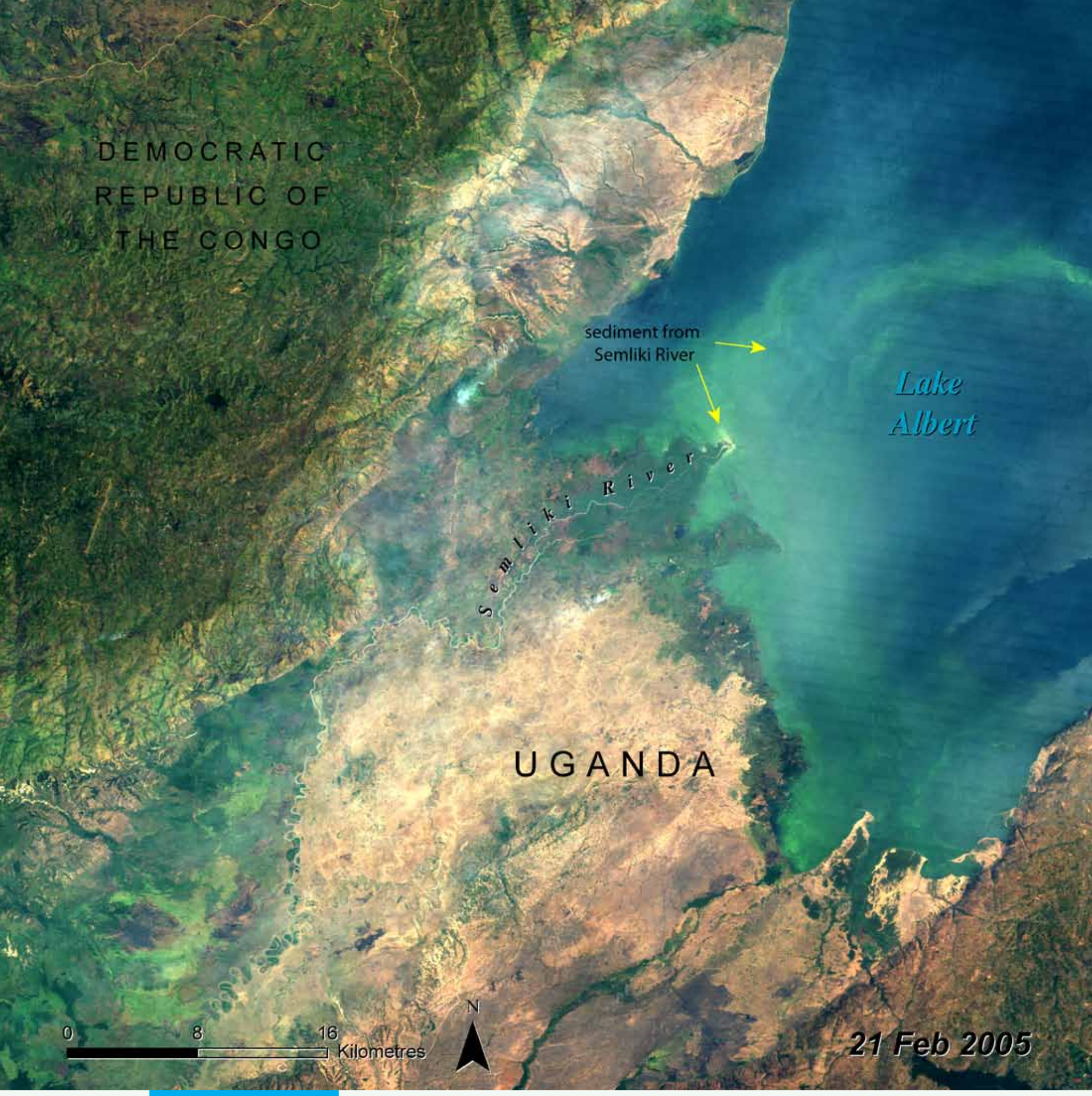
0 1 2 Kilometres

N

21 Feb 2005

Source: Atlas of Environment Change for Africa, UNEP 2008

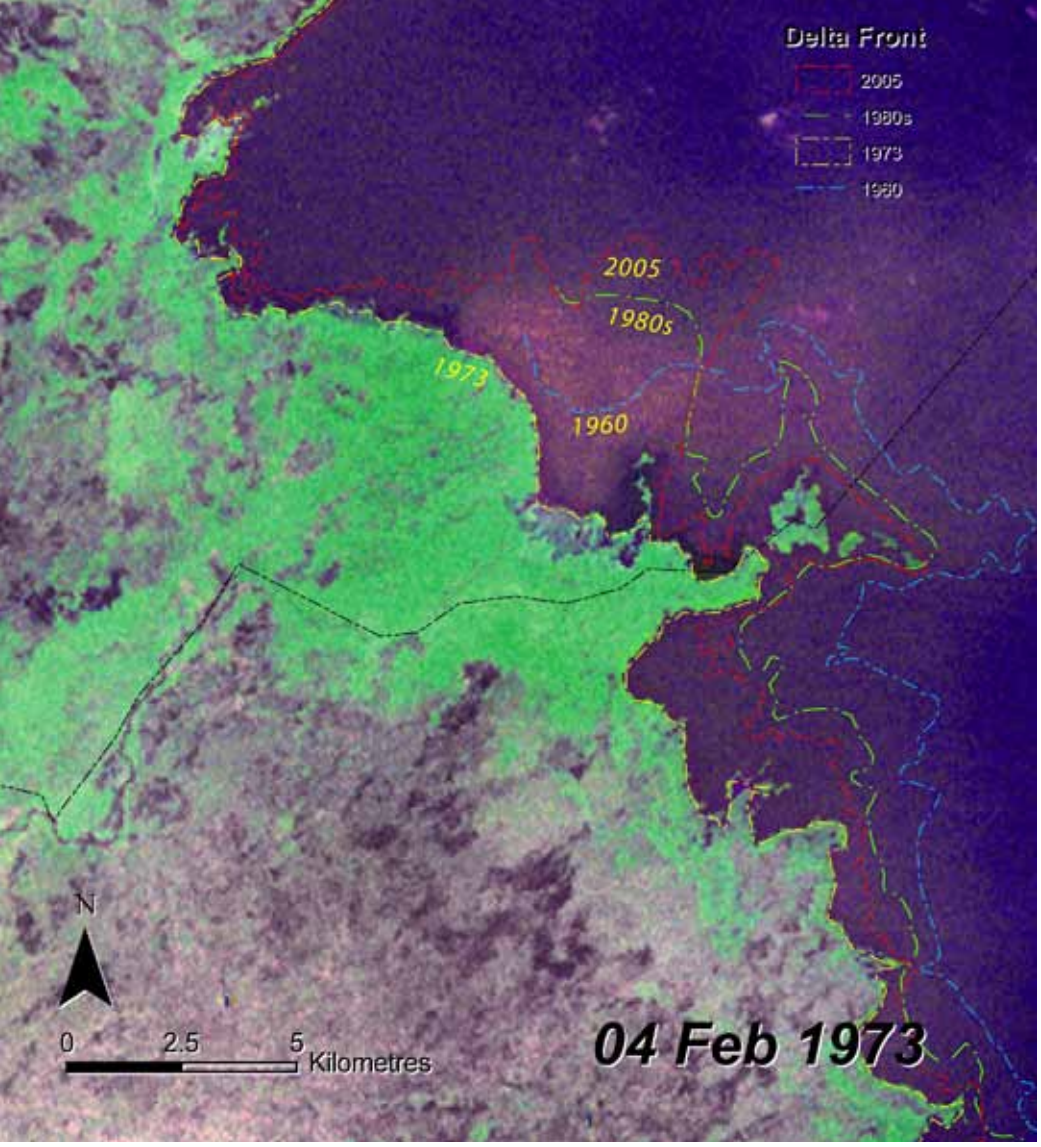
flow in the receiving streams which feed into Lakes George and Edward and Semliki River, discharging water into Lake Albert and finally into the Nile. The biodiversity and tourism potential of the Rwenzori will also be affected.

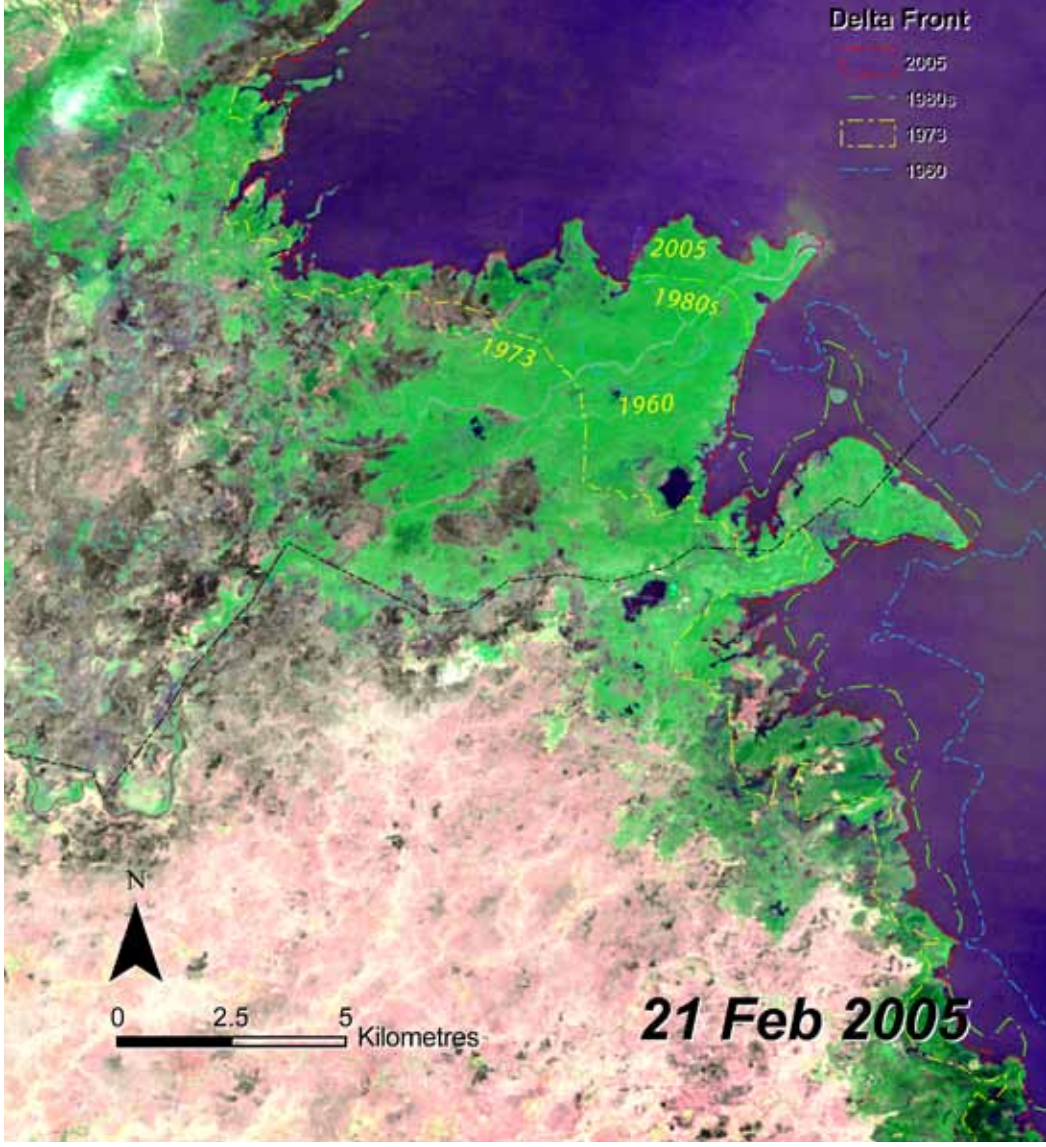


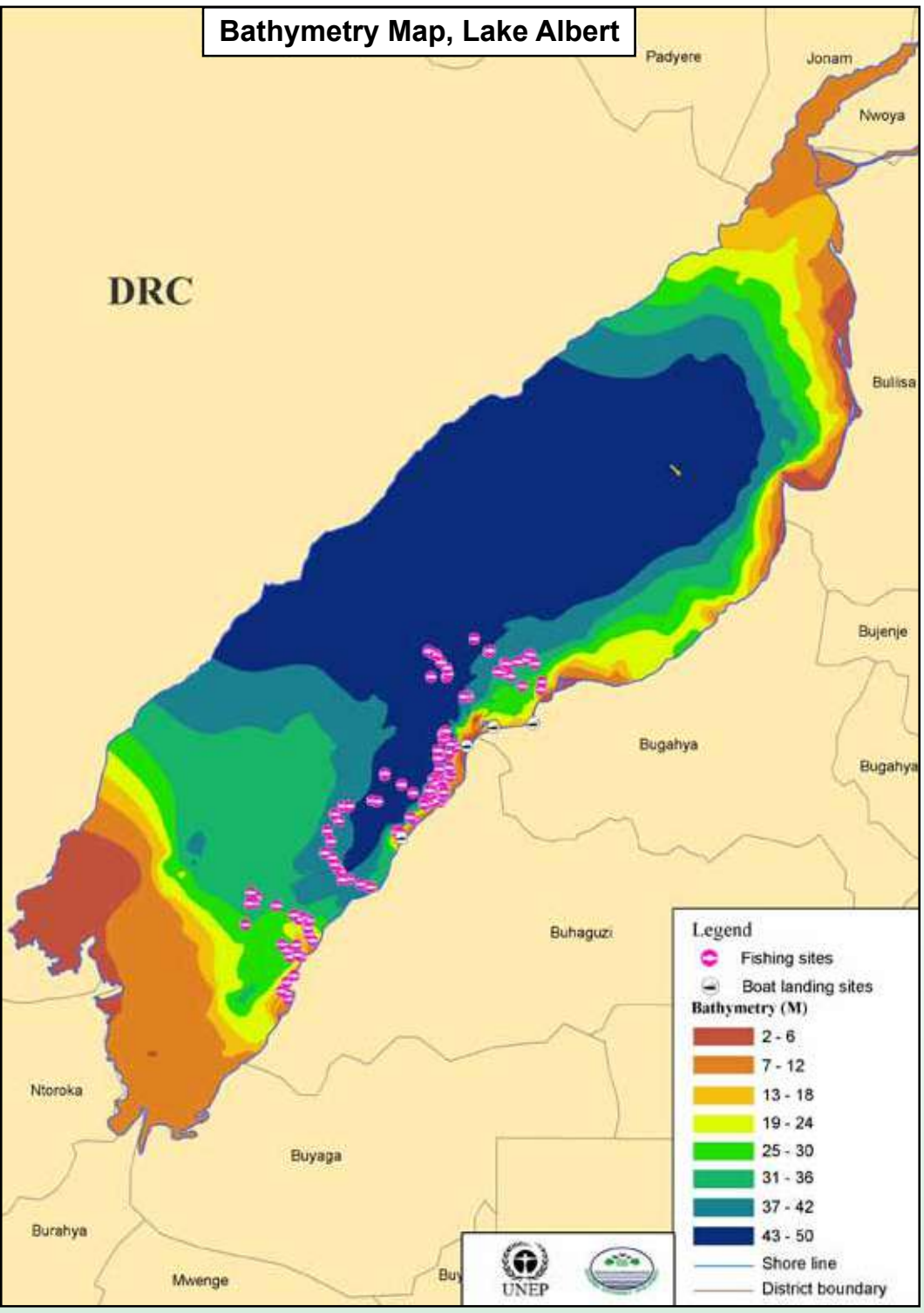
River Semliki

Eroded banks of River Semliki; Expansion of shoreline due to increased siltation of Lake Albert due to land degradation

River Semliki is one of the most important rivers that form Uganda's natural drainage system. The river derives its origin from Lake Edward through Mt. Rwenzori and a series of tributaries that join it along its 140 km course in the Albertine Rift (Western Rift Valley), before draining into Lake Albert. In the first 40 km, the river travels through a heavily forested Semliki National Park, while for the remaining distance it flows through grasslands that are inhabited by the Batuku pastoral community. The river is geopolitically important because it defines the border between Uganda and the Democratic Republic of Congo (DRC). The satellite image of February 2002 shows River Semliki depositing silt into Lake Albert.







Lake Albert is Africa's seventh largest lake situated in the western rift valley on the border between Uganda and the Democratic Republic of Congo. It lies at an altitude of 616 m above sea level, is 160 km long and has an average width of 32 km. In the south-west, the Semliki River brings into the lake the waters of Lake Edward and at its north-eastern side corner just below Murchison Falls; it receives the Victoria Nile from Lake Kyoga. The southern part of Lake Albert is shallower possibly due to to silting. This part of the lake is the breeding area for fish.

There is evidence from the landsat TM image of 2000, spot image of 1980 and MSS image of 1973 that the shoreline is shifting southwards. The delta at the mouth of the river is due to siltation and it is expanding at a rate of 3.5 km/yr into the lake.

Semliki National Park

Semliki River Delta

A herd of cattle grazing and watering at the banks of River Semliki

Changing river course of the River Semliki

Increased river bank erosion due to overgrazing, melting of ice on the Mount Rwenzori and degradation of the water catchments has resulted in siltation changing the river course significantly over the years as it enters Lake Albert.

The Semliki River is in its old stage, and like any aging river, it has characteristic meanders and forms oxbow lakes in some places. In spite of its old stage, it still has enormous erosive power which is realized when it emerges from the forested Semliki National Park onto the Semliki flats in Rwebisengo sub-county, Bundibugyo District. This approximately 100 km long section of the river in the Semliki flats has seriously eroded its banks. The local communities along the river are cattle keepers who graze along and collect water from the same river. On the Uganda side, the town of Rwebisengo is only 1.5 km away from the river and there are numerous other homesteads along it. The human and livestock activities have greatly affected the natural vegetation along its course, thus leading to river bank breakage. Over 10 m of the river bank on Uganda's territory is eroded annually at various points and as a result, it seems to have doubled its width within the last ten years.

Looking up the North escarpment along Lake Albert

Oil exploration in the Albertine Graben

Oil eploration in the Albertine Graben

Since 1925 the area of Lake Albert commonly referred to as the Albertine Graben, has been known to possess potential for petroleum. Presently, it is confirmed that the Albertine Graben that is a biodiversity hot spot is now a petroleum zone. The area stretches from the West Nile region downwards to Kasese District.

Kagera River

Siltation of Lake Victoria from River Kagera; uncontrolled agricultural practices and pollution

Lake Victoria, the second largest freshwater body in the world (area 68,800 km^2), is generally shallow (max. depth 84 m; mean depth 40 m), and has an irregular shoreline of about 3,440 km in length. The lake lies astride the Equator between latitude 2.50 S and 1.50 N, and longitude 320 and 350 E; shared by three riparian states (Kenya 6%, Tanzania 51%, and Uganda 43%, by area). Lake Victoria catchments are constituted by five countries (Kenya, Tanzania, Uganda, Burundi, and Rwanda) and drained by a number of large rivers as well as many small rivers and streams. River Nile is the single outlet and 82% of the water input in the lake comes directly from rainfall.

Delta Front

1987

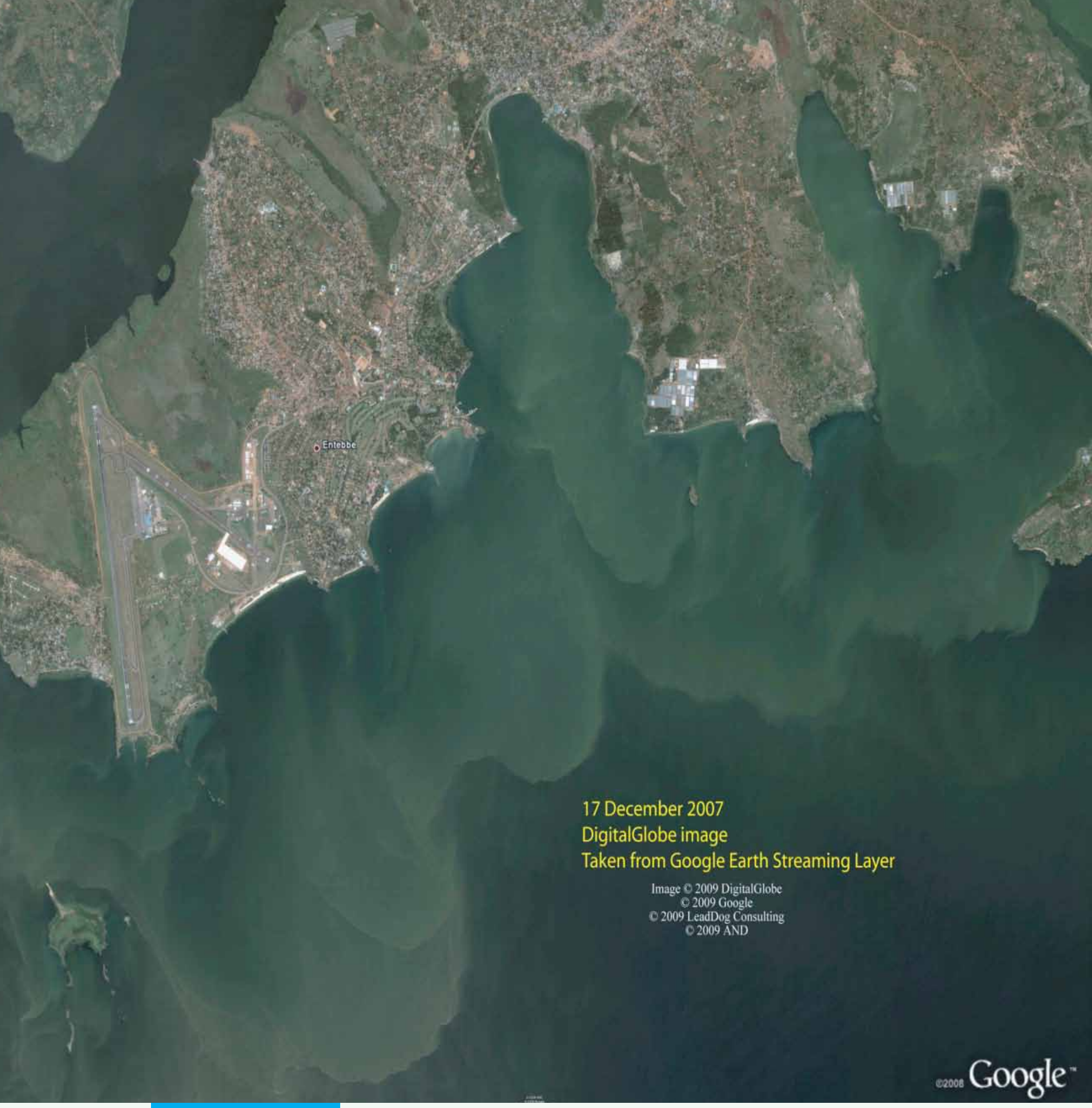
2008

N

0 0.5 1 Kilometres

23 Feb 2008

The Kagera River which originates from Burundi, and forms the Rwanda-Tanzania, Tanzania-Uganda borders is the largest contributor of water from the catchments. The satellite images of 1987 and 2008 show high reflectance of water from the Kagera River due to silt. Silt and suspended solids impact on water bodies by loading nutrients into the lake. Nutrients stimulate algae growth which reduces oxygen leading to eutrophication and reduction in fish. Siltation is mostly associated with agricultural activities. The delta at the mouth of the river has shifted more into the lake and it is likely to join with the small island below the mouth of the river (circled).



Lake Victoria

Green algae bloom, Water hyancith

Green algae bloom on Lake Victoria in Entebbe on the 17th December 2007

Water quality in Lake Victoria has declined greatly in the past few decades, owing chiefly to eutrophication arising from increased inflow of nutrients into the lake. Nutrient inputs have increased two to three-fold since the turn of the century, mostly since 1950. Concentrations of phosphorus have risen markedly in the deeper lake waters, and so has nitrogen around the edges. Stimulated by these and other nutrients, the five-fold increase in algae growth since 1960, and the shift in its composition towards domination by blue-green algae, are causing deoxygenation of the water,

The Kaawa **ship docks on the Green** algae bloom contaminated waters of **Lake Victoria at the Port Bell port, near Kampala.**

Water hyacinth at the shores of Lake Kyoga, Zengebe, Nakasongola District. The plant has devastating impacts on water bodies, aquatice biodiversity and people's livelihoods.

Restoration of Kagera River Basin: NEMA team and the Wetlands Management Department staff led by the Executive Director, Dr. Aryamanya-Mugisha (pointing at the silted river in background) conducted consultations with stakeholders from Isingiro and Rwanda on management and restoration of the river basin bordering Uganda, Rwanda and Tanzania (2006)

increased sickness to humans and animals drawing water from the lake, clogging of water intake filters, and increased chemical treatment costs for urban centers. Aside from the near-total loss of the deepwater species, the deoxygenating of the lake's bottom waters now poses a constant threat, even to fish in shallower portions of the lake, as periodic upwelling of hypoxic water causes massive fish kills. The increased nutrient loads have also spurred the water hyacinth infestations. In addition, massive blooms of algae have developed, and come increasingly to be dominated by the potentially toxic blue-green variety. The distance at which a white disc is visible from the surface, (a transparency index measuring alga abundance), has declined from 5 meters in the early 1930s to one meter or less for most of the year in the early 1990s. Water-borne diseases have increased in frequency. Water hyacinth, absent as late as 1989, has begun to choke important waterways and landings, especially in Uganda.

