Landscapes of West Africa

A Window on a Changing World

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Landscapes of West Africa

A Window on a Changing World

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Preface

Dr. Djimé Adoum

Since the 1970s, West Africa has experienced many forms of climate stress — heavy rains, floods, and periods of drought. Drought has had a particularly devastating impact on agricultural production, pastoral livelihoods, and natural ecosystems. Economic losses alone are estimated in billions of dollars.

The concerns raised by these climate stressors have translated into initiatives to combat desertification and to adapt to climate change. The Comité Inter-états de Lutte contre la Sécheresse dans le Sahel (CILSS – The Permanent Interstate Committee for Drought Control in the Sahel) and the U.S. Agency for International Development (USAID) have put in place activities to benefit the population of the Sahel and all of West Africa.

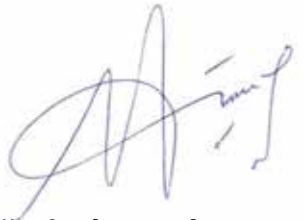
The West Africa Land Use Dynamics (LULC) Project is emblematic of this cooperation. Initiated in 1999, the LULC project has had several phases including training national experts to extract pertinent information from satellite images to characterize vegetation cover and producing tools and supporting information on land cover dynamics.

This atlas — Landscapes of West Africa: Window on a Changing World — is part of the current phase of the LULC project and provides insights into the changes occurring at national and regional levels through mapping time series data from 1975 to 2013. This work highlights landscapes that have undergone major transformations, and examines the drivers of change and their environmental and socioeconomic impacts.

The atlas showcases the accomplishments of the LULC project, and makes a case for further investment in natural resource management. Aimed at both decision-makers and the general public, the Atlas has a goal of making people aware of the changes taking place in the landscapes of the region.

Beyond raising awareness, the atlas also aims to incite action to protect the environment of West Africa and the Sahelian region. We therefore invite everyone — scientists, students, researchers, teachers, planners, managers of development or research projects, local, national and regional decision-makers, donors, members of civil society organizations, and visitors to the region — to make the most of this work.

Congratulations to the experts at CILSS, U.S. Geological Survey, USAID and the country-level teams of the LULC project for this fruitful partnership. We truly hope that this cooperation will continue and deepen, with the view of regaining the equilibrium of ecosystems. Doing so will constitute a decisive step towards realizing a green economy in West Africa, thereby enhancing the well-being of all West African people.



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FROM THE AMERICAN PEOPLE


Alex Deprez

At the core of the U.S. Agency for International Development's (USAID's) mission is a deep commitment to work as partners in fostering sustainable development. Environments that are vulnerable to changing climate patterns are often the most reliant on agriculture for food and income, and the least able to financially protect themselves or respond to disasters. As effects of climate change are felt more severely, advanced mitigation and adaptation measures are key to resilience.

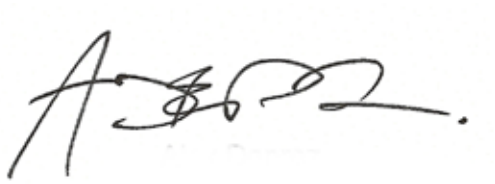
Rapid changes are occurring across West Africa's natural and human landscapes and balancing the need to preserve natural ecosystems with the need to grow more food, together with ensuring resilience in the same ecosystems, is a challenge. USAID West Africa's (USAID/WA) Environmental Threats and Opportunity Assessment and its Climate Change Vulnerability Assessment revealed that timely and accurate information, indispensable for good governance in the environmental sector, is scant and barely accessible. Mitigating climate change impacts and conserving biodiversity can support sustainable development, and prevent countries from sliding further into poverty.

USAID/WA worked in partnership with the U.S. Geological Survey (USGS) and the Comité Inter-états de Lutte contre la Sécheresse dans le Sahel (CILSS – The Permanent Interstate Committee for Drought Control in the Sahel), to analyze changes in land use and land cover in West Africa and to better understand trends over the past 40 years with the goal of improving decision-making in land management. Products derived from these analyses include maps that provide a clear record of changes and trends in three periods — 1975, 2000 and 2013 — in 17 West African countries and aggregated to the regional level.

These maps and analyses form the foundation for future landscape scenarios and contribute to a body of best practices for the re-greening of landscapes in West Africa. Application of the atlas and associated data goes beyond informing decision-making on land use planning. The time series maps provide credible information to help countries account for their carbon emissions to the United Nations Framework Convention on Climate Change and can also be used to quantify carbon emission trends in West Africa for the past 40 years.

This achievement would not have been possible without the U.S. Landsat Program. Landsat satellites have provided the longest-ever continuous global record of the Earth's surface. A partnership of the National Aeronautics and Space Administration and the USGS, the Landsat program provides image data that show the impact of human society on the planet — a crucial measure as the world's population has already surpassed seven billion people. The first Landsat satellite was launched in 1972 and now, 44 years later, Landsats 7 and 8 are continuing to provide an unbroken record of the Earth, providing critical information for monitoring, understanding and managing our resources of food, water, and forests. No other satellite program in the world comes close to providing such a long, unbroken record of geospatial information of the planet.

Knowing that these analyses will be put to use for decision making in natural resource management, I would like to thank all of the teams that worked tirelessly to produce this Landscapes of West Africa atlas. And my sincere gratitude goes to CILSS, the USGS, and the multitude of government institutions in West Africa for their commitment to completing this influential work.



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On behalf of the governments and the people of West Africa who have benefitted from the West Africa Land Use Dynamics Project, the Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS – Permanent Interstate Committee for Drought Control in the Sahel) expresses its profound gratitude to all those who have contributed to the publication of this atlas. In particular, we would like to thank:

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The U.S. Geological Survey Earth Resources and Observation Science (USGS EROS) Center for the scientific and technical guidance, provision of satellite imagery, maps, field data and photographs, statistics and analyses;

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The national teams from across West Africa who provided valuable content for the maps and case studies.

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In Memory

Our thoughts are with three colleagues and friends who are no longer with us. All three contributed significantly to the success of the West Africa Land Use Dynamics Project, including major content contributions to this atlas:

Yendouhame John Kombaté, Responsable Suivi Evaluation et Communication, Agence Nationale de Gestion de l'Environnement, Ministère de l'Environnement, Togo;

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Introduction

Our global ecosystem is and has always been complex, dynamic, and in constant flux. Science tells us how natural forces of enormous power have shaped and reshaped Earth's surface, atmosphere, climate, and biota again and again since the planet's beginnings about 4.5 billion years ago. For most of the planet's history those environmental changes were the result of the interaction of natural processes such as geology and climate, and were described on the geological time scale in epochs spanning millions of years.

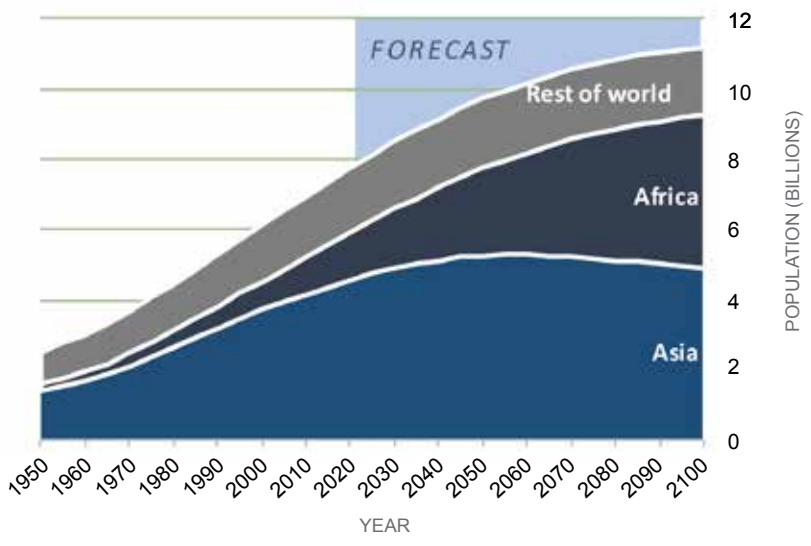
When humankind appeared on Earth around 200,000 years ago the influence of human activity on the environment must have been small and localized. The influence of scattered small groups of people on the global ecosystem would have been overwhelmed by the forces of natural systems (Steffen and others, 2007). Human population would not grow to 50 million (about 0.7 percent of the Earth's current population) for another 197,000 years. Population growth accelerated over the centuries that followed until the planet was adding more than that 50 million people every year. Our planet is now home to roughly 7.3 billion people and we are adding 1 million more people roughly every 4.8 days (US Census Bureau, 2011). Before 1950, no one on Earth had lived through a doubling of the human population, but now some people have experienced a tripling in their lifetime (Cohen, 2003).

With hunting and the use of fire, later agriculture and urbanization, and eventually the industrial revolution and modern technology, the ability of humans to shape their environment also grew exponentially. Earth scientists use the geologic time scale to describe time periods where different processes and forces shaped events in the Earth's history, such as ice ages and mass extinction events. They use periods of time they call epochs, which range from 11,700 years (the Holocene) to millions of years (the Pleistocene and Neogene). In about 2000, Earth scientists coined a new word — Anthropocene — to describe a new epoch where "the human imprint on the global environment has become so large and active that it rivals some of the great forces of nature in its impact on the functioning of the Earth system" (Steffen and others, 2011). Many in the Earth sciences believe that epoch has begun and that humankind with its vast numbers and its power to change the face of the Earth is at risk of putting the Earth system out of balance and causing the collapse of natural systems that are essential for humans to thrive, perhaps even threatening the future of all humankind.

"Mai lura da ice bashin jin yunwa" — He who takes care of trees will not suffer from hunger.

– Hausa proverb

Population growth in Africa and the rest of the world from 1950 to 2100



In 2015, the 17 countries included in this atlas are estimated to have a total population of over 369 million, representing a nearly 5-fold increase since 1950 — outstripping global population growth, which grew by 2.9 fold during the same time (UN, 2015). The young age structure of the West African population assures continued rapid population growth until 2050 and beyond. If United Nations estimates are correct the 17 countries in this atlas will grow to 835 million people by 2050; that would equate to 11.1 times as many people as lived on the same land in 1950 (UN, 2015)!

PHOTO (OPPOSITE PAGE): SUZANNE COTILLON / SGT

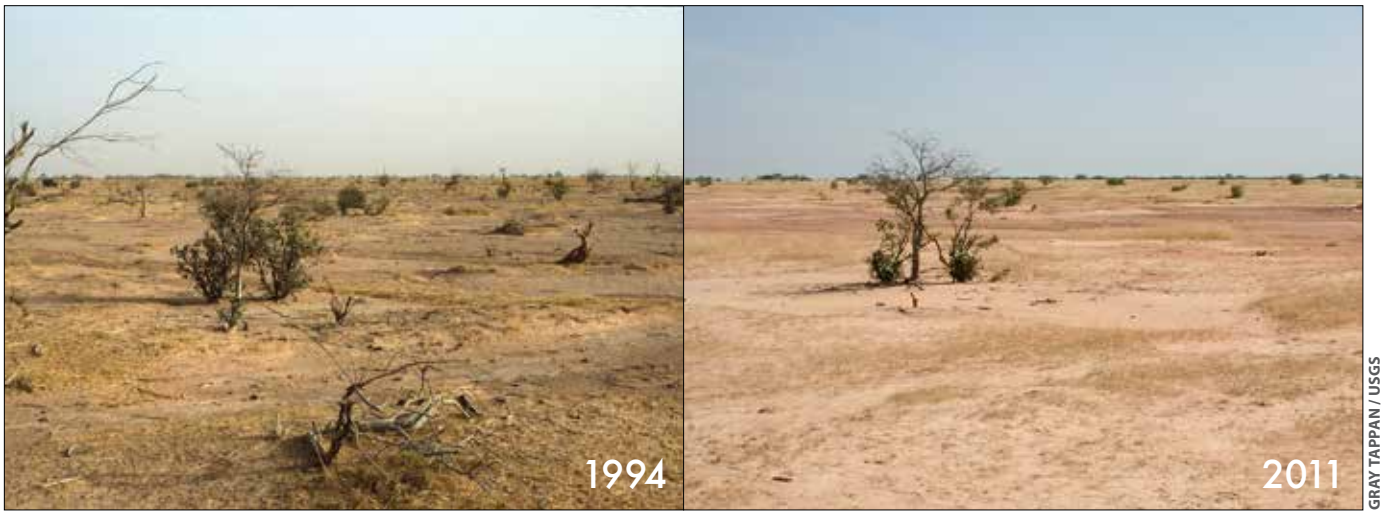
Wooded landscape fragmented by agriculture expansion in western Burkina Faso

JAMES ROWLAND / USGS

Parallel trends can be seen in the land cover changes of West Africa. With so many new families to feed, West Africa doubled the area covered by farms between 1975 and 2013. Vast areas of savanna, woodland, and forest landscape have been replaced or fragmented by cropland. At the same time villages, towns, and cities have grown in area — taking up 140 percent as much land as they had in 1975. In part to make way for those farms and settlements more than a third of the forest cover present in 1975 has been lost. In savanna and steppe landscapes of West Africa, drought, in some cases made worse by unsustainable land use practices, has degraded the vegetation cover contributing to a 47 percent increase in sandy areas (see top images pair, opposite page). The future is unpredictable, but the trends of the past four decades projected into the future would be unsustainable.

