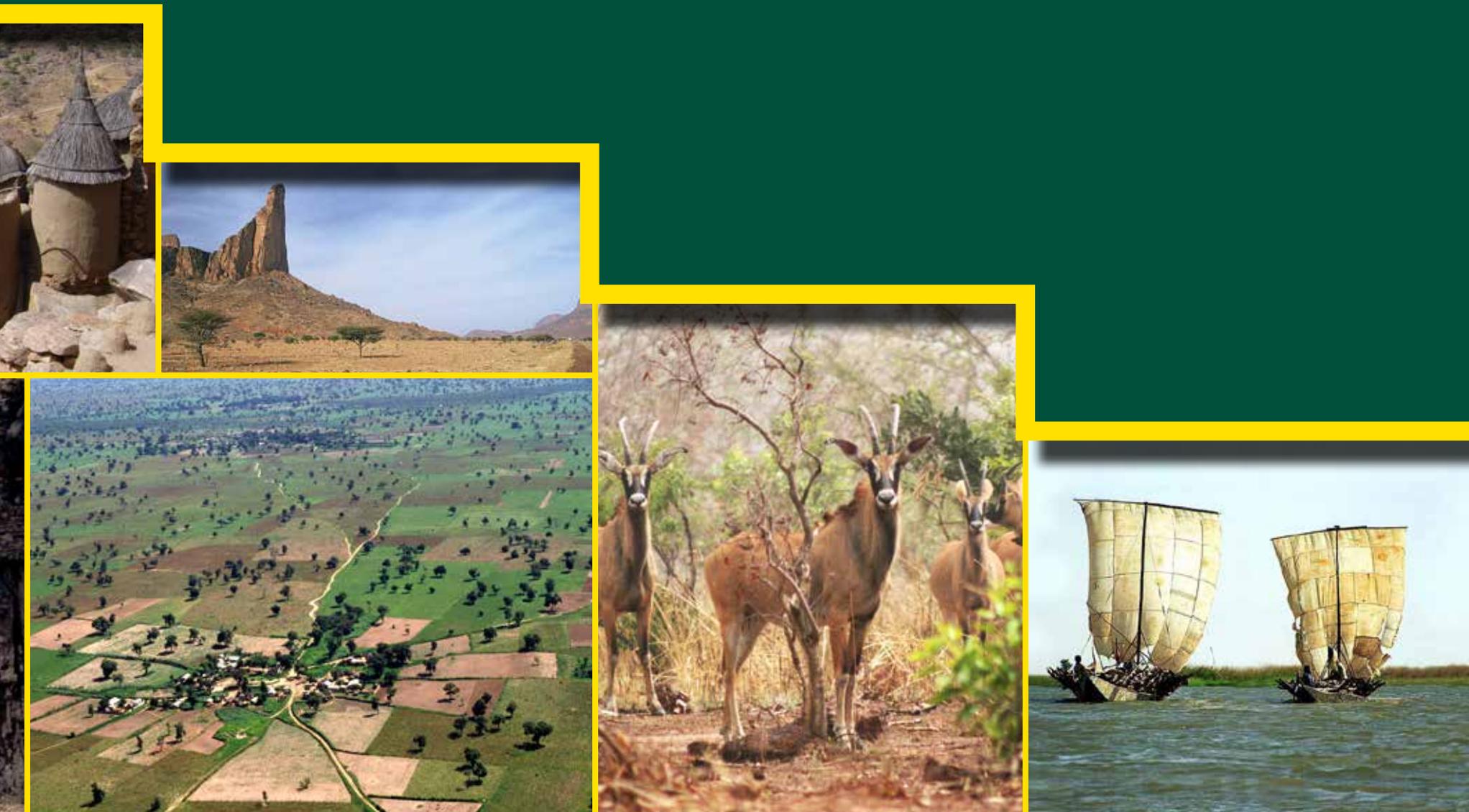


Landscapes of West Africa

A WINDOW ON A CHANGING WORLD



Landscapes of West Africa

A WINDOW ON A CHANGING WORLD



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science for a changing world

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On October 12, 2015, the Lunar Reconnaissance Orbiter took this striking view of the Earth as it circled 134 km above Compton Crater on the Moon, near the terminator between day and night. The sharp black outline of the lunar horizon is from mountains still on the night side of the terminator, silhouetted against the lower limb of the Earth. This image is reminiscent of the iconic Earthrise photograph taken by the crew of Apollo 8 as they orbited the Moon on December 24, 1968. Many people credit that unique view of our home planet as having sparked the environmental movement that so shaped our thinking about our planet during the 1970s and beyond.

