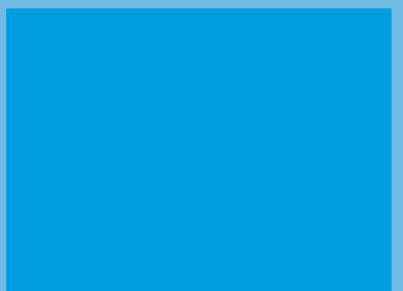
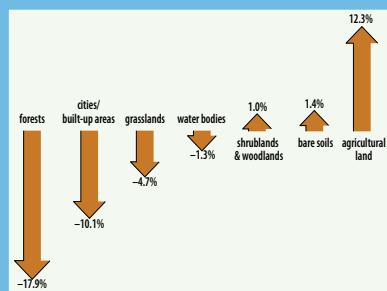
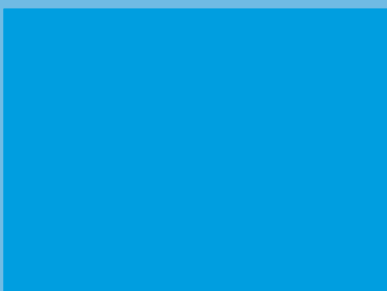
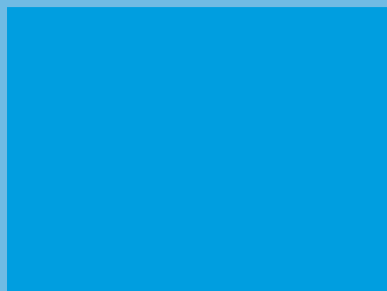


## The Environmental Resources of the Nile Basin



# KEY MESSAGES

- The Nile Basin has many unique aquatic and terrestrial ecosystems, and is home to thousands of species of plants and animals, many of them endemic to the basin.
- The basin's water and related environmental resources provide a wide range of societal goods and services, contributing between 40 and 60 per cent of the gross domestic product of the Nile riparian countries.
- The Nile's system of waterways and wetlands constitutes an important flight path for migratory birds and also a destination for migratory birds from other regions of Africa. Seventeen aquatic and wetland ecosystems within the basin have been designated as international Ramsar sites.
- Natural resources of the Nile Basin are under increasing pressure from a multiplicity of sources, mainly agriculture, livestock, invasive species, bushfires, mining, urbanization, climate change, and natural disasters.
- Many protected areas (national parks and game, wildlife, and forest reserves) have been established to conserve the basin's unique ecosystems, with mixed conservation success.
- The root causes of the rapid degradation of the basin's environmental resources are population growth, poverty, civil insecurity, and weak policy, legal, and institutional frameworks in the Nile riparian countries.
- The Lake Victoria Basin Commission (LVBC), the Intergovernmental Authority on Development (IGAD), and the Nile Basin Initiative (NBI) are examples of a growing number of regional frameworks established in recent years to address environmental degradation within the Nile Basin.
- Key recommendations for regional-level actions by the Nile riparian countries include the restoration of degraded water catchments critical for sustaining the flow of the major Nile tributaries, restoring badly degraded lands that export large quantities of sediments and cause serious siltation of reservoirs, and establishing a regional network for monitoring changes in water quality and land-use within the basin.



Clearing water hyacinth, an invasive species that has had an adverse impact on many parts of the Nile Basin, including parts of Lake Victoria.

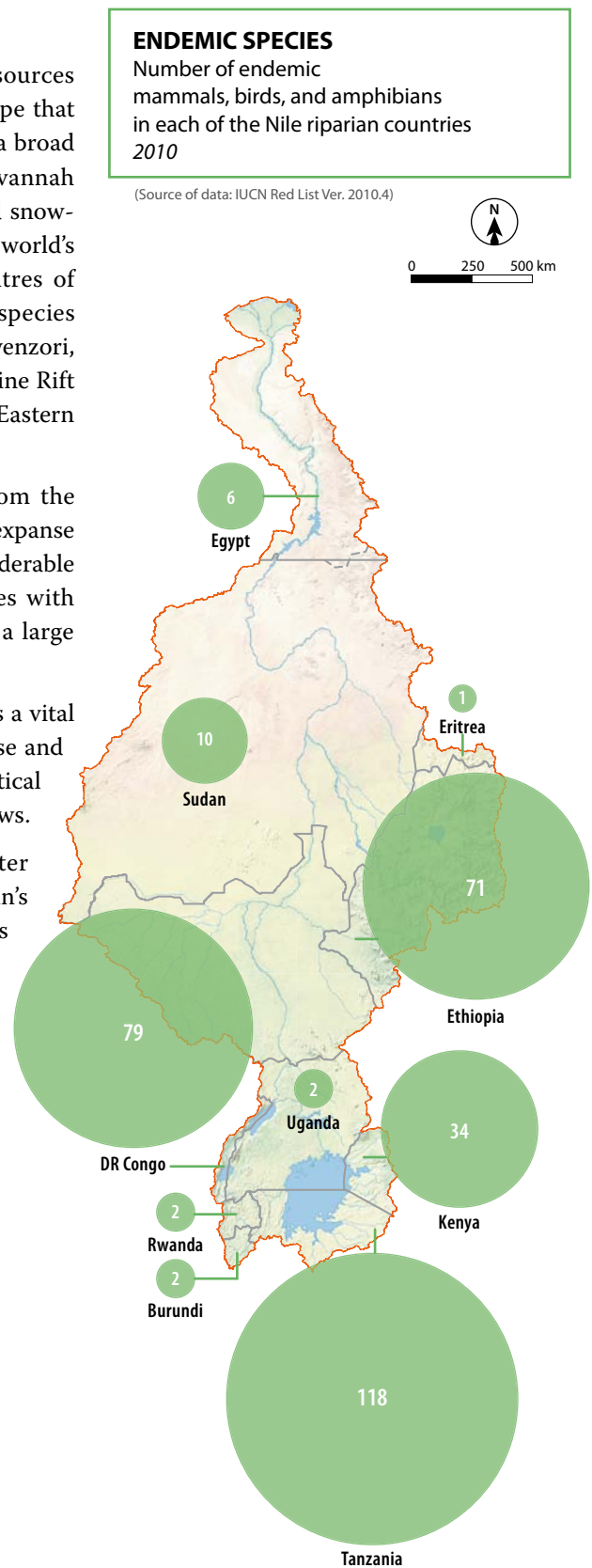
## THE NILE – A BASIN RICHLY ENDOWED

The Nile Basin is richly endowed by nature. Its water resources are an integral part of a complex and highly varied landscape that includes small and large lakes; massive riverine floodplains; a broad Mediterranean delta; forests, woodlands, and extensive savannah plains; semi-arid drylands and deserts; low-lying plains; and snow-capped mountains. The basin has a rich bird life, some of the world's largest congregations of large mammals, and several centres of endemism (i.e. areas with a high occurrence of endemic species such as the Ethiopian Highlands, the Sudd, Mts Elgon and Rwenzori, and Lake Victoria). A number of habitats, such as the Albertine Rift and Ethiopian Highlands, are part of the globally significant Eastern Afrotropical biodiversity hotspot.

The great biological diversity of the Nile Basin arises from the remarkable variability of its geophysical features and the vast expanse of its watershed, which spans 35 degrees of latitude. The considerable environmental resources provide the riparian communities with diverse goods and services, and support the livelihoods of a large proportion of the basin population.

A good understanding of the environment, of which water is a vital component, is essential for its proper management. Wise use and rational utilization of environmental resources are, in turn, critical for sustaining water resources – crucial for sustaining Nile flows.

This chapter builds upon the preceding chapter on water resources by providing an overview of the state of the basin's biophysical resources, their economic importance, the various threats they are facing, the root causes of the threats, and the measures needed to slow down or reverse the decline of the environmental assets. More detailed descriptions of the Nile ecosystem can be found in publications such as Rzóska (1976) and Dumont (2009). Only brief accounts of the environmental systems are presented below.





## KEY ENVIRONMENTAL RESOURCES

### Rivers

The Nile drainage network, which is described in Chapter 2, comprises many rivers, small and large. Among the bigger rivers are the Kagera, Nzoia, Victoria Nile, Semliki, Albert Nile, Bahr el Jabal, Bahr el Ghazal, Sobat, Blue Nile (Abay), Atbara (Tekezze) and Main Nile. The rivers are commonly fringed by gallery forests and herbaceous littoral vegetation. The latter is dominated by papyrus, common reed (*Phragmites australis*), water lily, Nile cabbage (*Pistia stratiotes*), and occasionally water hyacinth. The rivers are inhabited by numerous species of vertebrates, including the hippopotamus, Nile crocodile, Nile monitor, rock python, spotted-necked otter, and numerous cobras. They also support many species of birds, amphibians, and fish. Fish species of greatest economic importance include the cichlids (mainly *Oreochromis*, *Tilapia*, and *Haplochromis* species), cyprinids (mainly *Barbus* and *Labeo* species), catfish (*Bagrus sp.*), lungfish (*Protopterus sp.*), and freshwater eels (*Anguilla sp.*).



### LAND COVER IN THE NILE BASIN 2009

- irrigated croplands
- bare areas
- grassland
- mosaic croplands and vegetation
- rainfed croplands
- evergreen broadleaf forest
- mosaic forest-shrubland/grassland
- shrubland
- sparse vegetation
- wetland
- urban areas
- water bodies

(Map prepared by the NBI; source of data ESA Globcover Project 2009)

The NBI is not an authority on international boundaries.

Many species of molluscs (freshwater snails and slugs), oligochaetes (worms), and insects are associated with the Nile and its tributaries. The groups of aquatic insects include odonates (dragonflies and damselflies), mayflies, stoneflies, caddisflies, blackflies, midge flies, water beetles, and water scorpions. There are also decapods (freshwater crabs, shrimps, and prawn) that make up an important part of the food chain.

### Lakes

An estimated 3 per cent (95,926 km<sup>2</sup>) of the Nile's open water is in the form of lakes. Notable large lakes include Victoria, Kyoga, Albert, George, Edward, and Tana. The lakes are primarily located in the Equatorial Lakes Plateau region. The only major lake in the desert biome is Lake Nasser/Nubia, which resulted from the damming of the Nile at Aswan. The lakes in the basin have various functions, including acting as a habitat for aquatic plant and animal species, buffering the discharge of outflowing rivers against seasonal extremes, and acting as a trap for sediments from the headwater areas.

The lakes in the equatorial region are at different stages of eutrophication, and experience frequent algal blooms, low transparency, hypolimnetic anoxia (i.e. oxygen limitation in bottom waters), and occasional fish kills.

Lake Victoria is the world's second-largest freshwater lake by surface area, and acts as a natural reservoir for the White Nile. It has a convoluted shoreline dotted with large papyrus, *Loudetia*, and *Phragmites* wetlands. The lake contains over 500 fish species, and supports the largest inland fisheries in the world, with annual fish catches in the region of 500,000 metric tonnes. Commercial catches are dominated by: the Nile perch, Nile tilapia, and silver cyprinid. The lake is also used for hydropower generation, recreation, drinking water, and as a recipient of municipal and industrial wastewater.

## Lake Victoria

has a surface area of

68,000 km<sup>2</sup>

and drainage area of

184,000 km<sup>2</sup>

Daybreak over the Victoria Nile at Jinja, Uganda.





Lake Tana, the source of the Blue Nile (Abay), is located at the top of the eastern Nile watershed, and has alkaline water due to intensive evaporation. Its shores are mainly rocky but at the mouth of affluent rivers there are clusters of papyrus-dominated littoral vegetation. The lake has a significant commercial fishery based on tilapia, barbels, and catfish. Its endemic fish are prevented from spreading downstream by the Blue Nile (Tis Issat) Falls. Perhaps more important is the lake's cultural value. Some of its many islands hold monasteries dating from the 14th century that house remains of ancient Ethiopian emperors and treasures of the Ethiopian church. Water birds are quite abundant and otters have been recorded in the lake.



Man fishing on Lake Tana.

Of the smaller lakes in the basin, the most notable are the Rweru, Cyohoha, Mugesera, Ihema, Ruhondo, and Bulera in Kagera sub-basin; lakes No, Shambe, Dapiu, and Ambadi in the Sudd region; Lake Nasser/Nubia at The Sudan–Egypt border, and Lake Manzala in the Nile Delta.

Lake Nasser/Nubia, like the Equatorial Lakes, is hypereutrophic, and supports a thriving fishing industry based on tilapia, Nile perch, tiger fish, and cat fish. Annual fish catches are in excess of 20,000 metric tonnes.

### Wetlands

Wetlands represent 1.1 per cent of the total basin area, and include montane bogs, lowland herbaceous swamps, seasonally flooded grasslands, swamp forests, riverine wetlands, and lake-fringe wetlands. The basin wetlands are concentrated in two areas: the Equatorial Lakes region and the Sudd area in South Sudan. The Nile Delta north of Egypt, once an area of lush natural wetlands, has now been almost entirely converted into agricultural land.

The Nile Equatorial Lakes region is characterized by hilly terrain, large swamp-filled valleys, and lakeshore wetlands. The rivers in the region have sections of their courses partially or completely covered by swamp vegetation. Papyrus, reeds, cattails, water lilies, hippo grass, and other aquatic grasses are the dominant herbaceous plants, while palms (mainly *Phoenix reclinata* and *Rafia farranifera*), trees of the genus *Ficus*, *Sezygium*, *Mitragyna*, *Macaranga*, and *Acacia* are among the dominant woody species in the wetlands. The greatest concentration of wetlands in the basin is found in Uganda, while the most extensive wetland system is the Sudd in South Sudan.