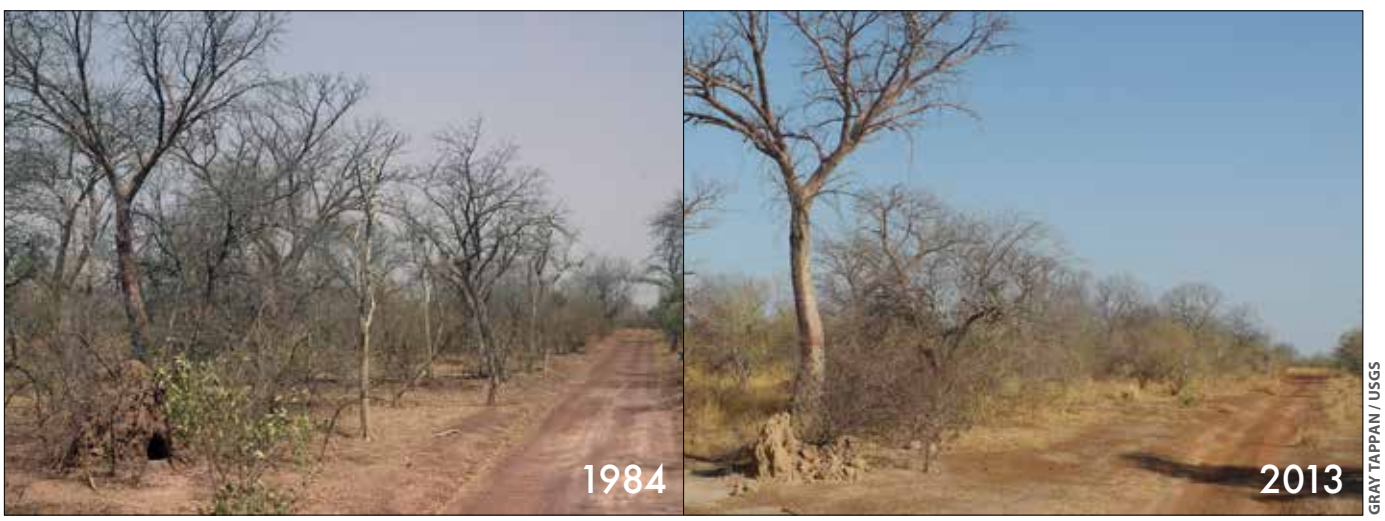
Conversion of the natural landscapes of West Africa to agriculture greatly reduces the natural biodiversity, and exposes the soil to wind and water erosion. The savanna, woodland, forest, and wetland ecosystems that are lost have some relatively tangible impacts such as the loss of natural ecosystem goods and services like wood for fuel and construction, honey, nuts, medicines, game animals, berries, and forage. There are also many important goods and services lost that are less visible such as biodiversity, carbon storage, water quality, water runoff versus infiltration, and regional climate functions.

Expansion of degraded land in the Ferlo region of Senegal



GRAY TAPPAN / USGS

Decline in vegetation cover and biodiversity in east-central Senegal

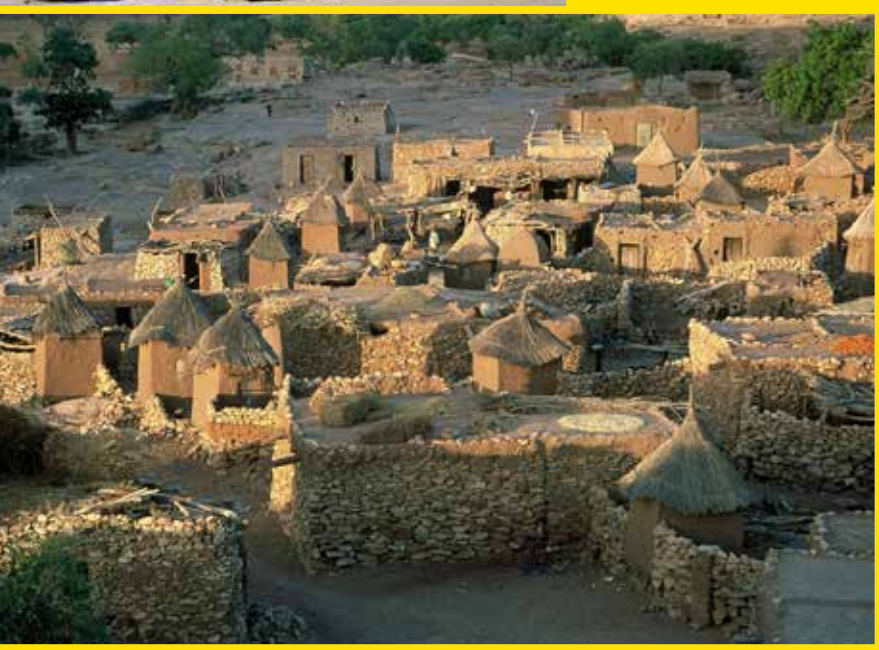


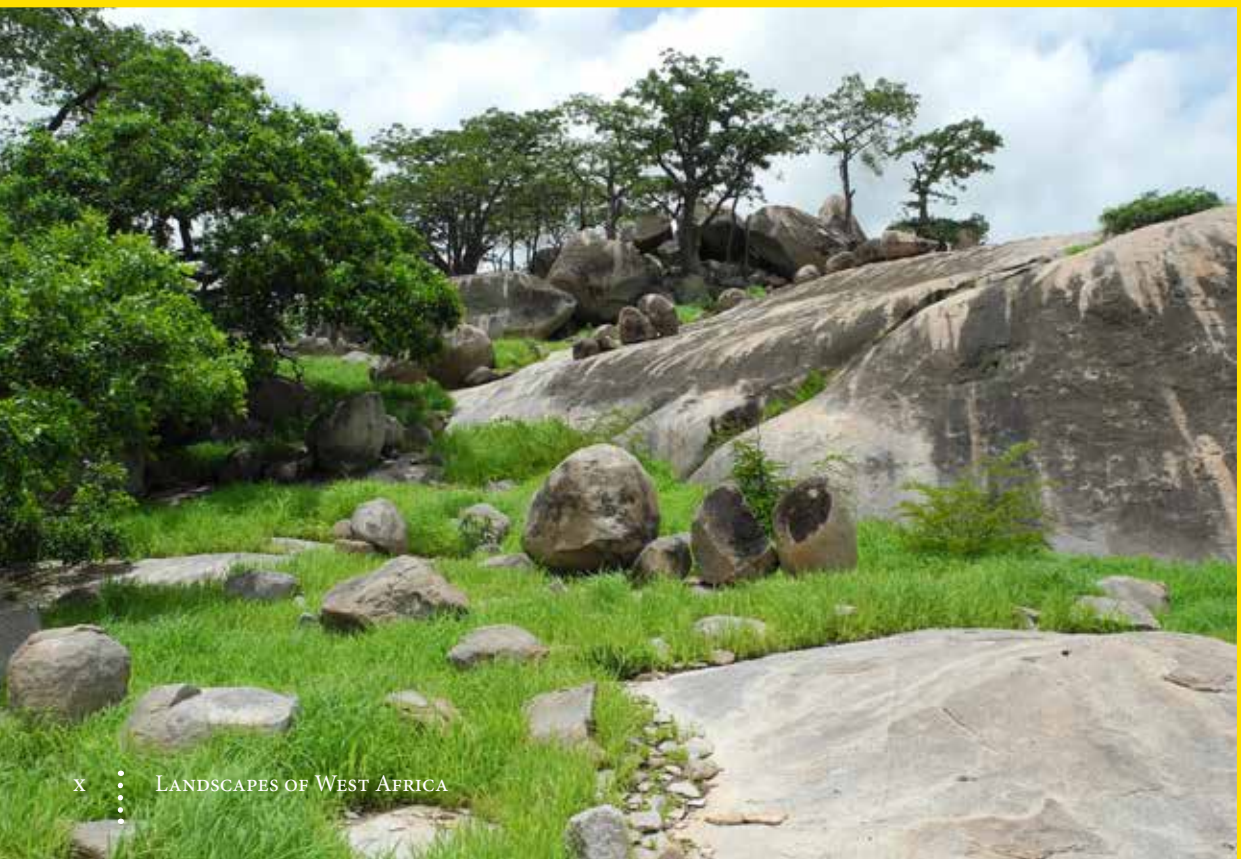
GRAY TAPPAN / USGS

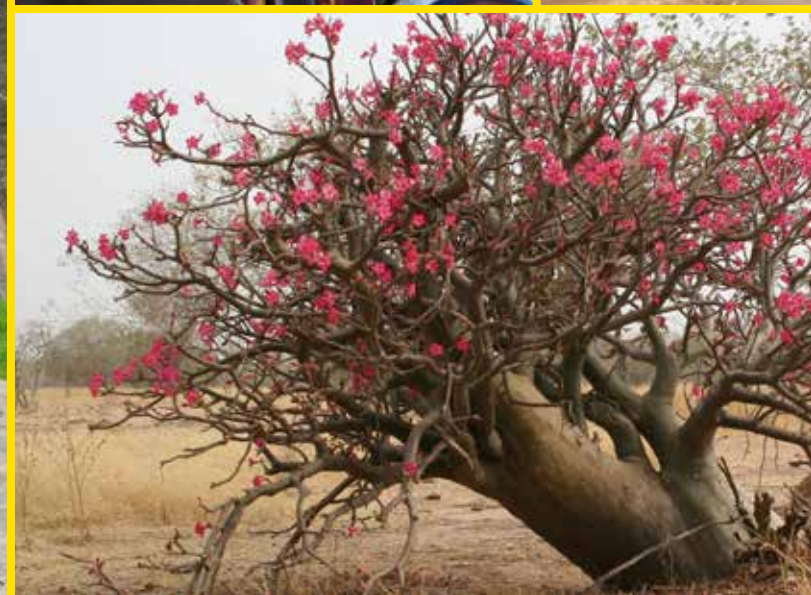
It is in the hands of today's decision makers to formulate wise, well informed choices about how to manage West Africa's land, to ensure that vital ecosystem services and agricultural productivity are able to support tomorrow's people. To make good choices the governments of West Africa need good information about the rapid changes now occurring, the causes of those changes, and the interactions occurring between climate, land use, other human activity, and the environment.

Experts from institutions in 17 countries in West Africa have partnered with the Comité Inter-états de Lutte contre la Sécheresse dans le Sahel (CILSS – The Permanent Interstate Committee for Drought Control in the Sahel), the U.S. Agency for International Development (USAID) West Africa and the U.S Geological Survey (USGS) to map changing land use and land cover and associated factors across much of West Africa through the West Africa Land Use Dynamics Project. This publication presents the results of that work. The following chapters present maps, graphs, tables, and images detailing the natural environment of these 17 countries and changes that have taken place over the past four decades.

This atlas tells a story of rapid environmental change with both hopeful and worrisome chapters. The story is told with maps and numbers detailing the rate, magnitude, and location of land cover change but also with words and images that seek to make the story more real for the people living in West Africa and around the globe. The hope is that this information helps to build a clearer picture of past and current land use and land cover in order to guide us all in making informed choices that will support the livelihoods and well-being of ours and future generations.







Chapter I

West Africa's Changing Environment

1.1
West Africa's Landscapes and Physical Geography

Physical Geography

The 8 million square kilometers and 17 countries covered by this atlas encompass a wide range of landscapes from alluvial valleys in Senegal and Ghana, sandy plains and low plateaus across the Sahel, and rolling hills of Togo to rugged mountains with summits reaching over 1,500 m in Guinea and 1,800 m in Niger. Covering approximately one quarter of Africa, West Africa contains a broad range of ecosystems, bioclimatic regions, and habitats from rain forest to desert.

West Africa can be divided internally through its natural features. Geology, relief, climate, vegetation, soils, and the responses of people to the patterns of its biophysical resources through human land uses all tend to be arranged along east-west belts. Pastoralists in northern Senegal would likely find their livelihoods more similar to those of pastoralists 3,000 km to the east in Niger than to those of someone raising cattle just 300 km south in Guinea-Bissau. Likewise the mix of crops varies more within Nigeria — from the semiarid north to the wet southern coast — than it does from one end of the West African Sahel in Senegal to the other in Chad. The most dramatic transitions in natural features and land use occur as one moves north or south across these belts we call bioclimatic regions. To better understand the geography of West Africa and how it drives land use, we briefly examine the geology, topography, hydrography, climate, and vegetation through these broad bioclimatic regions.