Apart from its beauty, this image of the Earth from the Moon shows the African continent quite prominently. A great amount of cloud cover characterizes the blue planet. Several large areas are, however, clear: the deserts of North Africa and the Middle East, and in the Southern Hemisphere, the drylands of southern Africa. The tropical regions of Africa's mid-section are partially covered by belts of clouds that mark the intertropical convergence zone, where the northern and southern circulation patterns merge.





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.

A handwritten signature in blue ink, appearing to read 'Djimé Adoum'.

Djimé Adoum, Ph.D,

Executive Secretary

CILSS

Ouagadougou, Burkina Faso



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FROM THE AMERICAN PEOPLE

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.

Alex Deprez
Regional Mission Director
USAID/West Africa
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Alex Deprez



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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In Memory

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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

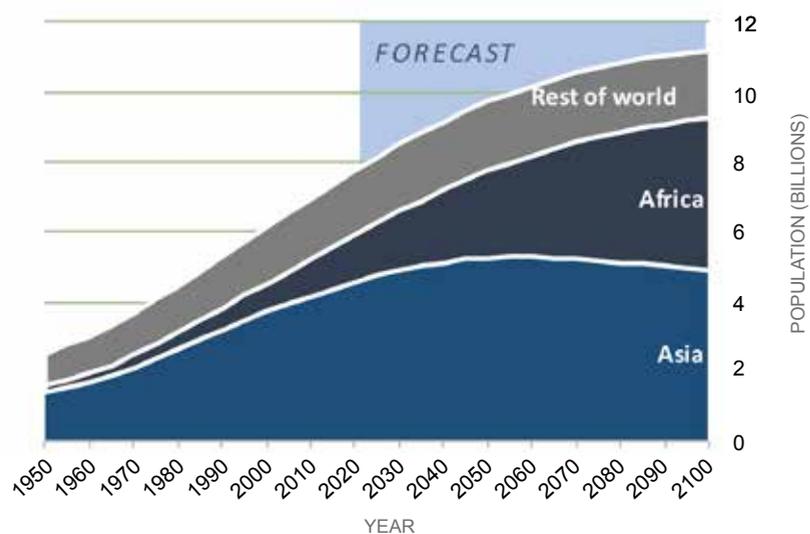
the collapse of natural systems that are essential for humans to thrive, perhaps even threatening the future of all humankind.

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)!

“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



Wooded landscape fragmented by agriculture expansion in western Burkina Faso



JAMES ROWLAND / USGS

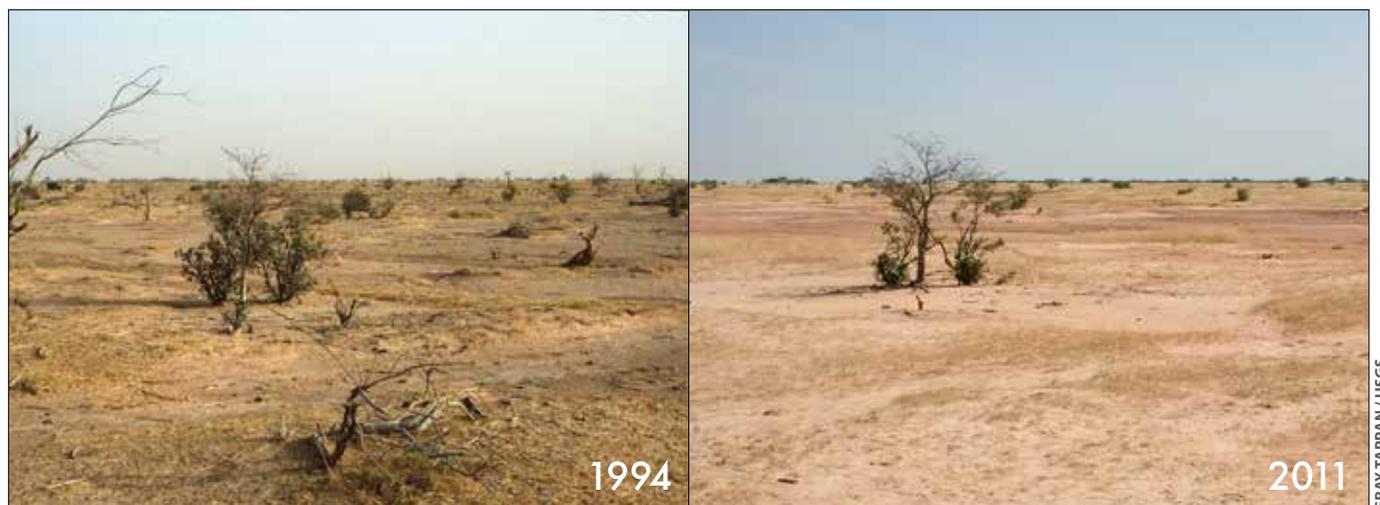
Parallel trends can be seen in the land cover changes of West Africa. With so many new families to feed, West Africa doubled the area covered by farms between 1975 and 2013. Vast areas of savanna, woodland, and forest landscape have been replaced or fragmented by cropland. At the same time villages, 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.