The Nile Valley and Nile Delta in Egypt have scatterings of wetland communities. The common aquatic plants growing along the banks of the Nile and its delta include the common hornwort, Canadian

Papyrus swamp, Uganda.



pondweed, curly-leaf pondweed, Egyptian lotus, and Eurasian watermilfoil. Floating plants include the water fern, water hyacinth, duckweed, and broad-leaf pondweed; and among emergent plants there are the foxtail flatsedge, jointed flatsedge, common reed, Spanish reed, and common cattail. Papyrus, once abundant along the banks of the Nile, and closely intertwined with Egyptian history, is now confined to small clusters in the extreme south of the country, on islands near Cairo, and in the Damietta branch of the delta.

### Soils

The Nile is covered by a variety of soil types that differ in their physical and chemical properties and hence their ability to support vegetation, wildlife, and agricultural production. The dominant soil types include vertisols (soils with a high clay content that cover large parts of South Sudan and the areas south and east of Khartoum), arenosols and leptosols (mainly composed of quartz and having a high gravel content) cover the semi-arid and arid drylands in The Sudan and Egypt), nitisols (grey nutrient rich soil found in the Ethiopian Highlands), ferralsols (red and yellow weathered soils rich in iron and aluminium oxides common in the Nile Equatorial Lakes region), and calcisols (fertile soils that have a high amount of lime found in Egypt and the Nile Equatorial Lakes region). Soil maps, and a further discussion on soils, can be found in Chapter 5.

## THE FAYOUM LAKES: A BIODIVERSITY HOTSPOT IN THE SAHARA

The Fayoum oasis, located in a natural depression southwest of Cairo, probably has the largest concentration of plant and animal life in the desert ecoregion of the Nile Basin. Watered by a channel of the Nile, the Bahr Yossef, the depression includes two man-made lakes – Wadi el Rayan and Birket Qarun – formed by drainage water from agricultural lands, which support a rich and varied desert biotic community and have been declared protected areas.

Wadi el Rayan has an area of 1,740 km<sup>2</sup>, of which 16 km<sup>2</sup> is wetlands and the rest desert. Vegetation in the Rayan valley is confined to inter-dune areas and the base of large sand dunes. A visitor to these dunes is likely to encounter 13 species of perennial plants, including individuals of Arta (*Colligonum comosum*) and Bawwal (*Zygophyllum album*). Animals found in the valley include the endangered slender-horned gazelle (*Gazella leptoceros*), Dorcas gazelle, Fennec fox, and Ruppell's fox, 11 species of reptile, and 40 species of resident and migrant birds.

Birket Qarun is larger in size (open water area is 230 km<sup>2</sup>) but more saline. Vegetation within this ecosystem is mainly comprised of *Tamarix nilotica*, *Nitraria retusa*, *Alhagi maurorum* and several species of salt-marsh plants. Non-



Fennec fox, one of the animals found in Wadi el Rayan.

avian species are rare, but include the Egyptian hyena, red fox, kudu, gnu, beaver, Egyptian cobra, red-spotted snake, and coral snake. Thousands of birds, comprising nearly 90 species, visit the lake each year, dominant among which are grebes, coots, ducks, swans, falcons, hornbills, macaws, gulls, terns, and cattle egret. The large bird population is supported in part by the rich fish stocks, mainly garfish, eel, muskie, halibut, and striped bass.



## THE SUDD: THE WORLD'S LARGEST TROPICAL WETLAND

The Sudd is located at the confluence of the White Nile tributaries (see Chapter 2) and comprises of the Bahr el Ghazal wetlands in the west, the Bahr el Jebel wetlands in the centre, the Sobat–Baro–Pibor wetlands to the east and the Machar marshes to the northeast. With an area of approximately 57,000 km<sup>2</sup>, the Sudd is the largest tropical wetland system in Africa and, possibly, the world. The Sudd wetlands hold great economic potential for the Nile Basin in general, and the young nation of South Sudan in particular.

The Sudd is comprised of several ecosystems, ranging from open waters with submerged vegetation; to emergent and surface-floating fringe vegetation; river-fed seasonally flooded grassland (toic); rainfed, seasonally flooded grassland; seasonally inundated woodland; and floodplain scrubland. Permanent swamp vegetation is dominated by *Cyperus papyrus*, *Typha domingensis*, *Phragmites karka*, and *Vossia cuspidata*. Over 350 plant species, 100 mammalian species, 470 bird species, 100 fish species, an unknown number of reptilian and amphibian species, and 120 species of insects inhabit the Sudd. Three protected areas – Shambe National Park, Fanyikang Game Reserve, and Zeraf Game Reserve – are located within the Sudd.

The Sudd is a stopover and wintering ground for birds of international conservation importance, such as the white pelican (*Pelecanus onocrotalus*), black-crowned crane (*Balearica pavonina*), white stork (*Ciconia ciconia*), and white-winged black tern (*Chlidonias nigra*). The site is believed to hold over 80% of the world's population of the shoebill stork (*Balaeniceps rex*) and is probably also important for the ferruginous duck (*Aythya nyroca*) and passing lesser kestrel (*Falco naumanni*). Birds that visit the wetlands in large numbers (from hundreds of thousands to over a million individuals) include the glossy ibis, marabou stork, African open bill, cattle egret, and spur-winged goose.

Several species of migratory mammals also depend on the Sudd for their dry-season grazing, including the white-eared kob,



Spur-winged geese, in the Sudd.

tiang, elephant, mongalla gazelle, and zebra. Other mammals of important conservation status that inhabit the Sudd include the Nile lechwe, Thomson's gazelle, sitatunga, waterbuck, and reedbuck.

The Sudd is inhabited principally by the Nuer, Dinka, and Shilluk ethnic groups, who engage in pastoralism, fishing, game hunting, and agriculture for livelihood. About 1 million livestock (cattle, sheep, and goats) are kept within the area, grazing mainly on the toic. The Sudd is believed to have the potential to provide up to 300,000 tonnes of fish annually on a sustainable basis.

Saddle-billed storks, members of an estimated population of more than 4,000 that over-winter in the Sudd.





**FLYWAYS**

For selected migratory birds dependent on habitats in the Nile Basin for a stop-over or for over-wintering





## ECOREGIONS IN THE NILE BASIN

The Nile Basin is subdivided into sixteen terrestrial ecoregions, reflecting the great expanse of the basin. Moving through the basin from south to north, there is a gradual change in elevation and climatic conditions, producing a striking latitudinal gradation in vegetation and fauna. This south to north (upstream to downstream) gradation in ecoregions is accompanied by a marked decrease in the diversity of plant and animal species.

**Victoria Basin forest-savannah mosaic:** Lying to the west and north of Lake Victoria, this is most notable for its high endemism and the diversity of its plant and animal species, resulting from the large range of habitats, and the presence of species from west and east Africa. It has a tropical moist climate with two rainy seasons (March–May and October–November). Annual rainfall ranges from more than 2,000 millimetres (mm) over Lake Victoria to 1,000 mm on the border with the Sudanian savannah ecoregion. Dominant forest trees are from the genera *Celtis*, *Diospyros*, *Uvariopsis*, and *Holoptelea*, while the woodlands are dominated by *Terminalia*, *Albizia*, *Combretum*, *Grewia*, and *Lonchocarpus* species. The grasslands are dominated by *Hyperrhenia*, *Themeda*, *Vetiveria*, *Pennisetum*, *Loudetia*, *Imperata*, *Adropogon*, *Setaria*, and *Cynodon* species. This ecoregion has a number of protected areas, with large populations of African savannah mammals.

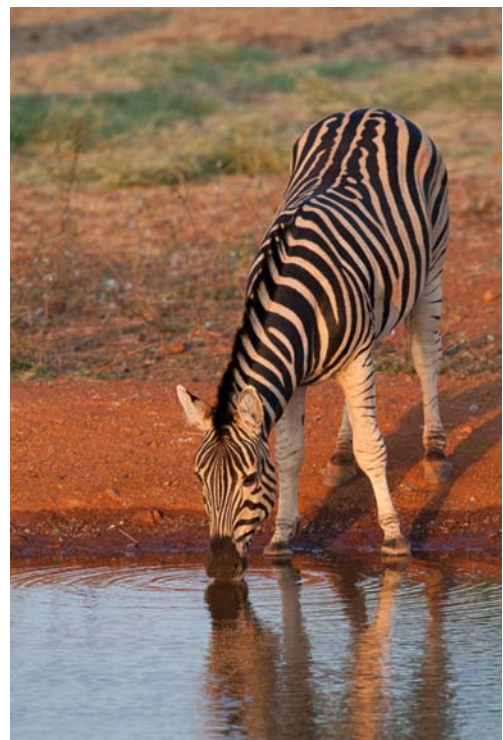
**Miombo woodlands:** The miombo woodlands, which stretch from the southwestern shoreline of Lake Victoria to the southwestern boundaries of the basin, are dominated by trees of the genera *Brachystegia* (mainly *B. floribunda*, *B. glaberrima*, *B. taxifolia*, *B. wangermeeana*, and *B. longifolia*), *Julbernardia*, *Isoberlinia*, and *Protocarpus*. The name of the ecoregion comes from the Bantu word ‘muombo’ for the tree *Brachystegia longifolia*. The miombo woodlands typically comprise of an upper canopy of umbrella-shaped trees, an irregular layer of sub-canopy trees, a discontinuous understorey of shrubs and saplings, and a patchy layer of grasses, forbs and suffructices. The ecoregion has a seasonal tropical climate. There is one wet season from December to April followed by a prolonged dry season. The area receives 1,000 to 1,200 mm rainfall annually but droughts are frequent and inter-year variability in rainfall high. Fires, started naturally by thunderstorms and by man, are a strong ecological factor. The ecoregion in Tanzania has extensive areas of near wilderness and four protected areas (Biharamulo, Burigi, Rumanyika-Orugundu, and Ibanda Game Reserves). Common large mammals include the elephant, common reedbuck, steinbuck, zebra, topi, sable, dikdik, sitatunga, hippo, lion, cheetah, hyena, and jackal. Bird life is rich in species but low in endemism.

**Acacia-Commiphora bushlands and thickets:** This stretches from the southeastern corner of South Sudan, through northeast Uganda, to the eastern and southern parts of the Lake Victoria catchment

### Ecoregion/ecological region

A geographically distinct assemblage of plants and animals that share similar environmental conditions and interact in such ways as to enhance their collective long-term survival.

Zebra in Biharamulo Game Reserve.



in Kenya and Tanzania. It is largely comprised of semi-arid and dry sub-humid lands that have a tropical and strongly seasonal climate. Mean annual rainfall ranges from 600 to 1,200 mm, but the timing and amount of rainfall varies greatly from year to year. The ecoregion is comprised of a mixture of woodlands, scrublands, and grasslands. Woody vegetation is dominated by *Acacia*, *Commiphora*, *Boswellia*, and *Crotalaria* species, while grasses are dominated by *Themeda*, *Setaria*, *Panicum*, *Aristida*, *Andropogon*, *Eragrostis*, *Stipagrostis*, and *Chloris* species. There are many different species of mammal, though few are endemic. The ecoregion supports large mammal populations both in general lands and conservation areas such as the Masai Mara National Reserve, Serengeti National Park, Maswa Game Reserve, and Kidepo National Park.

**Ethiopian montane grasslands and woodlands:** This is a biologically rich, but seriously threatened, ecoregion at elevations of 1,800 to 3,000 metres (m). It has a cool temperate climate, with rainfall of 1,600 to 2,500 mm per annum, mainly falling from May to October. There is a high rate of endemism owing to its geographical isolation and unique climate, but a high population density and intensive subsistence agriculture has led to loss and fragmentation of most of the natural habitats. Observations of intact plant communities suggest that the undisturbed vegetation consisted of a mixture of closed forest, grassland, bushland, and thicket. In the wetter southern parts, montane cloud forests occur at elevations of 2,000 to 2,500 m, characterized by shrubby zones of *Hagenia* and *Scheffera* species, and giant lobelias (*Lobelia gibberroa*). The drier southern parts have forests dominated by *Podocarpus*, *Juniperus*, and *Hagenia*. The Simien Mountains, in the north, have evergreen broadleaved montane forest at elevations of 2,300 to 2,700 m, dominated by *Syzigium*, *Juniperus*, and *Olea*. Above 3,000 m, moorland vegetation is dominated by giant lobelia, heathland scrub, grasslands, and herb meadows. A number of Ethiopian endemics and near-endemic fauna occur in this ecoregion: amphibians, reptiles, and small mammals, and larger mammals such as the Walia ibex, mountain nyala, gelada baboon, and Ethiopian wolf.