Geology

West Africa is remarkable for its geological variety. Like most of Africa, the region is largely composed of ancient Precambrian rocks (at least 541 million years old; the oldest rocks may be about 3 billion years old), which have been folded and fractured over hundreds of millions of years. These rocks are exposed over about one-third of West Africa and are part of the vast continental platform of Africa, which in West Africa has an average elevation of 400 m (Church, 1966). Numerous series of Precambrian rocks of various ages and their eroded surfaces provided a fairly level floor for the advance and retreat of shallow Palaeozoic seas (a major geologic era after the Precambrian, spanning about 289 million years). As these seas came and went, they deposited and eroded new material that formed the sedimentary rocks that overlay the ancient Precambrian

PHOTOS: GRAY TAPPAN/USGS; MICHIEL KUPERS; RICHARD JULIA

PHOTOS (CHAPTER 1): GRAY TAPPAN/USGS; MICHIEL KUPERS; RICHARD JULIA; MELISSA MATHIS/SGT
IMAGE (OPPOSITE PAGE): NASA BLUE MARBLE NEXT GENERATION

Physical Geography of West Africa

floor across the region. For example, a large sedimentary basin called the Senegalo-Mauritanian Basin extends across much of western Mauritania, two-thirds of Senegal, and into Guinea. It is composed of sediments deposited when the ocean covered this part of the African plate (Michel, 1973; Stancioff and others, 1986).

For most of West Africa, continental conditions have existed since the Eocene or Oligocene, that is, since the last 23 to 34 million years. Most of West Africa's mountain massifs and highlands, such as the Aïr Mountains, the Tibesti Mountains, the Adrar des Ifoghas, and the Fouta Djallon, originated as Precambrian folds (Church, 1966). Much later, volcanic activity in many of these highlands deposited additional layers of igneous rock. Volcanic outpourings have occurred throughout West Africa's geologic history, with major activity as recent as the Pliocene (2.5 to 3.6 million years ago), and even more recent activity in the Aïr and Tibesti Mountains.

During recent dry periods in the late Quaternary (0.5 to 1 million years ago), intensive weathering of sandstone formations produced much of the present day sand sheets that cover vast areas north of a line running approximately through Kano, Ouagadougou, Bamako and Dakar. These sand deposits fill in many irregularities of relief and mask much of the surface geology.

Relief

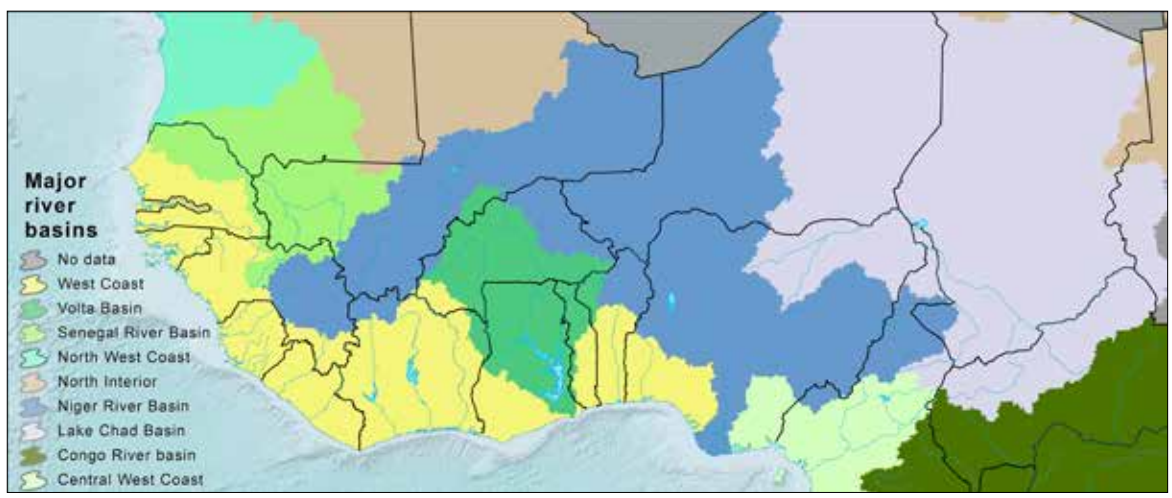
Relief on its own is not the source of great regional diversity in West Africa. For the most part, West Africa is relatively flat and low, which sets it apart from the other major regions of Africa. Nor does the relief do much to interrupt the zonal patterns and latitudinal belts of

climate and vegetation, except in the mountainous regions of the Fouta Djallon, the Guinea Highlands, the Jos Plateau, and the Aïr Mountains. In these areas, rainfall is somewhat higher than in the low plains around them.

Hydrography

Several major rivers, including the Niger — West Africa's longest river — originate in the Guinea Highlands, where rainfall is heavy. Other major rivers rise from Guinea's Fouta Djallon, including the Gambia and Senegal. The Senegal River drains a major basin — the third largest in West Africa after the Niger Basin and the Lake Chad Basin. West Africa's rivers experience great seasonal variations in river flow.

Major river basins in West Africa



(DATA SOURCE: HARVESTCHOICE, 2001)

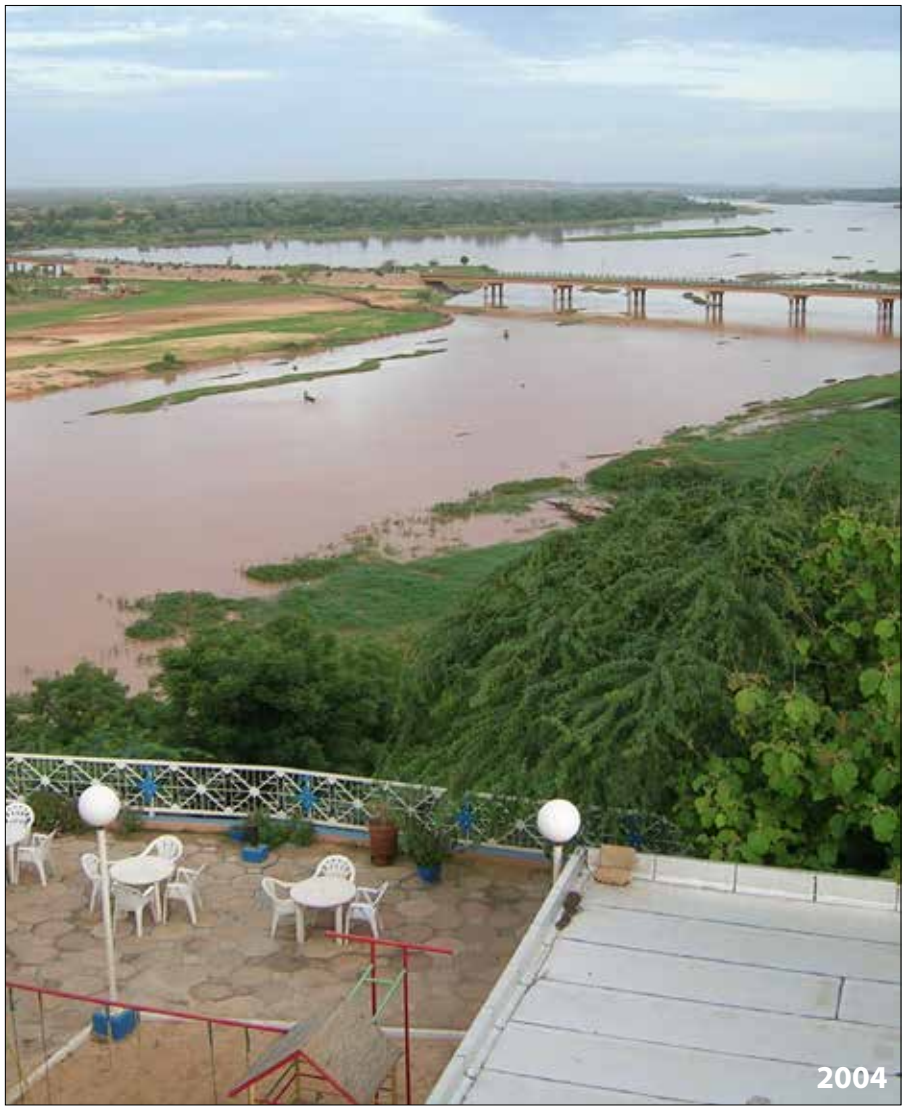
The Niger River is about 4,180 km long and passes through almost every climatic zone in West Africa. A vast inland delta has formed along its way in Mali, owing to the shallow slope of the river and sand accumulations that have obstructed its many channels. The Inland Niger Delta acts like a giant sponge, moderating the flow downstream and reducing the risk of flooding (see pages 146–147). Where the Niger arcs past Timbuktu in Mali's northern Sahel, sand accumulations push it southward. In Nigeria, the Niger River is joined by the Benue, its major tributary, which drains much of northeastern Nigeria.

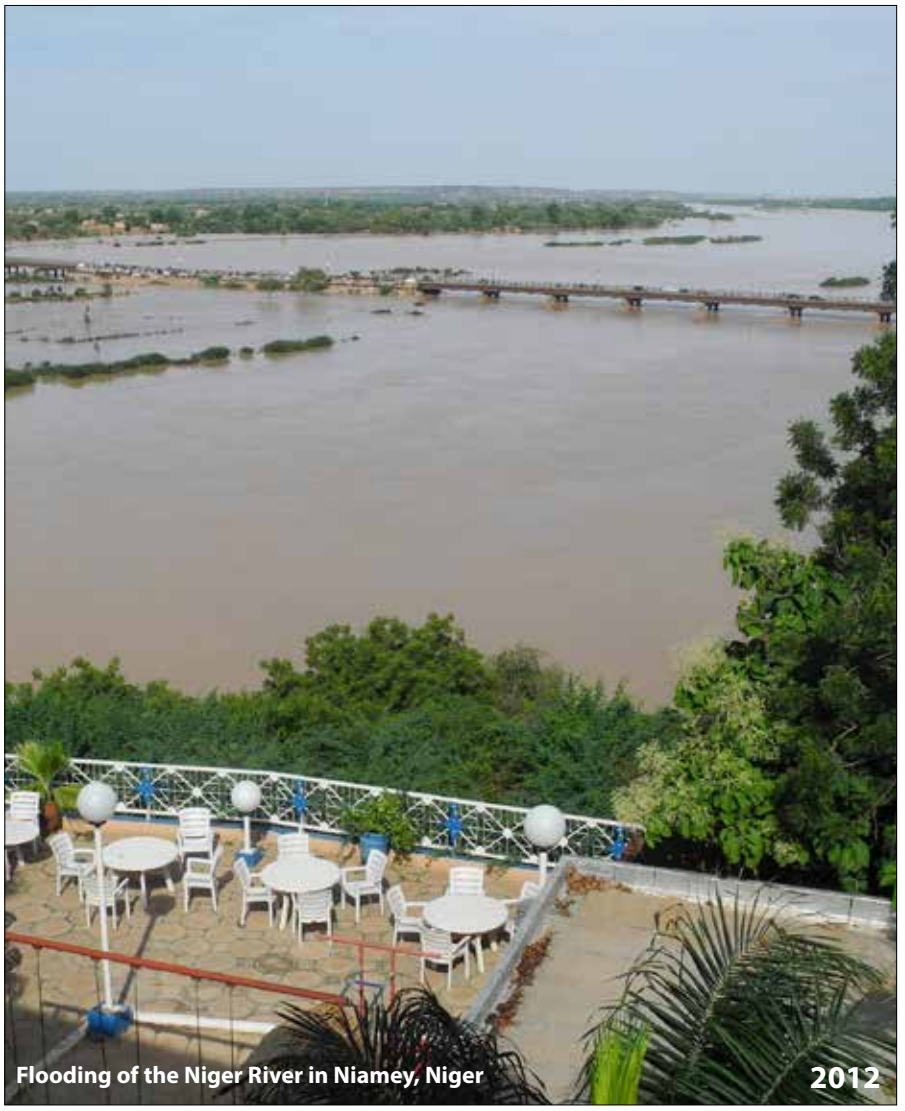
The Lake Chad Basin occupies a huge area, covering parts of Niger, most of Chad, Nigeria, Cameroon, and the Central African Republic. The catchment of the Chari and the Logone Rivers comprises the southern part of the Lake Chad Basin. They feed Lake Chad, which has shrunk to a small fraction of its 1960 size.

Many separate basins are defined by smaller rivers that drain the land between the Atlantic Ocean and the basins of the Senegal and Niger Rivers. Of these, two are worth mentioning: the Gambia, which drains central Senegal and the nation of The Gambia, and the Volta River, which starts at the confluence of the Nakanbé (White Volta) and the Mouhoun (Black Volta), and reaches into the Mossi Plateau in Burkina Faso. Ghana constructed the Akosombo Dam (completed in 1965) in a gorge where the Volta cuts through the Akwapim–Togo Range, creating the world's largest artificial lake, Lake Volta.