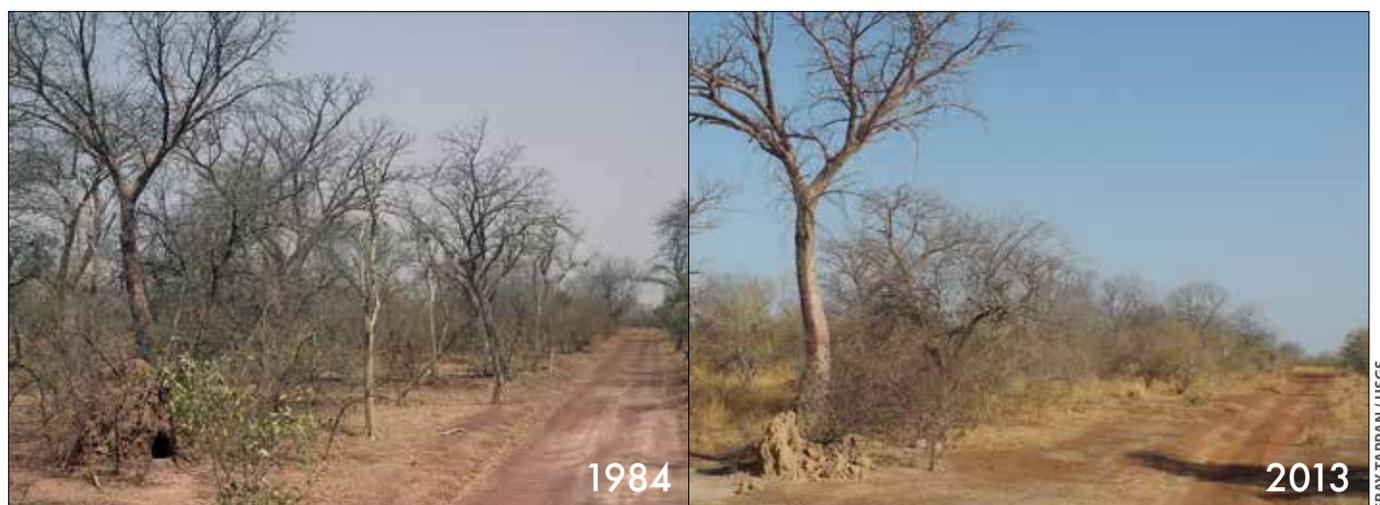
Conversion of the natural landscapes of West Africa to agriculture greatly reduces the natural biodiversity, and exposes the soil to wind and water erosion. The savanna, woodland, forest, and wetland ecosystems that are lost have some relatively tangible impacts such as the loss of natural ecosystem 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



Decline in vegetation cover and biodiversity in east-central Senegal



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.