**Sudanian savannah:** This ecoregion lies south of the Sahel and is divided by the Sudd into western and eastern blocks. It is generally flat, with elevation ranging from 200 to 1,000 m. The climate is tropical and strongly seasonal, with annual rainfall from 600 to 1,000 mm. Plant communities consist of undifferentiated woodland with an understorey of shrubs, herbs and grasses. During the dry season (November to March), most of the trees lose their leaves and the grasses may dry up and burn. Typical trees in the western block are from the genus *Acacia*, *Combretum*, *Terminalia*, *Anagoissus*, and *Kigelia*, while the eastern block is dominated by *Combretum*, *Terminalia*, *Anogeissus*, *Boswellia*, *Lannea*, and *Stereospermum* species. Bamboo (*Oxytenanthebra abyssinica*) is prominent in the western river valleys of Ethiopia. Dominant grasses include *Hyparrhenia*, *Cymbopogon*, *Echinochloa*, *Sorghum*, and *Pennisetum* species. Although parts of



The rare Walia ibex in the Simien Mountains of Ethiopia.

Sudanian savannah in the dry season, when fires lit by pastoralists to promote grass growth destroy existing trees and suppress saplings.

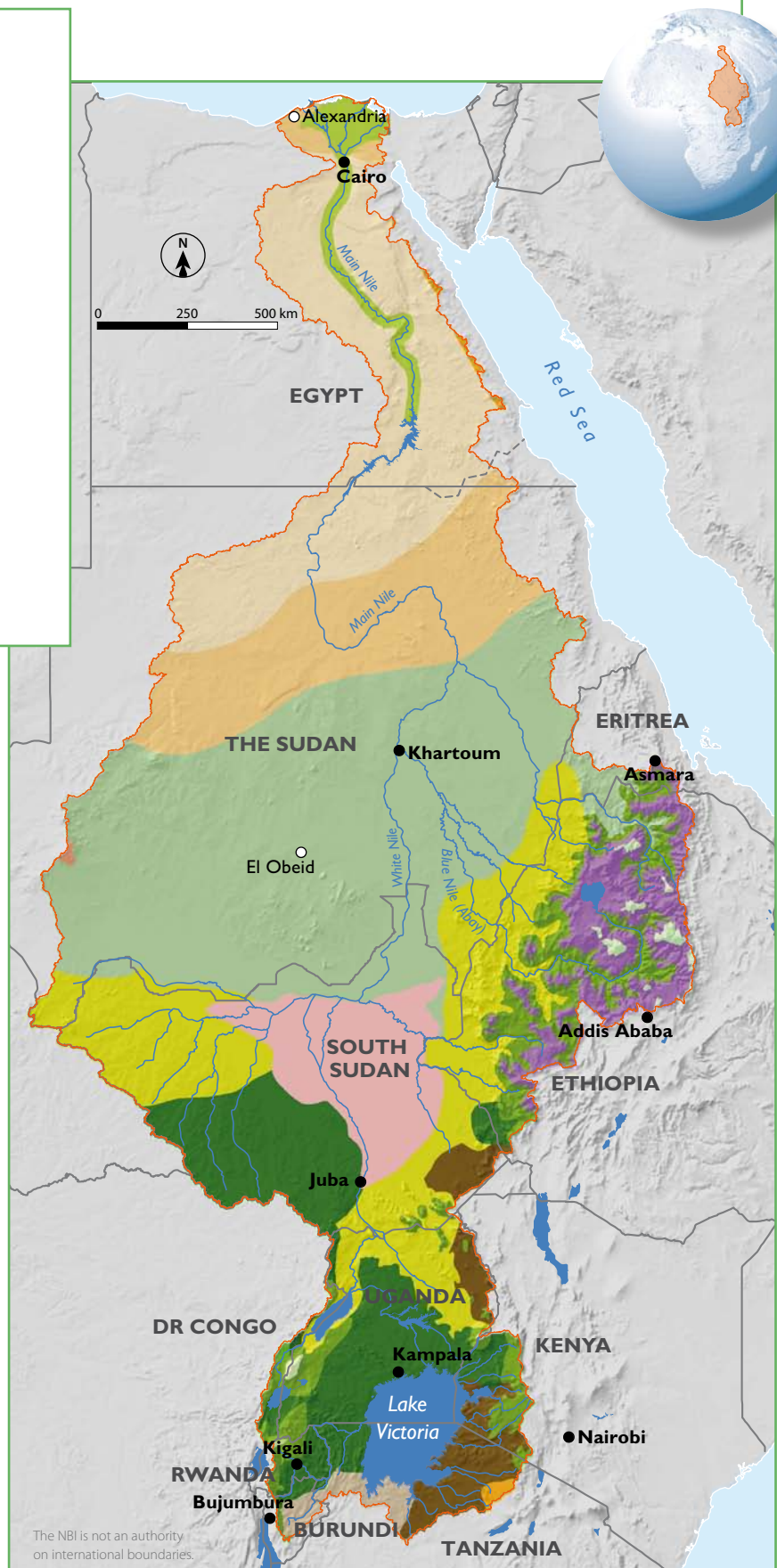




### ECOREGIONS IN THE NILE BASIN

- coastal desert
- flooded savannah
- Sahara desert
- Sahelian acacia savannah
- montane xeric woodlands
- woodlands and steppe
- grasslands and woodlands
- montane moorlands
- montane forests
- grasslands
- Sudanian savannah
- bushlands and thickets
- lowland forests
- forest-savannah mosaic
- miombo woodlands
- water bodies

(Map prepared by the NBI; source of data: Terrestrial Ecoregions GIS database)



The NBI is not an authority on international boundaries.

this habitat have been adversely affected by agriculture, fire, and timbering, some relatively undisturbed locations harbour healthy populations of large mammals.

**Sahelian acacia savannah:** The largest ecoregion in the Nile Basin, this forms a transition zone between the true Sahara desert and the wooded savannah biomes. It has low-lying, flat topography and a hot tropical climate characterized by strong seasonality. Annual rainfall, which mostly falls in the months of May to September, ranges from 600 to 2,000 mm. During the dry season, hot dry winds blow from the north, often bringing with them dust and sand from the Sahara. The vegetation is characterized as Sahel acacia wooded grassland and deciduous bushland. The most common tree is *Acacia tortilis*. Others are from the genus *Acacia*, *Commiphora*, *Balanites*, and *Boscia*. Grass cover is dominated by *Cenchrus biflorus*, *Schoenefeldia gracilis*, and *Aristida stipoides*. Away from permanent water bodies, the dominant form of land-use is pastoral nomadism, with cattle as the main livestock. Near permanent water bodies, irrigated agriculture is practised, especially along the banks of the Blue Nile (Abay). The Gezira Irrigation Scheme, one of the world's largest irrigation projects, is located in this ecoregion.

**Sahara desert:** The Nile Basin has 1.34 million square kilometres of arid and hyper-arid lands located between latitudes 11°30'N and 31°30'N. The arid belt is comprised of three ecoregions: the south Saharan steppe and woodland, the Sahara desert ecoregion, and the north Saharan steppe and woodlands. The Sahara desert ecoregion covers parts of the northern area of The Sudan and nearly all of Egypt. In the hottest months, temperatures may exceed 50°C, while in the coldest months they may fall below freezing. The region is characterized by hot, dust-filled winds that blow for much of the year. Annual rainfall is below 25 mm but multi-year droughts are common. The region is underlain by vast groundwater aquifers that penetrate the surface in a few places, giving rise to oases. Prominent land forms in the desert include sand dunes, stony plateaux (hamadas), gravel plains (reg), dry valleys and riverbeds (wadis), salt flats and non-salty depressions (dayas). Vegetation in the desert is extremely rare, with most areas covered by bare soil or rock. Scanty and stunted vegetation dominated by *Acacia*, *Tamarix*, and *Calotropis* species can be found along some wadis and dayas. In places with sufficient groundwater, hamadas are covered by *Anrthirnum ramosissimum* and *Onomis angustissima*. A few desert antelopes such as the slender-horned gazelle and redfronted gazelle may be found in small numbers in a few places.



Acacia tree in desert of Bayuda, north of Khartoum, The Sudan



**Saharan woodlands and steppe:** The Sahara desert is bound to the north and south by steppe and woodland ecoregions. The South Saharan woodlands and steppe ecoregion covers a broad belt extending from the western to northeastern areas of The Sudan, while the North Saharan woodlands and steppe ecoregion covers the Nile Delta and the Mediterranean coastline in Egypt. Mean annual rainfall in the two ecoregions ranges from 50 to 200 mm but years with no rain are common. Vegetation is scant and mainly found along wadis and dayas. Plant species that can be commonly observed include thorn acacia, creosote bush, sage bush, desert milkweed, desert willows, *Capparis* shrubs, date palms, doum palms, desert tobacco, and a number of annual grasses (mainly *Aristida*, *Ephedra*, *Panicum*, *Zygophyllum*, *Eragrostis*, and *Stipagrostis* species).

The woodlands and steppe are inhabited by a number of animals that have adapted to the harsh desert conditions. They include the Fennec fox, striped hyena, hares, ground squirrels, rock hyrax, dorcas gazelle, slender-horned gazelle, desert lynx, weasel, Saharan horned viper, Saharan sand viper, shrews, gerbils, jirds, jerboas, lizards, geckos, rats, and bats. The steppes and woodlands are economically important as pasturelands, and are used to keep herds of sheep, goats, and camels. Rainfall is insufficient to support rainfed agriculture, but irrigated agriculture is practised in oases, along wadis, and near major water bodies such as the Nile River.

Camels in Southern Kordofan, The Sudan.



## FAUNA

The varied floristic and climatic conditions of the Nile Basin support an equally diverse assemblage of fauna. On the African continent, the Nile and its system of lakes, rivers, and wetlands is second only to the Congo basin in the number of fish species it supports. The large terrestrial fauna, now mostly concentrated in protected areas, are remnants of large populations that once roamed the African plains.

There are more than 15 national parks in the Nile Basin, which provide protection to many animals that are endemic, vulnerable, or critically endangered. There is a larger number of other types of protected areas - game reserves, game control areas, animal sanctuaries, nature conservatories, forest reservations, Ramsar sites, and World Heritage Sites – in the basin.

### THE ALBERTINE RIFT REGION

The Albertine Rift region is one of Africa's top biodiversity hotspots. Approximately 150 km wide, it runs from the northern tip of Lake Albert to the southern tip of Lake Tanganyika, and comprises the low-lying flat bed of the rift valley and steep escarpments on the sides of the trough. It is located at the intersection of Africa's major ecoregions, bordered to the west by the Guinean-Congolian rainforest, to the south and southwest by the Cameroon and Angola forests and woodlands, to the east by the Eastern Arc Mountains and to the north by the Kenyan highlands. This is one of the reasons for the outstanding species diversity and endemism.

The Albertine Rift is home to approximately 40% of the mammals, 50% of the birds, 14% of the reptiles, and 19% of the amphibians of Africa. The species that are endemic to the Nile Basin part of the rift are mainly small mammals such as shrews, rats, and bats, as well as frogs and toads, chameleons, butterflies, and dragonflies. Some of the larger endemic animals include the mountain gorilla, Rwenzori duiker, owl-faced monkey, L'Hoest's monkey, and the Rwenzori turaco.

The Albertine Rift also contains 5,793 plant species, which is about 14.5% of the plant species of mainland Africa. About 567 are endemic to the rift, with the highest concentration of plant species and endemics located in Virunga National Park in the Democratic Republic of Congo, followed by Bwindi Impenetrable National Park in Uganda. The endemic plants include *Thunbergia kamatembica*, *Bothriocline ruwenzoriensis*, *Senecio johnstonii*, *Impatiens burtonii*, and *Ipomea hildebrandtii*.



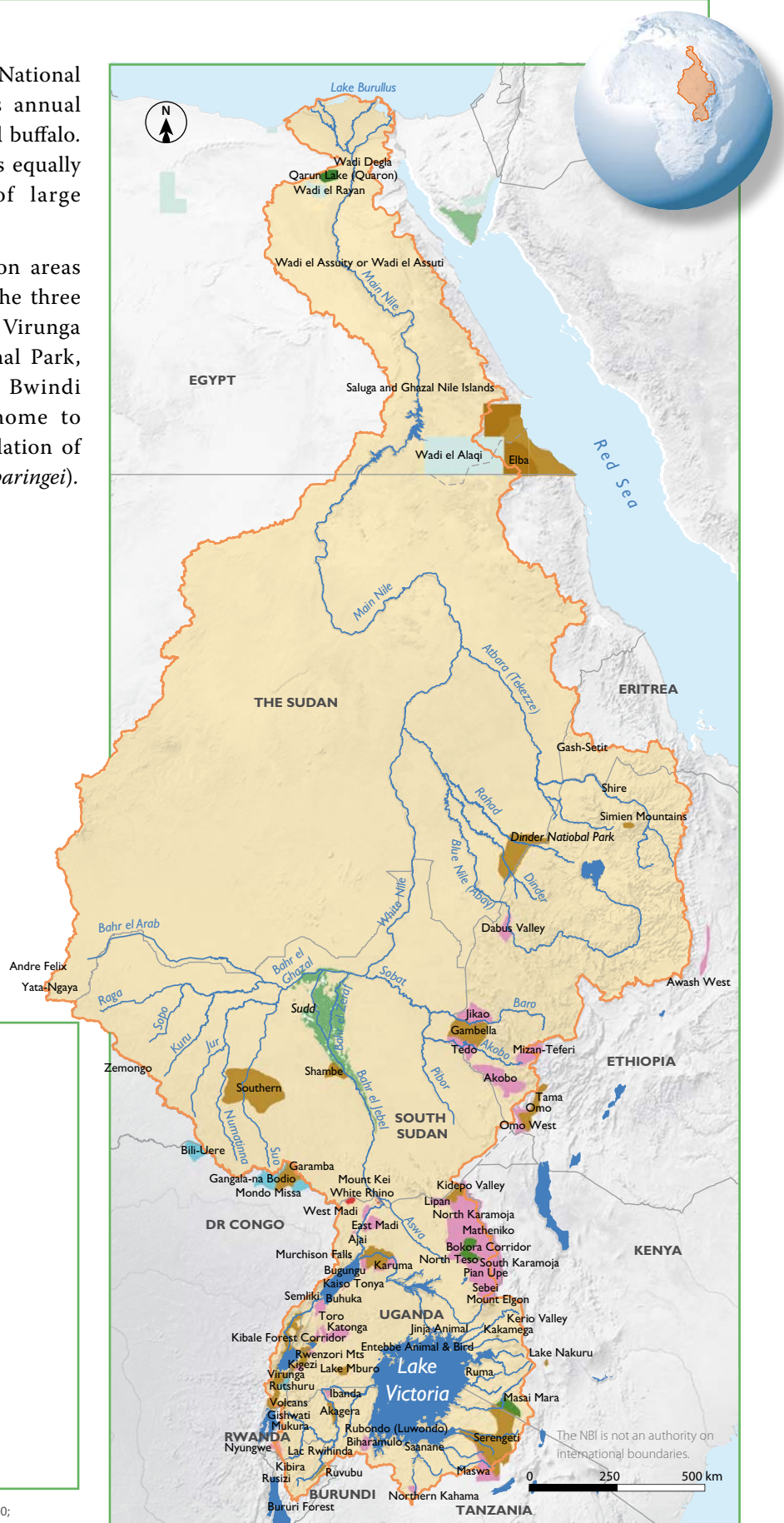
A forest of giant groundsel on the slopes of the Virunga Range, northern Rwanda.