Climate

Most of West Africa, from the southern Sahara to the humid coastal countries, has only one rainy season, which lasts from one to six months. The area of two rainy seasons, a long one and a shorter one, is limited to the southern portions of the coastal countries from Liberia to Nigeria. The climate is related to the advance and retreat of the intertropical front — the interface between two air masses — one hot and humid and the other cool and dry. This front migrates annually north and south, following the position of the sun, with a lag of 1 to 2 months. In the winter months (December to March), there is an anticyclonic high pressure area centered over the Sahara. It drives the Harmattan, a desiccating, dusty wind that blows rather persistently from the northeast, drying out landscapes all the way to the coast. In the summer the high pressure area is replaced by a depression, bringing warm, moist winds in from the Atlantic in the southwest (from the Gulf of Guinea) (Arbonnier, 2000; Zwarts and others, 2009). Generally, the dry season lengthens and annual rainfall decreases with increasing latitude. Conversely, in the southern latitudes, rainfall increases and the dry season shortens, often to just four months (December to March). Maximum temperatures and temperature ranges also increase with latitude. In the humid south, temperatures vary little, whereas in the arid north one temperatures range from 0˚C to more than 45˚C (Church, 1966).





GRAY TAPPAN / USGS

PHOTO (OPPOSITE PAGE): MICHIEL KUPERS

From north to south — from the Sahara to the humid southern coast — West Africa can be subdivided into five broad east-west belts that characterize the climate and the vegetation. These are the bioclimatic zones known as the Saharan, Sahelian, Sudanian, Guinean, and Guineo-Congolian Regions, shown in the map on page 8. The lines between these regions represent more of a transition along a continuous ecological gradient than sharp boundaries. There is considerable variation among different authors in the definition and geographic delineation of these regions, though most use long-term rainfall averages to define the boundaries. Since long-term rainfall levels have generally decreased since the 1960s (but increased somewhat in the past two decades), some authors consider these bioclimatic regions to have shifted somewhat southward (Gonzalez, 1997). Since these regions are often referenced in this atlas, it is useful to present their general characteristics. They are presented from driest to wettest climatic regimes.

Saharan Region

The Sahara, or Saharan Region, stretches across the whole northern extent of West Africa, formed by the Sahara Desert. It consists of a variety of arid landscapes varying from sandy sheets and dune fields to gravel plains, low plateaus, and rugged mountains. Vegetation cover is sparse to absent, except in depressions, wadis, and oases, where water is present at or just below the surface. Average annual rainfall ranges from 0 to 150 mm per year.

Sahelian Region

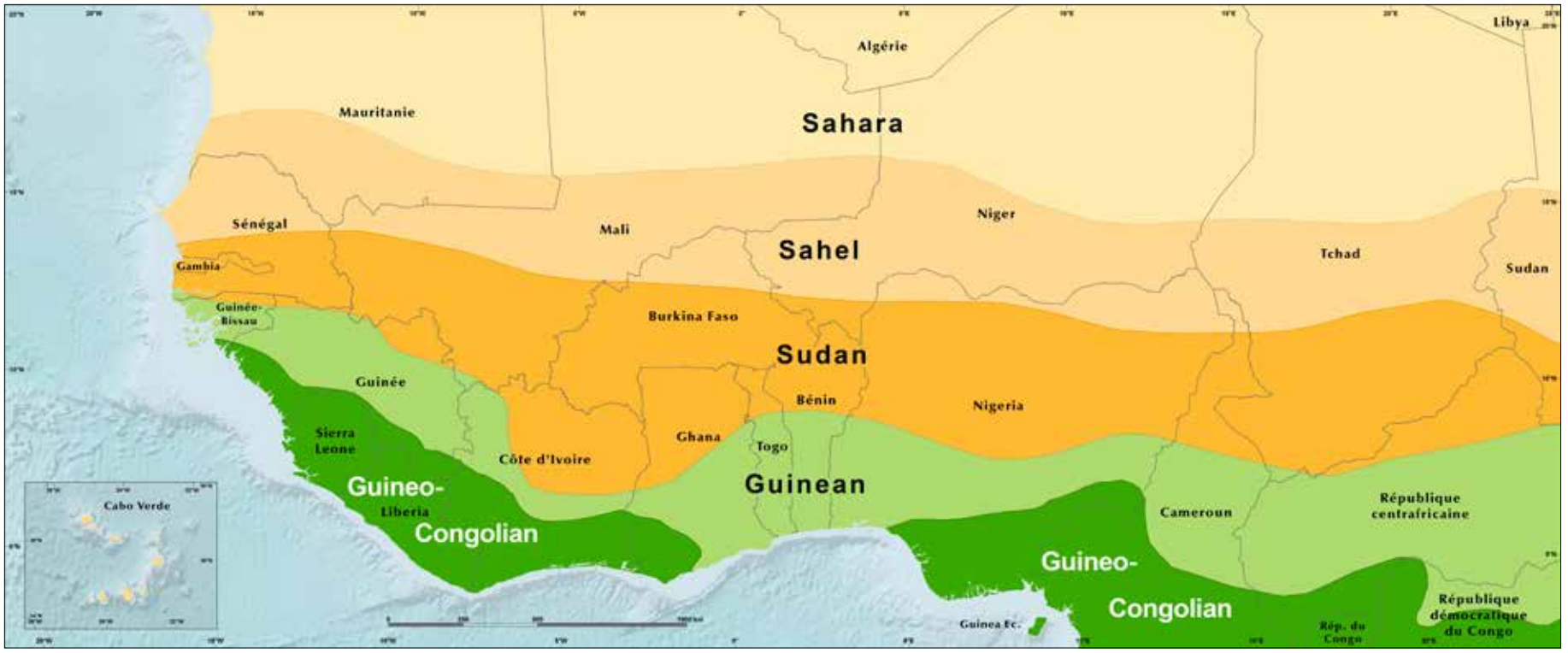
The Sahel, or Sahelian Region, is a broad semiarid belt, extending from the Atlantic Ocean to Sudan (and to the Red Sea), averaging about 350 km wide. Climatically, it is characterized by average annual rainfall between 150 and 600 mm, with great variability in amount and timing in a given year. It has an ecologically dry season of 8 to 9 months. Vegetation in the Sahel is generally characterized by open herbaceous types (steppe and short grass savanna) often mixed with woody plants. It is known for its thorny trees, particularly from the genus Acacia, and mostly annual grasses from the genera Aristida and Cenchrus. The number of woody plant species is relatively low. The present physiognomy of Sahelian vegetation results from long-term human and animal presence. Annual grass fires often sweep across its landscapes where there is ample grass cover. The Sahel is also home to countless small wetlands, like in eastern Mauritania, as well as some major ones including the Senegal Delta, the Inland Niger Delta, and the Lake Chad area.

Sudanian Region

The Sudan, or Sudanian Region, consists of a very large belt immediately south of the Sahel, with average annual rainfall between 600 and 1,200 mm and an ecologically dry season of 5 to 7 months. It is the domain of the savanna — ranging from open tree savannas to wooded savannas to open woodlands. As in the Sahel, rainfall is spread over the months when the sun is high

Temet, Niger: a wadi in the Sahara

Bioclimatic regions



(typically May to October). The short, annual grasses of the Sahel are replaced in the Sudan Region by tall, perennial grasses, mainly of the genus Andropogon.

The savannas almost always have a woody component, with trees growing among the tall grasses. There are at least 80 species of trees specific to this bioclimatic region (Aubréville, 1938). In the northern part of the Sudanian Region, tree savannas tend to dominate, whereas the southern reaches of this region typically transition into denser wooded savannas and open woodlands. Fire has been part of the region's ecology for millennia. Both natural and human-induced bush fires sweep though the savanna areas, burning up to 80 percent of their area each year. Gallery forests, with tall tree species more common in the Guinean Region to the south, follow watercourses, penetrating deep into the Sudanian Region. They are generally not affected by bush fires and often act as natural fire breaks.

Guinean Region

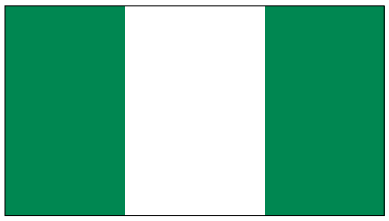
The Guinean Region lies immediately south of the Sudanian Region, generally defined by average annual rainfall between 1,200 and 2,200 mm. This is the domain of the seasonally wet-and-dry deciduous or semi-deciduous forest. Despite the relatively high rainfall, this region has a distinct dry season of 7 to 8 months, which distinguishes it from the Guineo-Congolian Region. The forest canopy is generally dense and closed, forming over a heterogeneous woody understory. Tree height is high, averaging 18 to 20 m. Guinean forests in their natural setting are generally not affected by bush fires. Present day landscapes of the Guinean Region are mostly altered by human activity, particularly slash-and-burn agriculture, so that the actual extent of Guinean forest is rather limited. Most of what remains has been modified by humans. The tree and wooded savannas are also extensive. Some authors consider that the forests have been replaced by "derived savanna," a mosaic of cropland, bush fallow, and secondary forest resulting from centuries of human influence (Keay, 1959). Gallery forests of varying width follow watercourses.

Guineo-Congolian Region

The Guineo-Congolian Region is the wettest in West Africa, with average annual rainfall between 2,200 and 5,000 mm. The rainfall can be distributed across most of the year, or in two rainy seasons with short drier periods between the rains. This region is split geographically into western and eastern blocks, separated by the Dahomey Gap where savanna reaches the coast. These blocks are often referred to as the Upper Guinean and Lower Guinean Forests, respectively (Church, 1966). This region is thought to have been mostly forested in the past, but today only a fraction of the land is forested. Nevertheless, the forest flora is the richest in West Africa. The forests are dense, with trees reaching over 60 m. The upper tier usually has a discontinuous canopy, towering over a lower, dense canopy. In the undergrowth, woody climbers and epiphytes are characteristic. Herbaceous ground cover may be found but can also be absent.