Lake Kyoga

Shallow lake, unstable water levels and water surface areas, sudds, changes in catchments flora and fauna

Lake Kyoga is a shallow lake with a surface area of 4000 km^2. Half a million people live on its shores and some on the floating sudds, relying on the lake for their livelihood. The Kyoga system is characterised by high hydrological variability leading to large fluctuations in lake levels, water surface areas, shoreline lengths and associated changes in flora and fauna. During the early part of the last century, Kyoga and Kwania were shallow swamps with little open water. The most important hydrological event in recent history was the sudden, drastic increase in lake level following very heavy rains

APAC DISTRICT

A

Lake Kyoga

Sudds

LUWERO DISTRICT

0 5 10 Kilometres

N

13 Oct 2002

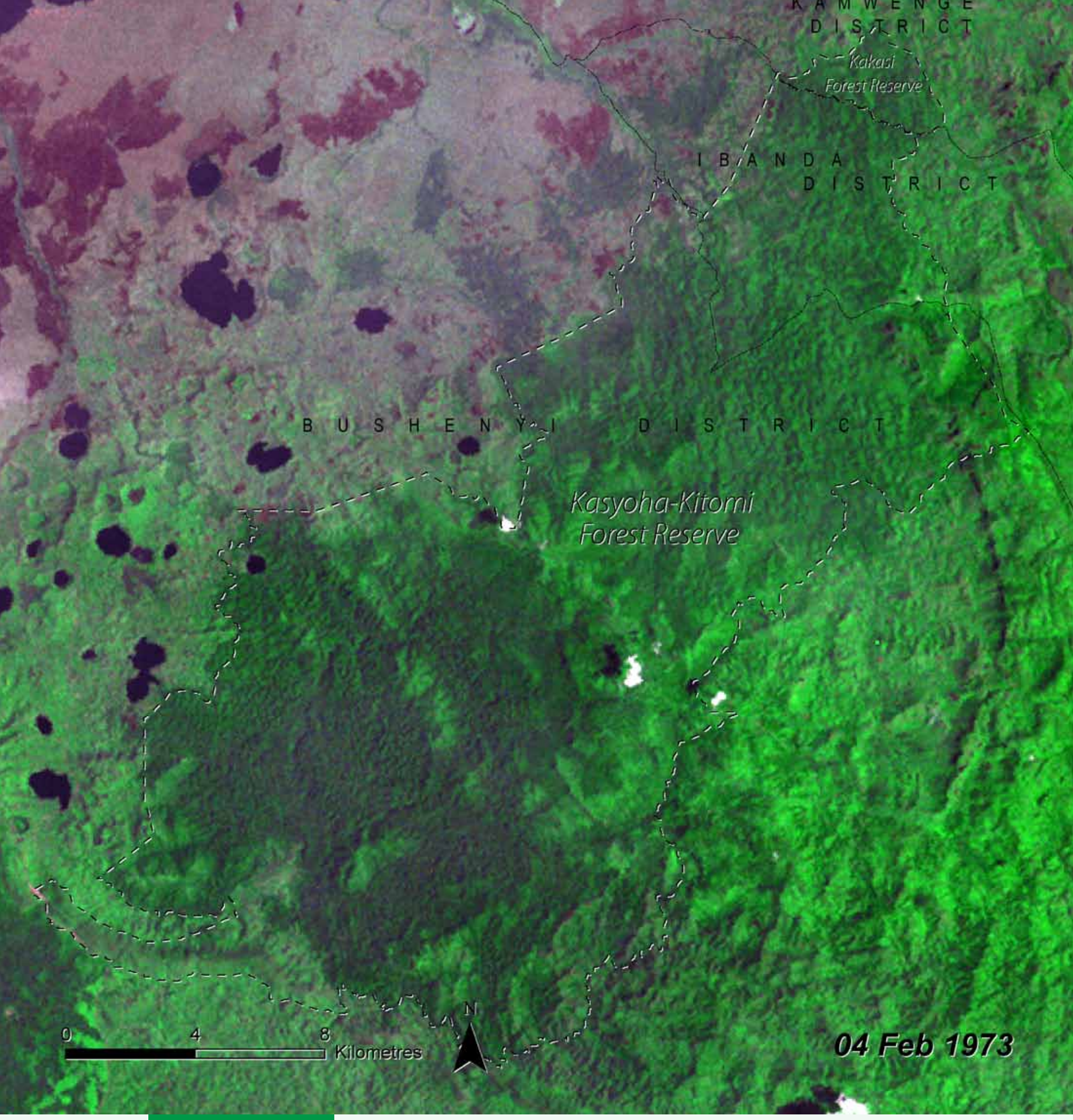
in the early 1960s that resulted in considerable expansion of open water areas of the lakes. Water levels and lake surface area declined in a fluctuating manner during the next two decades until a second major flood event occurred as a result of El Niño rains in 1997/98. The satellite images of 1986 and 2002 show the floating sudds on the lake. By 2002 the outlet of the Nile had been blocked leading to flooding on some of the shore lines. Evidence of flooding can be seen at point A of 1986 and 2002 images respectively.

NEMA staff and Lira District officials in a follow-up meeting on enforcement of illegal settlements on sudds (2006). The meeting took place inside a 'Disco/Film' make shift structure.

Sudds and blockage of the River Nile on Lake Kyoga

Sudds occur as floating land masses on the lake and they are as old as the lake. The Nile River is the effective creator of these sudds. As it progresses it drags the papyrus and mud along and in the long run sudds form and drift off into the centre of the lake where they continue to grow into large masses. The satellite image of 1986 shows sudds floating on the lake. However, the flood event of 1997/1998 caused a large number of papyrus sudds to be released from the shoreline and to float downstream towards the Nile outlet of the lake. At the point the outlet is narrow and this caused the sudds to jam and form a blockage in early 1998. As more floating sudds continued to drift downstream, they added to the bottleneck, forming a papyrus blockage 16 km long and over 80 km^2 in area (satellite image of 2002). This vegetative blockage slowed water flow from the Nile outlet and raised water levels by 2m in 1999-2000. Two channels were opened by the Directorate of Water Development (DWD) in 2001-2002 and later on a team from Egypt had to dredge to allow water flow downstream.

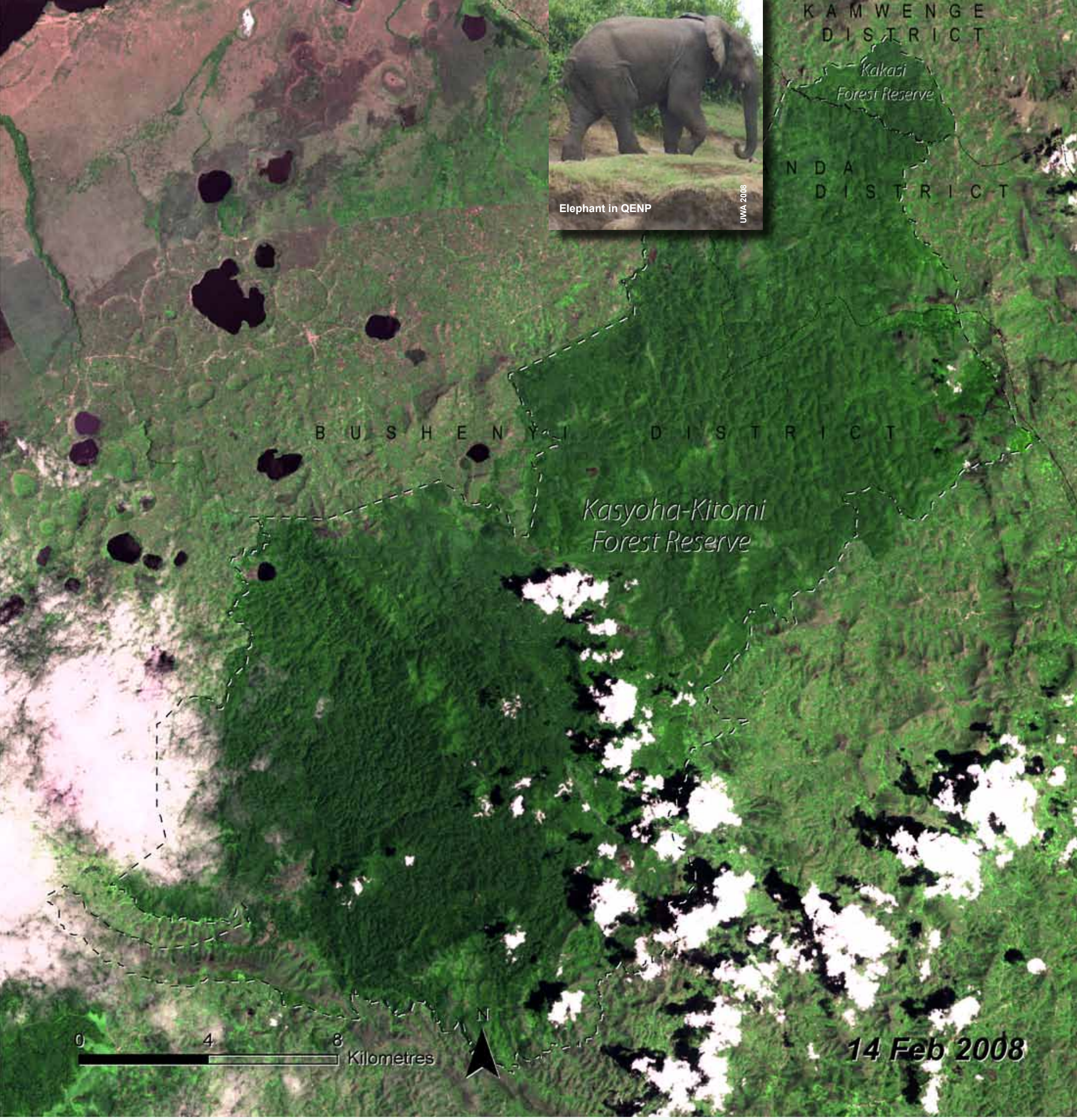
Above: Illegal settlements on the sudds. Inset: A 'Film hall'. Communities at the sudds lead recklessles lives.
Below: Technical staff inspecting the sudds and catchments.



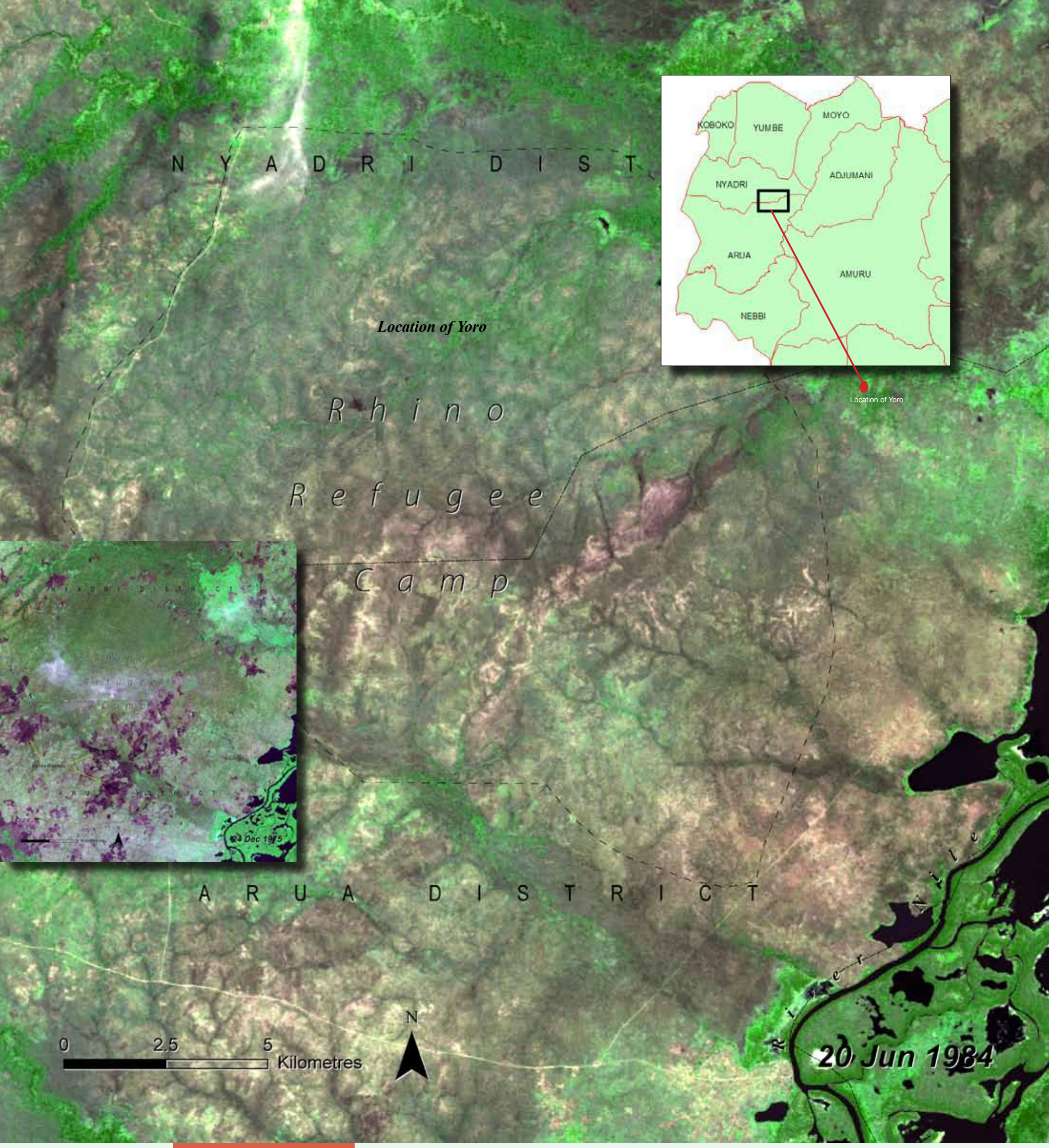
Kasyoha-Kitomi Forest Reserve

Deforestation, protected areas, encroachment

The Kasyoha-Kitomi Forest Reserve is part of the network of protected areas that form the largest area of protected land in the Albertine Rift. The diversity of the region is fantastic and Kitomi Forest contributes a great deal to that aspect. Kitomi provides critical habitat for over 350 chimpanzee and 300 elephants. This forest reserve is shared between the districts of Bushenyi, Ibanda and Kamwenge and the largest part of the forest falls in Bushenyi district. In the year 2000, it became apparent that encroachment and illegal logging within the thin corridor between Kitomi Forest and Kyambura Wildlife Reserve (which forms part of Queen Elizabeth National Park (QENP)) was threatening to sever this 400 km² of vital



habitat from QENP. Implications of this are that the chimpanzee population of the region would become separated making two populations unviable. This area is a critical seasonal resource for the elephants of the central sector of QENP. Elephants are being forced to pass through protected area 'farmland', destroying crops as they move along, just to reach an area that they have always used (http://www.ugandacf.org/Projects/ksr_project.html). The forest area from the 1960 topographic maps was 444 km^2 and the same area from the Landsat TM image of 2000 is 368 km^2. In 2008 the boundary of the forest is very distinct as all the surrounding areas have been turned to farmland.



Rhino Refugee camp

Impact of refugee settlements in West Nile

The presence of refugee settlements has had an environmental impact on land in West Nile, particularly deforestation as a result of Sudanese refugees producing charcoal to sell in south Sudan. Most Sudanese refugees live in settlements and cultivate their own food on designated land. Located on the banks of the River Nile in the northwest corner of Uganda, Rhino Camp hosts approximately

N Y A D R I D I S T R

R h i n o

R e f u g e e

C a m p

refugee settlements
&
loss of natural vegetation

see inset image

A R U A D I S T R I C T

N

0 2.5 5 Kilometres

15 Oct 2006

14 Feb 2009

26,000 refugees, the majority of whom are from southern Sudan. Rhino Camp consists of widely-scattered residential areas over an area of 225 km^2, interspersed with agricultural land cultivated by the refugees. In 1989 the area was covered with vegetation and wetlands. By the year 2008, the area had been turned into farmland.

NEMA 2007

Misuse of seasonal wetlands: Teso floods in 2007

Chapter 4

Tracking Environmental Sustainability

Restoration of bare hills in Mbarara District, 2005

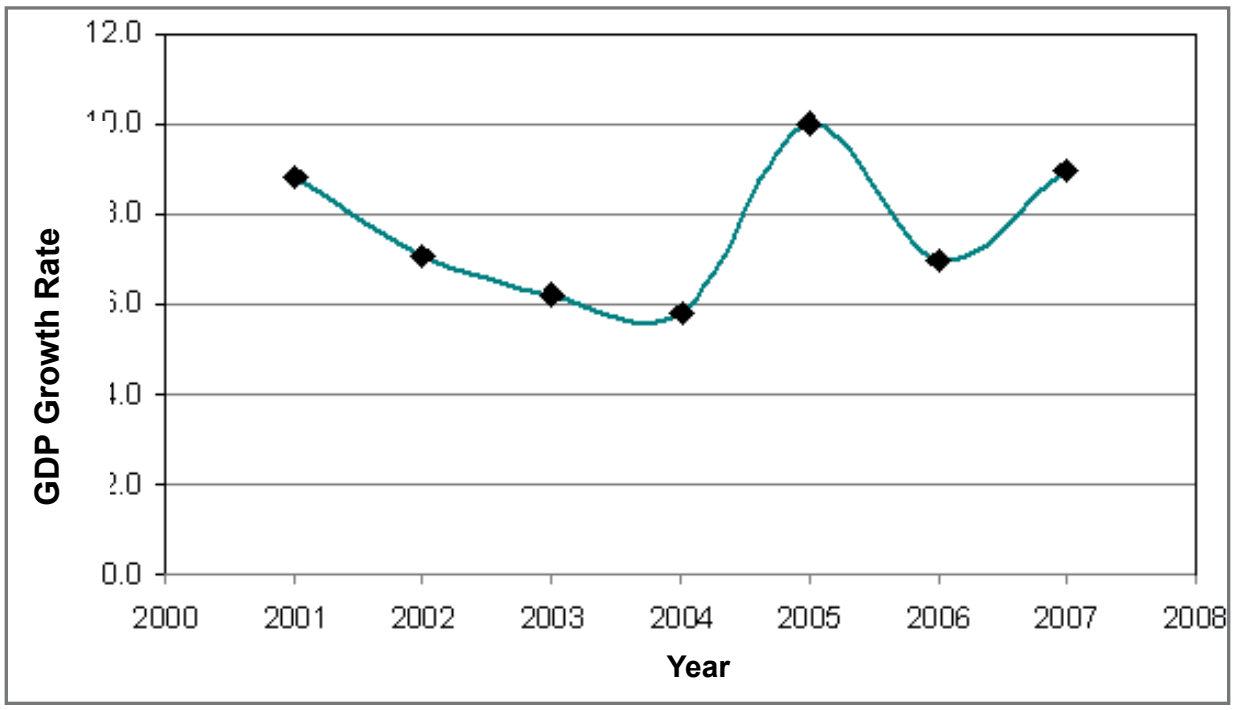
Uganda's economy enjoyed positive growth throughout the first part of this decade. GDP growth was 6.0 per cent per annum for most of early 2000s, but increased to 7.1 per cent in 2008. Environment and natural resource (ENR) assets accounted for the bulk of this growth. For most years, ENR contributed more than 50 per cent of GDP.

Uganda's economy is closely linked to her rich environment and natural resource base. Agriculture however continues to determine Uganda's success in terms of economic growth and poverty reduction. The sector's share of GDP remains high at 21% (2007) having only recently reduced from 47.7% in the late 1990's and 41.6% in the early 2000's. The sector continues to absorb the largest share of the labour force.

More than 73% of the population is mostly the primary agricultural sub-sector. The country is well endowed with both renewable and non-renewable resources including minerals, forests, wetlands, fertile soils, wildlife, lakes and rivers, hydro-power and a good climate.

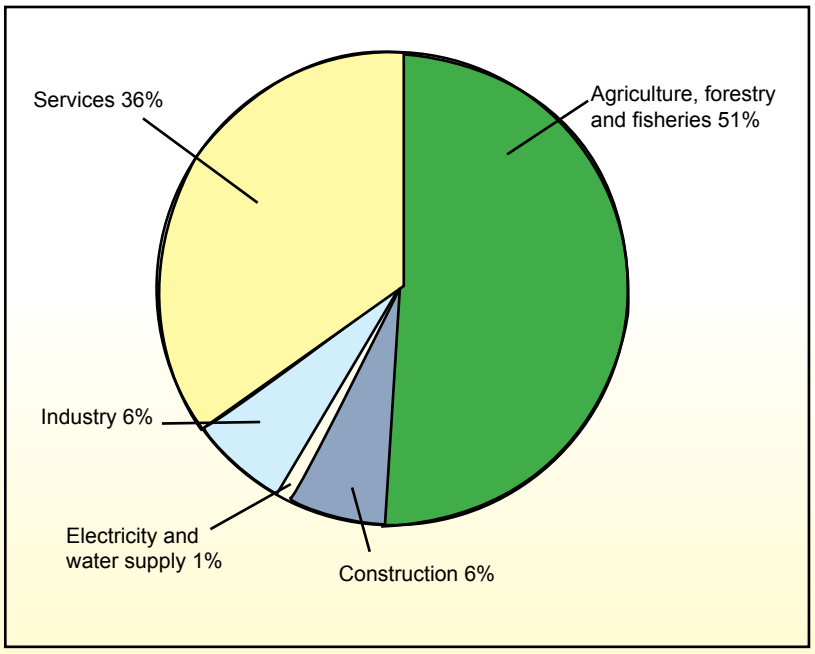
Although GDP increased positively in the last 23 years, the positive benefits of GDP growth have not been felt in every household in Uganda.

Poverty and inequity continue to prevail albeit at a reducing level.Some of the causes of persistent poverty and inequality include rapid population growth (2.3 per cent and one of the fastest in the world) and environmental degradation. Rapid and unplanned population growth overstretches the capacity of the environment to sustain economic progress and human well-being.

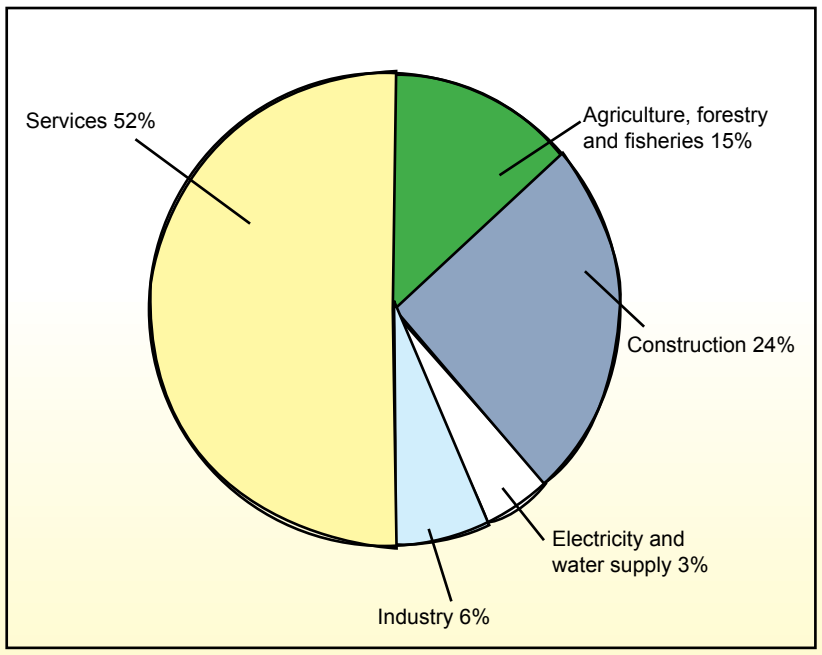


GDP Gowth Rate

Source: **UBOS 2008**



1992



Project 2008

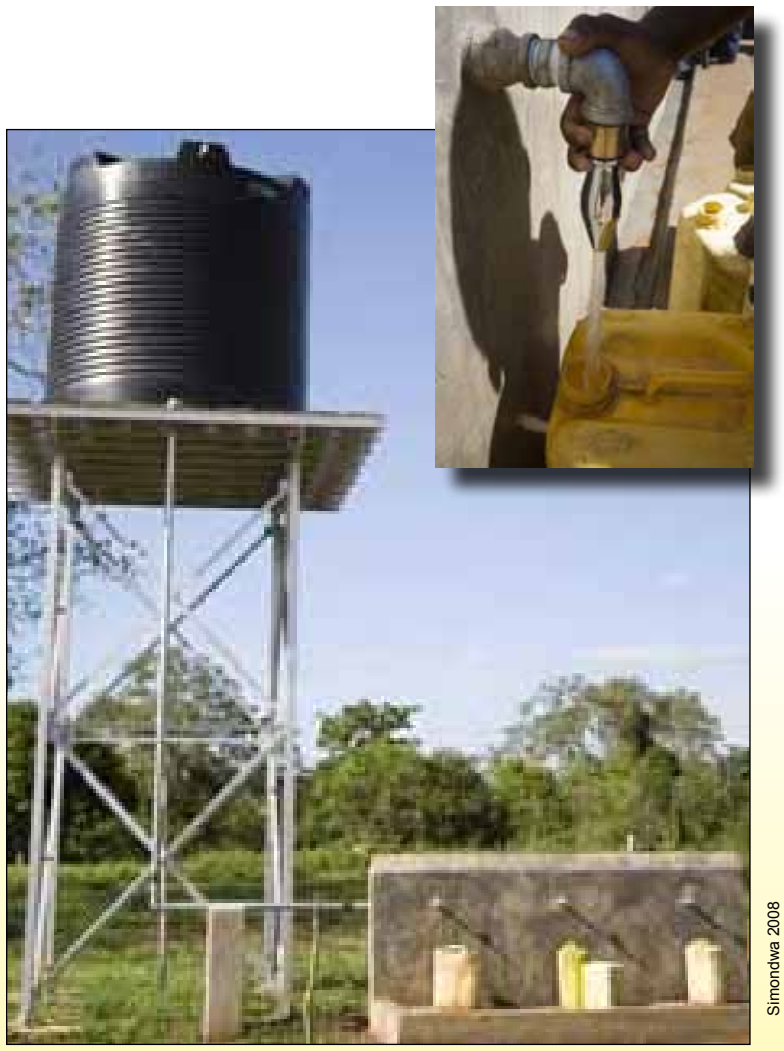
Source: State of Environment Report for Uganda 1996 and Uganda Bureau of Statistics 2008

Uganda's MDGs Status
Uganda has made substantial progress towards achieving the MDGs, although more needs to be done if all are to be attained. With continued good policies, Uganda appears likely to achieve targets for Goals 1, 3, 6, 7 and 8.
The country may also achieve Goal 2 on Universal Primary Education (UPE) and the target for hunger. This will however require greater effort in encouraging children to complete Primary level education.
However, progress towards Goals 4 and 5 – to reduce child mortality and to improve maternal health – is uncertain. Most mortality is due to malaria, diarrheal diseases and upper and lower chest infections most of which diseases have a direct environmental link.
Considerable effort has gone into providing safe water within easy reach for all Ugandans by 2015. However, achievements todate still fall short of the target.
Uganda is reported to be losing its forest cover through deforestation. Various studies (e.g FD, 2000; MFPED, 1994; FAO, 2000 - cited in UNDP, 2004) report estimates of varying annual deforestation rates from 550 km^2 per year to 700 km^2 - 2,000 km^2 per year, primarily due to deforestation for agricultural land.