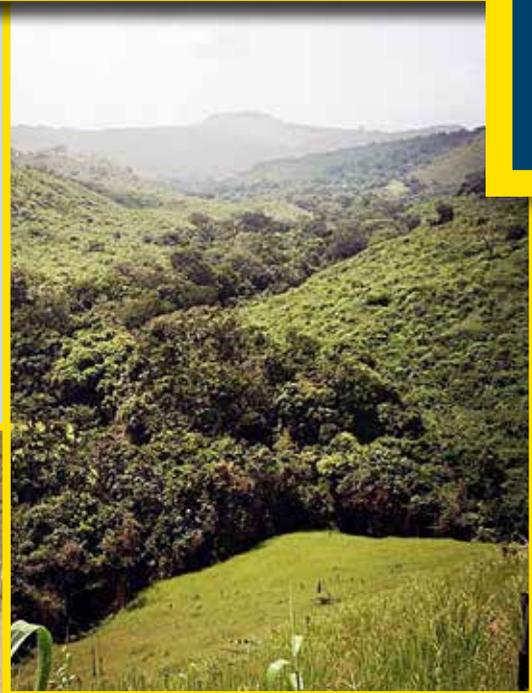
Experts from institutions in 17 countries in West Africa have partnered with the Comité Inter-états de Lutte contre la Sécheresse dans le Sahel (CILSS – The Permanent Interstate Committee for Drought Control in the Sahel), the U.S. Agency for International Development (USAID) West Africa and the U.S 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