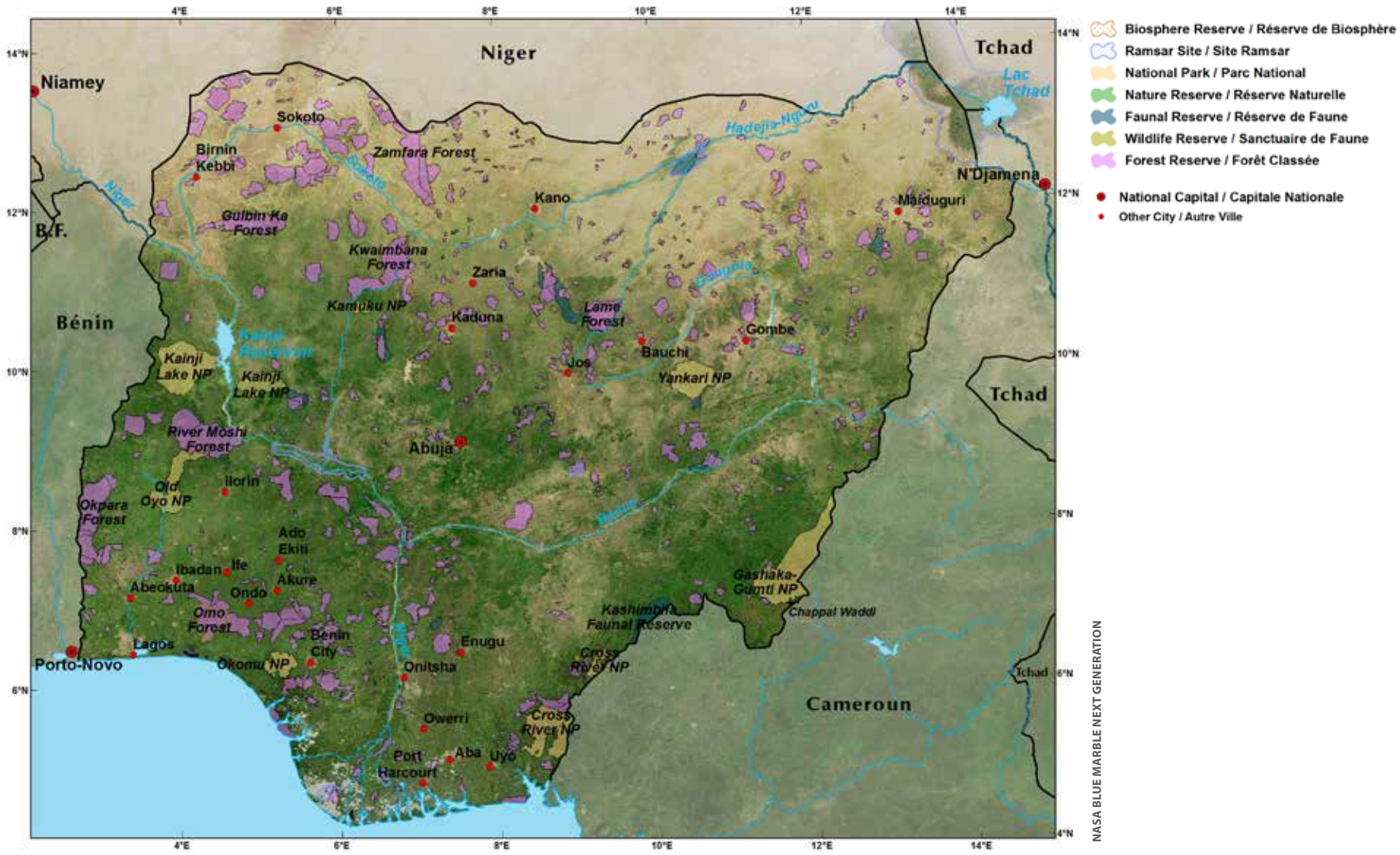
Chapter II

Country Profiles, Land Use and Land Cover, and Trends



Federal Republic of

Nigeria

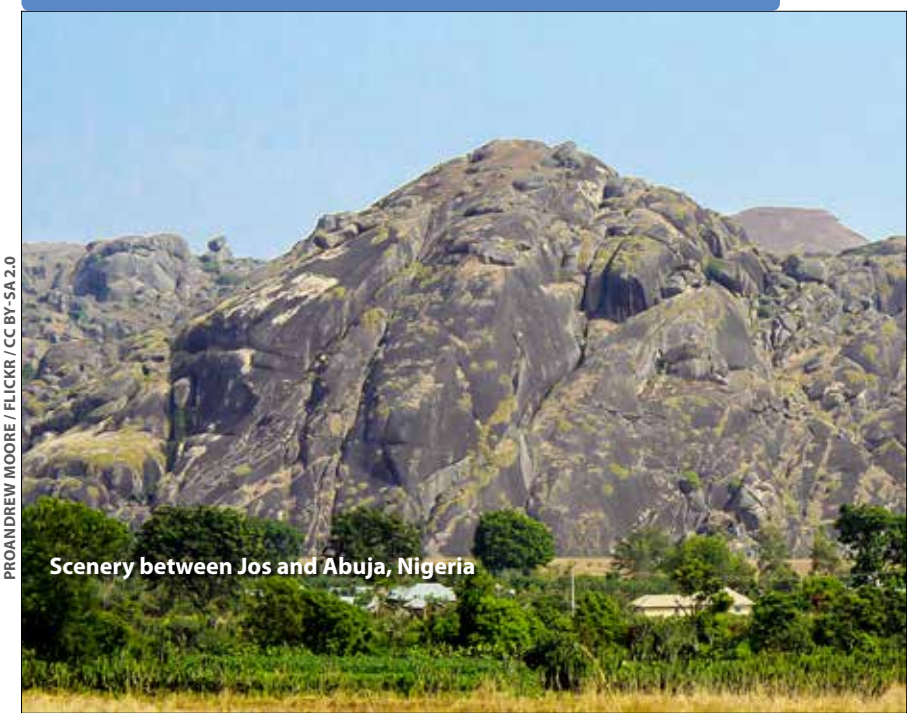


Total Surface Area: 923,768 km²
Estimated Population in 2013: 172,817,000

Nigeria is the most populous country in West Africa, and currently the seventh most populous in the world. About half of Nigerians are urban dwellers. Nigeria's urban character is unique in Africa, counting 11 cities of over 1 million, and more than 70 cities of over 100,000 inhabitants. Rapid growth in both population and the economy exerts a strong pressure on Nigeria's diverse natural resources, from the tropical coastal plains in the south to the Sahelian savannas in the north. After running 4,000 km from the Guinean Highlands through West Africa, which makes it Africa's third longest river, the Niger reaches the Gulf of Guinea on the Atlantic Ocean in Nigeria, where it ends in a network of channels forming a large coastal delta with extensive mangrove and swamp forests. The Niger Delta, which covers about 70,000 sq km, is a hotspot of plant and animal biodiversity, but it also holds Africa's second largest oil and largest natural gas reserves, which have fueled Nigeria's economy, the second largest in Africa by nominal gross domestic product (GDP). Diversity and extremes characterize Nigeria both culturally and environmentally, making it a microcosm of all Africa's promise and problems.

Environmental Highlights:

- Deforestation
- Desertification
- Crude oil pollution
- Second largest swamp forest on the continent (after Congolian swamp forest)



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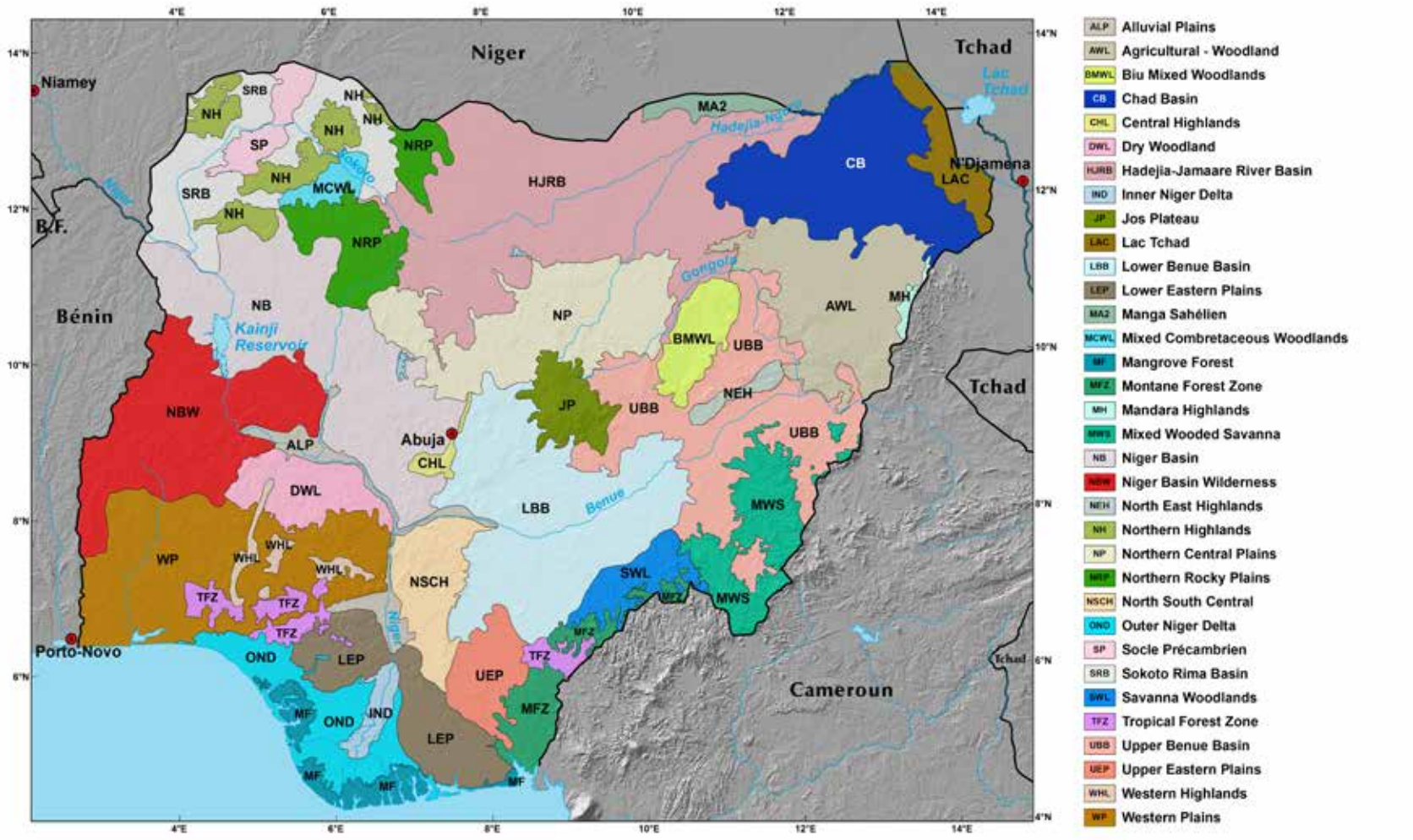
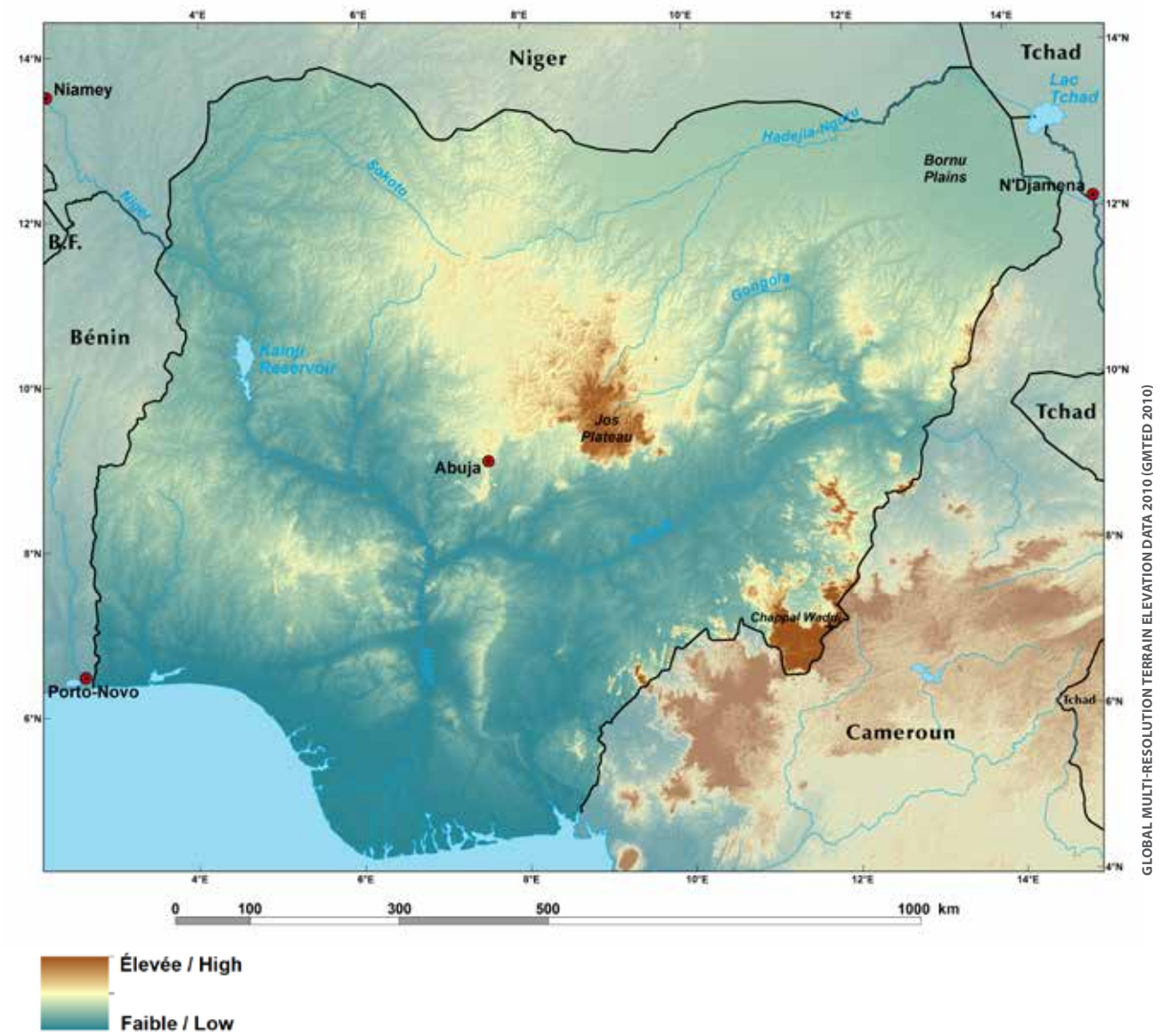
Scenery between Jos and Abuja, Nigeria

Ecoregions



Shaded Relief



The majority of Nigeria's heartland is formed by the valleys of the Niger and Benue Rivers, which merge into each other, making a "y-shaped" confluence. The Niger River and its tributaries create a lifeline for Nigeria's agriculture in the semiarid northern and central parts of the country, as they supply water for a variety of food and cash crops. The coastal plains are found in both the southwest and the southeast, mostly covered by swamp and mangrove forests, merging into highly degraded forest inland. To the southwest of the Niger valley lies a rugged landscape defined by the Western Plains (WP) interspersed with the Western Highlands (WHL). The heavily populated Jos Plateau with its semi-temperate climate, Nigeria's largest area above 1,000-m elevation, rises prominently from the riverine plains. The northern part of the country is characterized by somewhat lower elevations, level terrain, and sandy soils, where agriculture dominates.