UNDP, 2007, Millennium Development Goals Uganda's Progress Report

UPHOLD 2008

Malaria control: PMI Net Retreatment launch at Nabwigulu Sub county, Kamuli District (2008)



Simondwa 2008

A typical 3-point water supply, Kamuli District Inset: A self-closing water tap prevents wastage

MDG	Performance	How vulnerability affects achieving MDGs	Strategies for reducing vulnerability to support achieving MDGs
1. Eradicate extreme poverty and hunger	• Population living below the poverty line reduced from 56% to 31% between 1992 and 2006 • Between 1995 and 2006, the proportion of underweight children reduced from 25.5% to 20.4% • Food calorific intake deficiency increased from 58.7% in 1999 to 68.5% in 2006	• The impairment of ecosystem functions inevitably leads to a narrowing of livelihood choices especially for poor people • Disasters like floods affect food security and general human well being like it was with north eastern parts of the country	• Ensure sound and equitable management of natural resources. • Robust food security programmes especially in northern Uganda • Building the capacity of disaster preparedness and refugees department to deal with the challenges of disaster
2. Achieve Universal Primary Education	• The introduction of UPE in 1997 led to a substantial increase by 132% in gross enrollment from the pre-UPE total of 3.1 million in 1996 to 7.2 million children in 2006	• Dwindling forests and woodland cover leads to scarcity of wood. This means children have to spend more time looking for fuel, which can reduce time and concentration at school	• Restore and maintain ecosystem health and services • Promote renewable energy technologies that are energy efficient
3. Promote gender equality and empower women	• The affirmative action policy led to an increase in the proportion of females to the total student enrollment by 31% in 1993/94 to 40% in 2002 and up to 42% in 2004 • In the current Parliament, 89 of the 310 members are women, representing 28.7% of the legislative body. This is an improvement from the 18% registered in 1995	• Gender issues like conflicts in land resources management, unequal access to land and resources disempower women • Violence and sexual abuse against women especially in the northern war region makes women vulnerable to diseases, etc.	• Ensure equitable access to natural resources by all • Develop policies that alleviate violence and sexual abuse against women
4. Reduce child mortality	• Over the period 1995-2000, maternal mortality stagnated at about 505 deaths per 100,000 live births • To meet the MDG target, Uganda will need to reduce its mortality rate from 505 to 131 deaths per 100,000 live births by 2015	• Indoor air pollution affects women's health and can make women less fit for childbirth and at greater risk of complications	• Improve access to efficient energy technologies • Improve air quality and limit exposure to toxic chemicals
5. Improve maternal health	• Over the period 1995-2000, maternal mortality stagnated at about 505 deaths per 100,000 live births • To meet the MDG target, Uganda will need to reduce its mortality rate from 505 to 131 deaths per 100,000 live births by 2015	• Indoor air pollution affects women's health and can make women less fit for childbirth and at greater risk of complications	• Improve access to efficient energy technologies • Improve air quality and limit exposure to toxic chemicals

MDG	Performance	How vulnerability affects achieving MDGs	Strategies for reducing vulnerability to support achieving MDGs
6. Combat major diseases	• According to the 2004-05 Uganda HIV/AIDS Sero Behavioral Survey (UHSBS), 6.4% of adult population in Uganda are infected with HIV • Overall, there has been a declining trend of HIV infection from a peak of 18% in 1992 to the current figure • Malaria accounts for 52% of outpatient department attendance, and 30% of in-patient admissions. The disease is responsible for 9-14% of all in-patient deaths. However, the in-patient deaths for children under-five attributed to the disease are about double at 20-23%	• Opportunistic diseases that are environment related e.g. diarrhea, cholera some times kill HIV patients prematurely • Prevalence of malaria and other major killer diseases have a correlation with poor hygiene and sanitation	• Ensure robust hygiene and sanitation programmes at community and household levels
7. Ensure environmental sustainability	• There is an increase in water service coverage nationwide from a little over 20% in 1991 to almost 68% in 2006. Equally, the Uganda Population and Housing Census reports a rise in water service coverage from 26% in 1991 to 68% in 2002 • However, there is wide documentation on persistent degradation of the country's natural resources, namely: declining soil fertility, deforestation, (particularly outside protected areas), pasture degradation, decreasing fish stocks and water pollution	• Current trends in environmental degradation must be reversed in order to sustain the health and productivity of the country's ecosystems • Stressed ecosystems cannot support economic development sustainably	• Reduce and mitigate climate variability and change. • Ensure effective implementation of the country's environment policies • Rethinking and strengthening environmental governance • Strengthening the adaptive capacity to climate change

MDG Facts
31%of the Ugandan population lives below US$1.00 per person per day
20.4% of Ugandan children go to bed hungry
84% of Ugandan children are enrolled in primary school
The average Ugandan woman spends 9 hours a day on care labor activities such as fetching water, firewood and caring for the sick.
13.7% of children die before their fifth birthday
7.6% of infants die before their first birthday
For every 100,000 new mothers, 435 die while giving birth
Only 41% of births are attended by skilled personnel
6.4% of the Ugandan population is infected with HIV/AIDS
67% of Ugandan households have access to safe water today

Source: NEMA 2008

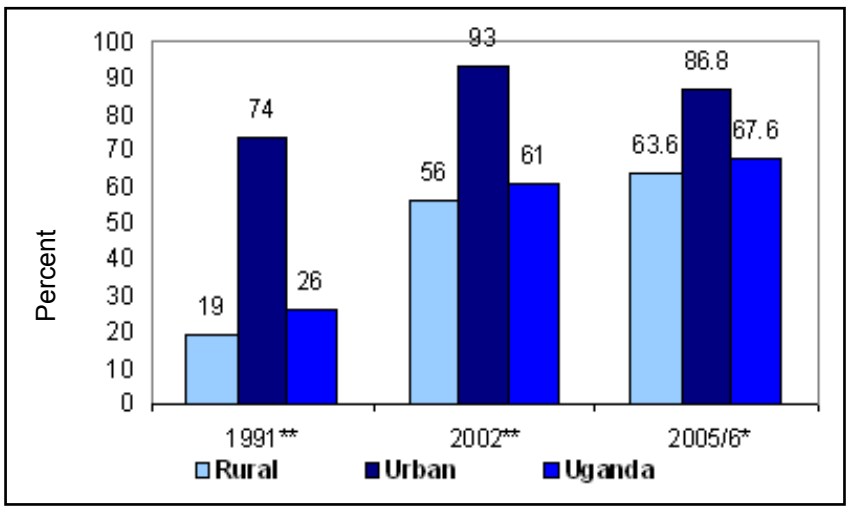
Access to safe drinking water

MDG 7 on environmental sustainability aims among others at halving the proportion of people without sustainable access to safe drinking water by 2015.

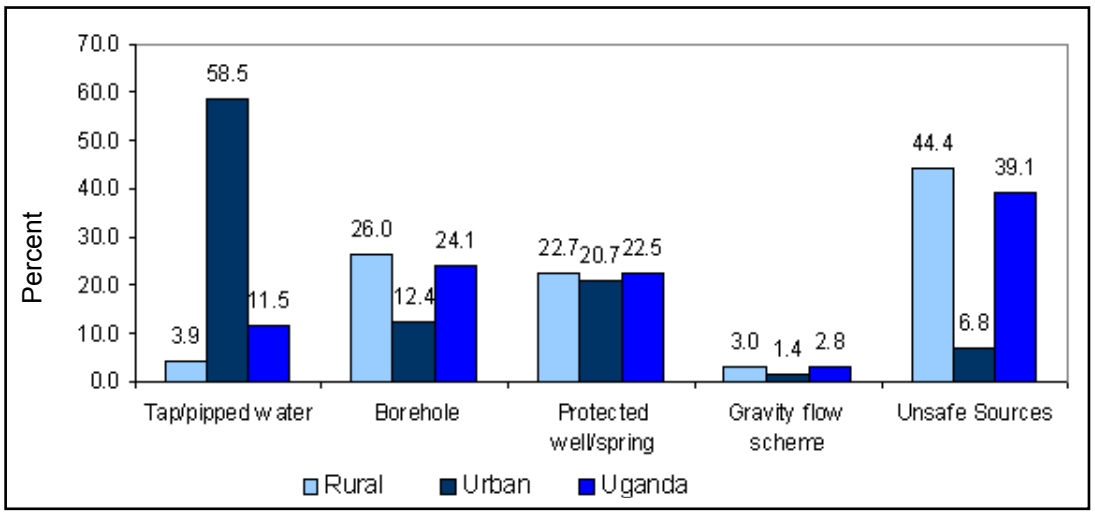
Water sources considered safe include piped water, boreholes, protected springs and gravity flow schemes.
Sixty seven percent of all households in Uganda now have access to safe water sources.

The challenge is sustainability of these sources in view of increased degradation of water catchments and surface water sources.
In urban areas the proportion of people with access to safe water is 87 percent while it is 64 percent in the rural areas.

Access to safe drinking water



Distance to safe drinking water for the regions

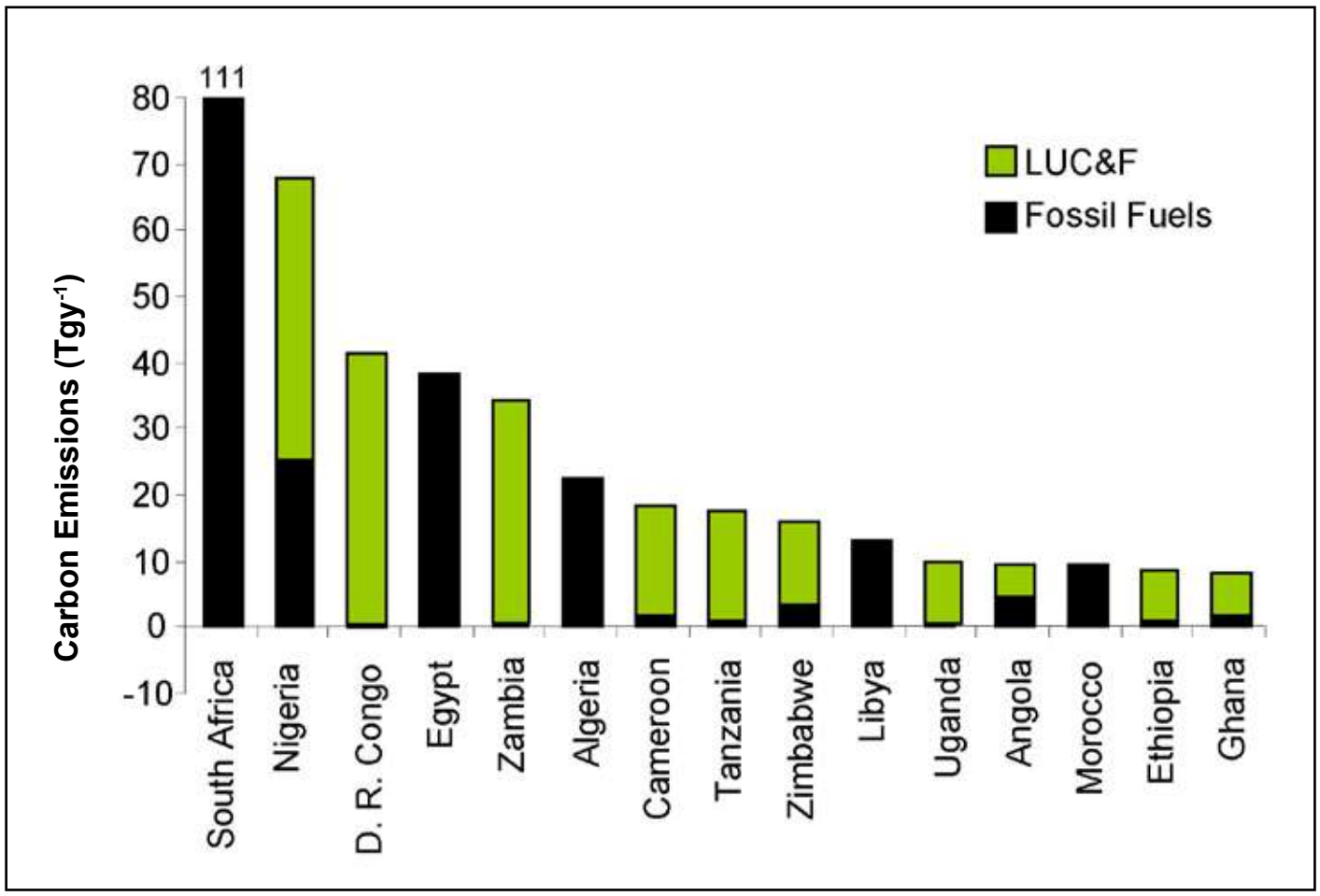


Source: UBOS, UNHS 2005/6, 2002 Uganda Population and Housing Census Analytical Report

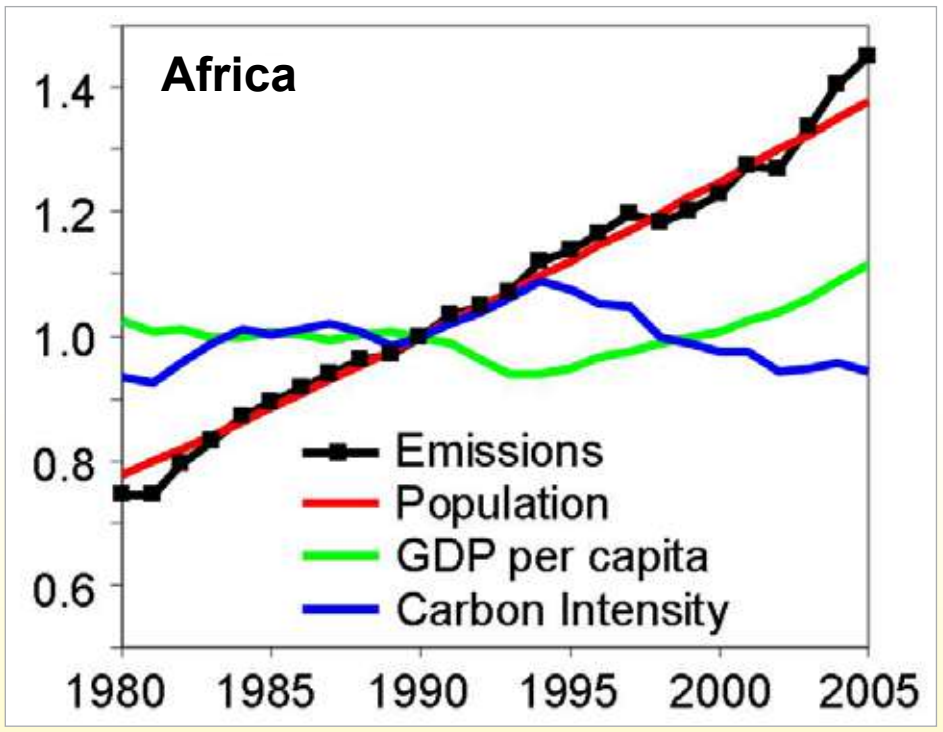
A man accesses unsafe drinking water from a pond in Migera, Nakasongola District

Green House Gas Emissions

Although Uganda is not a major contributor to the global GHGs emissions load, the impacts of global warming are already with us. The main source of green house gas emissions in Uganda is land use change and deforestation.

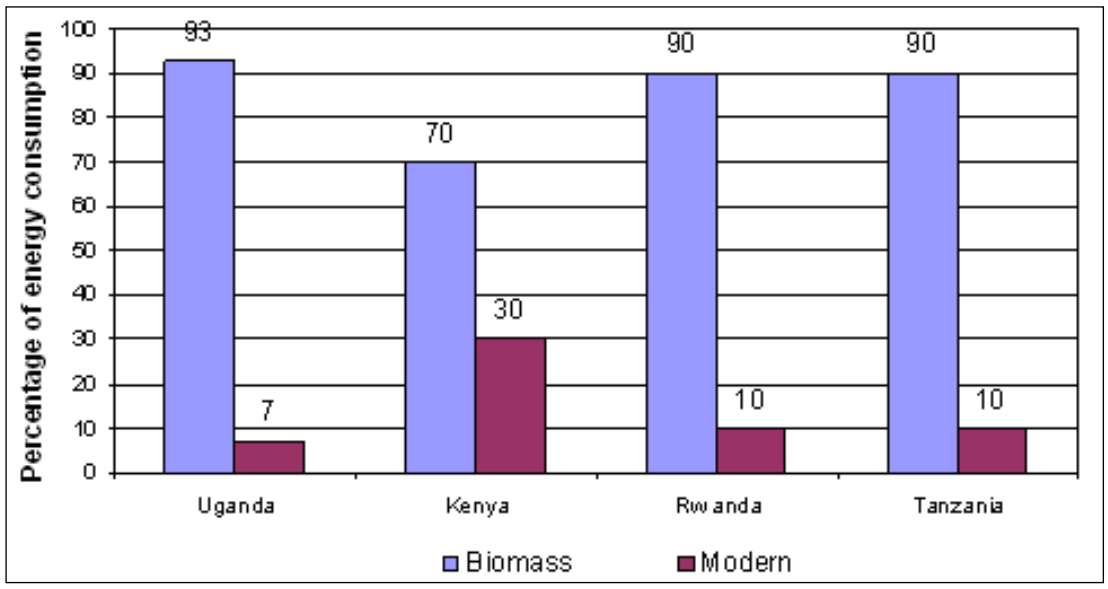


Source: Canadell et al 2009



Source: Canadell et al 2009

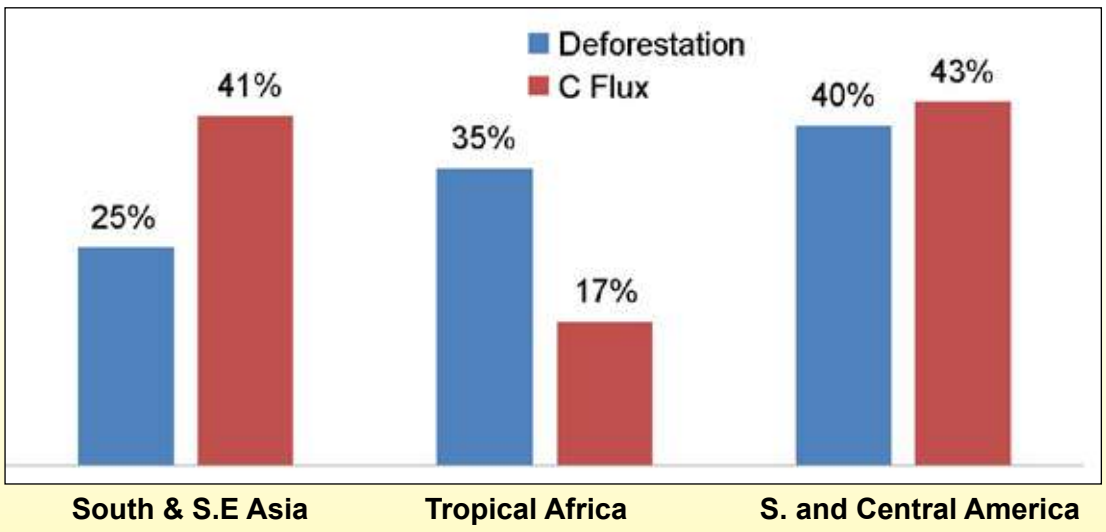
The 2000–2005 growth rate in African fossil fuel emissions was 3.2% per year (y^{-1}) very close to the global average. Fossil fuel emissions per capita in Africa are among the lowest in the world, at 0.32 t per year (y^{-1}) compared to the global average of 1.2 t per year (y^{-1}). Uganda has the highest consumption rate for biomass energy in the East African region (93%). This has implications on GHG emissions and loss of forest cover.



Source: State of Environment Report for Uganda (2008)

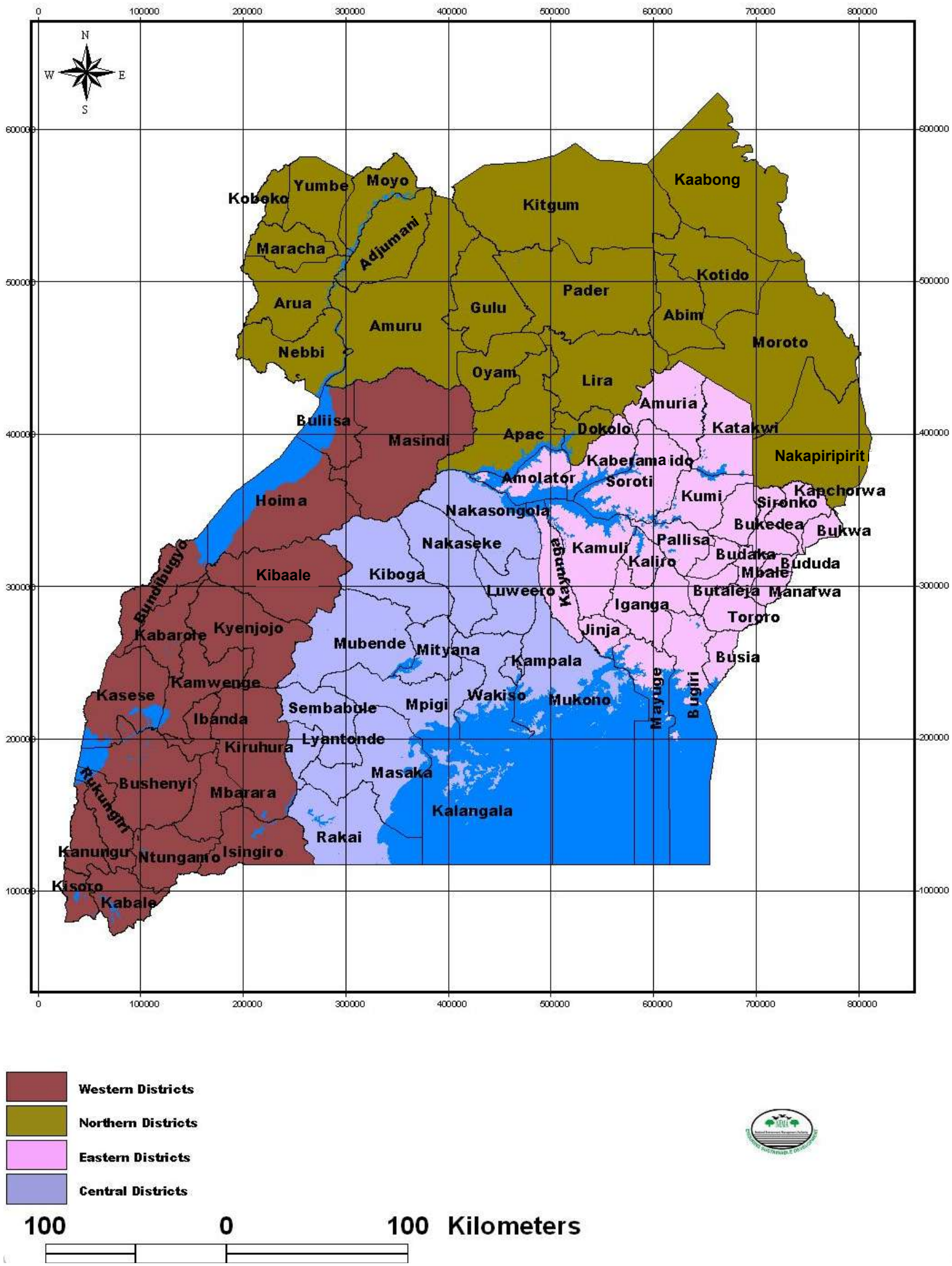
Bush burning in Nakasongola District, Central Uganda

Regional Emissions from LUC&F



Source: Canadell et al 2009

DISTRICTS OF UGANDA



Source: NEMA 2008

John Gibbons: Uganda At A Glance 2002

Ethnic groups of Uganda

Source:Uganda at a glance (2007)

Uganda is divided into four regions namely; Central, Eastern, Western and Northern regions. These regions are further divided into 83 districts spread across the country. The Central Region covers an area of approximately 61,403 km^2 and the major principal towns are Kampala, Kira, Nansana, Masaka and Entebbe. The eastern region of Uganda covers an area of approximately 39,479 km^2 and the major towns are Jinja and Mbale. The region is renowned for its agricultural activities that thrive on the fertile soils, abundant water and rainfall. The area is also famous for its sugar plantations, breweries and is a major tourist attraction as it is the source of the river Nile. The western region of Uganda covers an area of 55,277 km^2 and the major town in the area is Mbarara.

The district of Mbarara is located 266 km from Kampala and was part of the traditional Ankole Kingdom. The region is rich in mineral resources, wildlife and currently undergoing a major transformation with the on-going oil exploration and developments in the Albertine Graben. The area is a prime tourist destination and boasts of national parks, breathtaking mountain terrains and rainforests that are home to the mountain gorilla. The Northern region of Uganda covers an area of approximately 85,392 km^2 and the principle towns are Gulu and Lira. Gulu is the commercial center of the region located 332 km from the capital city Kampala. The major economic activity in the region is agriculture and the majority of the people are engaged in farming.