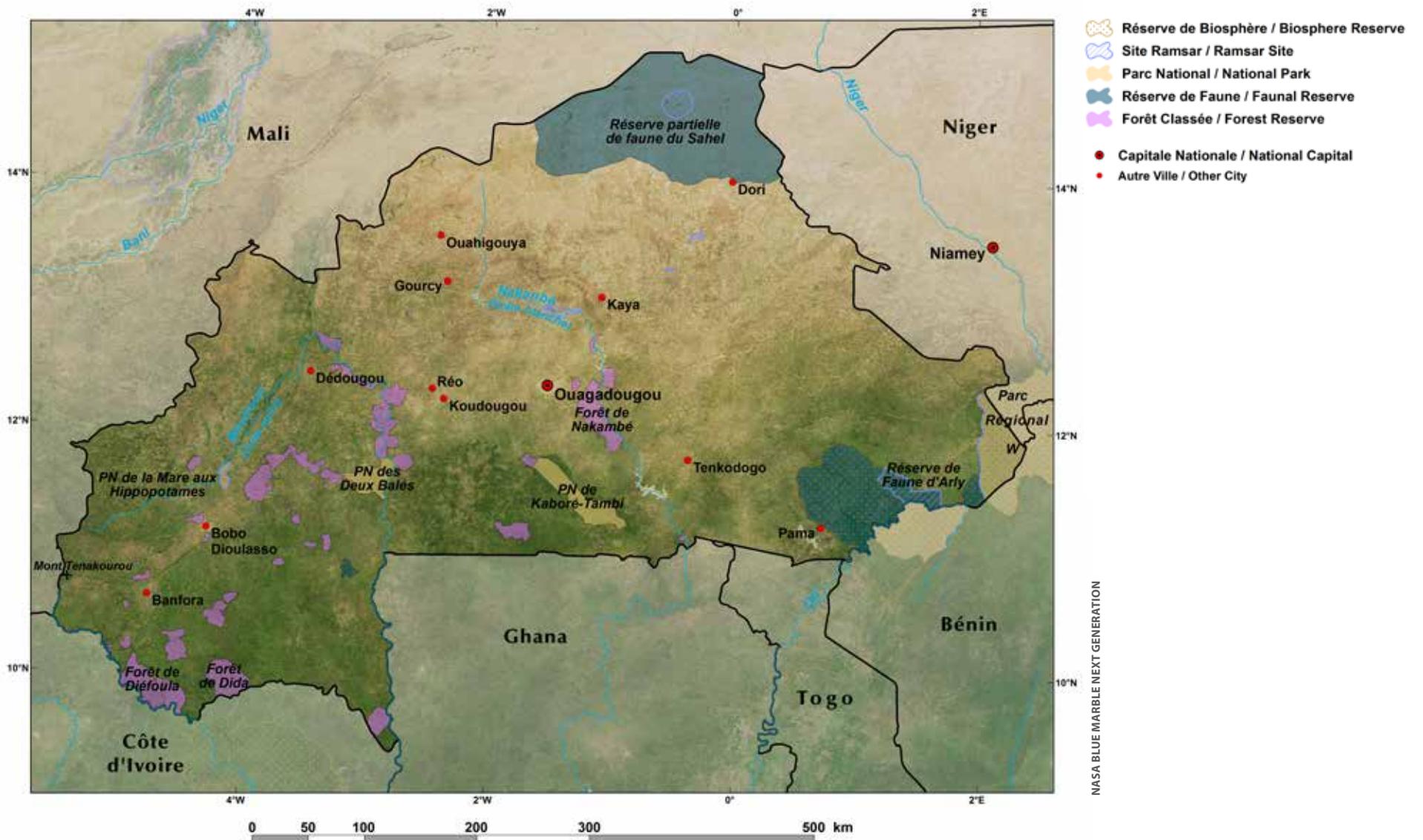
III

Country Profiles, Land Use and Land Cover, and Trends





Burkina Faso



Total Surface Area: 274,400 km²
Estimated Population in 2013: 17,085,000

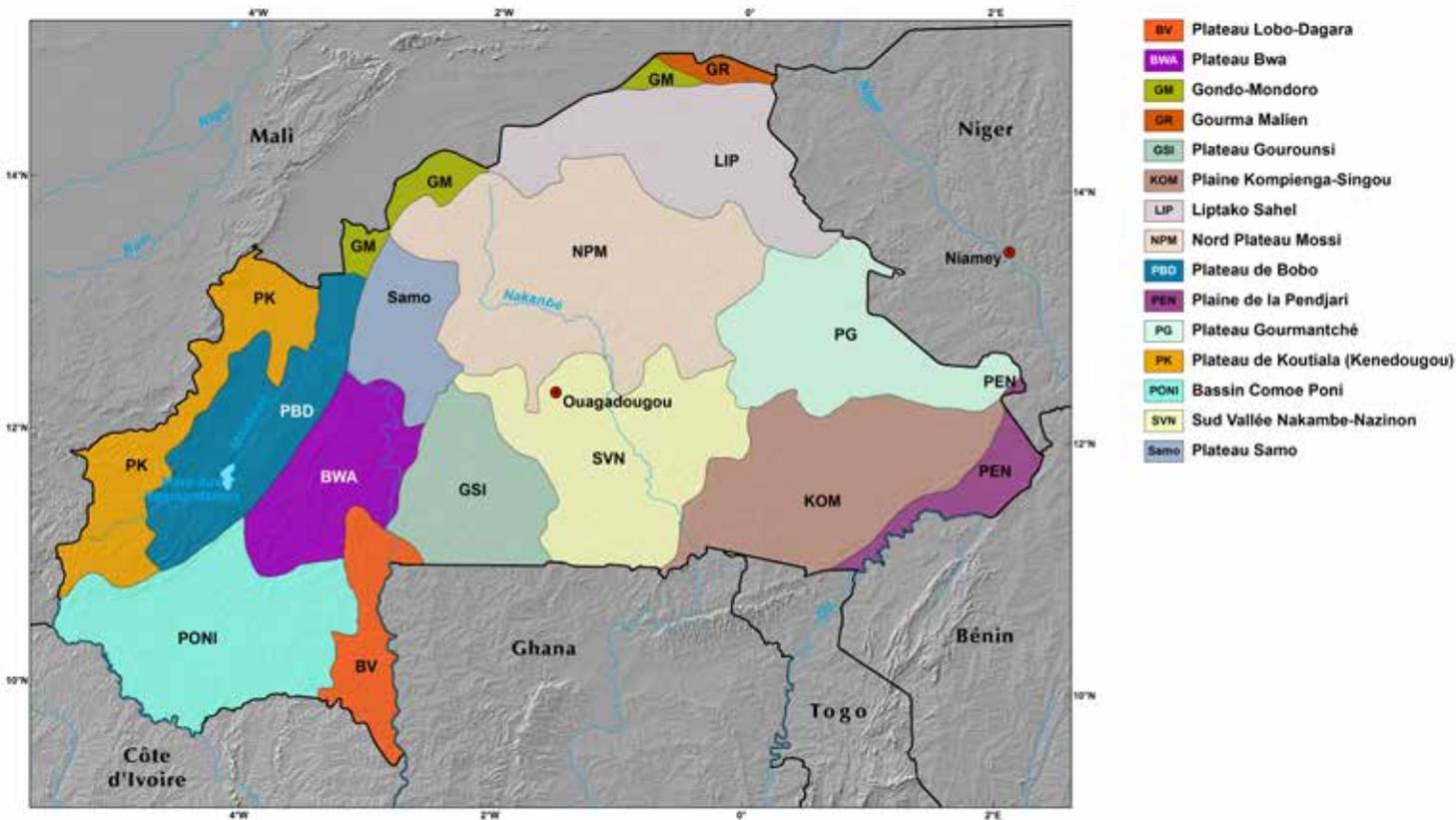
Burkina Faso, (named Upper Volta until 1984) is a landlocked country that spans across the semiarid Sahel and the more humid Sudan bioclimatic zone. Burkina Faso is culturally rich, but limited in its endowment of natural resources. As in many other countries in the region, rural-to-urban migration has spurred the growth of urban areas. However, agriculture still accounts for 32 percent of the country's gross domestic product (GDP) and employs about 80 percent of the population. In the north, where rainfall averages 300–400 mm per year and is limited to a short wet season, animal husbandry is the main livelihood. Rainfall is somewhat higher across the Central Plateau, where agriculture has been the dominant activity for centuries. Cotton is the main cash crop; however, livestock production is also an important source of income. In order to reduce its vulnerability to droughts and water shortages, Burkina Faso has built many dams and levees along major rivers and their tributaries. These reservoirs meet the water needs of the urban population and provide for irrigation of horticultural crops during the dry season, contributing to the country's agricultural diversity. In addition, Burkina Faso has successfully attracted foreign investments and has experienced a rise in gold prospecting and production. With