The Serengeti and Masaai Mara National Parks feature the world-famous annual migration of wildebeest, zebra and buffalo. The Sudd in South Sudan features equally impressive mass migrations of large mammals.

Other transboundary conservation areas of considerable significance are the three connected national parks of the Virunga Mountain chain (Virunga National Park, Karisimbi National Park, and Bwindi Impenetrable National Park), home to the world's only remaining population of mountain gorilla (*Gorilla baringei baringei*).



**MAJOR PROTECTED AREAS IN THE NILE BASIN 2012**

- national park
- national reserve
- forest reserve
- game reserve
- hunting reserve
- protected area
- the Sudd
- river
- lake
- country boundary
- The Nile Basin boundary

(Map prepared by the NBI; source of data: IUCN-WCMC 2010; www.ramsar.org)





A shoebill stork, one of the many species of bird that depend on the region's wetlands and lake shores.

### WETLANDS AND RAMSAR SITES IN THE NILE BASIN

2011

- permanent wetland
- seasonal wetland

Wetlands designated of international importance under the Ramsar Convention

- 1 Virunga National Park
- 2 Rugezi–Bulera–Ruhondo
- 3 Lake Bisina System
- 4 Lake George
- 5 Lake Mburo–Nakivali System
- 6 Lake Nabugabo System
- 7 Lake Nakuwa System
- 8 Lake Opeta System
- 9 Lutembe Bay
- 10 Mabamba Bay
- 11 Murchison Falls–Albert Delta
- 12 Nabajuzi System
- 13 Rwenzori Mountains
- 14 Sango Bay–Musambwa Island
- 15 Sudd
- 16 Dinder National Park
- 17 Lake Burullus



The NBI is not an authority on international boundaries.

(Map prepared by the NBI; source of data: AFCover and www.ramsar.org)



## USE OF THE BASIN'S RESOURCES

About 232 million people live in the Nile Basin, and use and depend on its varied natural resources and ecosystems in many ways. Indeed, the human development in the region is closely linked to the ability of the environment to provide a variety of goods and services and to sustain these into the future.

The environmental sector contributes an estimated 40 to 60 per cent of the gross domestic product of the Nile riparian countries. The beautiful natural scenery and wide diversity of plants and animals make the basin a popular tourist destination and thus a major source of revenue.

The environment is also a source of water for drinking and agricultural irrigation, and of firewood, charcoal, building materials, natural dyes, industrial raw materials, medicines, fodder, food (including fish, game meat, fruits, wild fruits, and honey), and of hydroelectric power to basin communities.

Environmental resources also play a key role in maintaining climate stability, protecting water catchments, controlling flooding, maintaining dry season flow in perennial rivers, enhancing groundwater recharge, controlling soil erosion, maintaining soil fertility, and purifying wastewater.



Tourists viewing Kabalega Falls, Uganda.

## HUMAN PRESSURES

Despite their great importance, the environmental resources of the basin are under increasing pressure from a combination of both natural and man-made factors. Agricultural and grazing lands are being degraded; water quality is declining; wetlands and forests are being lost; natural resource are being exploited at rates beyond their natural recovery rates; pollution from urban, industrial, and agricultural sources is increasing; waterborne diseases are spreading; and the harmful impacts of floods and droughts are intensifying .

Many of these threats have a direct impact on human health and welfare, while others undermine people's ability to secure their livelihoods, with poorer people being most affected. The main anthropogenic pressures are further discussed below.

**Agriculture:** The agricultural sector places pressure on environmental systems through land clearance and wetland reclamation for crop production, exposure of soil to erosion, sediment export, excessive water abstraction for irrigation, soil salinization, salt-water intrusion, and water-quality pollution from farm wastes, pesticides, and

fertilizers. Pressures from indiscriminate land clearance, wetland drainage, soil erosion, eutrophication, and sedimentation are discussed under Chapter 2: The Water Resources of the Nile Basin.

Wetland drainage for agriculture is widespread in the Nile Equatorial Lakes region. In Rwanda, close to 60 per cent of the 162,000 hectares of wetland are used for agriculture. The result has been the drying up of springs, reduced water outflow from wetlands, low groundwater recharge, and disruption in ecological function of wetlands.

Agricultural drainage water from irrigation schemes is a significant point source of water pollution. In The Sudan and Egypt, where there are large areas of land under irrigation, drainage water from agricultural fields is contaminated with fertilizers and pesticide residues and causes serious pollution of receiving waters. Fish in Lake Nubia at the border of The Sudan and Egypt have been found to have high concentrations of pesticide residues from contaminated drainage water coming from the Gezira scheme.

The Nile Delta downstream of the Delta Barrage is an area of intensive irrigated agriculture. Return flow from the farms pollutes drainage canals and branches of the Nile with fertilizer and pesticide residues. The common pesticide residues in the agricultural drainage water, in order of decreasing frequency of occurrence, are endrin, total beta-hexachlorocyclohexane (BHC), total dichlorodiphenyltrichloroethane (DDT), endosulfan, heptachlor epoxid, and heptachlor. The most polluted area with respect to pesticide residues is Kafr el Zayat city. Of the two Nile Delta distributaries, the Rosetta branch is more contaminated with pesticide residues than the Dimietta branch. Pesticide residues are also much higher in Lake Manzala than the River Nile due to direct discharge of irrigation drainage water. Pollution-control efforts by the Egyptian government from the early 1980s have resulted in considerable improvements in water quality and prevented the problem from getting out of hand. Generally, the concentrations of pesticide residues and heavy metals in the River Nile have been falling over the last two decades, and in most locations are within the levels permissible for human consumption. Notwithstanding, water pollution remains a major issue in Egypt.

Environmental degradation from agriculture, industry, and urbanization in the Nile Valley and Delta in Egypt has led to the disappearance of many native plants and animals. The delta vegetation has become so impoverished that it can no longer support healthy populations of fauna except in a few protected areas. Among the notable large animals eliminated by human pressure are the Nile crocodile, hippo, and the most famous of the birds of ancient Egypt – the sacred ibis.



A Nile crocodile, nearly hunted to extinction on Lake Victoria.



Sacred Ibis, found in the Nile countries, but no longer in Egypt.



**Livestock production and fisheries:** Over-exploitation of rangelands through overgrazing is a serious problem in parts of the basin such as the toxic grasslands of South Sudan, Ethiopian Highlands, northern Rwanda, northern Tanzania, and the cattle belt in Uganda. In these areas, stocking rates, influenced by cultural tendencies, are far in excess of the carrying capacity of the rangelands. Among other things, the high stocking levels lead to disappearance of palatable pasture grasses and to increased runoff and soil erosion from the rangelands. During droughts, pastoralists in the neighbourhood of protected areas such as the Gambella, Shambe, Queen Elizabeth, Akegera, and Biharamulo drive their herds in the protected areas, thereby bringing livestock in direct competition with wildlife for water and pasture, and increasing the risk of disease transmission from livestock to wildlife and *vice versa*.

High fishing pressure and the use of illegal fishing gear has led to a marked decline in fish stocks in the Nile Equatorial Lakes. Attempts to boost fish production through introduction of exotic species (such as the Nile tilapia and Nile perch) has upset the ecological balance in the lakes and led to the extinction of some of the endemic fish species.

**Bushfires:** Each year wildfires are lit by farmers and pastoralists in parts of the basin to prepare land for cultivation and allow for regrowth of pasture grasses. These fires cause serious destruction and bring about marked changes in the species composition of plants and animals.

**Poaching:** Up to the late 1980s, poaching was rampant in the protected areas in the basin. Wildlife were killed or trapped for bush meat, animal parts (such as ivory, horns, and hides) or for illegal trade in live animals (biopiracy). Poaching led to drastic decline in wildlife numbers in the protected areas and extinction of some species. Professional hunting and a booming trade in crocodile skins in the 1960s brought the Nile crocodile to near extinction on Lake Victoria. Although poaching has been largely brought under control, the animal populations have not recovered to their 1960s levels.

**Urbanization:** Although urbanization may alleviate pressure on the rural environment by offering alternative income and livelihoods, it brings with it a different set of challenges. Rapidly growing and unplanned urban centres often lack the infrastructure and institutions needed to protect human and environmental health, to supply adequate water and sanitation, or provide affordable housing and transportation. Most of the large urban areas in the basin have conventional municipal wastewater treatment systems. However, the systems were built many decades ago, and their capacity has not grown in tandem with population growth. Therefore, many large urban centres in the basin do not possess proper treatment systems for domestic wastewater, which ends up eventually contaminating the environment with organic matter, plant nutrients, suspended solids, and pathogenic organisms.



Lightweight plastic bags are a problem across the region, causing serious flooding if they block drainage systems, which is one reason why several countries in East Africa are leading the world in banning them.

Open-air burning is the most common method of waste disposal in settlements such as this one on the southern fringe of Khartoum, The Sudan.



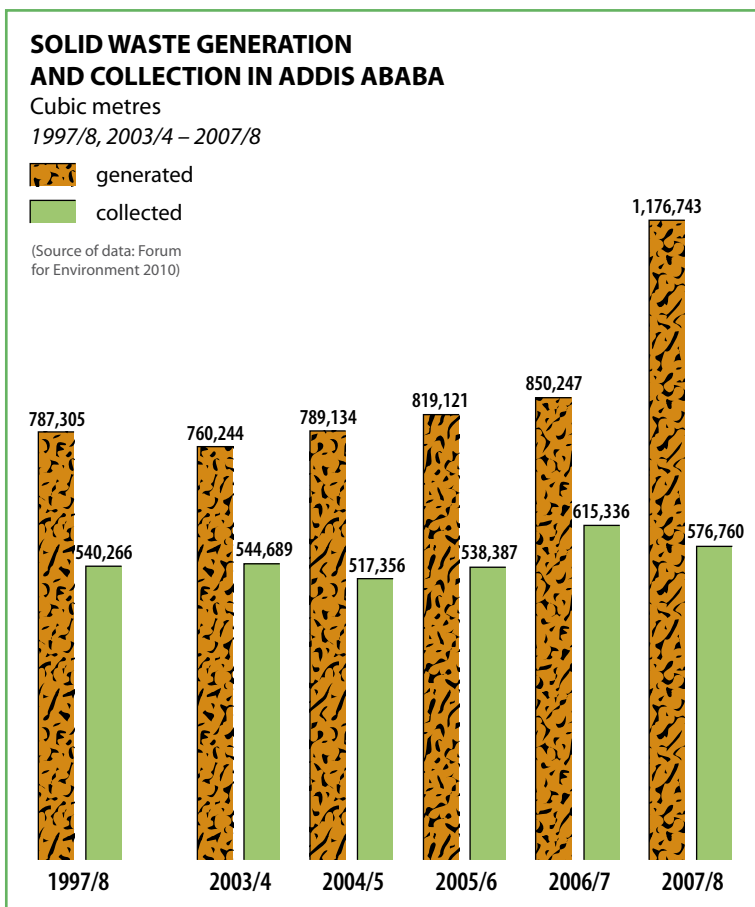
Solid-waste management in the urban areas is also generally poor. Commonly, uncollected garbage accumulates in large heaps in the backstreets, which in turn can find its way into the Nile tributaries through stormwater runoff.

The construction sector, which is concentrated in urban areas and experiencing a boom across the region, requires building poles, timber, stones, sand, clay, and limestone for



Poles that have been transported 300 miles from Renk in Upper Nile state to be sold in Khartoum.