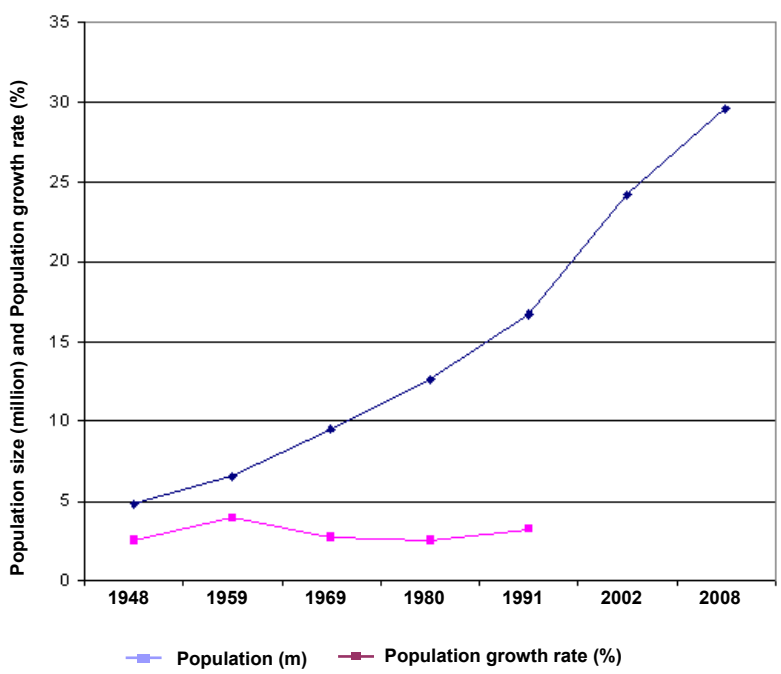
Population growth

Projected population

Region	1991 Census	1996 (a)	1998 (a)	2000 (a)	2015
Central	4,843,594	5,627,800	5,906,500	6,185,400	8,438,400
Eastern	4,128,469	4,983,100	5,307,300	5,631,600	8,547,400
Northern	3,151,955	3,763,600	3,992,200	4,220,700	6,230,100
Western	4,547,705	5,473,100	5,823,000	6,172,600	9,300,700
Uganda	**16,671,705**	**19,847,600**	**21,029,000**	**22,210,300**	**32,516,600**

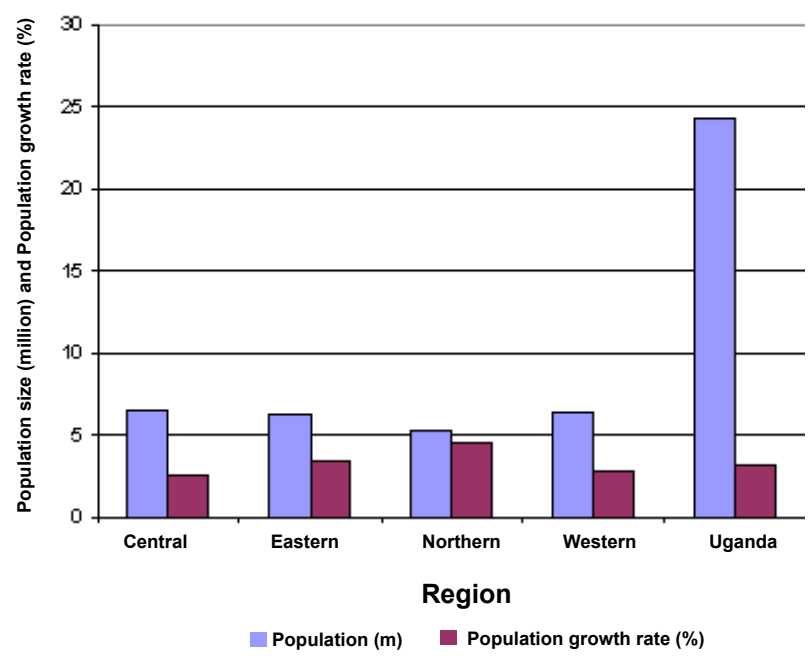
Source : MFPED: Statistical Abstract, (1998)
NEMA (1998): State of Environment Report for Uganda (1998)

Population growth rate



Source: NEMA (2008) SOER

Population growth by region

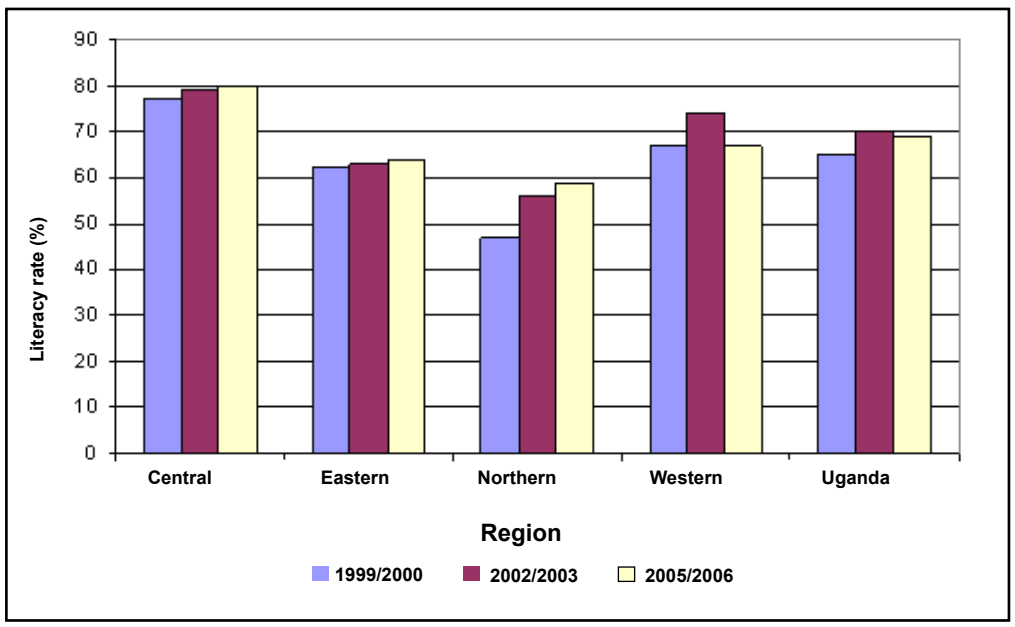


The total population of Uganda has increased from 4.8 million in 1948 to 29.6 in July 2008, and is likely to reach 103.2 million by 2050 (MFPED 2007, UBOS 2008). The population growth rate is one of the highest in the world, at 3.2 per cent. This is significant as there are six times as many people trying to survive on the same amount of natural resources as there were 60 years ago. Already, the government has been unable to keep up with demands on infrastructure such as land, roads, with water supply, energy grids, the built environment, and services such as education and health. The result is that the pressures on rural lands, forests, water and biological resources is increasing dramatically to meet the needs of the growing population. There are regional differences in population growth.

Literacy rate

Literacy rates as a measure of social performance indicate that the central region is doing much better than the other regions of the country. Opportunities for employment, better education and health care in the region have encouraged in migration contributing to the growing human population in the region. This growth in numbers is putting immense pressure on the environment to provide resources for the growing population.

Literacy rates for the population aged 10 and above



Source: UBOS-UNHS 2005/06

Literacy rate

Region	Male	Female	Average
Central	18.8	24.8	21.9
Eastern	9.6	15.9	12.8
Northern	33.8	37.1	35.5
Western	11.5	13.2	12.4
Uganda	**21.9**	**17.9**	**19.7**

Source: UBOS Survey 2008

Region	1999/2000	2002/2003	2005/2006
Central	77	79	80
Eastern	62	63	64
Northern	47	56	59
Western	67	74	67
Uganda	**65**	**70**	**69**

Source: UBOS-UNHS 2005/06

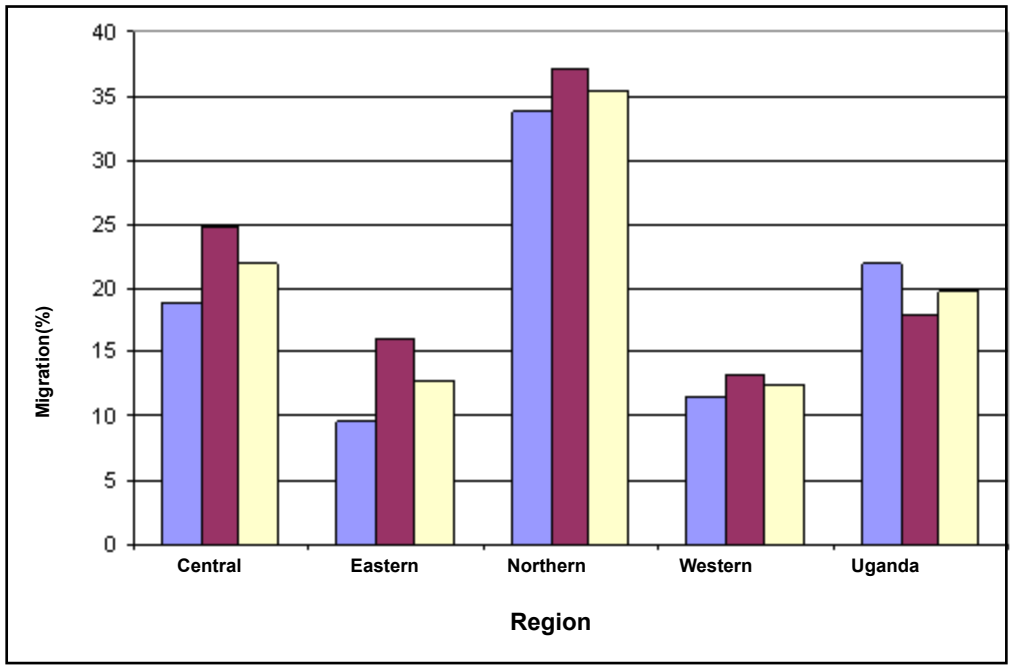
NEMA 2009

Pupils of Jjanyi Primary School in Wakiso District. NEMA visited the rural UPE (Universal Primary Education) school during the Schools ESD (Education for Sustainable Development) planning activities in February 2009.

Rural migration

Regional variations in 2005/06 show that the Northern region had the highest proportion of individuals migrating with 36 per cent as compared to the other regions, the major reason being insecurity. However, with the prevailing peace this trend is likely to change. Other reasons cited for migration is drought, eviction and disease.

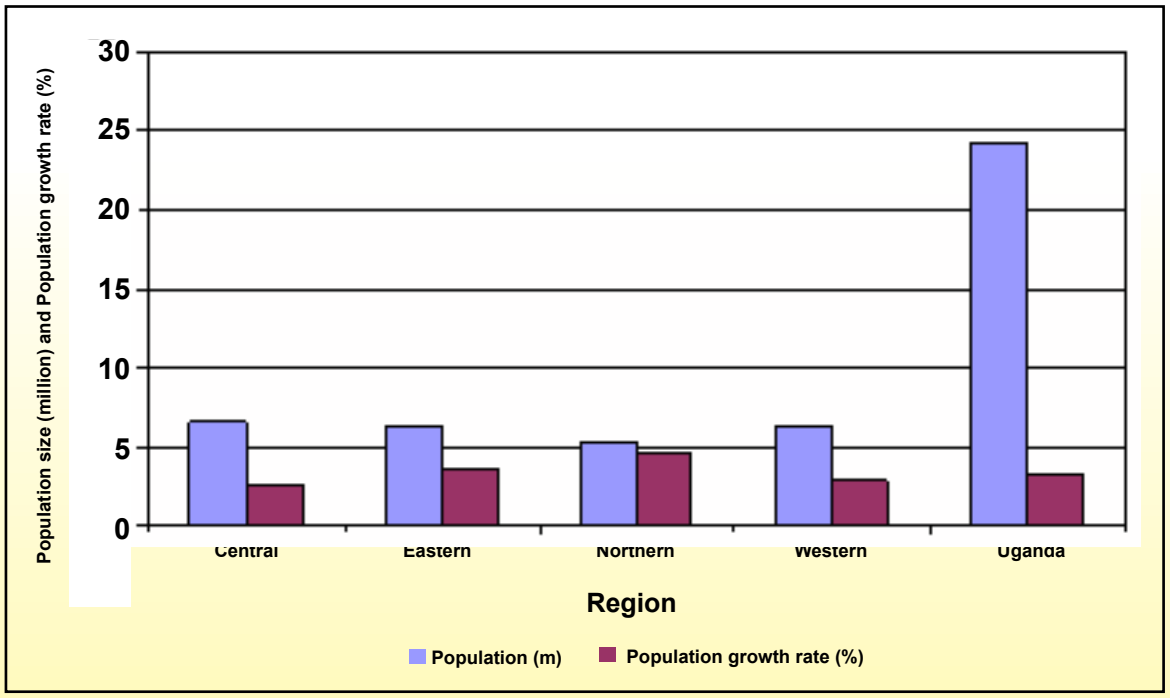
Rural migration per region



Source: UBOS-UNHS 2005/06

Region	Population (millions)	Population growth rate
Central	6.6	2.6
Eastern	6.2	3.5
Northern	5.3	4.6
Western	6.3	2.8
Uganda	**24.2**	**3.2**

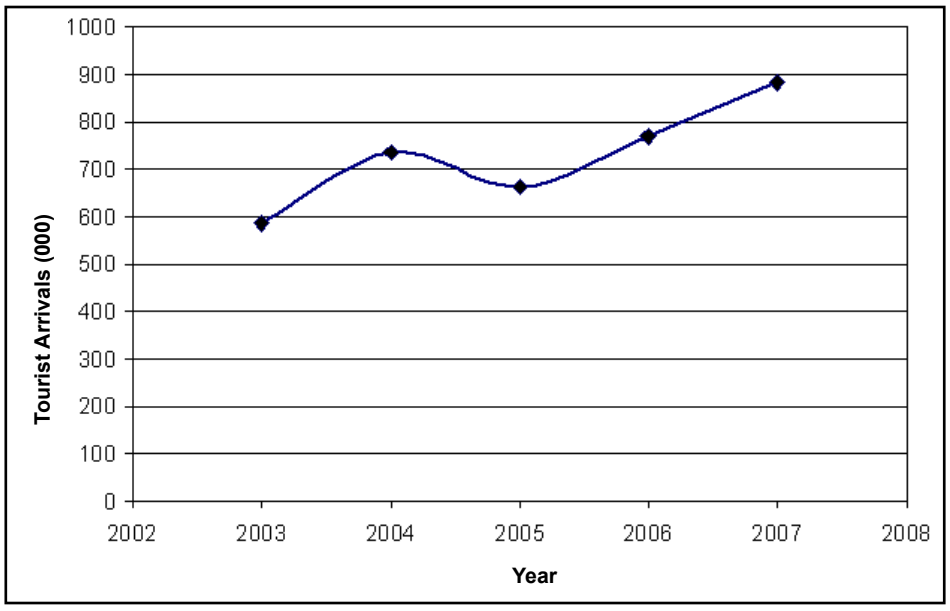
Source: 2002 Population and Housing Census Report



Tourism and the Environment

Uganda's tourism directly depends on the country's environment and natural resource base. Conservation of this natural resource base is critical to supporting tourism and its contribution to sustainable development.

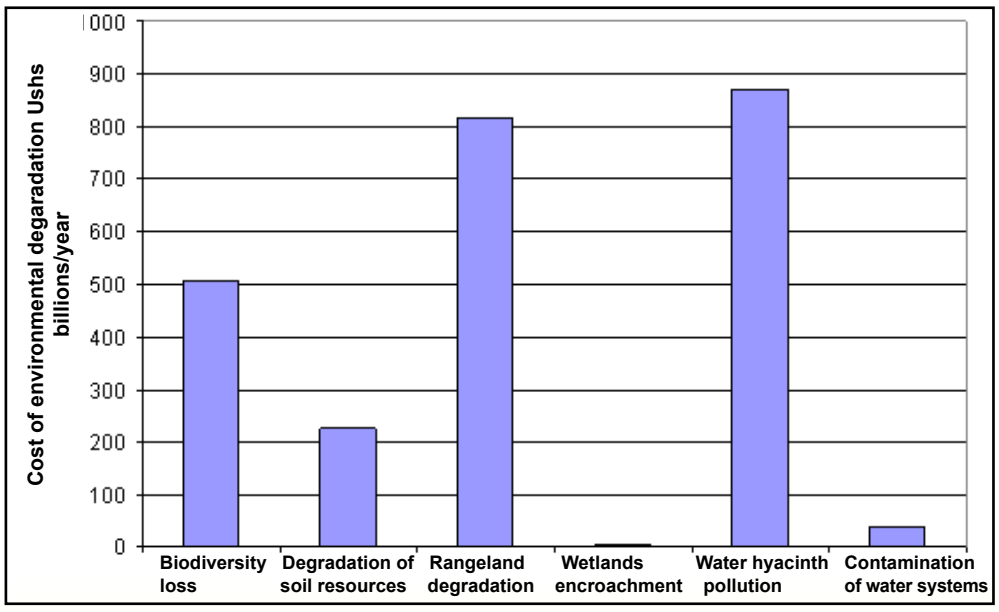
Tourist Arrivals 2003-2007



Source: NEMA (2008) in press

Year	Total arrivals (000)
2003	586
2004	738
2005	662
2006	770
2007	883

Cost of environmental degradation and loss to Uganda's economy



Source: Moyini and Muramira (2001)

	Ushs billions/year
Biodiversity loss	506
Degradation of soil resources	225
Rangeland degradation	815
Wetlands enchroachment	2
Water hyacith pollution	870
Contamination of water systems	38.61

Science and technology

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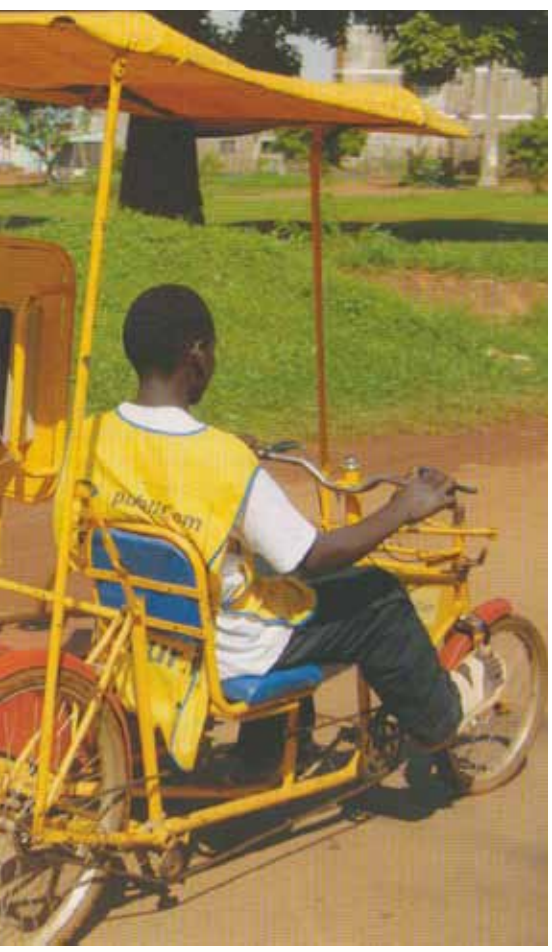

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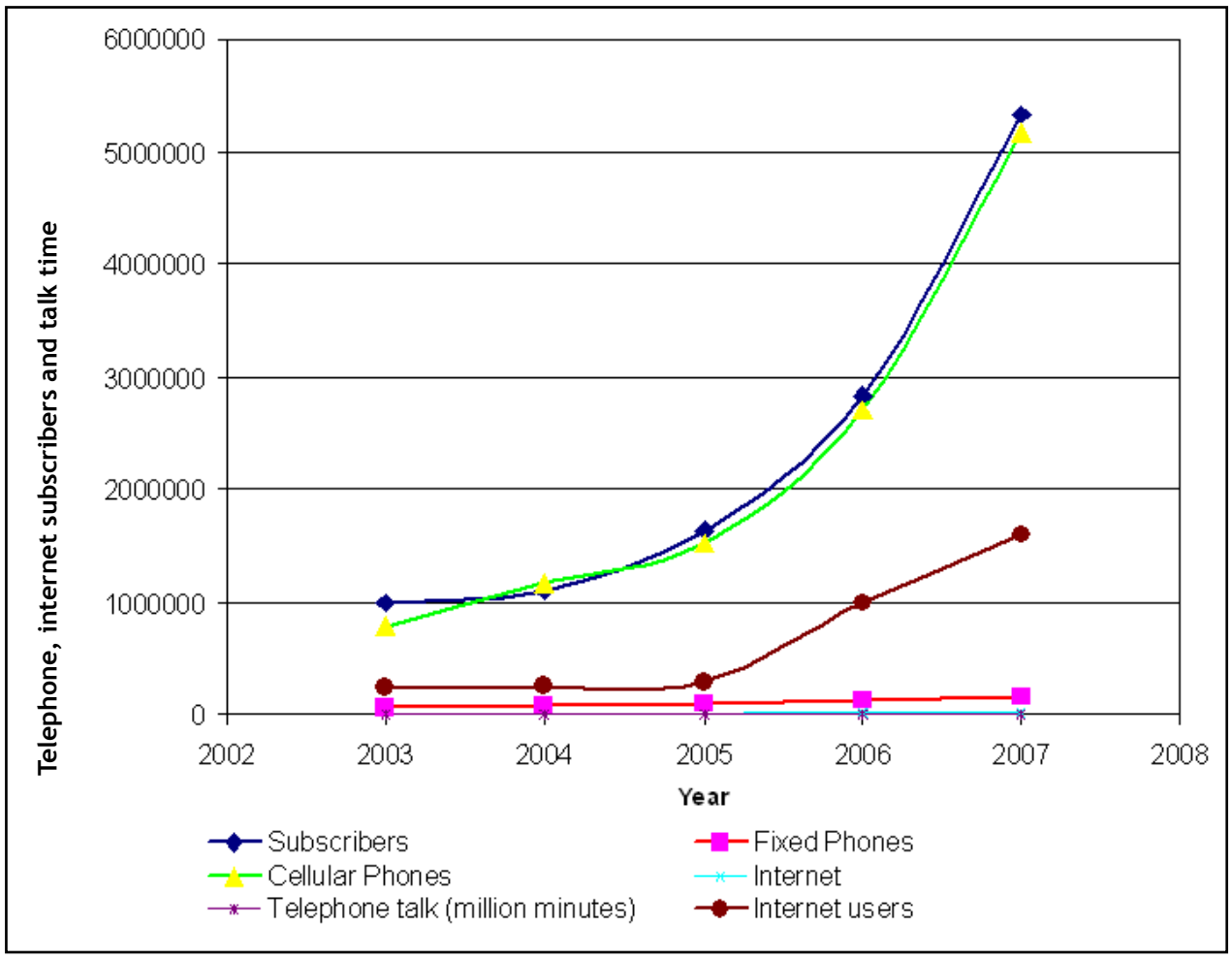
A portable telephone in Uganda.
Source: Africa Atlas of Our Changing Environment (2008)

Telephone and internet subscribers from 2003 - 2007



Year	2003	2004	2005	2006	2007
Subscribers	985828	1111692	1625902	2827479	5329202
Fixed phone	65793	82495	100777	129863	165788
Cellular phone	777563	1165035	1525125	2697616	5163414
Internet	6500	7024	8000	9500	15000
Telephone talk (million minutes)	1308	1559	1724	2307	3005
Internet users	233675	252513	287600	1000000	1600000

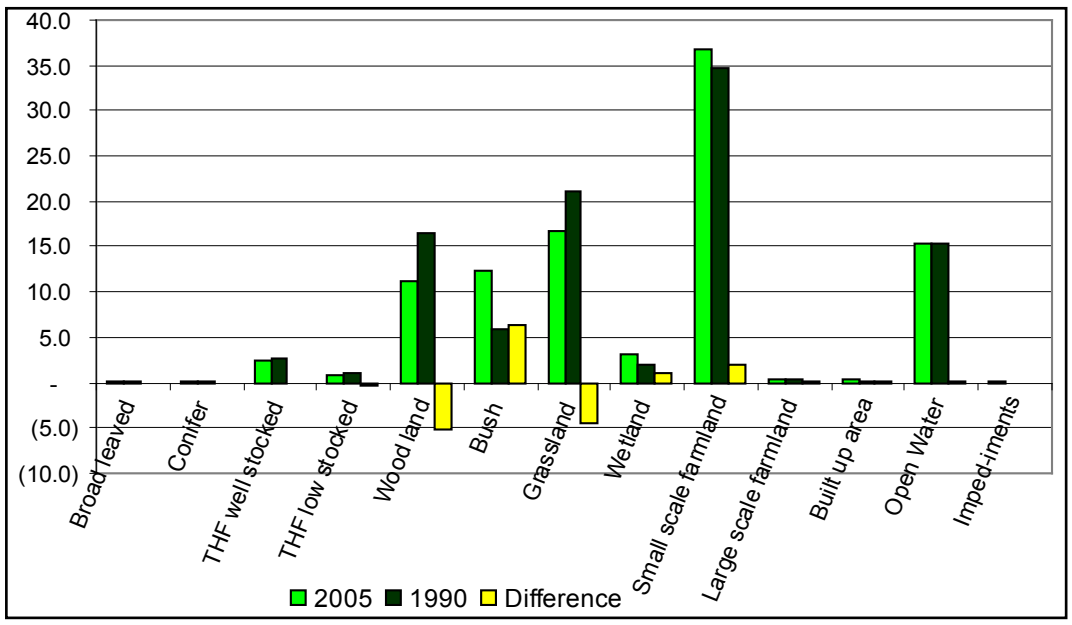
Source: NEMA, National State of Environment Report for Uganda 2008 (in Press)

Some of the Telephone and Internet companies in Uganda (2009)

Land use and land cover

Over 36 percent of Uganda's surface is under small scale farming. From 1990 to 2005 land for small scale farming increased meaning that land originally for other use is now being cultivated.