Land Use, Land Cover and Trends

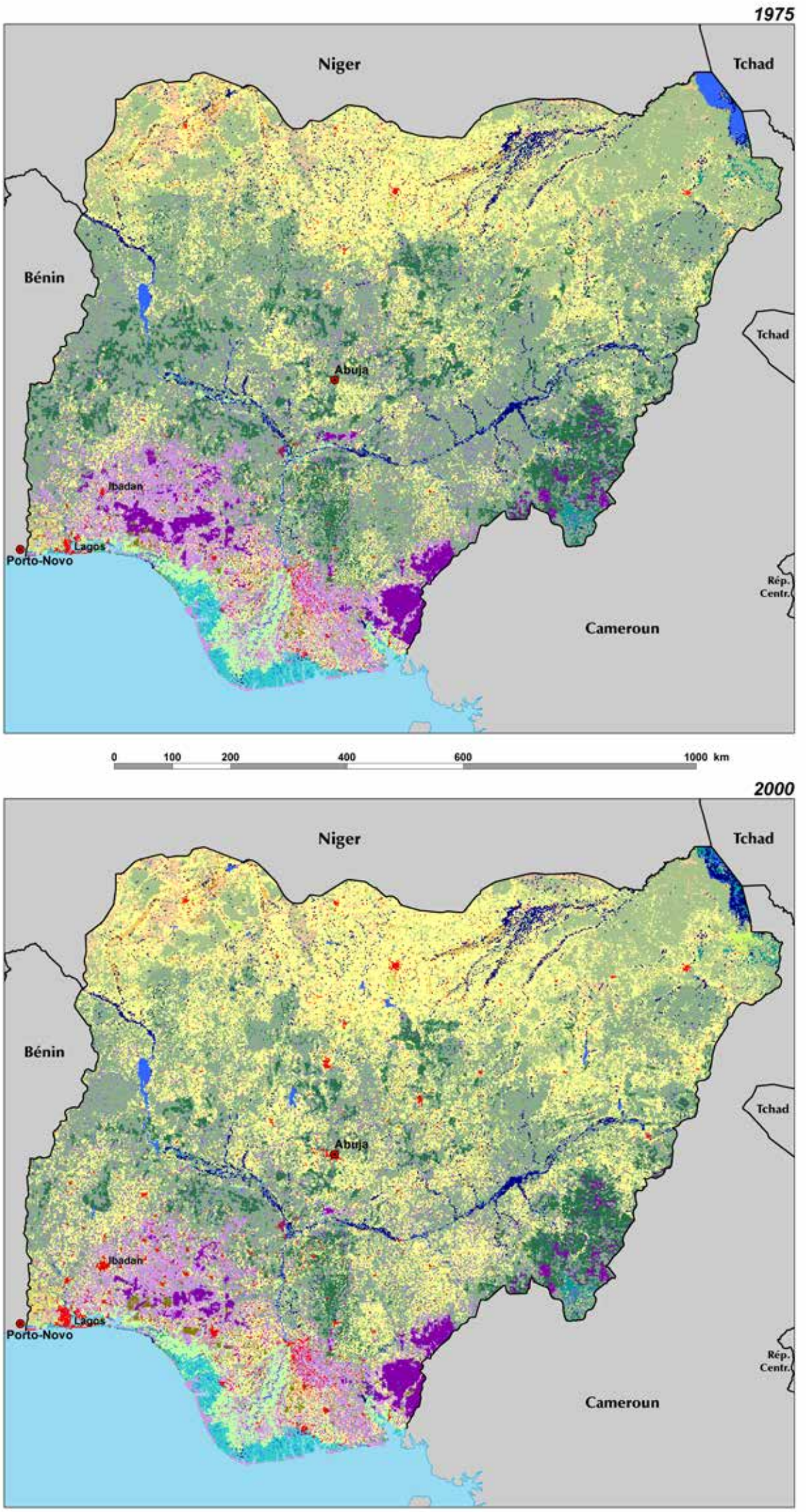
Not surprisingly, the country that is home to the largest population of the region also has by far the largest area under cultivation. In 2013, rainfed agriculture accounted for 380,000 sq km in Nigeria, covering over 40 percent of its national territory, up from 20 percent in 1975. From 1975 to 2000, 130,000 sq km of new agricultural land were taken under the plough, with an additional 110,000 sq km from 2000 to 2013. The magnitude of these transitions — together exceeding the size of the entire country of Ghana — is unparalleled in the region. Nigeria is also the only country of the region in which agriculture has traded places with savanna, and doubled its area in 38 years, to make it the largest land cover type.

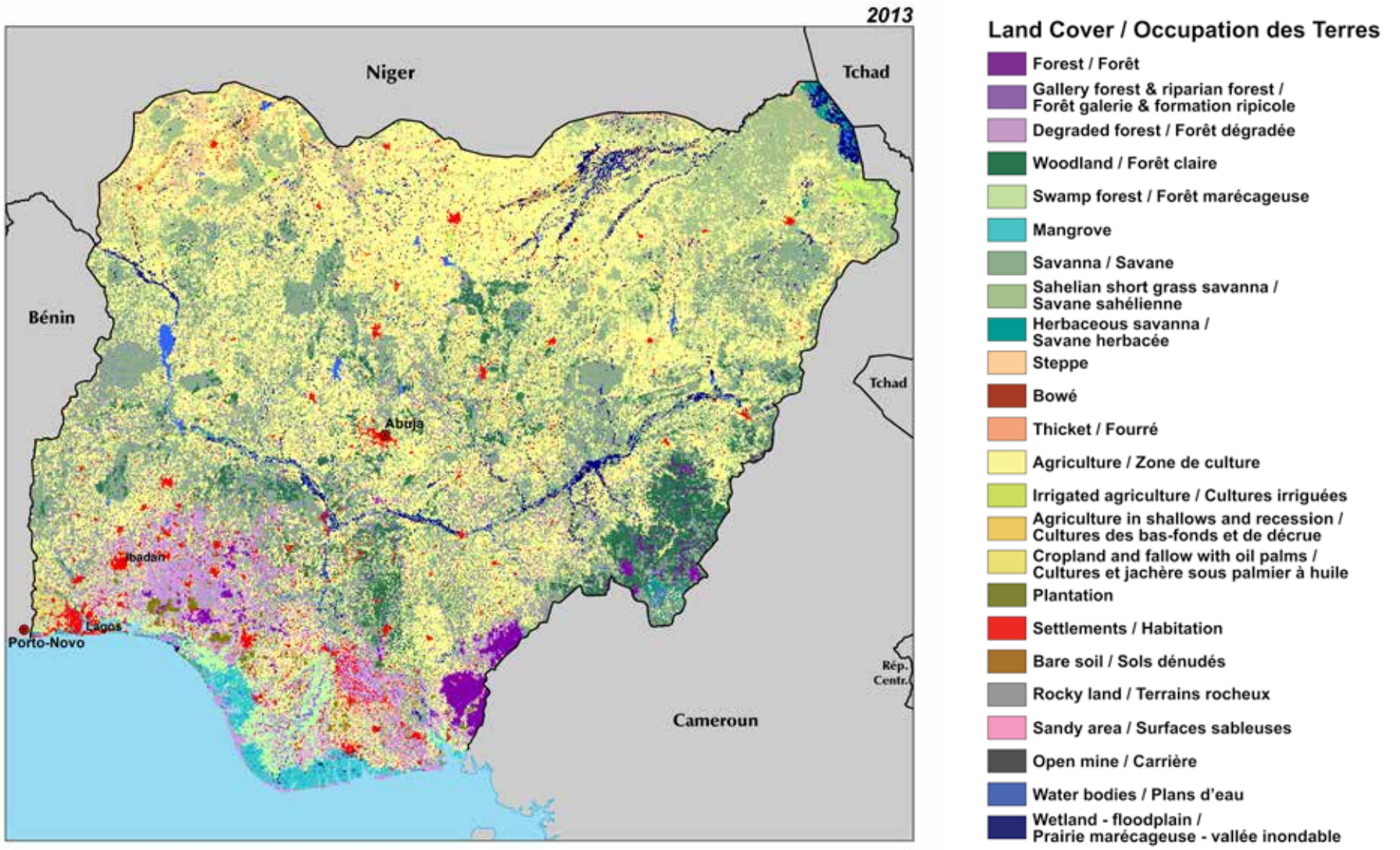
The expansion of agriculture was observed across all ecoregions from the forest zone of southern Nigeria, where root and tree crops dominate, to the forest-savanna transition of the center of the country, where mainly root crops are found, to the grain belt of semiarid northern Nigeria. The Niger and Benue Basins, promoted as a prime agricultural development area and future bread basket since the 1970s, has seen the most prominent encroachment of agriculture into the savanna, sharpening the outlines of the remaining protected areas. Not all protected savanna areas, however, have been spared from the fast agricultural expansion.

While the transition from savanna to agriculture constituted the largest land cover change in

Ogun state, Nigeria

JBDONDANE / FLICKR / CC BY-NC 2.0

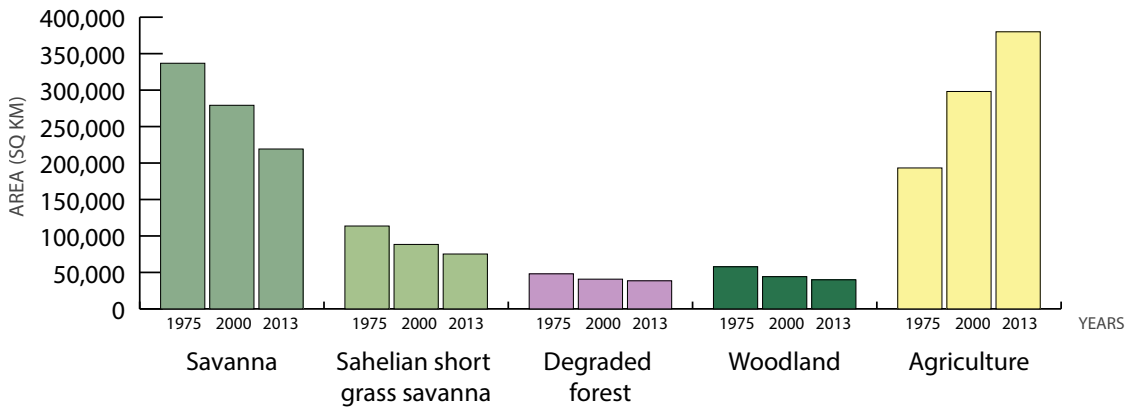




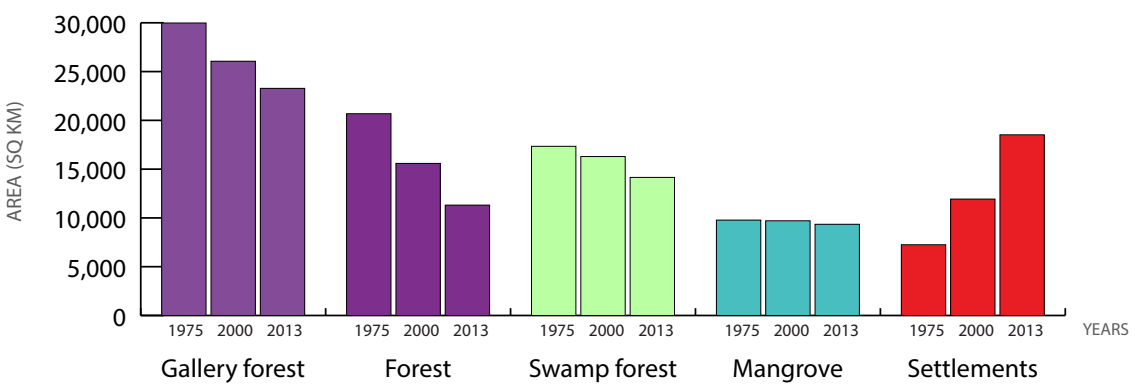
terms of area, some changes in the smaller land cover categories also stand out as important. High rates of change were observed for settlements, irrigated agriculture, plantation, and open mines, with gains accelerating from 1–2 percent per year between 1975–2000 to 2–4 percent per year in the 2000–2013 period. Under the pressures of a rapidly growing population and economy, forests, gallery forests and woodlands, in addition to the savanna land cover types, were all being diminished, with loss rates increasing to over 2 percent per year during the 2000–2013 period. Forest area decreased by 45 percent from 1975 to 2013.