A large proportion of garbage in Addis Ababa remains uncollected. A similar situation exists in other large urban areas in the basin.



Rubbish strewn across wasteland on the outskirts of Cairo. Several thousand hectares of agricultural land in Egypt are lost each year to such expansion of human settlements.





cement. Uncontrolled extraction of these materials contributes to alteration, fragmentation, and destruction of the natural habitats of the Nile Basin. The demand for commercially valuable tree species is so high that it is driving some species towards extinction.

**Industry:** Pollution from untreated industrial effluents in the major urban areas is another serious environmental problem. The large urban areas in the basin have many mainly agro-processing industries (such as coffee hullers, grain milling, sugarcane milling, fish processing, milk processing, soap manufacture, edible oil processing, breweries, soft drink manufacture, meat packing, and confectioneries). These produce wastes high in organic matter, suspended solids, and plant nutrients. There are also a number of factories with more toxic wastes, such as tanneries, paint mixing, drug and battery manufacture. The Ethiopian part of the basin is notable for the number of tanneries in operation.

Cities located on the shores of Lake Victoria discharge treated and untreated effluent into the lake. Inflow of untreated domestic effluent and contaminated runoff from the city of Kisumu and its surroundings has been a major contributor to the acute eutrophication and severe water hyacinth infestation of Lake Victoria's Winam Gulf.

In Egypt, which is the most industrialized country in the Nile Basin, water pollution from industrial, municipal, and agricultural sources is a serious issue that exacerbates the already grave water scarcity problem of the country. Egypt's many industries include agro-based (such as sugar mills, manufacture of edible oil, fruit processing, and confectionery), chemical, electroplating, petroleum refineries, pesticide manufacturing, plastics and rubber manufacturing, and heavy engineering. These industries are mainly concentrated in greater Cairo and the Nile Delta region, and only partially treat their effluent prior to discharging it into the Nile, irrigation canals, public sewers, and into the ground. The discharge of partially treated wastes causes many problems, including oil and heavy-metal pollution.

Pollution from the industries in the basin is not limited to water pollution, but includes air, soil, and sound pollution.

**Mining:** The Nile riparian states have a diversity of mineral resources that include gold, silver, chromium, copper, iron, tin, tungsten, tantalum, phosphates, limestone, natural gas, and petroleum. Production for most minerals is at low level, but the few mining activities are having deleterious impacts on the environment. Artisanal gold mining, perhaps the most widespread mining activity in the basin (which occurs in many parts of Tanzania, Uganda, DR Congo, The Sudan, and Ethiopia), poses a threat to the

Untreated effluent from a sugar factory in The Sudan flows into the White Nile, 2007.



environment through indiscriminate clearing of land, as does the use of mercury during the amalgamation stage of gold production. Petroleum production, which is at commercial scale in the two Sudans, exerts considerable pressure on the environment.

**Domestic energy:** In most Nile Basin countries, 80 per cent of households rely on biomass to meet energy needs. But even in urban areas, where there is greater access to electricity, many households use wood fuels – mainly charcoal – for cooking. Rampant logging has left a large proportion of the basin land exposed to wind and water erosion. This has in turn led to increased sediment loading, siltation, and eutrophication of water bodies. The loss of fertile topsoil layers is also escalating the destruction of upland habitats and reduction of their ability to support livelihoods.

### SOUTH SUDAN: ENVIRONMENTAL CHALLENGES OF THE PETROLEUM SECTOR

Major reserves of natural gas and petroleum have been discovered in several locations within the Nile Basin, including the Albertine Rift Region and the White Nile floodplains. The natural gas and oil reserves, by coincidence, are located in biodiversity hotspots. Their exploration and development, if not well managed, could cause species extinction and gross environmental damage. The situation in South Sudan provides a good overview on the environmental challenges posed by the petroleum industry to the basin.

Only a small part of the oil-bearing areas of South Sudan have been fully explored. The current oil fields are located at Bentiu and Thar Jath in Unity State; and at Adar and Mallut in Upper Nile State. Production in the future is expected to double or treble the present peak capacity of 260,000 barrels per day. Oil revenues today account for over 98% of the annual budget of the government of South Sudan.

The areas targeted for oil exploration are particularly vulnerable to environmental damage as they have few roads, are relatively well forested, have soft soils, and flood for several months a year. The concession area Block 5A that encompasses the Bentiu and Thar Jath oil fields is sandwiched between the Bahr el Ghazal and Bahr el Jebel rivers. This area – part of the greater Sudd, toic, and White Nile reticulation system – lies west of the Zefah Game Reserve and supports many unique assemblages of flora and fauna. The area is also home to multiple agro-pastoral communities, who practise recession agriculture, and migrate seasonally with large livestock herds.

Many negative environmental and social impacts have occurred from petroleum exploration and production

in South Sudan. These include large-scale intrusion into previously undisturbed areas; damage to pastoral lands and dwellings from road construction; disruption of drainage patterns by road construction leading to drying of streams; interference with recession agriculture; and hindrance of wildlife access to water.

At the oil production sites, multiple hazards occur, including the discharge into the environment of untreated or partially treated water; needless emissions of greenhouse gases from flaring of produced gas; and secondary development impacts resulting from the attraction of populations seeking employment and other benefits from the oil industry.



A black-crowned crane, a species already considered vulnerable that would be put at greater risk if its habitat in South Sudan were disrupted by oil exploration.



**Invasive species:** Invasive species are plants, animals, and microorganisms that occur outside their natural range. They are introduced intentionally for economic or agricultural purposes, or accidentally, through tourism, travel, or trade. Invasive species may originate from foreign lands or from a different part of the same country or region. Once introduced, invasive species may spread very fast and threaten the survival of native species. The invasive species are able to proliferate quickly as a result of having little, if any, form of natural control (such as competitors, predators, parasites, or pathogens) in their new host environment. Within the aquatic ecosystems of the basin, the most widely distributed invasive alien species include the water hyacinth, purple nutsedge, common carp, and Mozambique tilapia. Water hyacinth affects the entire Nile system but has had the greatest impact on the headwaters of the White Nile, especially on the Kagera River, Lake Victoria, and the Sudd. Water hyacinth infestations block waterways, interfering with their use for transport, fishing, and swimming.

Water hyacinth mats also prevent sunlight and oxygen from penetrating the water column and reaching submerged plants and animals, thus reducing biological activity. Furthermore, the hyacinth mats provide breeding grounds for snails carrying schistosomes (bilharzias) and malaria mosquitoes, thereby causing public health problems in irrigation schemes and along infested waterways. In Egypt it is difficult to find a canal, stream, or drain not infested by water hyacinth, particularly in the Fayoum and the Nile Delta.

The purple nutsedge is one of the basin's worst crop weeds, and affects both rainfed and irrigated agricultural areas. The common carp, which is used in the basin for angling and as an ornamental fish, feeds in a manner that alters aquatic habitats, thereby affecting the survival of native species. The Mozambique tilapia, which eats almost anything from algae to insects, is used for aquaculture and control of mosquitoes. However, populations of the Mozambique tilapia in the wild have become established within the basin from intentional release or escape from fish farms. The Mozambique tilapia can harm native fish populations through competition for food and nesting space, as well as by directly consuming small fish.

The terrestrial ecosystems of the basin are also affected by invasive plant and animal species. Common among the terrestrial invasive plants are crop weeds such as speargrass and bristly foxtail; and pasture invasives such as lantana, lemon guava, catclaw, and weeping wattle. The pasture invasives are unpalatable, toxic, or have low



A small water hyacinth mat such as this can quickly spread to become a major problem.



nutrient value. They commonly displace good pasture grasses and shrubs, thereby reducing the ability of pastures to support livestock and wildlife. In the toxic savannah grasslands of South Sudan, frequent bush fires are helping fire-resistant but unpalatable invasive species such as speargrass (*Imperata cylindrical*) to increase their cover at the expense of more desirable fodder grasses. Invasive terrestrial animal species are also present and include the speckled mousebird and ring-necked pheasant.

As well as invasive species from other regions of Africa or the world, the basin contains invasive species that are native but have spread to areas beyond their natural range, for example, the Nile tilapia, Nile perch, Ngege (*Tilapia zillii*), domestic donkey, and the cattle egret. These species can interfere with the ecosystems in a similar way to that of the non-native species. Intentional and accidental introductions by humans have been responsible for the spread of many of the native species.

**Civil insecurity:** This term is used to describe situations where there is insurgency, lawlessness, rebellion, armed conflict, or civil strife. Civil war has been responsible for the decline of biodiversity in many parts of the basin, notably in Burundi, eastern DR Congo, Rwanda, Uganda, South Sudan, and Ethiopia. It is generally the case that areas suffering from civil insecurity are associated with depressed economies and unsustainable exploitation of environmental resources. In such areas, there is a breakdown in government structures and increase in uncontrolled lumbering and poaching of wildlife. Sprawling camps of displaced persons emerge within or near the conflict zone. The lands in the immediate neighbourhood of such camps become badly degraded as the displaced population cut surrounding trees for firewood and construction of temporary shelters.

In some instances, the displacement of populations by civil insecurity helps to protect plants and animals from human exploitation. This has been the case in parts of South Sudan, where aerial surveys conducted by the Wildlife Conservation Society in 2007 found stocks of wild animals in numbers that rival those in the Serengeti. The survey estimated 800,000 white-eared kob, 250,000 mongalla gazelle, 160,000 tiang, 13,000 reedbuck, 8,900 buffalo, 8,000 elephants, and 2,800 ostrich to be occurring in the areas around Jonglei, Boma, and Madingilo National Parks.



*Lantana camara*, a common invasive plant species in the Nile Basin.



White-eared kob in South Sudan.



## NATURAL PRESSURES

**Climate change:** Climate change is predicted to become the largest single driver of biodiversity loss over the next 100 years and threatens the survival of the plants and animals through a shift in temperature to a range in which the species are not well adapted. To survive, species will be compelled to shift habitat ranges or migration patterns. Climate change further affects plants and animals through emergence and increasing range and virulence of diseases. Species not able to evolve or shift their habitat ranges quickly enough will be at risk of extinction or suffer drastic loss of individuals.

Different parts of the basin are expected to be affected to different degrees by climate change, with the most sensitive areas being the Nile Delta in Egypt, the Sahel ecoregion in Sudan, the montane forest ecosystems in the headwater areas, and the freshwater lakes of the Equatorial Lakes region. Large areas of the Nile Delta are expected to be affected by sea-level rise and salt-water intrusion. The Sahel ecoregion is expected to experience the highest level of temperature rise, accompanied by an increase in aridity and rate of desertification. This will pile pressure on the already fragile ecosystems, and intensify competition and conflicts for environmental resources among pastoralist communities. The montane forest ecosystems of the Nile Basin are among the most sensitive and vulnerable to the impacts of climate change. They have been, and continue to be, affected through the retreat of glaciers, reduction of frost, shift in tree lines, and change in species composition. The habitable areas for many endemic species such as the mountain gorilla and walia ibex is fast shrinking. Between 25 and 42 per cent of the plant species in Africa are predicted to completely lose their habitat in 2085, while between 10 and 40 per cent of the animals are expected to become critically endangered or extinct by the same period. Climate change is driving marked ecosystem changes in the Equatorial Lakes through stronger and more prolonged seasonal thermal stratification, and acute dissolved oxygen limitation in bottom waters (hypolimnetic anoxia).

**Desertification:** This term refers to the degradation of semi-arid and sub-humid drylands located at the margins of true deserts. Desertification results from a complex interplay between natural climatic and human-induced processes, with the latter, probably, as the main driver of the process in recent years. Communities living at the edge of deserts accelerate the process of desertification through overgrazing and removal of woody vegetation, and through poor agricultural practices and unsustainable groundwater exploitation. The decline in vegetation cover associated with natural and



A member of the remnant population of the rare and endangered mountain gorilla in the montane forests of Rwanda.

Encroaching sand dunes in Arji, Northern State, Sudan, 2007.



anthropogenic activities leads to increased soil erosion, remobilization of sand dunes, increased aridity, deterioration of pastures, failing crops, increased civil conflicts, and further displacement of people. In the Nile Basin, the country most affected by desertification is The Sudan, particularly the northern states such as Northern Kordofan, Northern State, North Dafur, West Dafur, and Nile State.

**Natural disasters:** These occur frequently in the Nile Basin, and lead to the stress and death of wildlife or stagnation in their populations. The common natural disasters in the region arise from drought, flooding, storms and hailstones, disease epidemics, and landslides. Drought, the most widespread of the natural disasters, occurs frequently, causing loss of pasture and drinking water for wildlife, and occasionally resulting in wildlife die-offs. Drought affects all of the national parks in the basin, right from the Masai-Mara-Serengeti and Akagera National Parks in the equatorial headwater areas, through Queen Elizabeth, Lake Mburo, and other National Parks in Uganda, to the wildlife reserves in South Sudan and southwestern Ethiopia.

Unusual flooding of the Mara River, another natural disaster, is known to cause drowning of large numbers of animals during the great annual migration of the wildebeest and zebras in the Mara watershed. Flooding in the Sudd area leads to expansion of the wetlands and reduction in grazing area for wildlife and livestock. A natural outbreak of anthrax in Queen Elizabeth National Park in 2005 caused the death of over 300 hippos.

Wildebeest crossing the Mara River.