Uganda's Land use and land cover, percentage



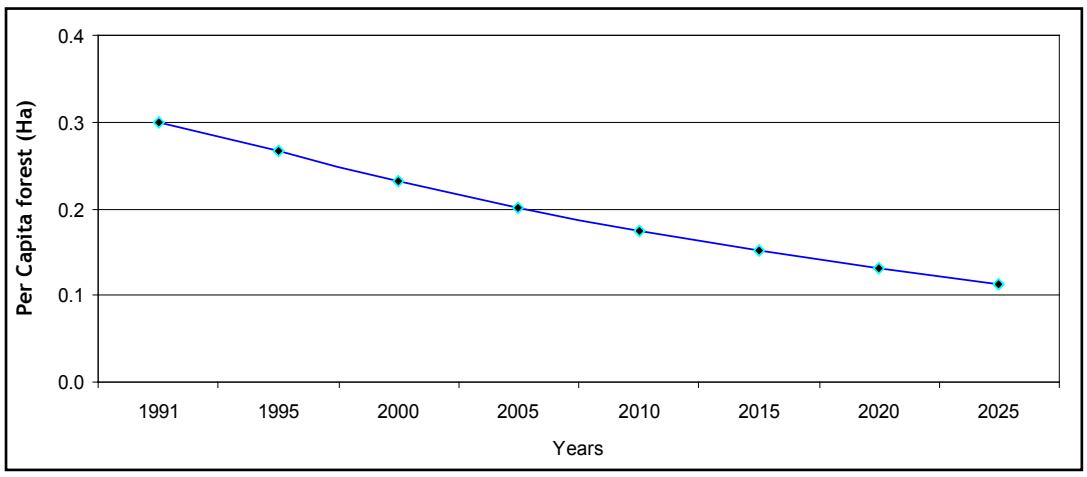
Source: NFA 2008

Per Capita Forest

Per capita forest has been reducing and the trend is expected to continue if nothing is done to halt the situation.

Reduction is attributed to deforestation and increasing population pressure.

Per Capita (Forest Area)

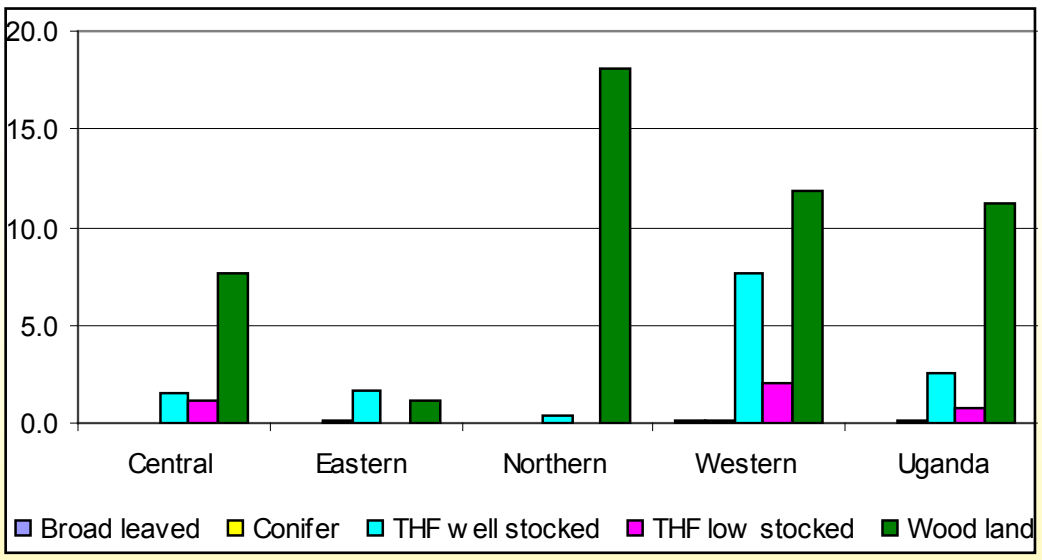


Source: NFA 2008

Vegetation cover per region

The northern region has the highest woodland; the eastern is almost bare.

Proportion of vegetation Cover (%), 2005



Source: NFA 2008

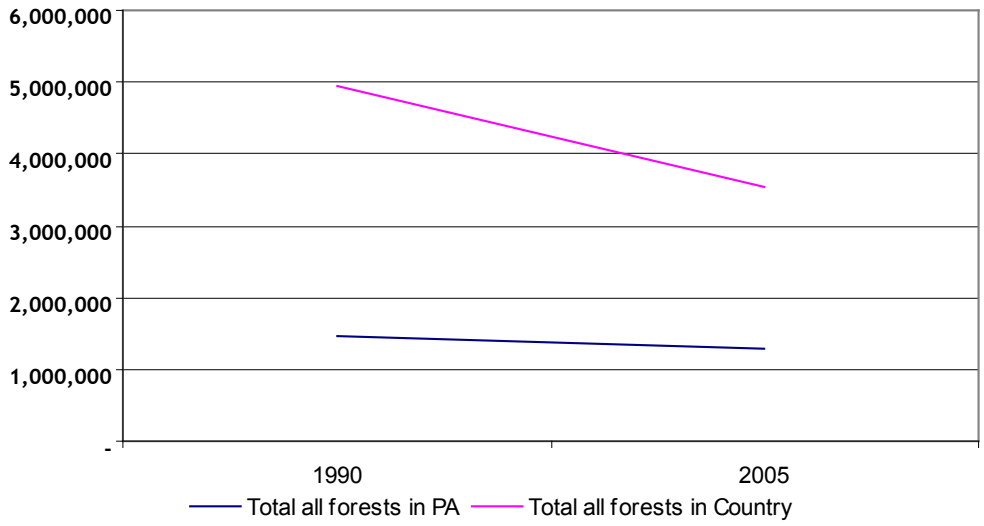
Forest Loss

Although deforestation has been more or less controlled in the Protected Area (PA) estate, most of Uganda's forests occur on land outside protected areas. The deforestation is rapid, spelling intense future pressure on the protected area

Ibanda bare hills

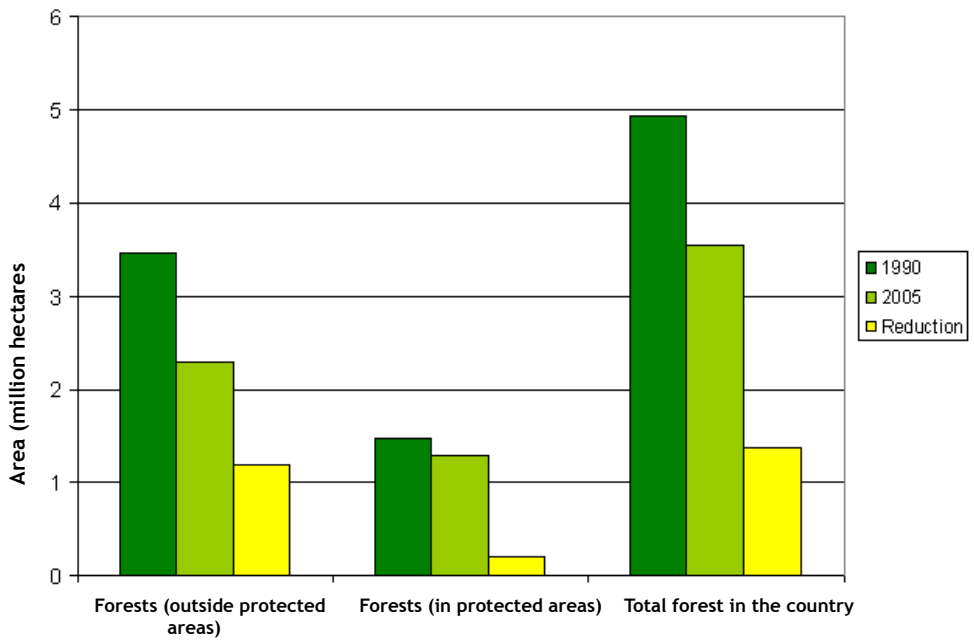
Restoration of bare hills in Mbarara District, 2005 by NEMA support to District micro projects

Forest loss (Hectares)



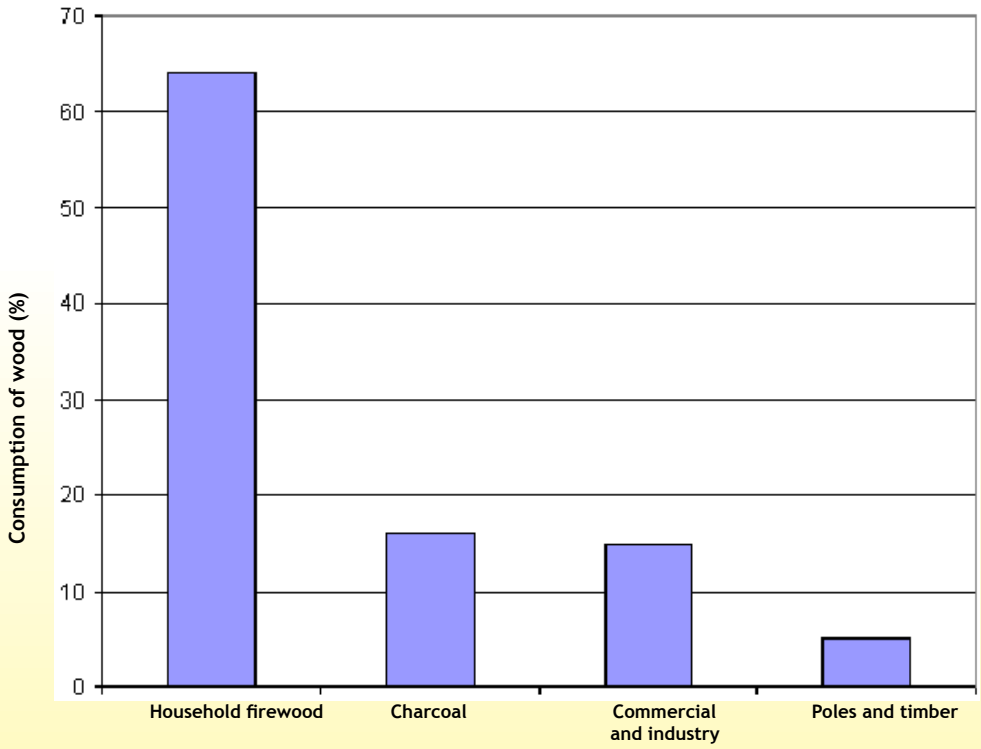
Source: NFA 2008 *Note*: PA refers to Protected Areas

Forest Reduction



Source: NFA 2008

Forest consumption



Source: NFA 2008

Forest Reserves

NEMA 2008

Mabira Central Forest Reserve

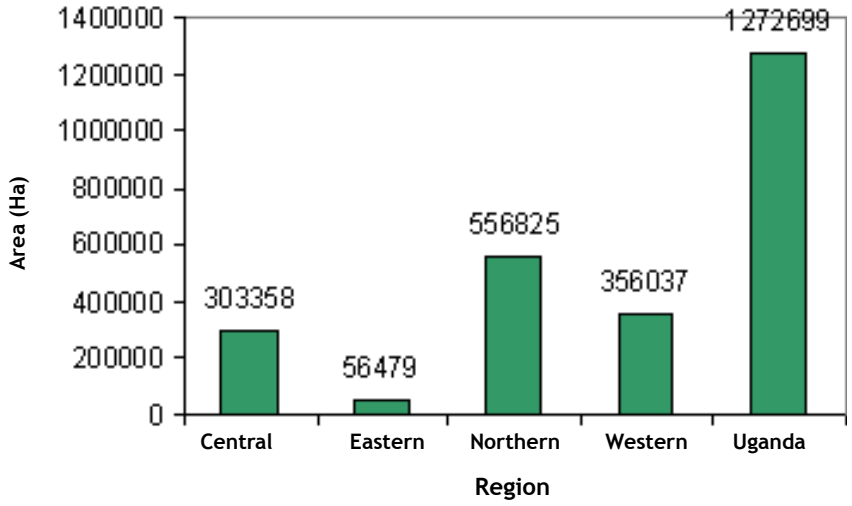
Grace Nangendo 2008

Budongo Central Forest Reserve

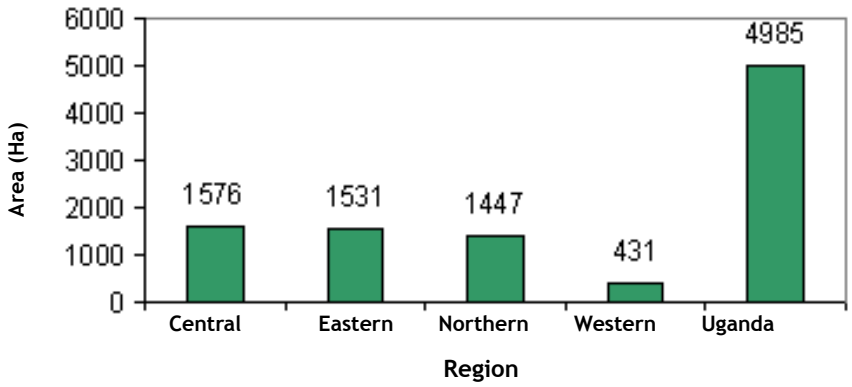
Below: NEMA staff and District Environment Officers plant trees on Nabyewanga Hill, Masaka District during their annual meeting (2007)

NEMA 2007

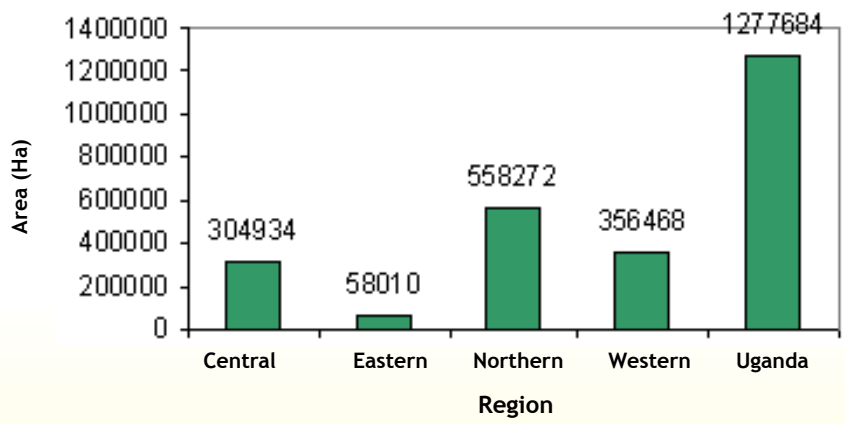
Central Forest Reserves



Local Forest Reserves



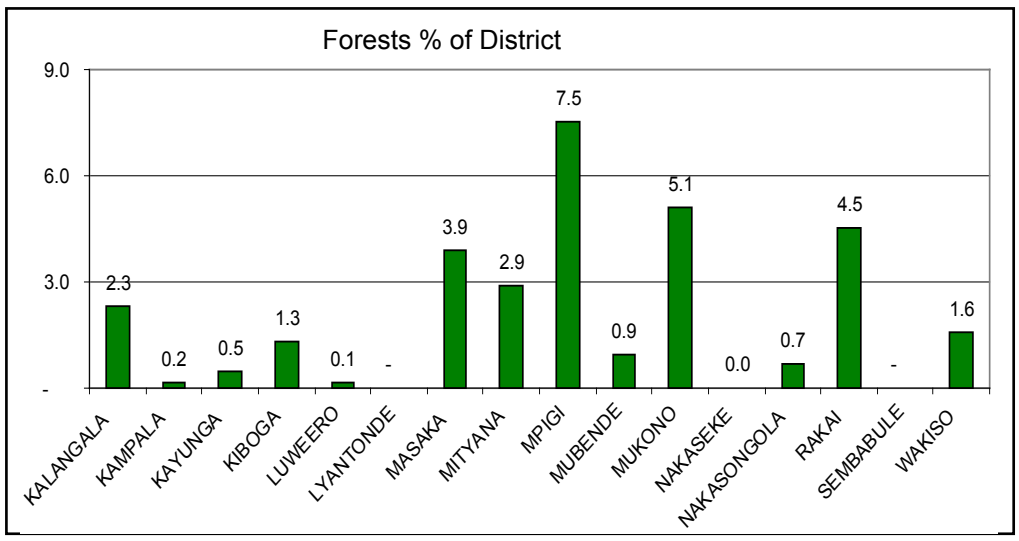
Total Forest Reserves



Forests by District (Tropical High Forests and Plantations)

From the central region, the districts of Nakaseke, Luwero, Lyantonde, Kampala and Sembabule have percentages below 0.5 percent of forest cover to the district land Nakaseke is the most affected with almost no parts of the district covered with forests. Mpigi had the largest coverage of about 7.5 percent of the district covered with forests.

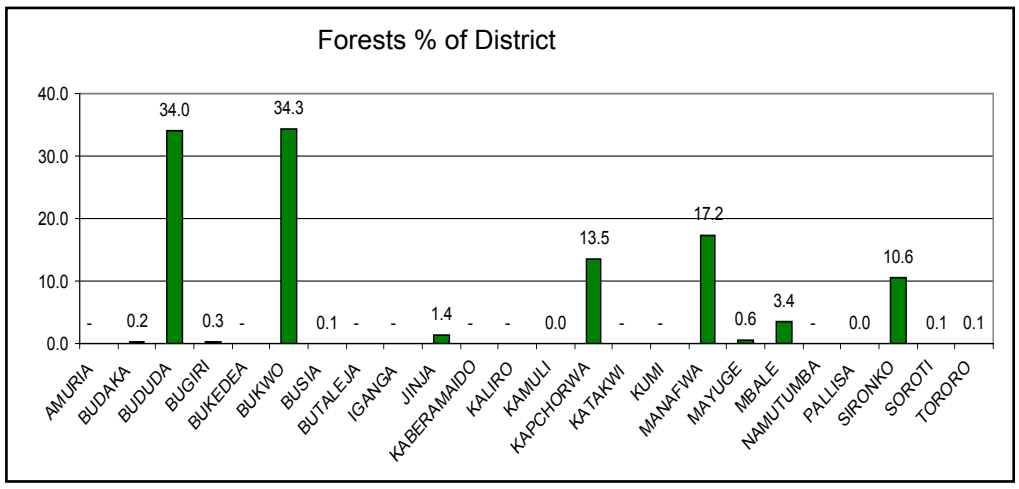
Forest cover for the districts in the Central region



Source: NFA 2008

From the eastern region, except for Bududa, Bukwo, Jinja, Kapchorwa, Manafwa Mayuge, Mbale, and Sironko the rest of the districts had forest coverage below 0.5 percent of the district land.
Bududa and Bukwo had the highest coverage with 34.0 and 34.3 percent of their respective district land covered with forests.

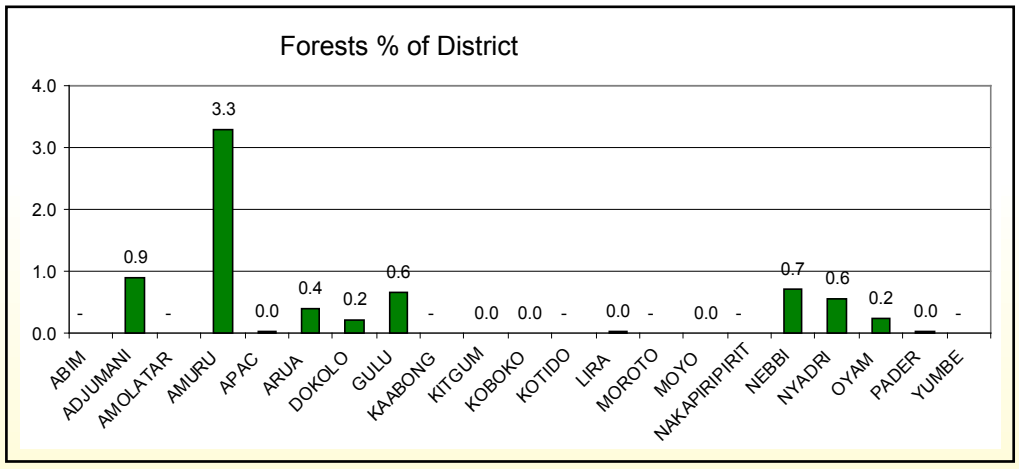
Forest cover for the districts in the Eastern region



Source: NFA 2008

In the northern region, only Adjumani, Amuru, Gulu, Nebbi and Nyadri had the districts forest coverage above 0.5 percent. Although Amuru had the largest coverage of forest it was only 3.3 percent.

Forest cover for the districts in the Northern region

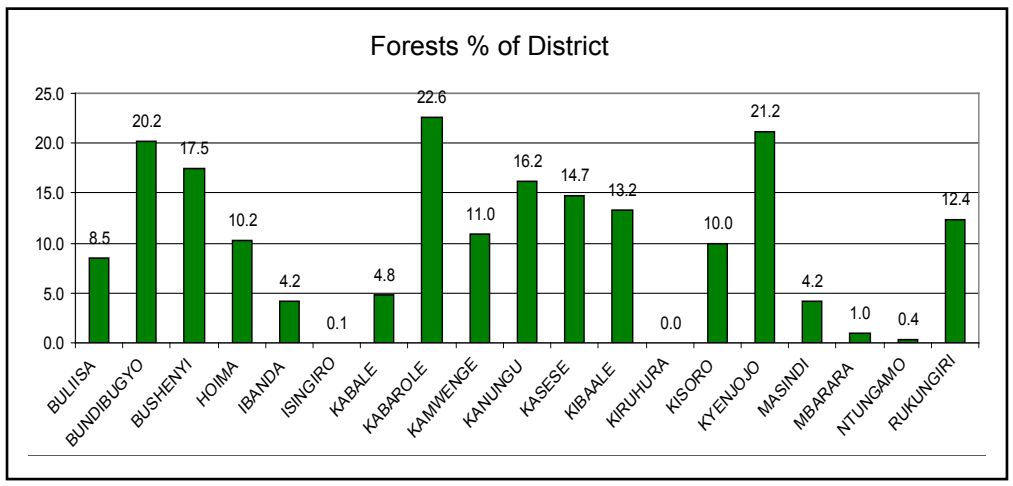


Source: NFA 2008

From western region, only Isingiro, Kiruhura

and Ntungamo had the percentage of forests of their districts less than 0.5.
Kabarole and Kyenjojo had the largest percentage of their districts covered with forests at 22 and 21 percent respectively.

Forest cover for the districts in the Western region



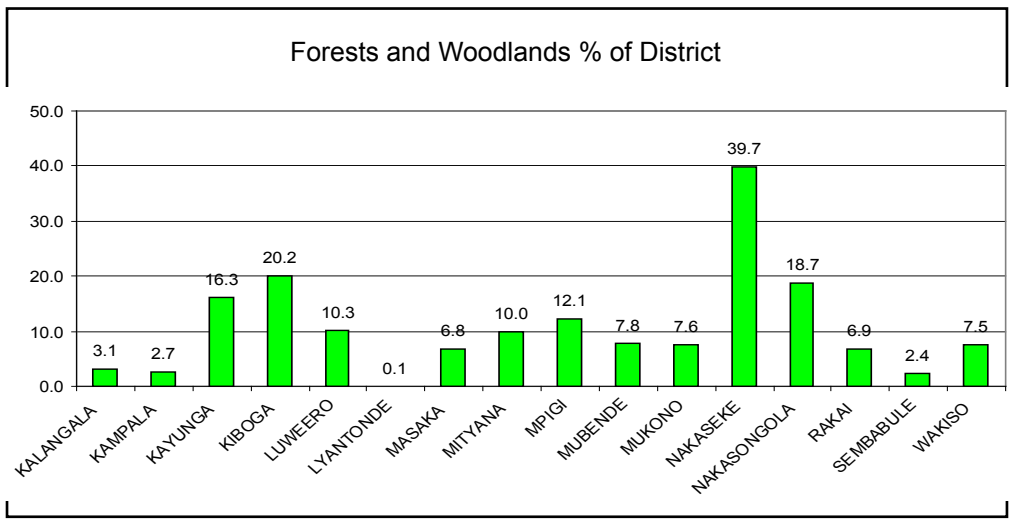
Source: NFA 2008

Woodland and forest area as Percentage of Total district area

Nakaseke had the highest percentage (39.7 percent) of combined forest and woodland cover as a percentage of District land cover while Lyantonde had the lowest of 0.1 percent in the Central region.

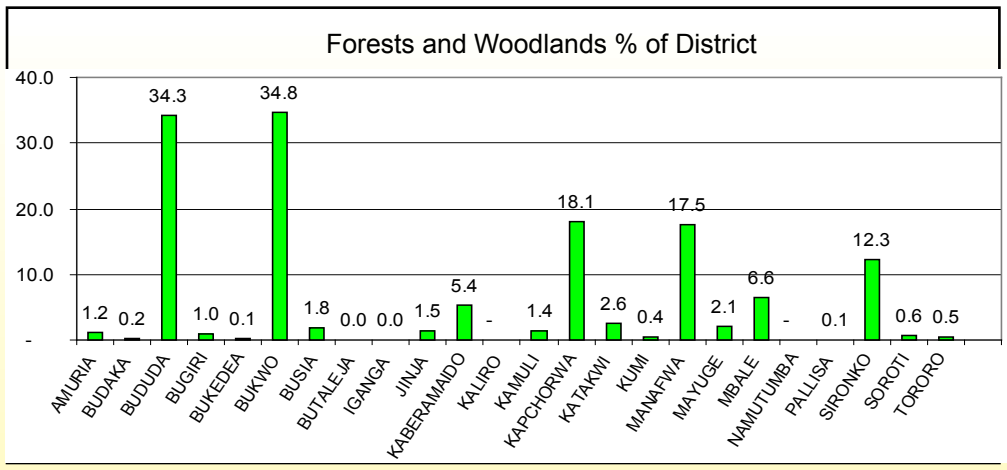
Bukwo had the highest percentage of combined forest woodlands for eastern region.