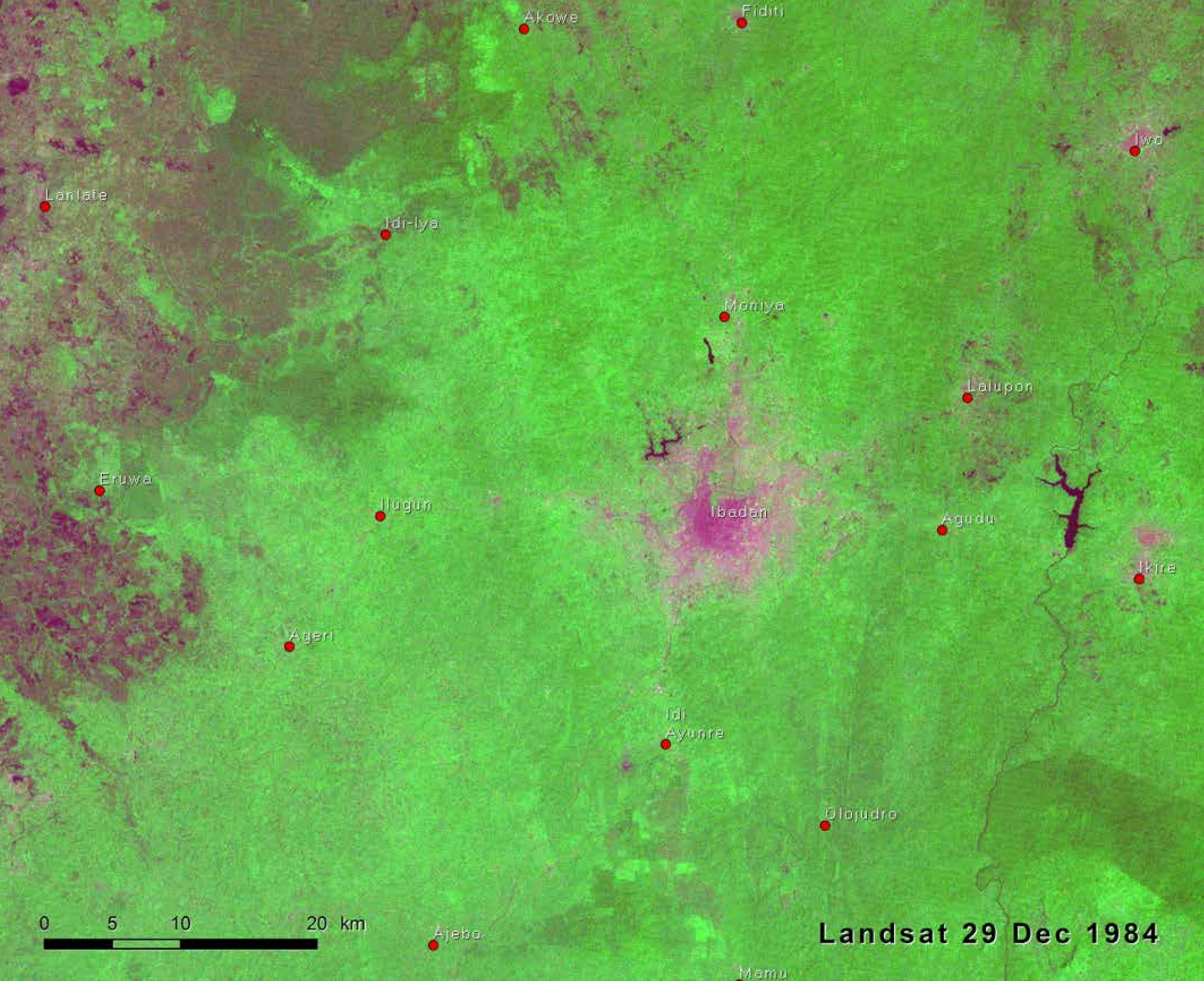
While the area of mangroves and swamp forests along the coast and in particular in the Niger Delta — important hotspots of biodiversity — has decreased less than that of some other land cover types, the health of these ecosystems has been severely damaged by recurrent oil spills caused by accidents, poor maintenance, and sabotage of the large-scale oil extraction infrastructure in the Delta. Environmental regulations are weak and rarely enforced, and there are no effectively protected areas in the Delta, whose forest and animal populations are considered under severe threat (World Wildlife Fund, 2016).

Large area classes



Small area classes





Urban sprawl of Ibadan into savanna and forest habitat

In pursuit of economic opportunity, many Nigerians have moved from rural to urban areas. As a result, the proportion of Nigerians living in cities has risen from 19 percent in 1975 to 46 percent in 2013, leading to a rapid physical expansion of urban areas (UN, 2015). The growth of the city of Ibadan is a good example of the urban sprawl seen in cities throughout Nigeria.

Ibadan was once a military stronghold of the Yoruba Empire, dating back to the 16th century. Ibadan's growth was spurred by a connection to the railroad in 1901, which cemented its role as a major trading center of agricultural goods produced in the surrounding region, such as cassava, cocoa, cotton, rubber, timber, and palm oil. Today, Ibadan is a vibrant commercial, industrial, and administrative center, which hosts chemical and electronic industries, motor vehicle assembly plants, and a number of other industries, including flour milling, leather working, and furniture making (Fourchard, 2003).

Until 1970, Ibadan was the largest city in sub-saharan Africa (Fourchard, 2003). Population figures are sparse but suggest a population of 847,000 in 1975 rising to about 2,790,000 in 2013 (UN, 2015). According to the land cover maps (see pages 166–167) the city's built-up area increased from 84 sq km in 1975 to 528 sq km in 2013. New development occurred particularly along the major road axes, such as the Ibadan-Lagos expressway to the south of the city and the Eleyele expressway to the northwest. By 2013, the cities of Moniya and Agudu were already parts of the Ibadan metropolis. If the present rate of expansion continues, surrounding towns such as Idi Ayunre

(to the south), Ikire (to the east), Fiditi (to the north), and Ilugun (to the west) will be linked to the built-up area of the sprawling metropolis.

The rapid sprawl has eaten into forested areas, savanna, farmland, fallow lands, and river floodplains. Forests and wetlands have been degraded. In the Eleyele wetland — a modified natural riverine wetland in the northwest quarter of Ibadan — an estimated 66 percent of the wetland riparian forests were lost between 1984 and 2014 due to the urban expansion (see inset). Waste effluent discharge from the city also contributed to deterioration in water quality (Tijani, Olaleye and Olubanjo, 2012).

Like other cities in Nigeria and the developing world, Ibadan has been growing at a very rapid rate, but the provision of social services and basic infrastructure has not kept pace. Unmanaged urban growth and haphazard development of informal housing have resulted in a gradual deterioration of the environment and a decline in the quality of life.

Progressive expansion of agriculture in Niger State, Nigeria

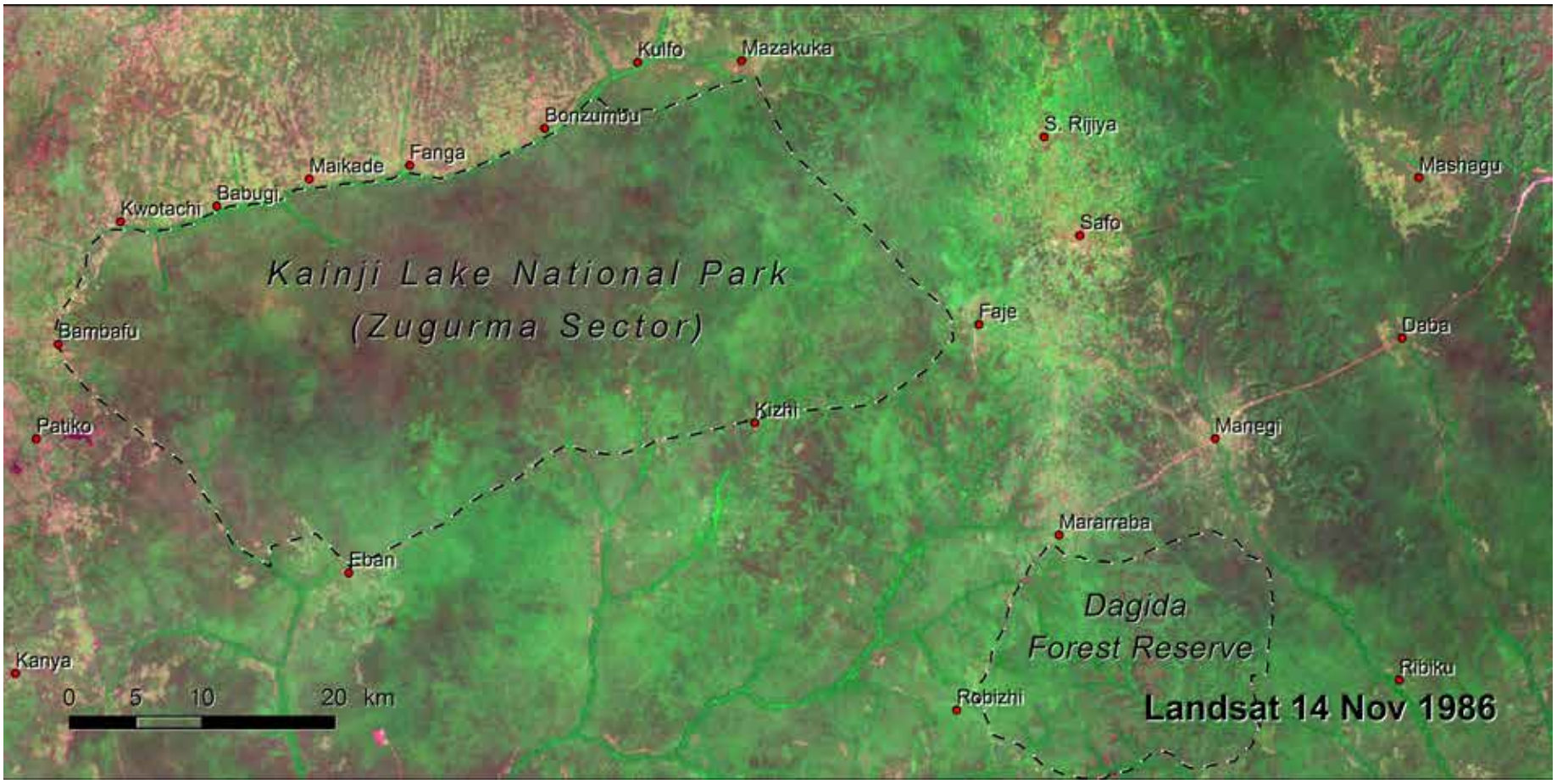

A Kob in Kainji Lake National Park

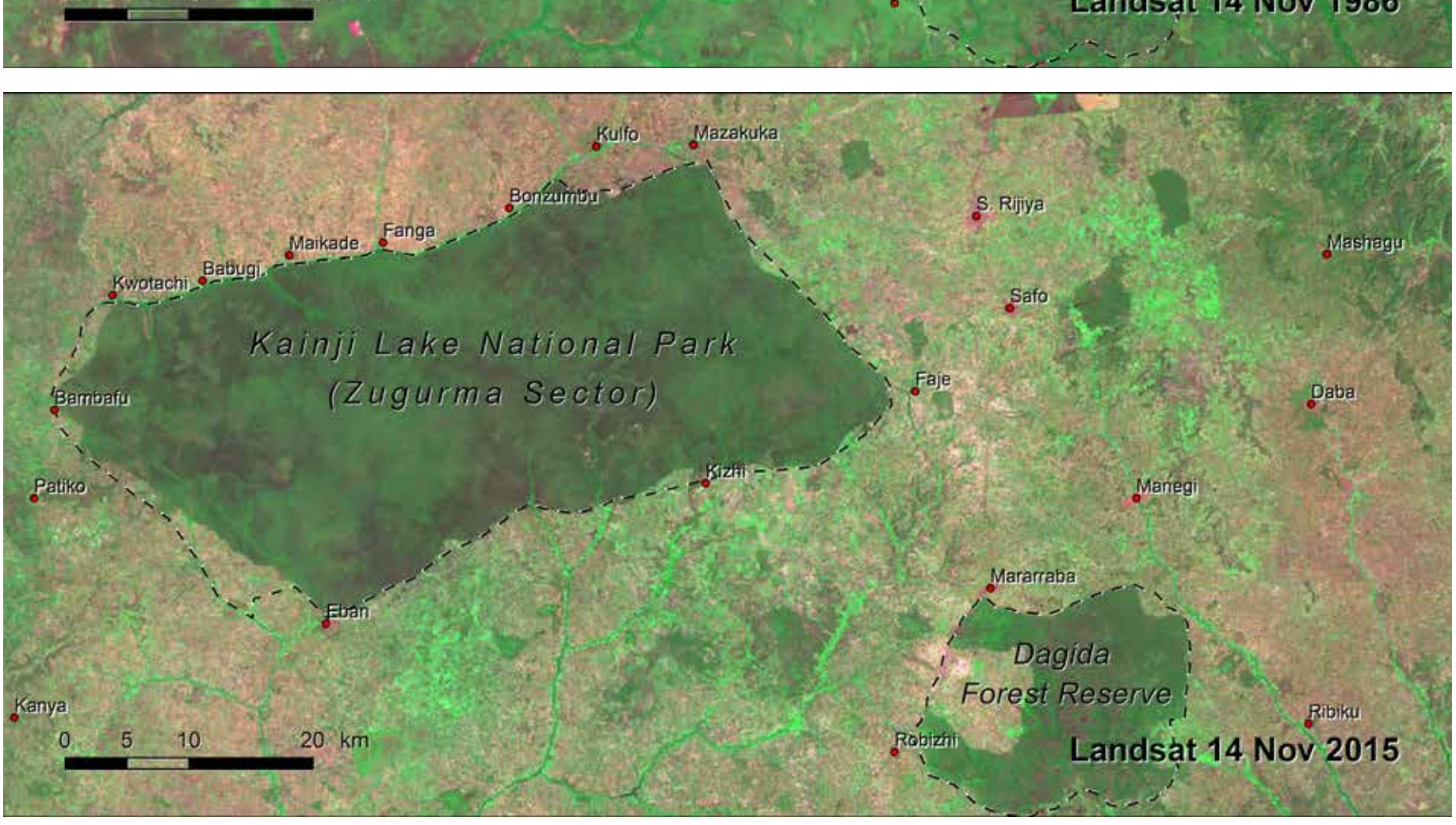
JEREMY WEATE / FLICKR / CC BY 2.0

The Middle Belt of Nigeria, which straddles the southern Sudanian and northern Guinean climatic zones, has historically been sparsely populated. In the 1970s, it was seen as the last land frontier and future bread basket of the nation. The area around the Zugurma Sector of the Kainji Lake National Park and the Dagida Forest Reserve exemplifies the significant land use transformation that the Middle Belt has gone through in the past 40 years.