## IMPACT OF PRESSURES

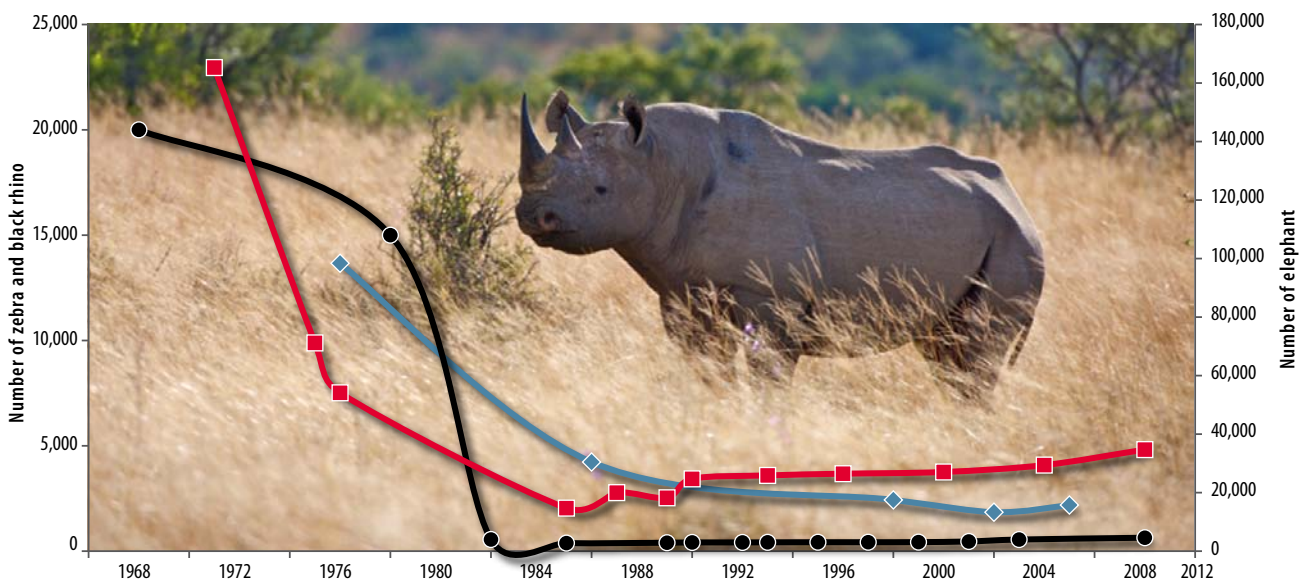
**Landcover changes:** One of the impacts of increasing human activity in the basin has been changing land cover. Satellite images of the basin for the years 2005 and 2009 show substantial changes in the area of certain habitats. These changes are considered to reflect natural expansion and contraction in the area of vegetation types, as well as human-induced land-use changes.

### WILDLIFE DECLINE

Decline in populations of black rhino, elephant, Grey's zebra 1970–2010

- black rhino
- elephant
- Grey's zebra

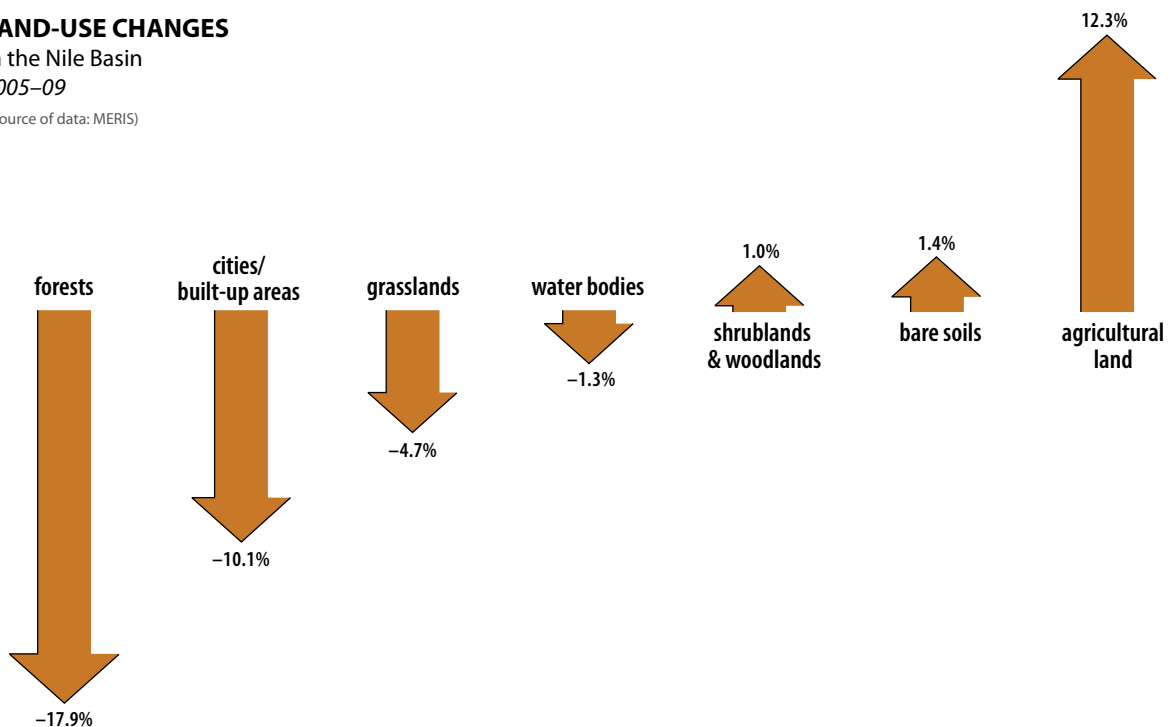
(Source of data: NEMA (Kenya) 2011)



### LAND-USE CHANGES

In the Nile Basin  
2005–09

(Source of data: MERIS)



**Destruction of critical watersheds and ecosystems:** Many of the watersheds critical for sustaining the Nile flows have been badly degraded. One such ecosystem is the Mau Forests Complex – the largest water tower in Kenya. The Mau Complex feeds major rivers draining into lakes Victoria, Turkana, and Natron, and supports critical economic activities, including hydropower generation, tourism, and agriculture. About 100,000 ha of the Mau Forests Complex (about one quarter of the total ecosystem) was destroyed by human encroachment between the mid 1990s and 2010, thereby severely affecting the flow of rivers originating in the forests and thus hydropower generation. The forest area in a nearby ecosystem – Kakamega Forest – was reduced by 50 per cent between 1965 and 1991 by human encroachment. Kakamega Forest is the only surviving rainforest in Kenya, and home to several endemic animals and plant species. Other critical watersheds affected are the montane ecosystems of Mt Elgon, Mt Rwenzori, and the Ethiopian Highlands.

**Loss of biodiversity:** An increasing trend arising from the combined impact of numerous human activities such as habitat fragmentation by agriculture, overharvesting of environmental resources, poaching, and encroachment in protected areas, is a sharp decline in biodiversity. Populations of wild animals in the national parks have fallen drastically, many are threatened or critically endangered, and some have gone extinct.

**Miscellaneous impacts:** Other impacts arising mainly through the activities of humans include loss of soil fertility, soil salinization, saltwater intrusion (in the Nile Delta), surface and groundwater pollution, and reservoir sedimentation.

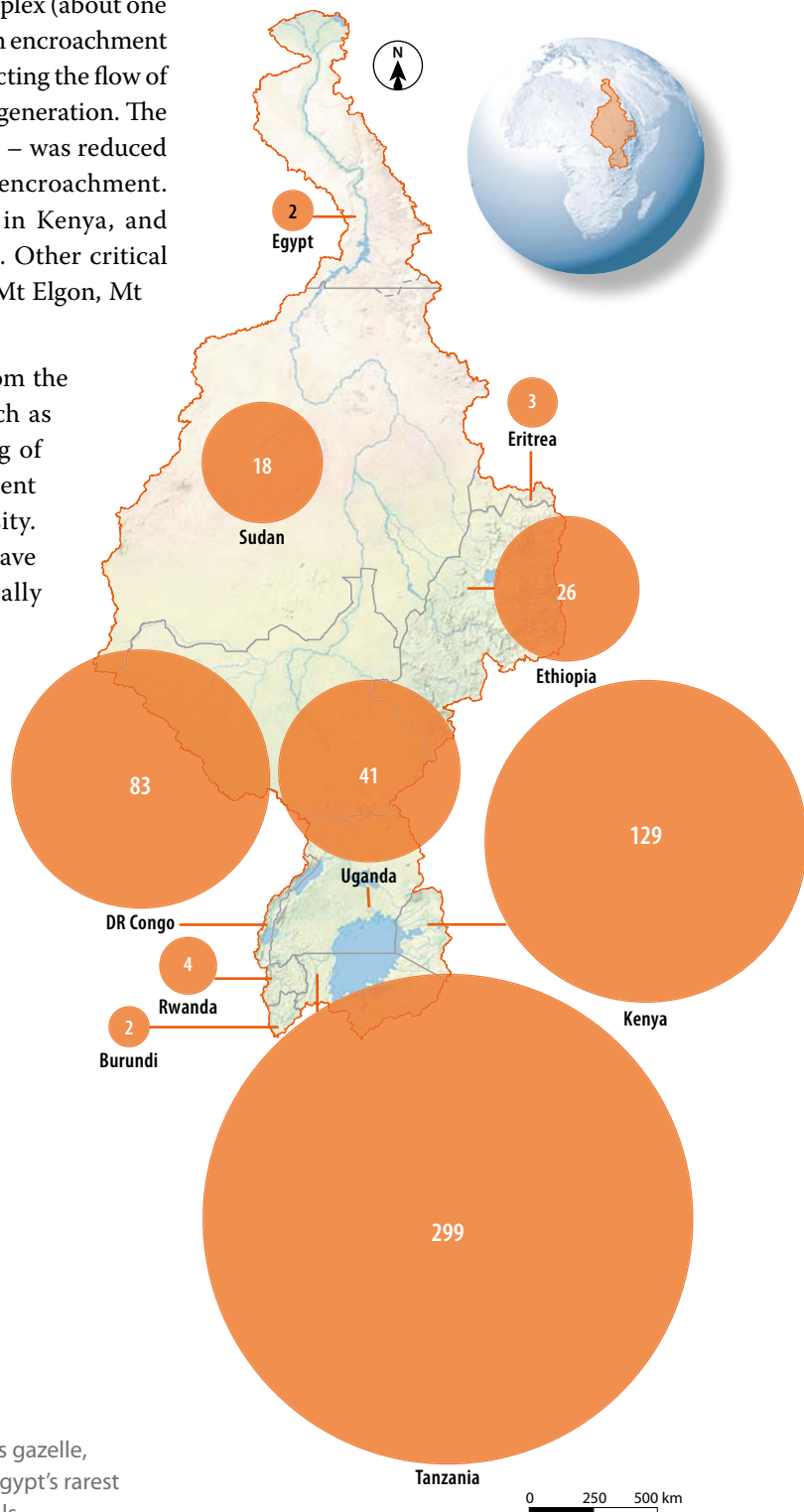


A Dorcas gazelle, one of Egypt's rarest mammals.

**THREATENED SPECIES**

Number classified by IUCN as extinct, critically endangered, endangered or vulnerable in Nile riparian countries 2010

(Source of data: IUCN Red List Ver. 2010.4)





## ENVIRONMENTAL DEGRADATION: UNDERLYING FACTORS AND POTENTIAL REMEDIES

### UNDERLYING FACTORS

Addressing the sustainability of environmental resources necessitates developing a clear understanding of the underlying causes of the pressures and threats to the basin's water and related natural resources.

#### Population growth

The population within the basin is projected to increase to 312 million by 2025. Although the rise in population will be accompanied by an increase in rural–urban migration, the bulk of the population will continue living in rural areas and depend on environmental and natural resources for subsistence and livelihood (see chapter 4). Meeting the needs of the rising population will, among other things, necessitate more virgin land to be put under cultivation or converted to pastures;

more trees cut for firewood, charcoal, timber, or poles; more water supplied for human and livestock consumption, more fish caught for consumption and sale; and more land cleared for erecting human settlements, improving transport infrastructure, etc. Thus, the rapid rise in population is expected to be accompanied by escalation in anthropogenic pressure on the environmental and natural resources of the basin.

#### Poverty

The present land degradation in the headwater parts of the basin has its roots in poverty. Many of the Nile Basin countries are among the poorest in the world. Their populations are heavily dependent upon the environmental resources for their daily subsistence and livelihoods. In situations of poverty and social insecurity, short-term survival prevails over medium- and long-term conservation goals. The unregulated use of these resources creates an unsustainable situation, leading to deforestation, soil erosion, and land

degradation, which in turn lead to decreases in land productivity, wildlife population decimations, and loss of biodiversity. The destruction of the natural resource base leads to greater impoverishment of the population, and perpetuates a vicious cycle of poverty and environmental degradation. It is important to point out that, sometimes, provision of goods and services for consumption by the wealthy and non-poor cause greater environmental damage than those attributable to the poor.