Woodland and forest cover as a % of the total area in a district for the Central region



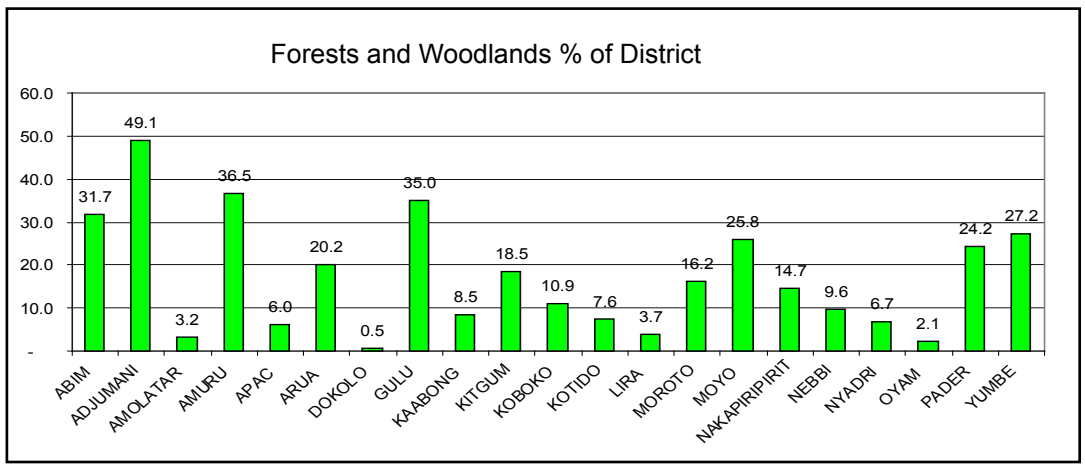
Source: NFA 2008

Woodland and forest cover as a % of the total area in a district for the Eastern region



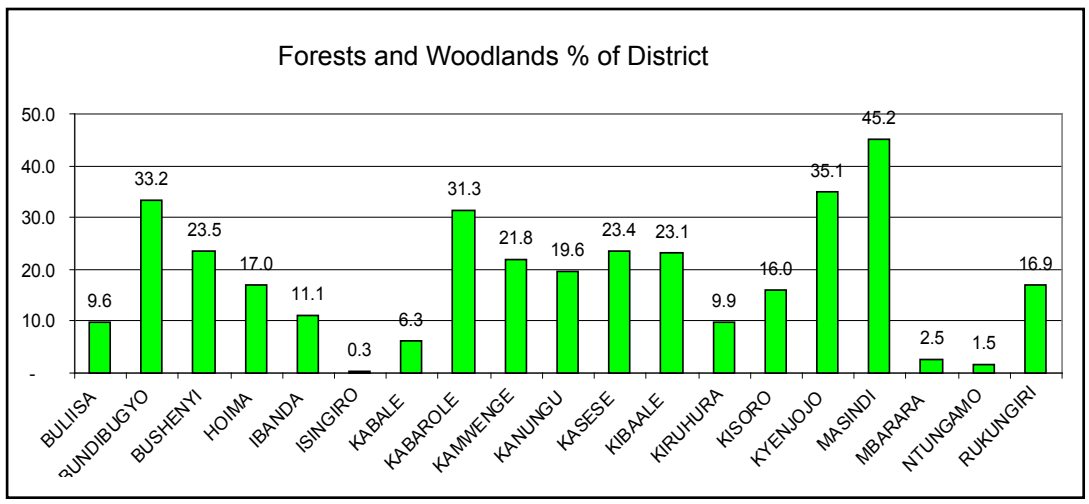
Source: NFA 2008

Woodland and forest cover as a % of the total area in a district for the Northern region



Source: NFA 2008

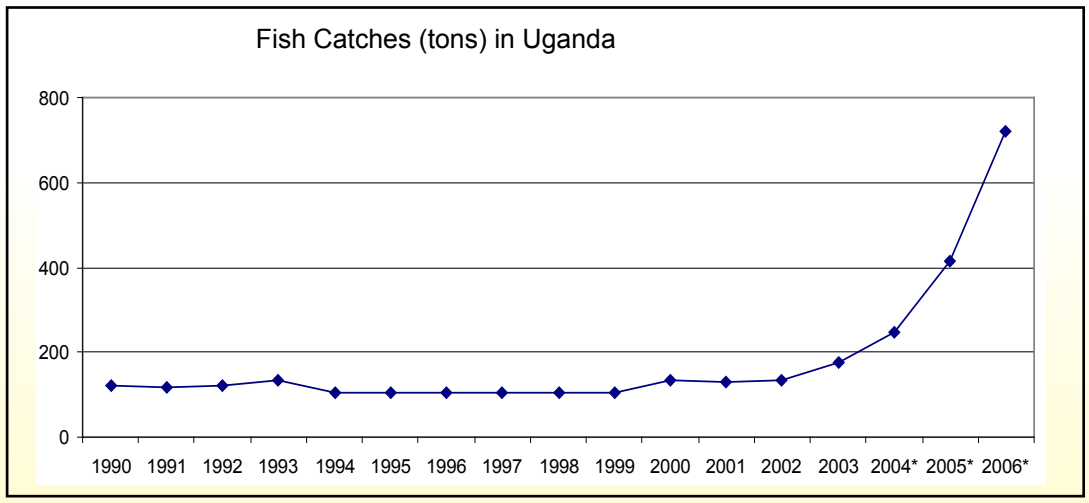
Woodland and forest cover as a % of the total area in a district for the Western region



Source: NFA 2008

Fisheries

There is a general steady increase in fish catch in Uganda. The estimated fish catch increased from 249.0 tons in 2004 to 721.0 tons in 2006. Most of the catch is however processed for export, leaving very little fish on the local market. Fish prices have sky-rocketed, yet fish previously provided for a cheap and easily accessible source of animal protein for the poor.

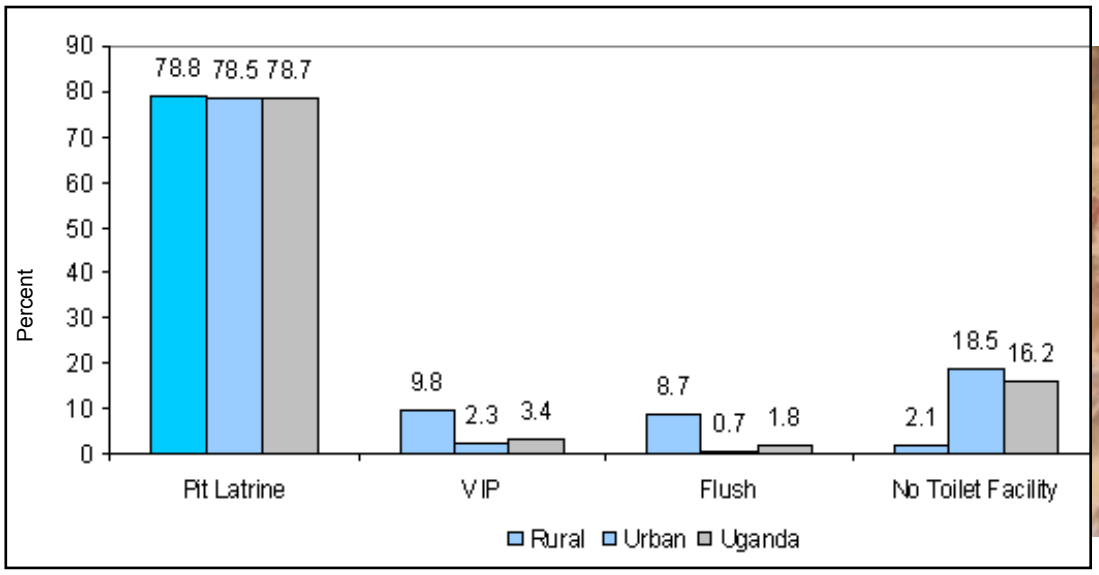


Source: Fisheries Department 2008

Latrine Coverage

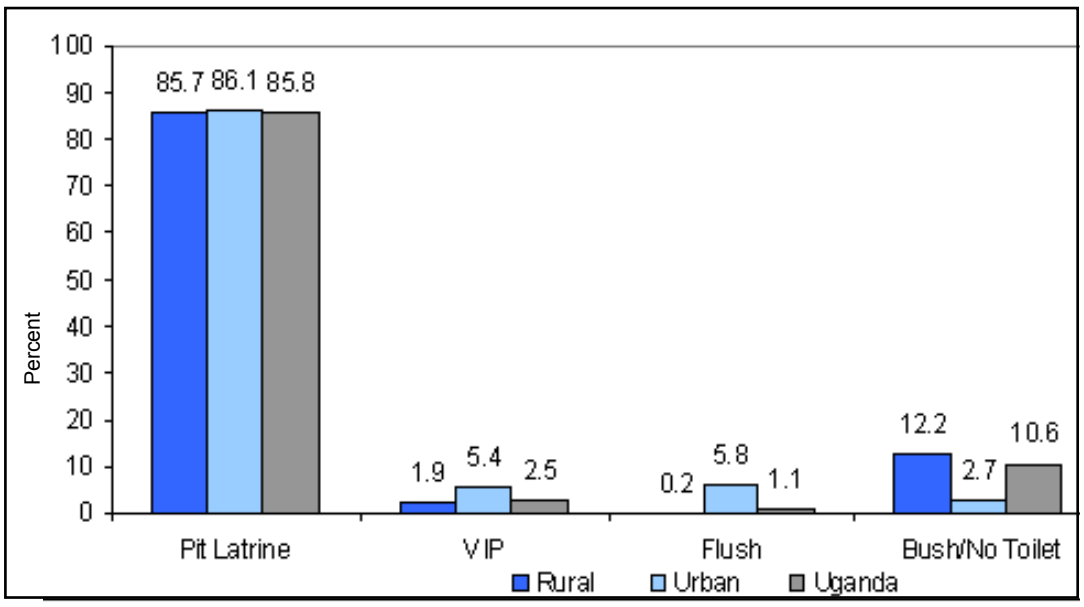
The use of proper toilet facilities is important in ensuring hygiene and preventing hygiene related diseases. In 2005,10.6 percent of the households did not have toilet facilities and used bushes. About 86 percent of households used a pit latrine and only 3 percent used a Ventilated Pit-Latrine (VIP).The proportion of households without any toilet facilities is higher in rural areas than urban areas. The overall proportion of people without toilet facilities however, decreased from 16.2 percent (2002 Uganda Population and Housing Census, Analytical Report) in 2002 to 10.6 percent in 2005/6 (UNHS 2005/6) The northern and eastern parts of the country had the largest proportions of households without toilet facilities with proportions of 21 and 16 percent respectively.

Distribution of Household with Toilet Facility by Residence (2002)



Source: UBOS, UNHS 2005/6

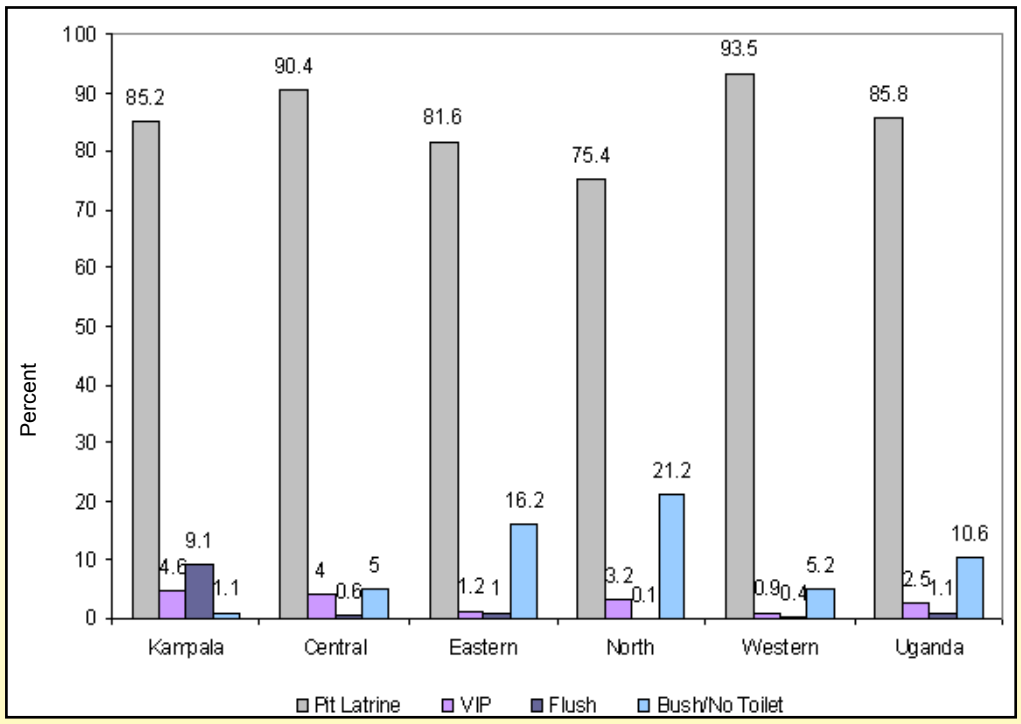
Distribution of Household with Toilet Facility by Residence (2005)



Source: UBOS, UNHS 2005/6

A VIP latrine

Distribution households by Type of Toilet Facility by Region



Source: UBOS, UNHS 2005/6

Latrine in a surbub wetland

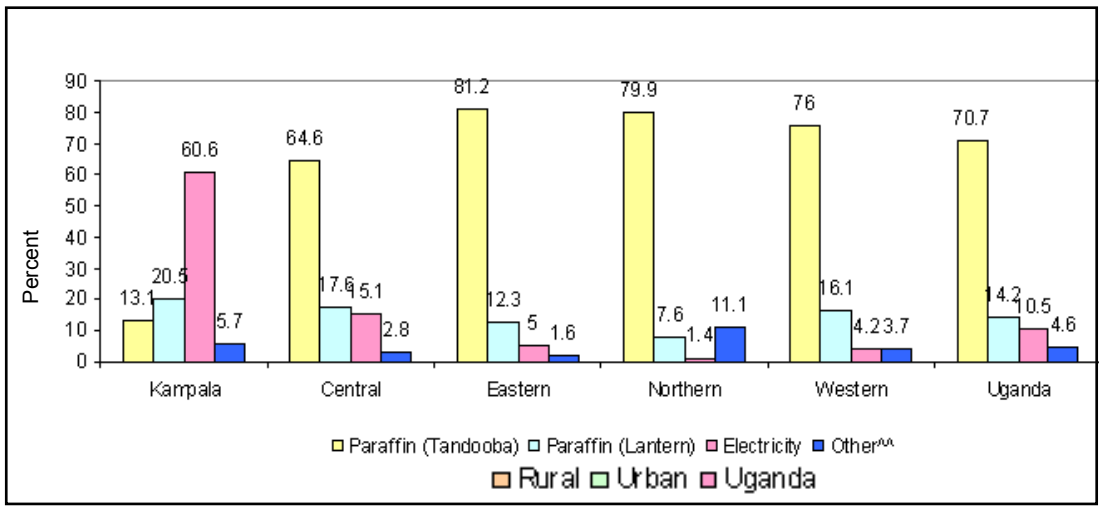
NEMA 2008

Access to Energy

A *tadooba*

The energy and technology types used for cooking and lighting have an impact on the health and safety of households. In 2005/6, 11 percent of households used electricity as the main source of lighting. 71 percent of households used *tadooba* (kerosene candle - see picture on left). The large proportion of people using *tadooba* indicates the size of the problem of indoor smoke pollution in Uganda. 14 percent used kerosene lanterns.

Distribution of Households by Lighting Fuel and Residence, (%)

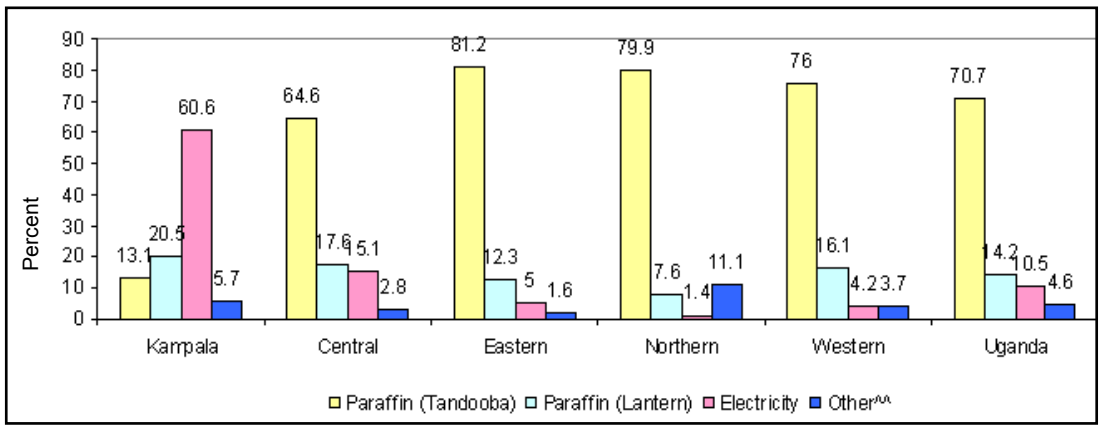


Source: UBOS, UNHS 2005/6

NEMA 2008

Construction of Nyagak Hydro electric power plant

Distribution of Households by Lighting Energy and Region, (%)

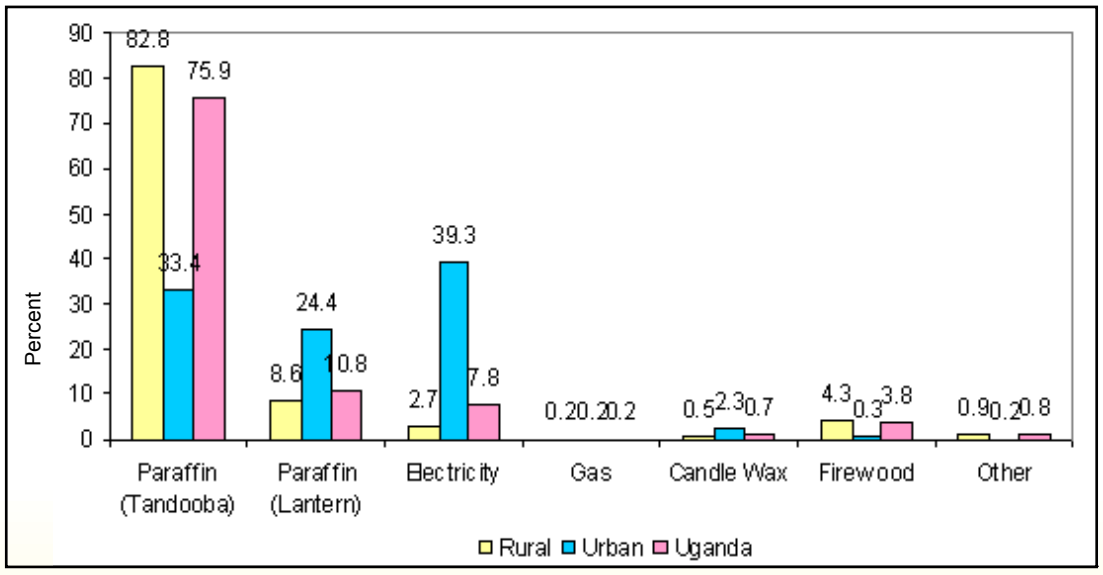


Source: UBOS, UNHS 2005/6

JEEP 2008

Solar energy: phone, battery and lantern charging at Wobutungulu by Joint Energy and Environment Projects (JEEP)

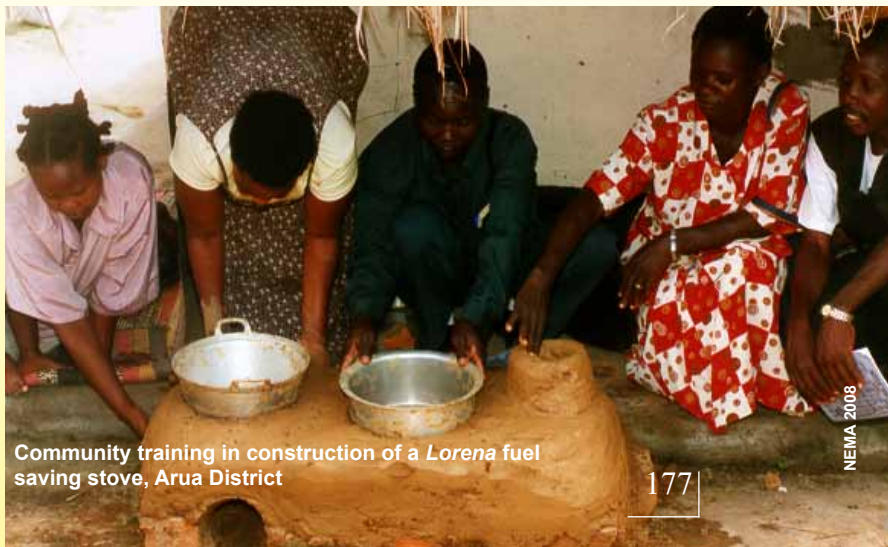
Distribution of Households by Lighting Energy and Source, (%)



Source: UBOS, UNHS 2005/6

NEMA 2008

Ferrying firewood for domestic use



NEMA 2008

Community training in construction of a *Lorena* fuel saving stove, Arua District

Energy for cooking in 2005-2006

Overall, 96 percent of the households in Uganda depend on wood fuel for cooking purposes. This is a challenge to achieving the MDG targets and promotion of environment sustainability. Less than 1 percent use electricity as the main source of energy for cooking.

Odipio Edward A. 2008

Roadside charcoal business along Arua-Pakwach highway, Arua District

A cook charcoal stove (*sigiri*), commonly used in urban households

NEMA 2008

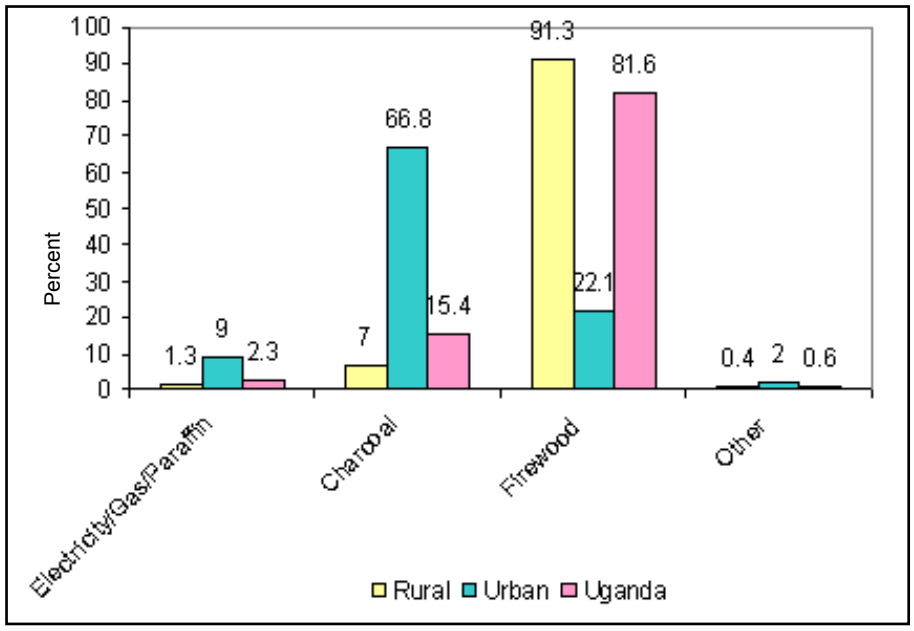
Pupils display charcoal briquettes during exhibitions to mark World Environment Day 2008 celebrations held at Bombo Commom Primary School, Luwero District. The celebrations were organised by ACEPA, a local NGO in Luwero District.

Biomass use

Region	Biomass %	Modern %
Uganda	93	7
Kenya	70	30
Rwanda	90	10
Tanzania	90	10

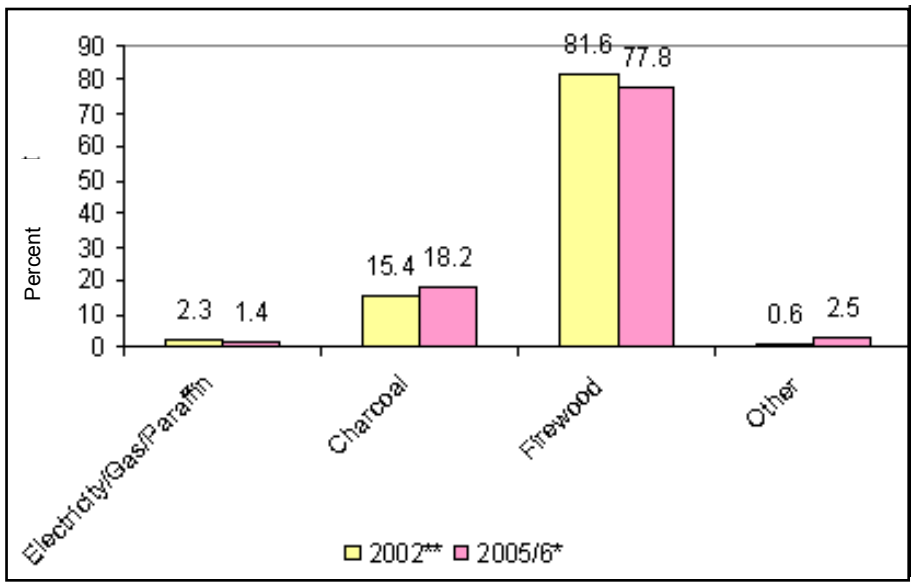
Source: NEMA (2007). Pilot Integrated Ecosystem Assessment. National Environment Management Authority and UNEP, Kampala, Uganda

Energy for cooking in Uganda



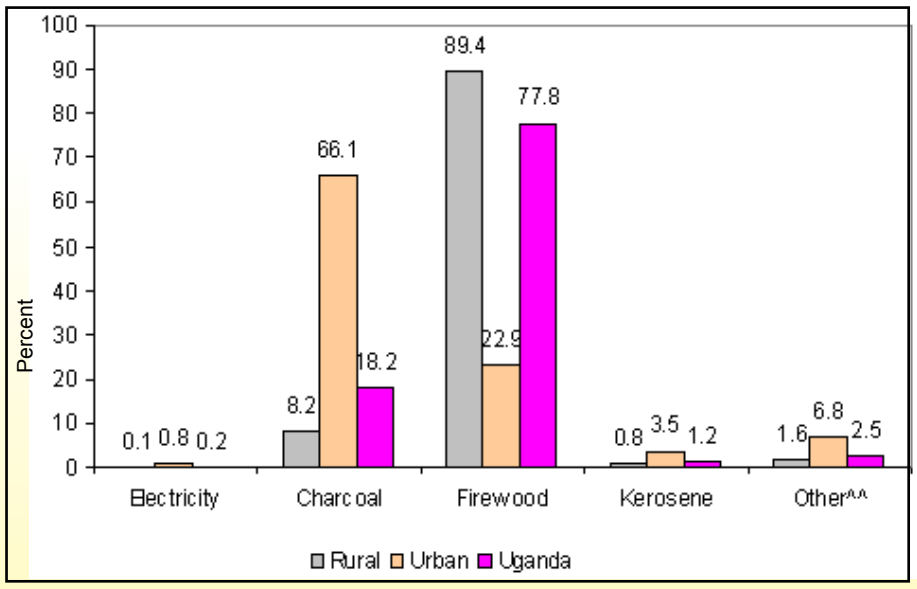
Source: UBOS, UNHS 2005/6

Energy for cooking 2002-2005



Source: UBOS, UNHS 2005/6

Energy for cooking 2005-2006



Source: UBOS, UNHS 2005/6

Per capita arable land by region

Central region

Lyantonde has the largest Per capita arable land of about 4.6 acres while Kampala, Wakiso, and Mukono are among the districts with the lowest per capita potential arable land.