The three Landsat images from 1972, 1986 and 2015 show the dramatic transformation in the area surrounding these two protected areas. In 1972, the darker green of the mostly unbroken wooded savanna has only scattered plots of shifting cultivation (lighter green areas). By 1986 the area north of Zugurma Sector and surrounding some of the villages is being converted to farmland (light tan, light green and pink areas). By 2015 the transformation of the area to farmland is almost complete, with a few islands of wooded savanna inside the protected areas.

The rapid expansion of agriculture in this formerly semi-natural area can be understood in the context of a changing Nigerian political economy. The oil boom of the 1970s and enactment of the Land Use Act of 1978 sparked a rush for land acquisition of formerly communal lands by wealthy private owners. The food crisis of the 1980s and restructuring of the economy along the lines of the International Monetary Fund (IMF) renewed the emphasis on food production. In 1984, the government of Nigeria banned the import of agricultural raw materials by the local bottling, flour and confectionary industries, which pushed these industries to acquire land at a large-scale to grow wheat and other grain crops.



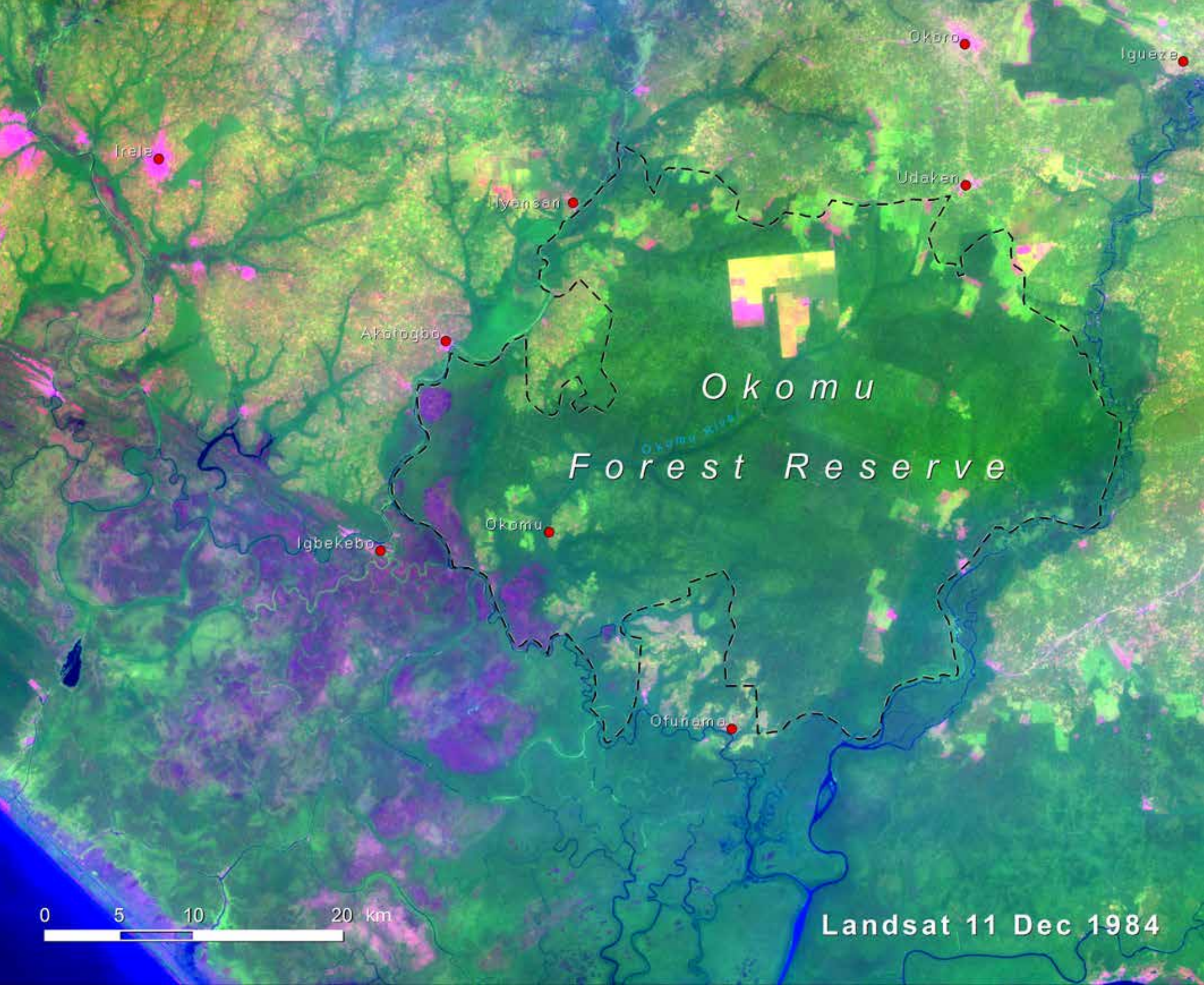


The land acquisitions by large owners engendered land use competition and conflicts between (1) a small land-owning class and a large class of landless peasants, (2) peasant farmers and migratory pastoralists who have seen their main source of dry season pasture shrink, and (3) peasant farmers, migratory pastoralists and the wildlife and forestry conservation authorities who are faced with increasing land use pressure around the parks as well as grazing and cropland encroachment into the parks.

If left unaddressed, the lack of an integrated policy that regulates access of different user groups to land resources will continue to threaten wildlife and biodiversity conservation within the game reserves in a State which currently records the highest population growth in Nigeria at 3.4 percent per year.

JEREMY WEATE / FLICKR / CC BY 2.0

Rice paddy fields, Niger State

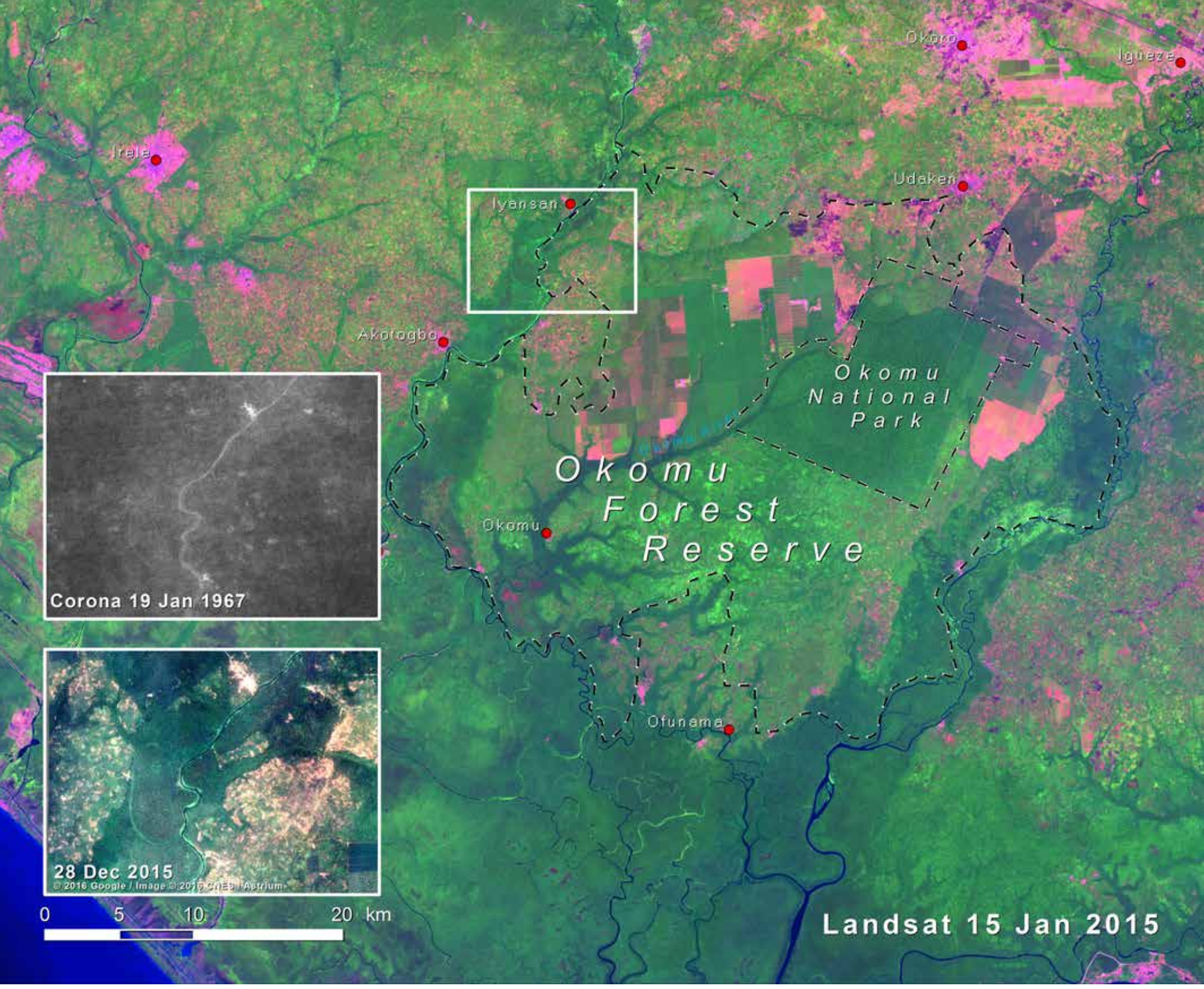


Tropical forest threatened by human activities in the Okomu Forest Reserve

Closed-canopy tropical moist forest once covered large parts of southern Nigeria, where some of the earliest ecological studies of tropical rain forest were carried out in the 1930s (Ajayi, 1998). Since that time, excessive logging and conversion to plantations and farmland have caused major losses of natural forest. Although no longer a pristine wilderness, the Okomu Forest Reserve still supports a small population of forest elephants and several species of threatened primates, including a viable population of the rare white-throated guenon, a monkey endemic to southwestern Nigeria (Oates, 1995).

The Okomu Forest Reserve was originally established by the British colonial government in 1912. It comprised 777 sq km, to which another 411 sq km were added to the north and east in 1935. From the beginning, it was planned that the reserve would be managed as a source of timber, and it has been exploited for its rich stands of mahogany. Since the 1940s, systematic rotational logging as well as "taungya" farming have been practiced in the reserve. In this forest management system, an area of forest is allocated to local farmers to be cleared and farmed, and subsequently reforested with useful tree species.

The Corona satellite photograph (see inset) from 1967 shows a still-intact forest canopy on both sides of the river, which delimits the northwestern boundary of the reserve. It is likely that the whole Okomu Forest Reserve



was blanketed with a continuous dense forest at that time. By 1984, large parts of the Okomu Forest Reserve had been converted to plantations of oil palm and rubber trees — partly as official concessions, partly illegally or only lightly controlled. A network of roads and settlements, along with farmland encroachment into the reserve, can be seen as well. Each year, a larger area of the reserve was assigned to taungya farmland. Although the taungya scheme had been envisaged to serve the local farming population, it soon attracted immigrant farmers from more densely populated areas of the country, leading to an increase in the overall population pressure on the reserve.

In 1985, a wildlife sanctuary of 114 sq km was carved out of the most intact area of the forest reserve. Poaching was brought under control in the sanctuary, which is a habitat to several endangered species including red-capped mangabeys, white-throated monkeys, chimpanzees, leopards, and the African forest elephant. In 1999, the Okomu Wildlife Sanctuary was designated a national park to increase its protection from the immense pressure from high rates of exploitation and human settlement expansion on its periphery (Onojeghuo and Onojeghuo, 2015). Okomu National Park remains the only fully protected part of the reserve and stands out against its surroundings in the 2015 Landsat image. The visible impact of rapid plantation expansion can be seen in the northern half of the reserve, which is dominated by large-scale rubber and oil palm plantations, whereas farmland has colonized the southern half.

Efforts have been made to provide sustainable livelihood opportunities to local communities, including controlled logging and hunting, reforestation, livestock rearing, and agricultural practices compatible with forest conservation. However, Okomu's status as a national park has not fully prevented the effects of deforestation within and around the reserve. Multipurpose forest management has been praised by some, but others have criticized it for neglecting protection efforts, arguing that integrating a development component has put Okomu at risk of ecosystem degradation.