#### Political instability

Political instability, which is often accompanied by breakdown in law and order, is a threat to endangered species such as the mountain gorilla, African rhino, and chimpanzees. Protracted civil wars extending over decades have affected Nile Basin countries such as Burundi, Democratic Republic of Congo, Ethiopia, Rwanda, South Sudan, The Sudan, and Uganda. Protected areas and national parks are favoured refuges for militant groups due to their remoteness, natural camouflage, difficult terrain, poor accessibility, and ready supply of food. Sometimes environmental and natural resources (game, firewood/charcoal,

timber, hides and skins, ivory, horns, minerals, etc) are harvested and sold to finance these groups. Civilian populations displaced by the conflict place further strain on the ecosystems they are forced to occupy as they are left to depend almost entirely on the environment for subsistence and survival. During counter-insurgency operations by the riparian governments, the bushes are frequently burnt to deny militant groups cover, leading to decimation or permanent out-migration of important wildlife species. Other species get stressed and flee from the noise of heavy artillery fire.

## UNDERLYING FACTORS


### Weak policy, legal, and institutional frameworks

In a number of Nile riparian countries, environment and sustainable development are still not sufficiently integrated into broader sectors such as agriculture, fisheries, transport, trade, energy, mining, and industry. Policy making is mostly not proactive but a reaction to unfolding or impending environmental crisis. Laws are sometimes enacted that are beyond the capacity of the

responsible government agencies to enforce. The agencies suffer from low budgetary allocations, inadequate manpower, poor transport facilities, and inadequate technical facilities such as environmental laboratories and monitoring equipment. Corruption (occurring at varying levels in the riparian countries) further weakens the enforcement of environmental laws.

## POTENTIAL REMEDIES

Coordinated interventions are needed in diverse sectors and at local, district, national, and regional levels to address the current pressures and threats to the environment in the basin. Key measures include:

<b>Political action</b>	Mobilizing and sustaining strong political commitment to wise use of environmental	resources at local, national, and regional levels.
<b>Outreach</b>	Strengthening and expanding public awareness and education programmes on the Nile environment; enhancing consultation and stakeholder participation and involvement, e.g. through Nile Day celebrations.	 <p>Regional Nile Day Celebrations in Jinja Uganda.</p>
<b>Preventive measures</b>	Strengthening frameworks for, and carrying out, cooperative basin assessments (CBA), environmental and social impact assessments (ESIA); strategic social and environmental assessments (SSEA); carrying out integrated	waste management; greening sectors of national development; consolidating macro-policy frameworks for sustainable development.
<b>Curative measures</b>	Promoting integrated waste management; promoting cleaner production in the industrial sector; constructing new wastewater	treatment plants and expanding existing; providing extension services to promote appropriate pesticide and fertilizer use.
<b>Environment resources management</b>	Identifying and restoring degraded critical habitats and watersheds; expanding re-forestation and afforestation programmes;	stepping up conservation efforts in critical habitats; promoting wetlands wise-use.
<b>Environmental monitoring</b>	Developing suites of environmental sustainability indicators; strengthening environmental monitoring systems;	strengthening monitoring and evaluation in environmental programmes.



## NATIONAL ENVIRONMENTAL GOVERNANCE FRAMEWORKS

### Common strengths and weaknesses

The policy, legal, and institutional frameworks for environmental governance in the Nile Basin vary in scope and strength from country to country. There are strengths and weaknesses that are common to all countries and strengths and weaknesses that are specific to countries.

The countries, in common, have moderate to comprehensive arrays of national policies, laws, strategies, and plans in sectors such as environment, water, forestry, agriculture, energy, wildlife, tourism, fisheries, mining, climate change, cultural heritage, resettlement, gender, and HIV/AIDS. Except in a few countries, there is a clear national lead agency for the environment. Systems for environmental and social impact assessments (ESIAs) and environmental audit (AU) have been established, and there are national programmes to address different environmental threats.

Weaknesses are more numerous than strengths, and include inadequate human capacity (in the public and private sectors); inadequate budgets (that cripple the operational capacity of national agencies); weak implementation, monitoring, supervision, and enforcement of policies and laws, in particular, weak post-ESIA follow-up on development projects; little synergy, and weak framework for inter-agency and cross-sectoral coordination; lack of regulations and standards needed for implementation of laws; ill-equipped facilities such as environmental laboratories; lack of technology for pollution abatement and waste purification; poorly developed environmental monitoring systems; some outdated laws (especially in the agriculture and mining sectors); lack of accreditation systems for resettlement action plan (RAP) professionals, and in a few countries, for environmental impact assessment (EIA) professionals as well; and low level of integration of social issues such as poverty reduction, gender, HIV/AIDS, and resettlement in environmental management programmes.

In general, Burundi, DR Congo, and South Sudan have relatively weaker policy, legal, and institutional frameworks for environmental governance as compared to other Nile riparian countries.

### Country-specific weaknesses

Weaknesses specific to countries are summarised below.

**Burundi:** Has no semi-autonomous lead agency for environmental management matters; has not established the Commission responsible for resettlement provided for in the Land Code (1986); the laws do not provide for use of tools such as Resettlement Action Plan (RAP).

**DR Congo:** Has no central agency responsible for overall coordination of environmental matters; has no EIA guidelines; some laws such as the Water Act are still in draft form; marginalized people are not recognized under the constitution; and state control of some mining areas is weak.



A gauging station recently installed as part of the NBI Mara River Basin Management Project.



**Egypt:** Has inadequate human resources for decentralized water resources management; resettlement planning is initiated late in the project cycle; mining laws are outdated; marginalized people are not legally recognized; and the country's HIV/AIDS policies provide for denial of working permits to people with HIV, which is against international standards for employment rights.

**Ethiopia:** Many sectoral agencies are not able to execute the functions delegated to them by Federal Environmental Protection Agency (FEPA); the law on land tenure does not protect the land rights of marginalized people.

**Kenya:** Most laws still need to be aligned with the 2010 constitution; the numerous land laws have not provided a mechanism for land re-distribution to ease the widespread land scarcity; there is limited public participation in EIA processes; and climate-change adaptation is poorly mainstreamed in other sectors.

**Rwanda:** Many stakeholders are not sufficiently sensitized on the importance of the EIA process; many provisions in the water policy are yet to be implemented; the agricultural policy does not adequately address needs of poor farmers.

**South Sudan:** Has a weak policy, legal, and institutional framework for environmental governance: the Environmental Bill has not been signed; environmental standards and regulations are not in place; institutional roles and responsibilities amongst key sectoral agencies are unclear; the laws and regulations for implementation of the water policy are not yet in place; decentralized structures for water resources and environmental management have not yet been established; there is no policy or law dealing with wild fires devastating protected areas; a number of laws such as the Forests Act (1989) were inherited from the North and are not in line with the policies of the new state; some policies such as the Wildlife Forces Act (2003) were inherited from the SPLM and need to be replaced; most protected areas do not have updated management plans; and current laws do not provide for community participation in natural resources management.

**Tanzania:** Has no system for accreditation of EIA and RAP practitioners; has no specific policy or law on resettlement and compensation; resettlement action planning is not provided for in power and mining sectoral laws; the procedures for identification of marginalized people are prohibitively lengthy.

**The Sudan:** Has no ministry solely dedicated to environmental management; the national land law conflicts with customary land-tenure systems; the EIA process does not start at project conception but at later stages of project preparation; discriminatory laws against women still exist; and there is no system for accreditation of EIA and RAP practitioners.

**Uganda:** About 75 per cent of the country's land is unregistered, which hinders its access for development; has no EIA guidelines for



the forestry sector; resettlement and compensation have not been mainstreamed in environmental laws and regulations; and the legal provisions for protection of cultural heritage are weak.

## REGIONAL ENVIRONMENTAL GOVERNANCE FRAMEWORKS

### **Nile Basin Initiative (NBI)**

There is no legal framework for regional environmental management covering all ten Nile riparian countries. In the Nile Equatorial Lakes region, with the exception of DR Congo and South Sudan, the riparian states are members of a regional block, the East African Community (EAC). The Eastern Nile region has no comparable grouping of countries.

The NBI, which is the only regional body that brings together all the Nile riparian countries, is best placed to provide a unifying framework for transboundary environmental governance, albeit on a temporary basis until a more robust arrangement is put in place by the Nile Basin States. Activities to prepare the NBI for a possible future role in environmental governance have been undertaken, and include the definition of the environmental management function of the future Nile River Basin Commission, and drafting of an NBI environmental and social policy and guidelines.

### **East African Community (EAC)**

The East African Community is a regional economic community (REC) with five member states (Kenya, Tanzania, Uganda, Rwanda, and Burundi) who are all Nile Riparian countries. The EAC was established by a regional treaty (the EAC Treaty of 1999) which, among other things, calls on partner states to cooperate on all areas of environmental and natural resources management. The partner states in 2006 concluded the protocol on Environment and Natural Resources Management to facilitate cooperation in environmental and natural resources management. This protocol is not yet ratified. Other EAC legal instruments of relevance to environmental governance include the Protocol for Sustainable Development of the Lake Victoria Basin, and the EAC Climate Change Policy.

The EAC Protocol on Environment and Natural Resources Management is intended to be the overarching instrument governing rational utilization and conservation of environmental and natural resources in the community. Through the protocol, partner states will seek to address issues such as biodiversity conservation, hazardous waste management, pollution control, ecological justice, climate-change adaptation, environmental education, capacity building, and public participation.

A principal point of focus under the protocol is the management of shared transboundary ecosystems such as the Lake Victoria and Lake Tanganyika basins; the Mount Elgon forest systems; the Minziro-

Sango Bay swamp forests; the Virunga and Kibira national parks; the Masai-Mara and Serengeti wildlife ecosystem, and the Amboseli-Monduli wildlife ecosystem. Most of the above ecosystems are part of the Nile ecosystem

### **Lake Victoria Basin Commission (LVBC)**

Within the EAC, the Lake Victoria region was designated as a special economic growth zone. The lake's catchment area is shared by all five of the EAC partner states. Starting from the beginning of the 20th century, the lake's drainage basin has been suffering degradation from a multiplicity of anthropogenic activities, but mainly from clearing of forests and savannahs, bush burning, and drainage of wetlands for expansion of agriculture and human settlements.

In an effort to reverse the degradation of the lake, the EAC member states adopted a protocol for the sustainable management and development of the lake, and established the Lake Victoria Basin Commission to oversee the management and development of the lake region. The countries are implementing an action programme to address the degradation of the basin. The first phase of the programme (LVEMP I) established a framework for cooperative management of the lake and its catchments; provided baseline information on the lake; introduced best practices in sustainable utilization of environmental resources; and built capacity for water and ecosystem management. The second phase of the programme (LVEMP II) seeks to further strengthen collaborative arrangements for management of the lake basin and reduce pollution from targeted hotspots and degraded sub-catchments.



Delegates at the Lake Victoria Commission Investment Forum 2010.

### **Intergovernmental Authority on Development (IGAD)**

Countries in Eastern Africa are also cooperating under the auspices of the Intergovernmental Authority on Development (IGAD) to address issues related to regional security, infrastructure development, drought, food security, and environment protection. IGAD was created in 1996 to supersede the Intergovernmental Authority on Drought and Development (IGADD). Its member countries are Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, The Sudan, and Uganda. The 1996 revitalization sought to develop IGAD into a fully fledged regional political, economic, development, trade, and security entity similar to SADC and ECOWAS.



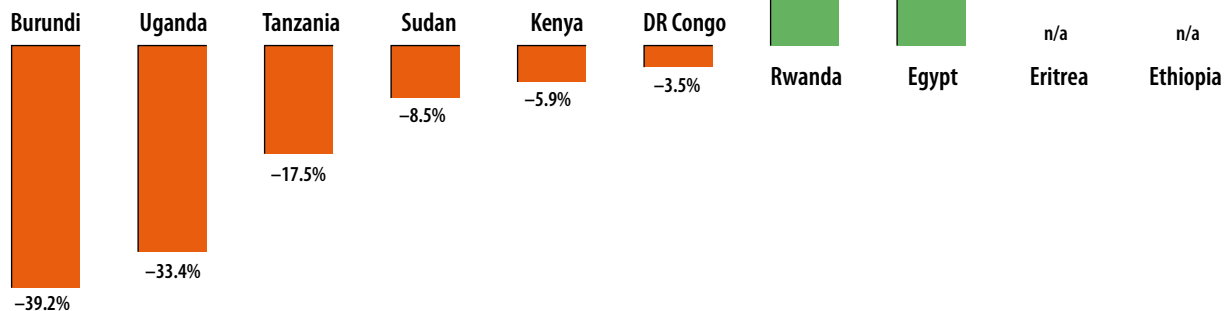
## RESPONSE UNDER NATIONAL FRAMEWORKS

There are wide-ranging activities being undertaken by the Nile riparian countries to respond to the pressures being exerted on the Nile environment. However, the magnitude of threats greatly outstrips the response measures at national and regional levels. Although there are many cases where remedial measures have been successfully applied, greater efforts will be required to control the widespread degradation and rapid deterioration in the environment.

### CHANGE IN FOREST AREA

As a percentage of land area  
1990–2008

(Source of data: UNDP 2011)



Tree planting is one of the response actions that has been widely embraced across the basin but, so far, has managed to reverse the decline in forest cover in only two countries. Examples of other response actions are shown below.