Eastern region

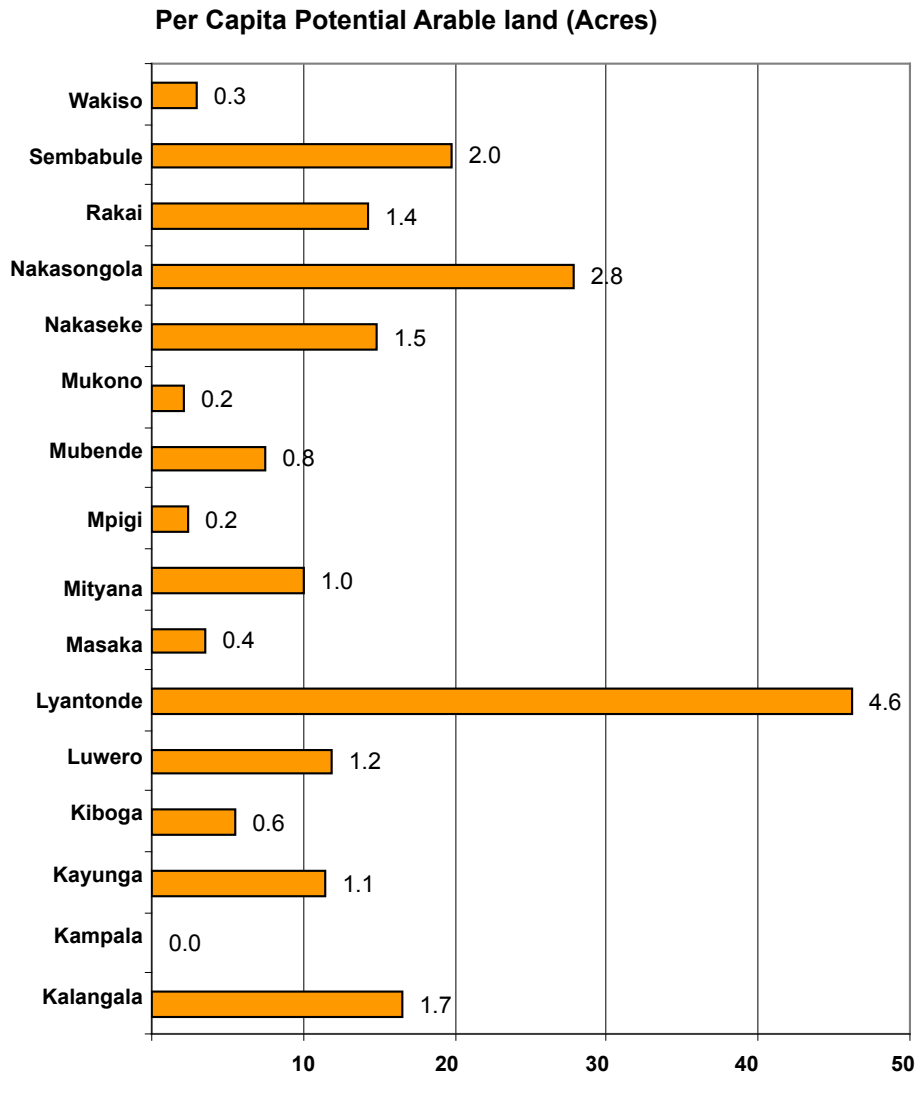
Kaberamaido, Katakwi and Amuria have the largest per capita arable land of about 1.0, 0.9 and 0.8 acres respectively while Bukwo, Kapchorwa, Jinja and Mbale were among the districts with lowest per capita of below 0.3 acres.

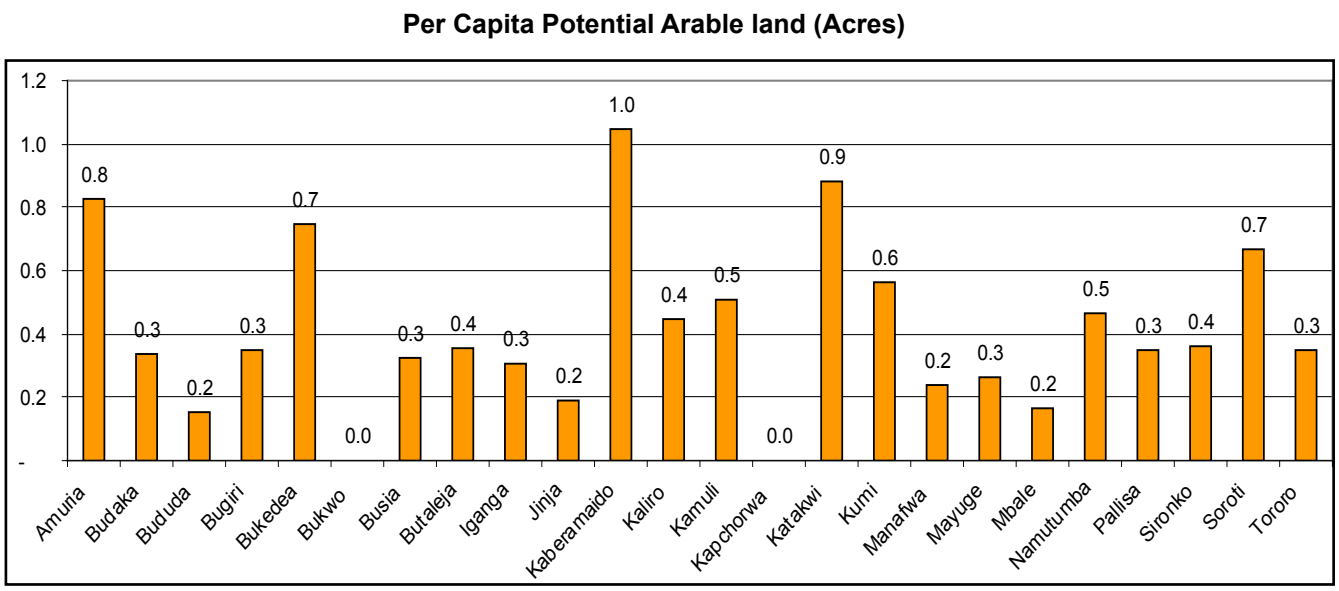
Western region

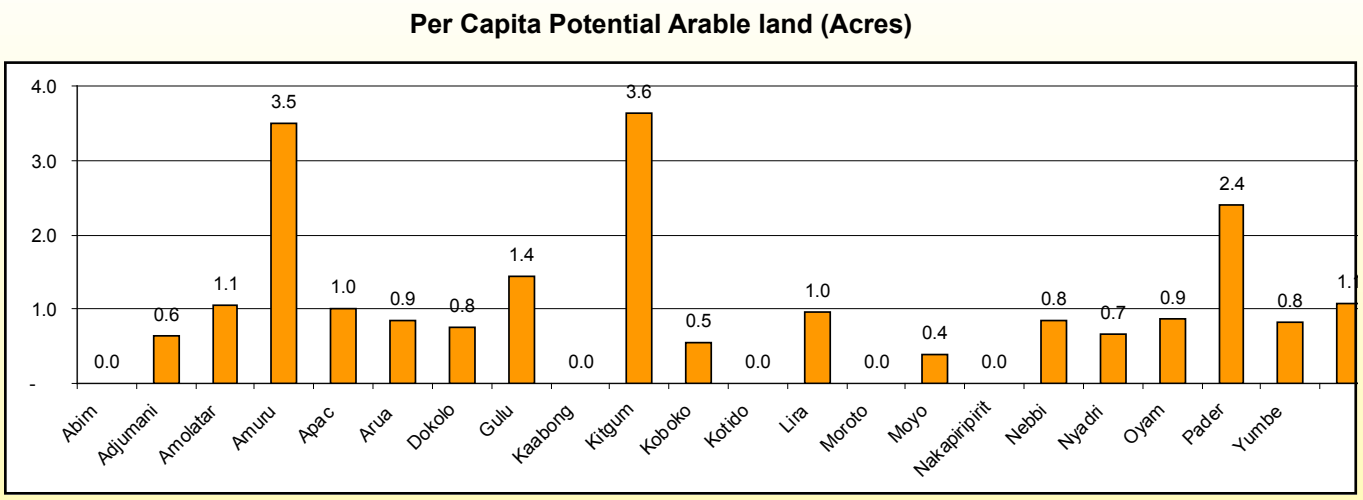
Kiruhura has the largest per capita arable land of about 2.2; Hoima, Bulisa, Kibaale and Kyenjojo had per capita Arable land of about 0.3, 0.4 and 0.4 acres respectively.

Northern region

Kitgum, Amuru and Pader have the largest per capits arable land of about 3.6, 3.5 and 2.4 acres; Abim, Kaabong, Kotido, Moroto and Nakapiripirit had almost no per capita arable land of all.

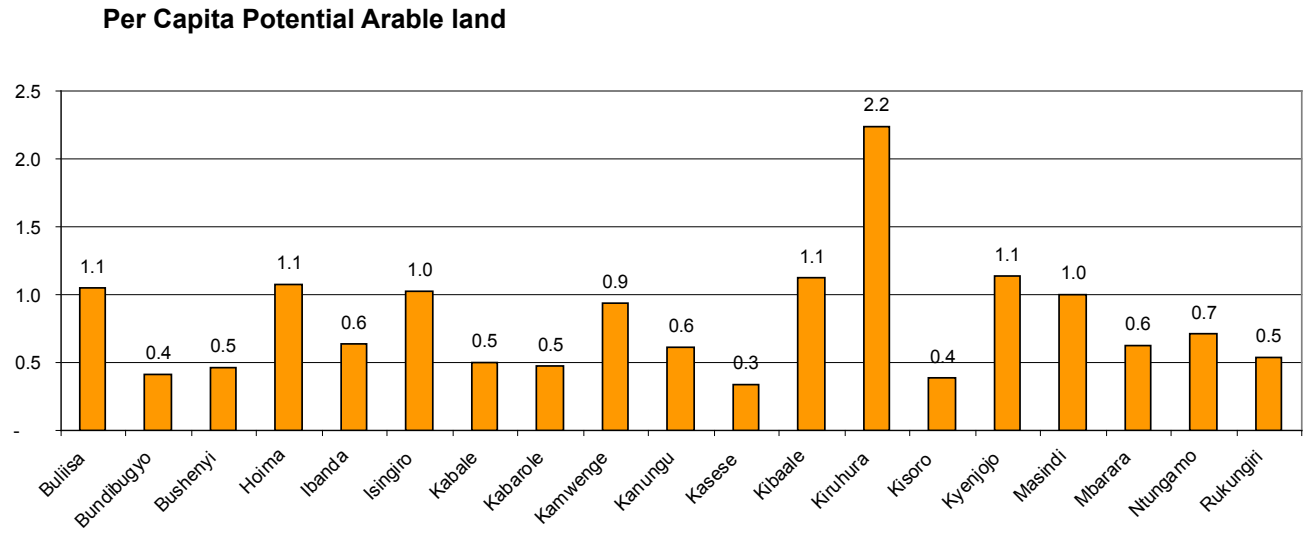


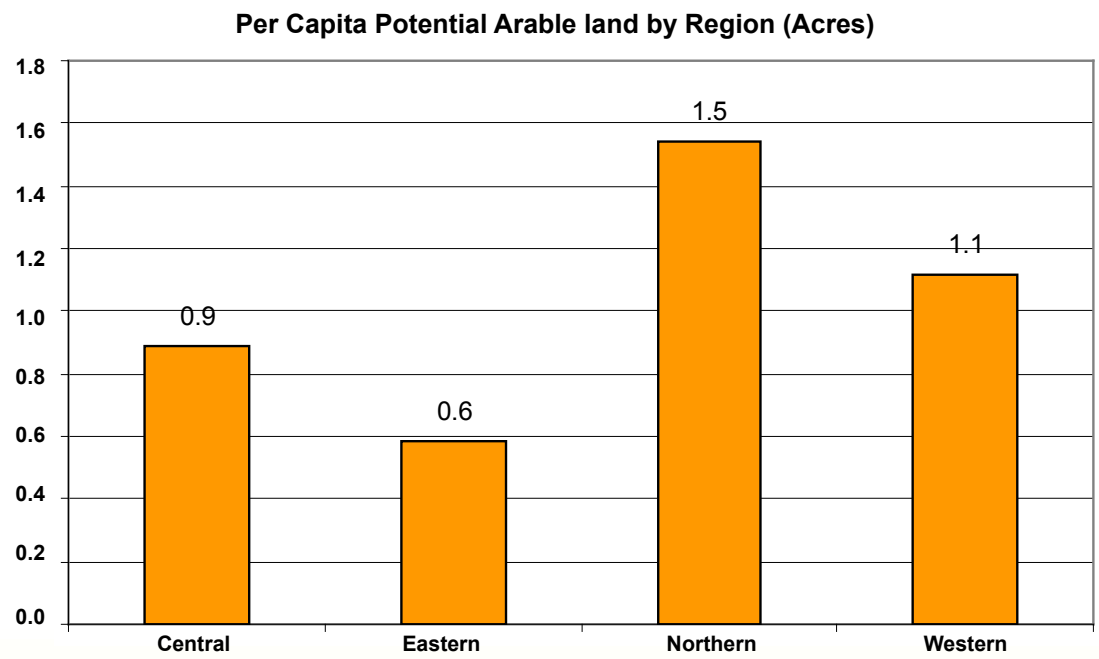




Arable land

Almost all Uganda's land is arable; excluding wetlands, impediments, protected areas, and open water sources. The northern region has the largest per capita potential arable land of 1.5 acres while the East has the smallest per capita arable land of about 0.6 acres.
Potential per capita arable land is likely to reduce with time if the population keeps increasing.





Chapter 5

Key findings and recommendations

Key findings

1. Mabira and Budongo forest reserves have shown recovery over the last 30 years. This is due to increased enforcement by the responsible institutions.
2. The melting of ice on the Rwenzori Mountains due to global warming has caused increased water flow in the Semliki eroding its banks and silting the Lake Albert.
3. The loss of woody biomass in Nakaseke and Nakasongola is alarming and undermines Uganda's development path.
4. The consumption of forest and woody biomass resources in both natural and planted forest is unsustainable.
5. Although there is increase in agricultural areas in the Karamoja region the problem of food insecurity will persist because of lack of water.
6. Siltation from the river Kagera is a threat to Lake Victoria and needs immediate action.
7. Building in water ways of Nsooba - Lubigi and Nakivubo channels in Kampala City is the main cause of flooding in the low lying areas. The situation is bound to become worse as the weather patterns are changing due to climate change and variability.
8. Expansion of Kampala City and reduction in green belts has increased the hard surface (built-up area) leading to increased runoff and silting Lake Victoria through Nakivubo channel.
9. Degradation of wetlands especially in the mountainous areas of Kabale and Kisoro will have far reaching impacts on the food security of these areas. These wetlands have a positive influence on the local weather even during droughts and should be restored if prosperity is to be achieved.
10. The flooding of the Teso region in 2007 occurred in areas mapped as seasonal wetlands which have been degraded due to overgrazing. Settlements should not be allowed in these zones.
11. Encroachment of the Mount Elgon National park especially by the Benet is part of the problem causing increased run-off, resulting in water logging and flooding in the low-lying areas of Ngenge and Lake Bisina.
12. Although bush burning is illegal, most parts of the country are in flames during the months of January and February. The areas most affected are Kooki hills in Rakai, the Ngenge plains in the east, the areas surrounding Budongo forest and Pader District in the North.
13. Civil strife and unrest resulting in IDPs increases the vulnerability of Uganda as a country and diminishes the chances of achieving MDGs targets.
14. In 2002, the percentage of households that used electricity was 80%, tadooba 76% and lantern 11%. Households using electricity in urban areas was 41% and only 4% in rural areas.
    Kampala had 61% of households using electricity, central 15%, north only 1%.

Recommendations

1. Efforts to reduce siltation of lakes Albert and Victoria should be stepped up. These lakes are likely to die if the situation is left to continue.
2. The Tree planting Act should be enforced if the country is to be maintained as one of the green belts of Africa.
3. Protection of Mount Elgon National Park should be a key priority for government. This park is not only protected for animals but also as a water catchment area. Degradation of this area will have far reaching impacts to both the communities in the Mt. Elgon area and the Teso plains.
4. Development in Kampala City should be carefully planned otherwise the risk of disasters will continue to rise.
5. Building in waterways and channels should stop.
6. Wetlands should be jealously protected as important ecosystems if we are to sustain the country's water regime and improve on people lives.
7. Bush burning has to stop. It is recommended that if one is to burn it should only be done once in five years.

Restored riverbank in Moyo District (2008)

NEMA 2006

Kika Group, a local dance troupe performs an Ozone layer creative dance during National World Ozone Day celebrations held in Mukono on 16 September 2006

Conservation and Wildlife

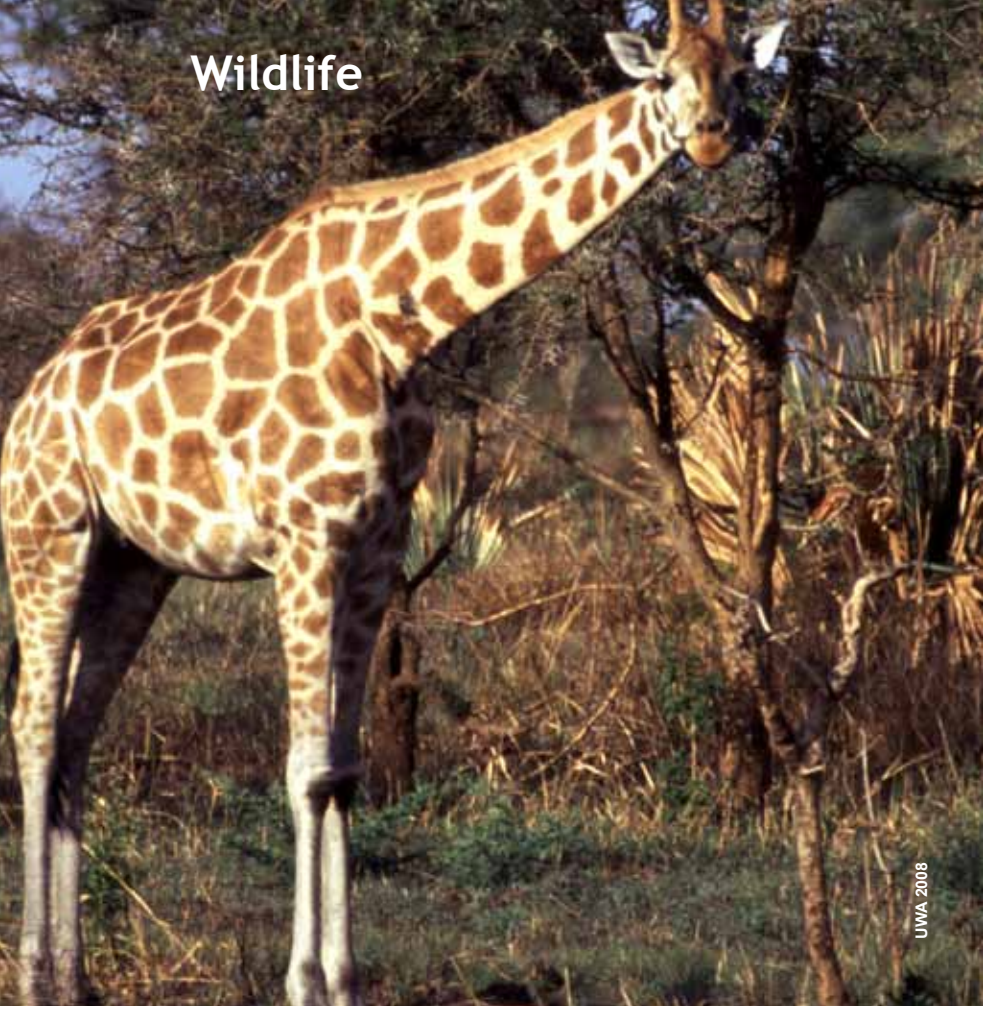
Species	1960s	1982-1983	1995-1996	1999-2003	2004 - 2006	Status in Uganda
Uganda kob	70,000	40,000	30,000	44,000	34,461	Population decreasing
Buffalo	60,000	25,000	18,000	17,800	30,308	Population increasing
Elephant	30,000	2,000	1,900	2,400	4,322	Population low, but slowly increasing
Hippopotamus	26,000	13,000	4,500	5,300	7,542	Population increasing slowly
Hartebeest	25,000	18,000	2,600	3,400	4,439	Population increasing slowly
Topi	15,000	6,000	600	450	1,669	Population increasing
Impala	12,000	19,000	6,000	3,000	4,705	Population low, but beginning to increase
Waterbuck	10,000	8,000	3,500	6,000	6,493	Population increasing
Burchell's zebra	10,000	5,500	3,200	2,800	6,062	Population increasing
Eland	4,500	1,500	500	450	309	Population low, may still be decreasing
Rothschild's giraffe	2,500	350	250	240	259	Population stable
Bright's gazelle	1,800	1,400	100	50	0	Very rare, precarious
Roan antelope	700	300	15	7	0	Very rare, precarious
Oryx	2,000	200	0	0	0	Extinct in Uganda
Black rhino	400	150	0	0	0	Extinct in Uganda.
White rhino	300	20	0	0	8	2 at UWEC and 4 in the sanctuary (Ziwa Rhino ranch)
Derby's eland	300	0	0	0	0	Extinct in Uganda

Wildlife Population trends in Uganda

Chimp at the Chimpanzee Sanctuary & Wildlife Conservation Trust (CSWCT), Ngamba Island, Mukono District.

Time to relax: the Hippopotamus in Murchison Falls National park

Wildlife



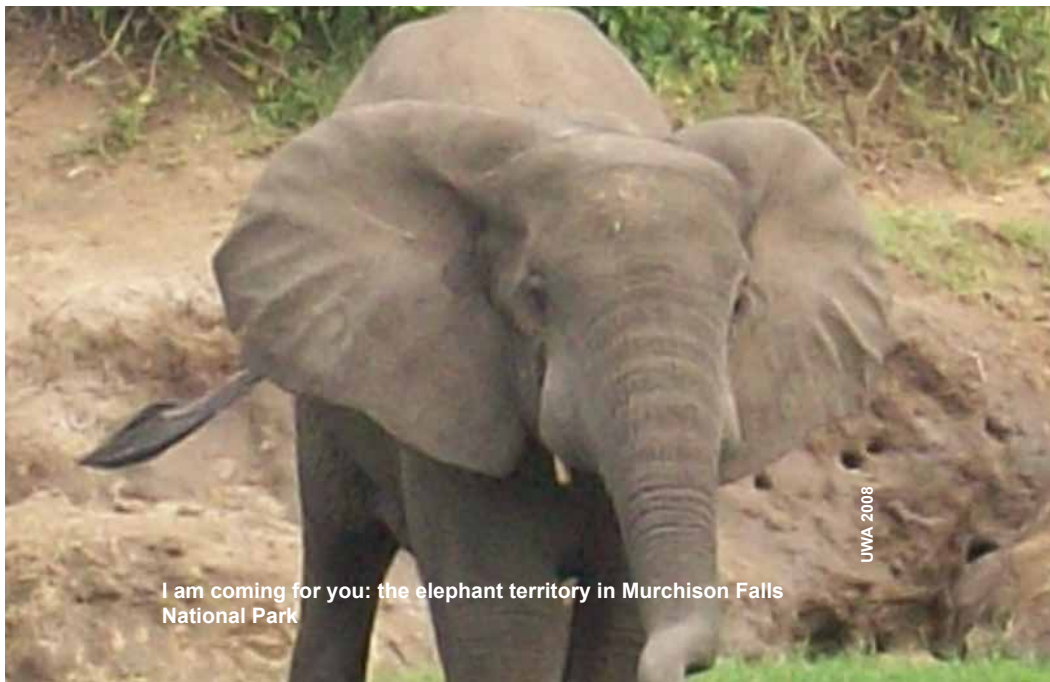
Where is my food- The Giraffe in Murchison falls national park looking for food after a wild fire.

A lioness in Kidepo National park receives attention

Spectacular male hot spring in Semuliki National Park

Sempaya female hot springs in Semliki National Park

The Zebra: the beauty of lake Mburo National Park



I am coming for you: the elephant territory in Murchison Falls National Park

Kitagata Hotsprings in Bushenyi District

Napak Rocks in Karamoja

Teso Rocks

Indegenous tree in northern Uganda

Children have fun with their cattle near Lwampanga landing site in Nakasongola District

Ankole cattle rangelands

Below Left to Right: Agriculture in Kiruhura District: cattle, goats and invasive species (*lantana camara* respectively)

Biodiversity

Ecotourism: Heart-shaped lake in Kabarole District

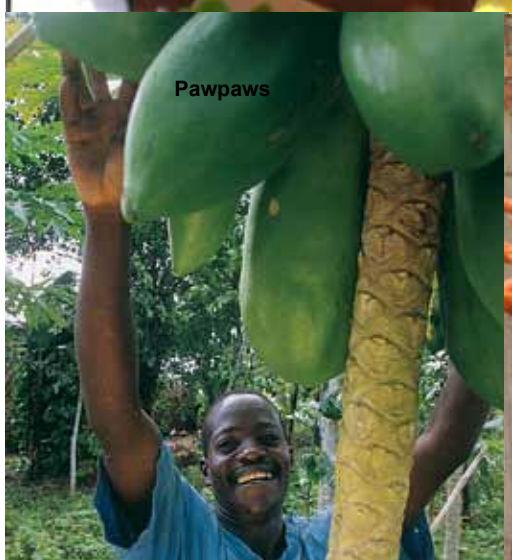
Katwe salt lake lake in Kasese District

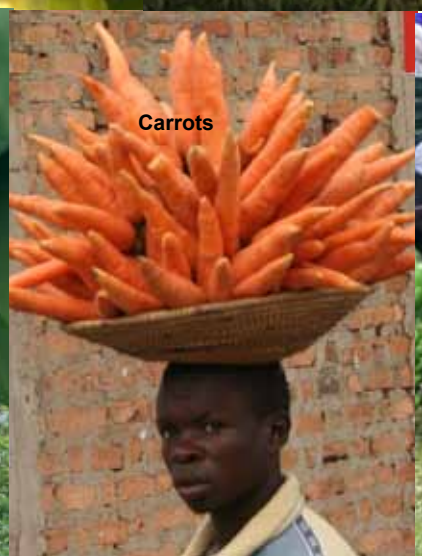
A Marabou stock (*karoli*) mother feeds its chicks outside NEMA House (2008)

Left to Right: Dried trees at Kumi and Kasese District Headquarters respectively; Thorny tree with rare bird nests in Queen Elizabeth National Park.

The cheeky monkeys in Queen Elizabeth National Park

Below: some of the Uganda fruits and vegetables





Hon. Maria Mutagamba, Minister of Water and Environment, plants a tree in Kasese (2007)

NEMA 2007

Hon. Jesca Eriyo, Minister of State for Environment, plants a tree in Arua (2008)

NEMA 2008

National World Environment Day Celebrations

NEMA staff during the match-past, Arua (2008)

NEMA 2008

UWEC display Chimpanzee sanctuary, Ngamba island (2008)

NEMA 2008

Hon. Jennifer Namuyangu, Minister of State for Water, plants a tree in Arua (2008)

NEMA 2008

Areas of interest

Houses of Parliament, Kampala

The Independence monument, Kampala

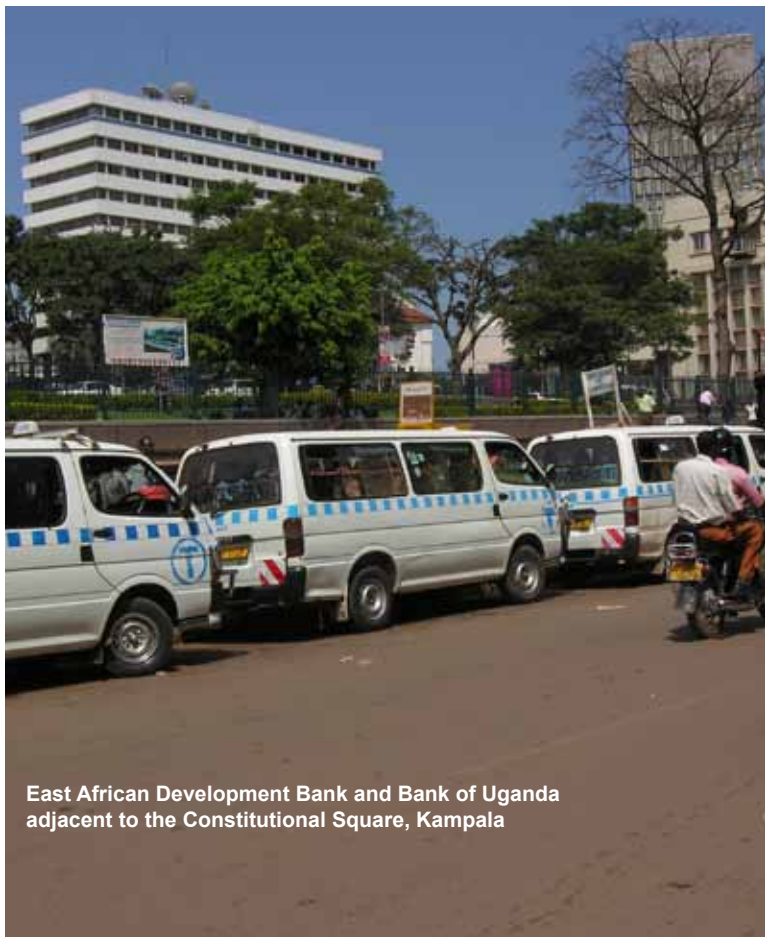
The CHOGM monument, Kampala

Mulago National Referral Hospital, Kampala

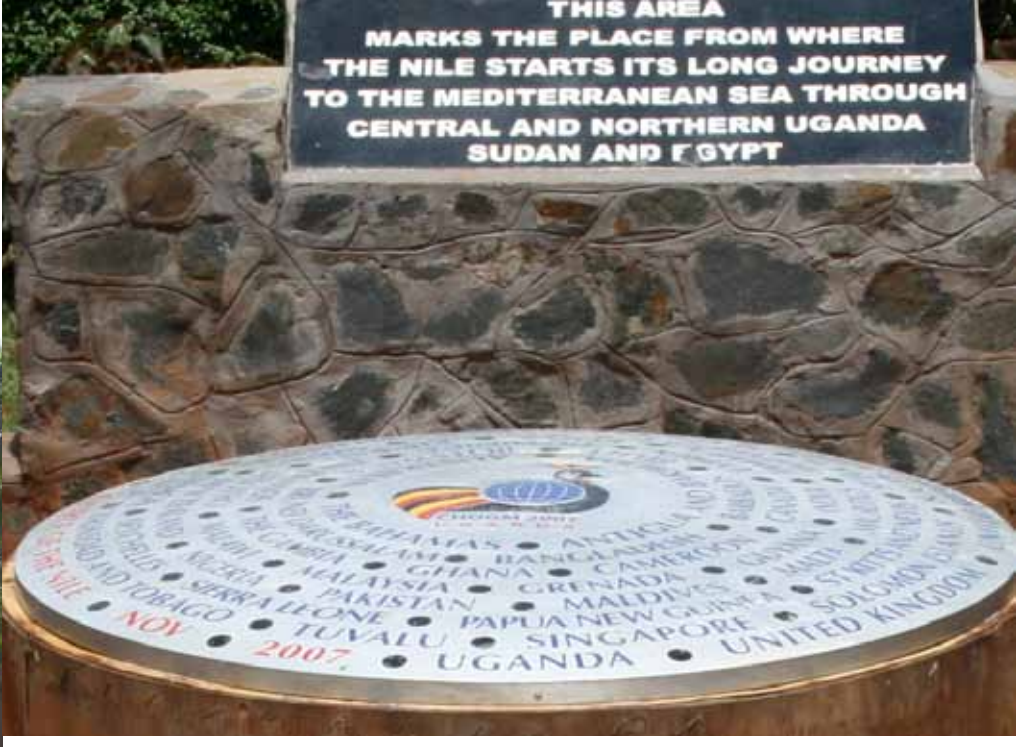
Makerere University Main Building, Kampala

Communications House, Kampala

Workers House, Kampala



East African Development Bank and Bank of Uganda adjacent to the Constitutional Square, Kampala



Monuments marking the source of the River Nile, Jinja

The spot where John H. Speke discovered the source of River Nile at Jinja in 1862

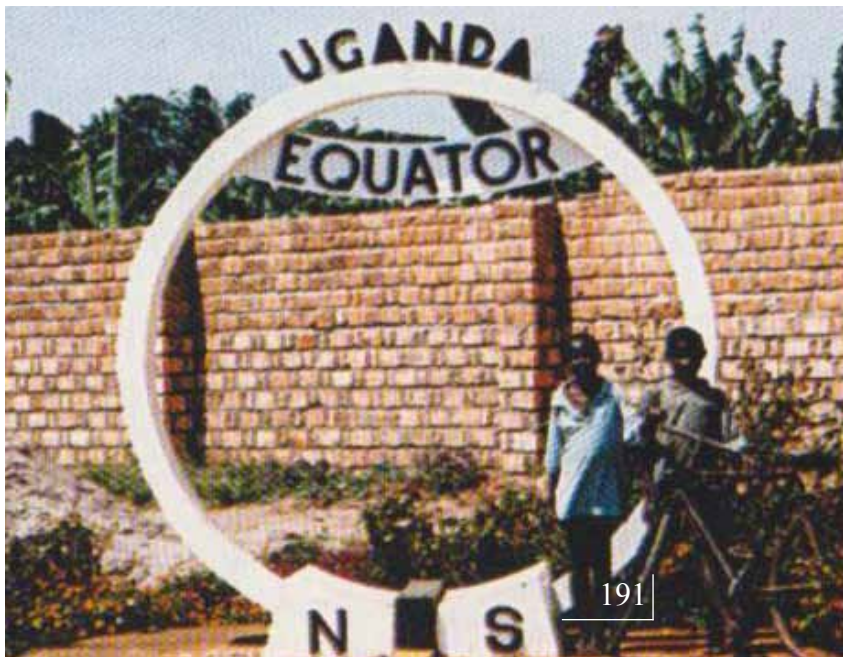
Mandela National Stadium at Nambole, Wakiso District

Main Post Office in Kampala City Centre

Statue of a cow, a symbol for Mbarara District, at the entrance to Mbarara Municipality, Western Uganda

The Uganda Museum, Kampala

Kampala Northern by-pass under construction



Nature

A modern country homestead near Mbarara town, surrounded by banana (*matooke*) gardens, pasture and hills

Ndeija hills in Ntungamo District

Murchison Falls

Below: Flocking birds

Sezibwa Falls

Below: Kalagala Falls

Impacts on our environment

Kalerwe market in a Kampala surbub

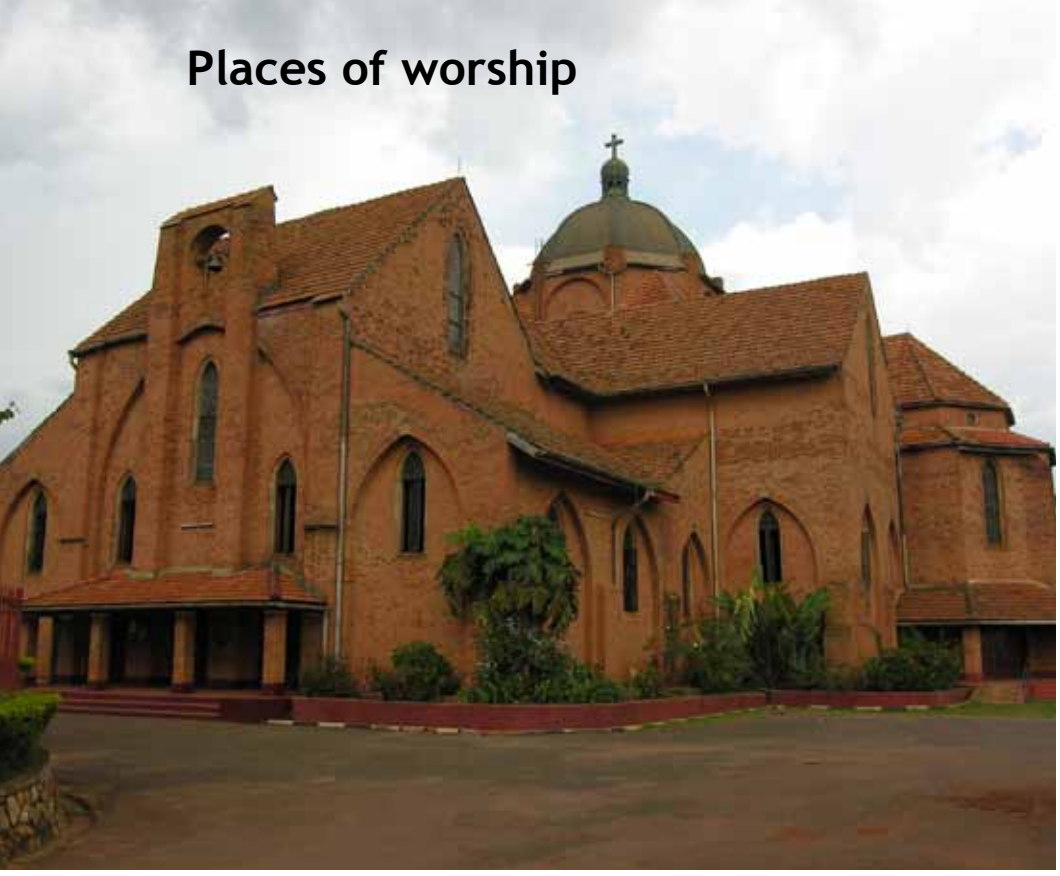
Burning unsorted soild waste at Nakawa market in Kampala

Residents of Kashaka, Kashari, Mbarara District inspecting their gardens after a 1 hr hail storm hit their area on the afternoon of 24th February 2007. A lot of crops were distroyed

Burning unsorted soild waste in rural Aruaa town

Above: Down town Kampala on the Burton Street-Luwum Street junction
Below: Nakulabye slum area

Places of worship



Namirembe Cathedral (Anglican)

Namugongo Martyrs Basillica (Catholic)

Rubaga Cathedral (Catholic)

Kibuli Mosque

Najanankumbi Seventh Day Adventist (SDA)

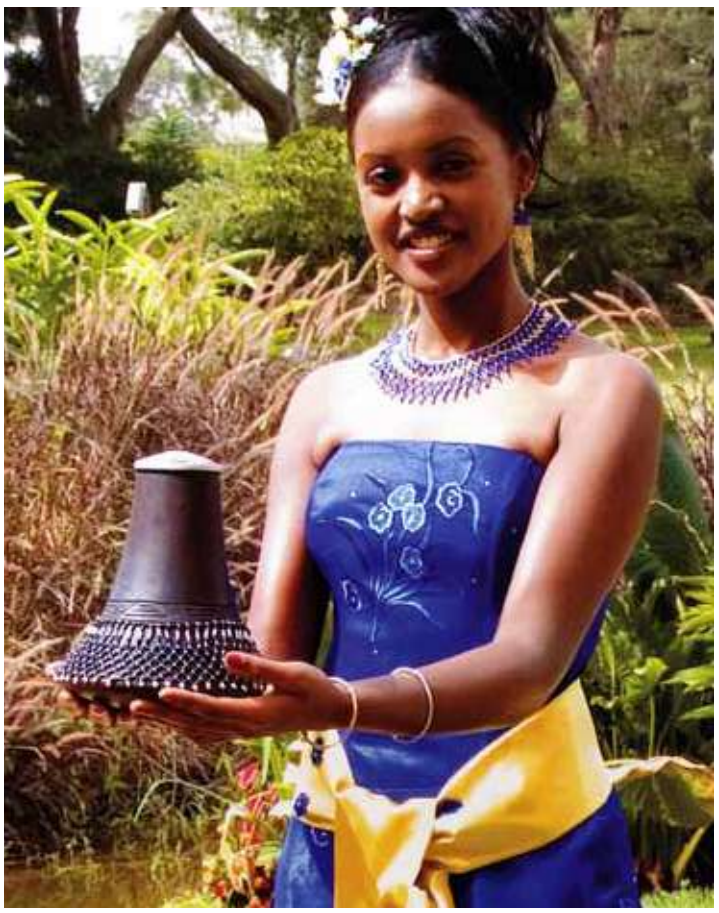
Namungoona (Orthodox)

Cultural aspects

Kasubi tombs, burial grounds of Buganda kings, Buganda kingdom

Mparo tombs in Bunyoro kingdom

Bulange, House of Buganda kingdom at Mengo, Kampala



Princess Komuntale of Tooro kingdom

A Batwa household, Kisoro District

Mbale Cultural site, Mbale District

Traditional aspects

Gisu *Imbalu* (circumcision) traditional dance

Traditional dance from northern Uganda

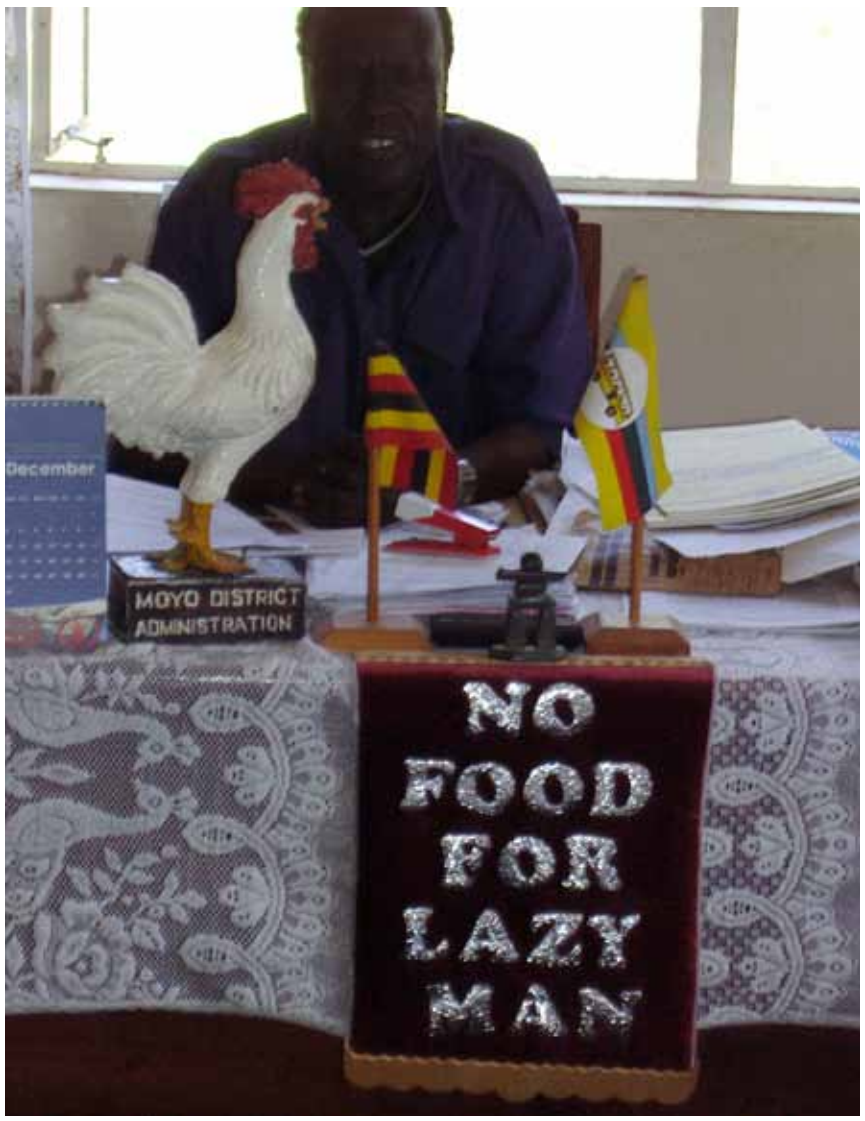
Baganda *Bakisimba* traditional dance

Elderly men from Namunyumya blowing traditional *Ngwaala* horns

Karamojong girls in their traditional attire

Soga girls dance *kamenhaibuga* traditional dance

Unique innovations and appearances



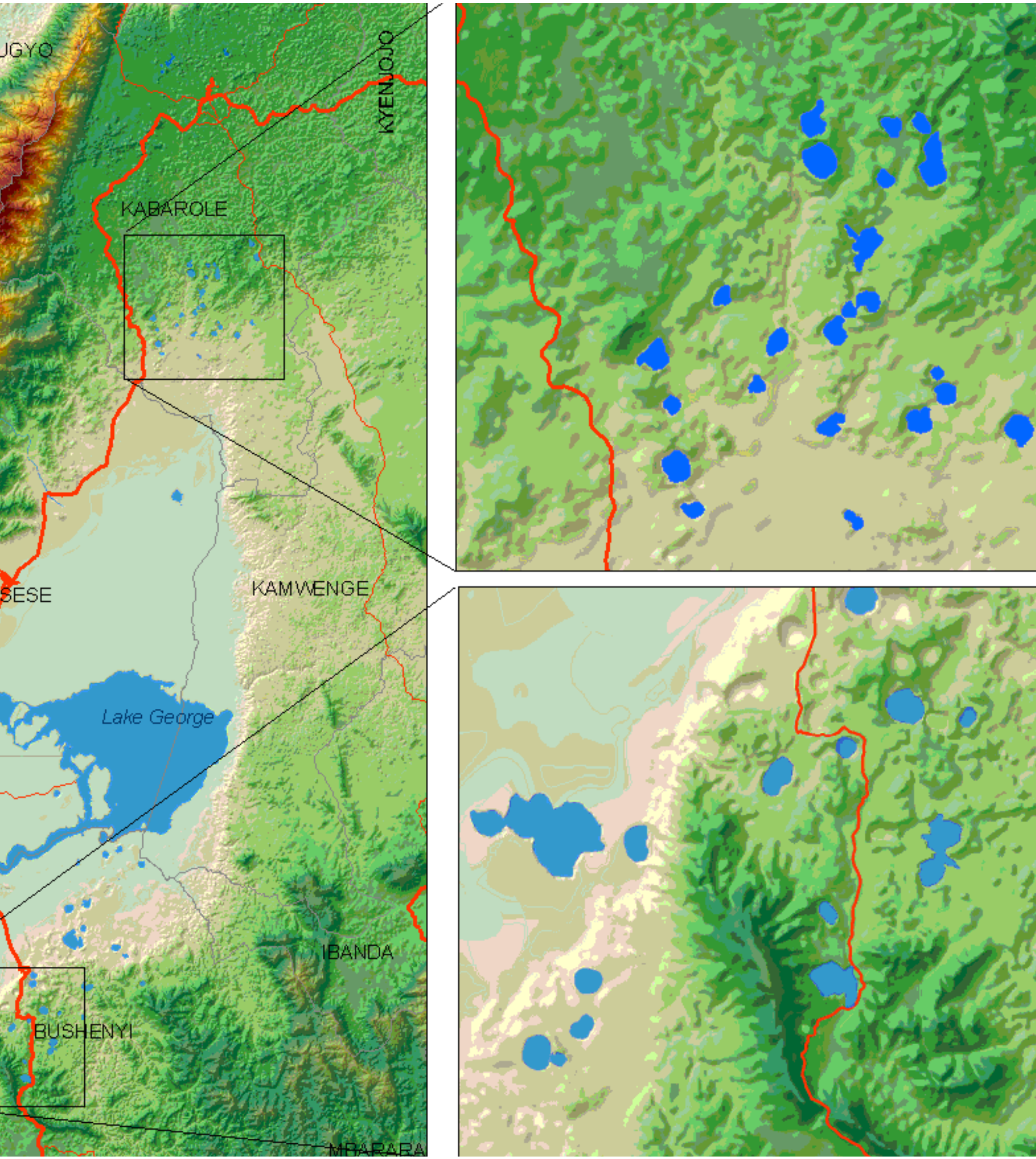
Self-discipline: An office in Moyo District

Gender balance: participation in national elections at grass root level, Kamuli District

Statue of a cow at the junction to Nakasongola District Headquarters

Stone carvings of a “bird” and “eggs” at the Chimpanzee Sanctuary, Ngamba island

Crater lakes in Uganda



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Acronyms

AEZ	Agro-ecological Zoning
AIDS	Acquired Immune Deficiency Syndrome
AKDN	Aga Khan Development Network
AKFED	Aga Khan Fund for Economic Development
AMCOW	African Ministerial Council on Water
CEC	Cation Exchange Capacity
CHOGM	Commonwealth Heads Of Government Meeting
DRC	Democratic Republic of Congo
DWD	Directorate of Water Development
EAC	East African Community
EIN	Environment Information Network
ENR	Environment and Natural Resources
EROS	Earth Resources Observation and Science
ESRI	Environmental Systems Research Institute
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GHGs	Green House Gas
GoU	Government of Uganda
HIV	Human Immunodeficiency Virus
IBAs	Important Bird Areas
ICT	Information and Communication Technology
IDP	Internally Displaced People
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union for Conservation of Nature
JEEP	Joint Energy and Environment Projects
MDGs	Millennium Development Goals
MFACOI	Multi Purpose Farmers Community Initiative
MFPED	Ministry of Finance Planning and Economic Development
MSS	Multi Spectral Scanner
MWE	Ministry of Water and Environment
NASA	National Aeronautics and Space Administration
NBI	Nile Basin Initiative
NDP	National Development Plan
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NGA	National Geospatial-Intelligence Agency
NGO	Non Governmental Organisation
NILE-COM	Nile Council of Ministers
NSOER	National State of Environment Reports
PA	Protected Area
PEAP	Poverty Eradication Action Plan
QENP	Queen Elizabeth National Park
RCMRD	Regional Centre for Mapping of Resources for Development
SOCADIDO	Soroti Catholic Diocese Integrated Development Organisation
SOE	State of Environment
SOER	State of Environment Report
THF	Tropical High Forests
TM	Thematic Mapper
UBOS	Uganda Bureau of Statistics
UHSBS	Uganda HIV/AIDS Sero Behavioral Survey
UNEP	United Nations Environmental Programme
UNHS	Uganda National Household Survey
UPE	Universal Primary Education
USD	United States Dollar
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
UWA	Uganda Wildlife Authority
UWEC	Uganda Wildlife Education Centre
VIP	Ventilated Pit-Latrine

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The Uganda Atlas of Our Changing Environment is a unique publication by the Government of Uganda that is modelled after Africa: Atlas of Our Changing Environment previously published by the United Nations Environment Programme. This environmental atlas seeks to safeguard the country's environment and inspire decision makers to action. In line with the One Planet Many People theme, Uganda in its natural splendour is undoubtedly the Pearl of Africa.

The objectives of this atlas are to:

- Integrate into and harmonize matters of the environment with Uganda's development goals
- Make use of satellite images to provide evidence on the country's changing environment

The Atlas reinforces the core values and aspirations of the National Sustainable Development Strategy and Vision 2025, which are major cornerstones linking the country's environmental outlook to its dynamic society. It further reaffirms Uganda's commitment to meeting Millennium Development Goal (MDG) No. 7, the targets of the Government's "Prosperity For All (PFA)" Programme, and ensuring environmental sustainability. In our fast changing world characterized by increased human activities, the Atlas documents and quantifies environmental changes. It combines ground photography and a bird's eye view of current and historical satellite imagery, illustrating extensive scientific evidence of our changing environment.