**Greening national economies:** A green economy is defined as one that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities. Potential greening interventions for the Nile countries include greening rural agriculture through integrated pest management, integrated nutrient management, low-tillage farming, agro-forestry, aquaculture, water harvesting, livestock integration, and planting nitrogen fixing crops; greening commercial agriculture through efficient water use; greening power production by investing in renewable energy such as wind, solar, and biofuels; greening tourism to increase local community participation; and greening trade by improving access to domestic and international markets for the poor.

Ethiopia recently formulated a green economy strategy which encompasses strategic actions based on four pillars, namely improving crop and livestock productivity; afforestation and protection of forests; expansion of investments in renewable energy production; and introduction of energy-efficient technology in the transport, industrial, and housing sectors. As part of its effort to implement the strategy, Ethiopia is seeking US\$2.6 million from the African Development Bank (AfDB) for construction of a wind farm at Assela, and implementation of Phase II of the Langanu Geothermal Project. In total, Ethiopia expects to receive US\$22.6 million from AfDB to finance numerous projects under its Scaling up Renewable Energy Program (SREP). Kenya and Tanzania are the other Nile riparian countries due to receive funding from AfDB for climate-related investments. South Sudan is receiving support from the European Union to construct a 50-MW power station that will use biogas and biomass as a source of energy. Other Nile states are also slowly making efforts to green various sectors of their national economies.

**Ethiopia – pursuing integrated environmental management:**

Integrated approaches spanning several sectors are being introduced to deal with the issue of land and environmental degradation in Ethiopia. Notable among these are the preparation of integrated river-basin development plans for the country's main drainage basins; preparation and implementation of integrated land-use plans at village, regional, and national levels; and promotion of indigenous and foreign soil- and land-conservation technologies such as lynchets, stone bunds, checkdams, contour trash lines/grass strips, level and graded bunds, and level and graded fanya juu terracing.

Changes in agricultural systems are also taking place, such as haymaking. A new law – the Ethiopia Rural Land Administration and Land Use Proclamation (2005) – decentralizes the management of land resources to regional and lower levels, and enhances tenure security, thereby encouraging farmers to invest in land-improvement practices. The Federal Government in 1994 classified 58 threatened highland forests as National Forest Priority Areas.

**Rwanda – restoration of Rugezi–Ruhondo–Bulera wetland:** The Rugezi–Bulera–Ruhondo wetland is an international Ramsar site located in northern Rwanda. Years of clearing and draining the wetland for agriculture and pasture led to dwindling water outflows, and caused a drop in electricity generation from downstream power stations. The government of Rwanda intervened to restore the wetlands and encouraged local farmers to return to their abandoned farms on the hill slopes above the wetlands. The government undertook to improve the productivity of farmlands by supporting local communities in constructing terraces and allowing re-growth of trees and shrubs. The wetland has recovered significantly, and water flows and power generation have since stabilized. In October 2010, Rwanda received a Green Globe Award for its restoration.



Workers open the valves of a dam near Mekelle, Ethiopia.



Hay being transported by truck in Ethiopia.



**Kenya – saving the Mau Forests Complex:** Degazettement of forest reserves (revoking of official status) and widespread encroachments on the Mau Forests Complex from the early 1990s have led to the destruction of over 25 per cent of the forests. Since 2008, the Office of the Prime Minister has been coordinating activities aimed at halting the degradation of the forests and maintaining their vital services to man and nature. These measures include the repossession of over 20,000 hectares of forestland; survey and demarcation of the forest boundary; re-settling families removed from the forest; setting up a Joint Enforcement Unit to control illegal activities in the forests; establishing and operating tree nurseries, planting over 25,000 trees in the forest; and establishing water-user associations for the Mau forests sub-basins. These management efforts are starting to take effect. The rate of forest clearance has dropped, and previously cleared areas are beginning to regenerate. Over US\$6 million has been mobilized from diverse sources to support the restoration of the Mau Forests Complex.

**The Sudan – combating desertification:** Despite the severity of desertification, its impacts are reversible. The Sudan was one of the first countries to ratify the UN Convention to Combat Desertification and has long experience in fighting desertification. Over the past decades, the government of The Sudan has focused on strengthening the institutional framework for combating desertification, integrating desertification control measures in national development planning, integrating indigenous knowledge in natural resources management, and embarking on capacity building and awareness-raising. Remedial measures introduced in affected areas include rest-rotation-grazing, planting sand-fixing plants and shelter belts, developing alternative energy sources for cooking, improving water-use efficiency, and controlling salinization in irrigated agricultural fields.



Degraded area of Mau forest.

## RESPONSE UNDER REGIONAL FRAMEWORKS

**The Nile Transboundary Environmental Action Project (NTEAP):** The Nile Transboundary Environmental Action Project was one of the eight projects of NBI's Shared Vision Program (SVP). It sought to provide a regional framework for the management of environmental challenges in the Nile Basin, and was comprised of five components:

1. institutional strengthening
2. community-level land, forest, and water conservation
3. environmental education and awareness
4. wetlands and biodiversity management
5. water-quality monitoring.

Key project outputs included training of environmental practitioners and community groups; the completion of 30 community-level micro-grant projects demonstrating best practices in management of transboundary land, soil, forest, and water resources; knowledge

products for environmental education and awareness; national baseline reports for water quality, and wetlands and biodiversity; a manual for water-quality sampling and analysis; draft Nile Basin wetlands management strategy, draft environmental management function of the future Nile River Basin Commission, and draft transboundary environmental and social management guidelines.

### WATERSHED MANAGEMENT UNDER ENSAP

With a total population of 110 million, the Eastern Nile watershed covers an area of 1.7 million km<sup>2</sup>. Parts of the watershed in the Ethiopian highlands are severely degraded due to poverty-driven overexploitation of natural resources. Without restoration of the degraded watersheds, future water resources infrastructure developments in Egypt, Ethiopia, or Sudan will have limited lifespan and economic benefits.




The NBI's Eastern Nile Subsidiary Action Program (ENSAP) included a project – the Eastern Nile Watershed Sustainable Management Project – designed to address this problem. Among the key outputs of the project was the completion of a Comprehensive Regional Assessment (CRA).

Apart from providing a deliberative consultation platform for the eastern Nile countries, the CRA process has also been a valuable as a mechanism for building confidence and capacity.









Another key outcome of the watershed management project was the design of a long-term watershed programme for the Eastern Nile, through which hotspots for watershed degradation and 13 investment projects for watershed management were prepared. The following national watershed management projects identified through this process are under implementation: Upper Rib, Upper Gumera, and Jemma (Ethiopia); Dinder, Ingasena, Lower

Atbara (Tekezze), Lau (The Sudan); and Lake Nasser/ Nubia (Egypt).

### VULNERABILITY TO EROSION In Blue Nile (Abay) Basin, Ethiopia

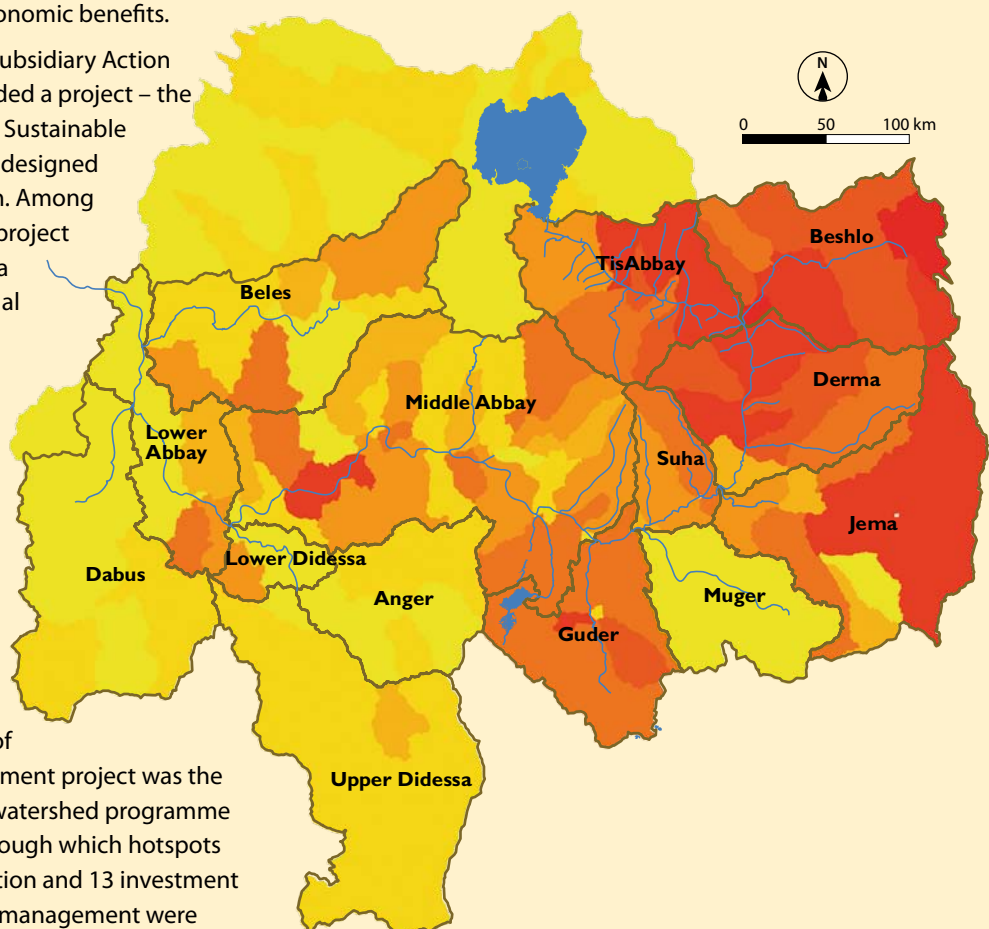
-  upper Blue Nile rivers
-  sub-watersheds
-  lakes

Estimated average soil loss  
tonne/Ha per year

-  > 3
-  3 – 10
-  10 – 15
-  15 – 20
-  20 – 40
-  40 – 50
-  50 – 100
-  100 – 175



(Map prepared by the NBI; source of data ENTRO)





## CONCLUSIONS AND RECOMMENDATIONS

The Nile has a large drainage basin spanning 35 degrees of latitude and traversing three major climatic zones. The basin is divisible into two broad areas: a semi-arid to arid northern half (in The Sudan and Egypt) that has little plant and animal life, and a wet and humid southern half (South Sudan, Democratic Republic of Congo, Uganda, Ethiopia, Kenya, Tanzania, Burundi, and Rwanda) with high biological diversity. Overall, the basin has many remarkable environmental features, among which are large rivers and waterfalls, extensive river floodplains, small and great lakes, wetlands, tropical low-land forests, montane forests, woodlands, and savannahs. The basin has many national parks, wildlife reserves, and nature conservation areas that abound with plant and animal life, some of which are endemic and endangered.

The environmental resources of the basin are critical for socioeconomic development, and are heavily depended upon by the basin population for subsistence and livelihoods. Despite their great importance, the environmental resources are in a state of decline and are coming under increasing pressure from a number of sources, both natural and human-induced. The key pressures arise from alteration, fragmentation, and destruction of natural habitats; over-exploitation and unsustainable utilization of environmental resources; pollution; invasive species; civil insecurity; climate change; desertification; and natural disasters. Weak institutional frameworks and poor enforcement of environmental regulations in the countries allows the problems to persist and worsen with time.

Many actions are required to address the threats to the Nile Basin environment, most of which have to be taken at national level. It is of great importance that the countries make the necessary interventions in a timely manner otherwise damage to the environment could become permanent or irreversible. The interventions mainly relate to pollution control and integrated watershed management.

At the regional level, there are a number of actions worth considering that could complement national efforts and improve the overall management of the Nile Basin environment. These include:

- Identifying major ecosystems of a transboundary nature that are critical in sustaining the flow of the main tributaries of the Nile, and developing and implementing joint programmes for their conservation and management.
- Identifying watersheds that are critically degraded and exporting large quantities of sediments that cause siltation of hydraulic structures and waterways outside the country of origin; and developing and implementing programmes for the restoration and sustainable utilization of such badly degraded watersheds.
- Setting up and operating regional monitoring networks that supplement national monitoring frameworks with information on basin-wide land-use, and water quality and pollution trends.



The Nile river bank near Aswan, Egypt.



- Supporting the strengthening of national capacity for environmental management in targeted areas, such as policy analysis, standards development and enforcement, environmental monitoring, and environmental education.

A number of Nile riparian countries are economically weak and may first need support from the international community to improve their levels of economic development and frameworks for environmental management before they can become effective partners in efforts to protect and conserve the Nile River Basin and its environmental resources.



### WATERSHED MANAGEMENT UNDER NELSAP

The Nile Equatorial Lakes region is an area of about 650,000 km<sup>2</sup> stretching from the highlands of central Burundi to the Sudd flats of South Sudan. This area, like the rest of the basin, has suffered from decades of degradation. Under NBI's Nile Equatorial Lakes Subsidiary Action Program (NELSAP), pre-feasibility and feasibility studies have been conducted for introducing transboundary integrated river-basin management approaches in critically affected watersheds.

The first set of studies was conducted in the watersheds of the Kagera, Mara, Sio-Malaba and Malakisi rivers and lakes Edward and Albert. The studies focused on preparing transboundary projects for soil and water conservation, catchment afforestation, wetland restoration, fisheries management, water-quality monitoring, and biodiversity conservation. Similar interventions are being considered for other watersheds, such as the Aswa river basin.