Environmental Highlights:

- Deforestation due to agricultural expansion
- Fragmentation of natural habitats
- Large number of reservoirs
- Agricultural production diversification
- Widespread adoption of soil and water conservation practices

rapid population growth (over 3 percent per year), Burkina Faso faces major challenges in reaching a balance between preserving its natural resources and feeding its growing population. Despite explosive cropland expansion into remaining natural landscapes, recent successes in land management and increased agricultural productivity are encouraging.

Ecoregions

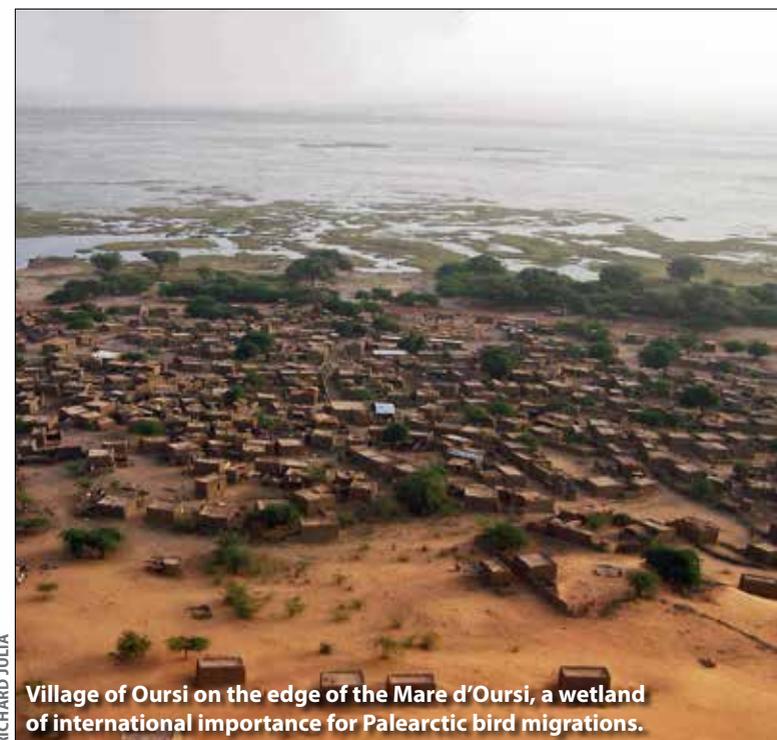
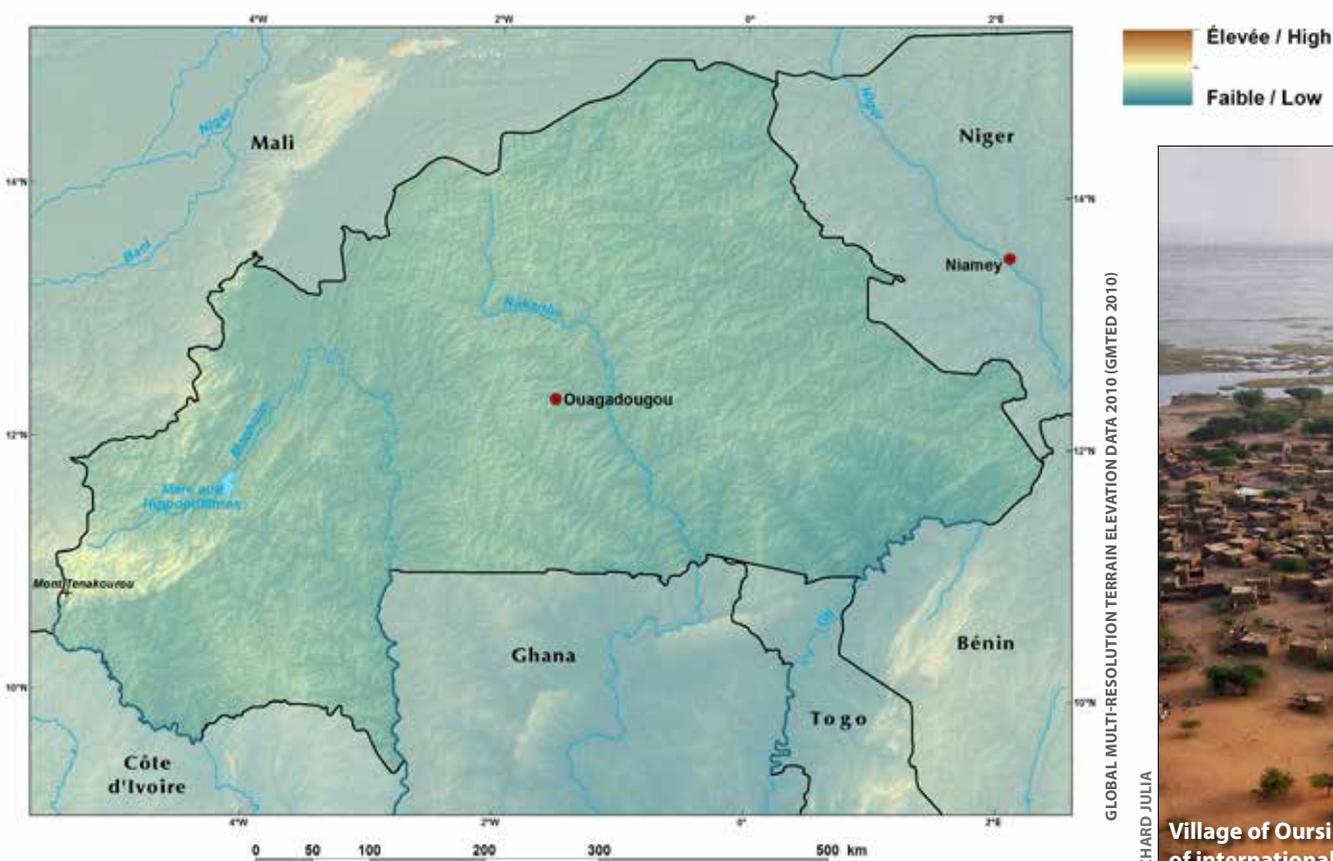


Burkina Faso is fairly flat, with an extensive penepplain that covers about three quarters of the country; elevations range from 250 to 400 m. The Koutiala Plateau (PK), a sandstone block situated in the country's southwest, is the highest and most rugged part of the country. Several rivers cross Burkina Faso; all are tributaries of one of three major rivers: the Volta, the Comoé, and the Niger.

The large northern ecoregions, Liptako Sahel (LIP), Gondo-Mondoro (GM), and Gourma Malien (GR), belong to the Sahelian Region and are dominated by shrub savanna and steppe. Moving south, the Plateaus of Samo, Gourmantché (PG), and the Nord Plateau Mossi (NPM – North

Mossi Plateau) dominate the north-central part of the country, where population density is high. The Mossi people have been farming here for generations, almost exclusively planting millet and sorghum, particularly in the numerous valleys and low-lying areas (Marchal, 1977; Dugué, 1993). The southern ecoregions, from the Pendjari plains (PEN) in the east, to the Bwa Plateau and Comoé Poni Basin (PONI) in the southwest, cover a wide bioclimatic gradient. With rainfall varying from 650 mm to over 1,000 mm, these ecoregions extend over the more humid Sudanian Region. The more favorable climate and permanent rivers make most of Burkina Faso quite suitable to agriculture, with cash crops becoming increasingly important.

Shaded Relief



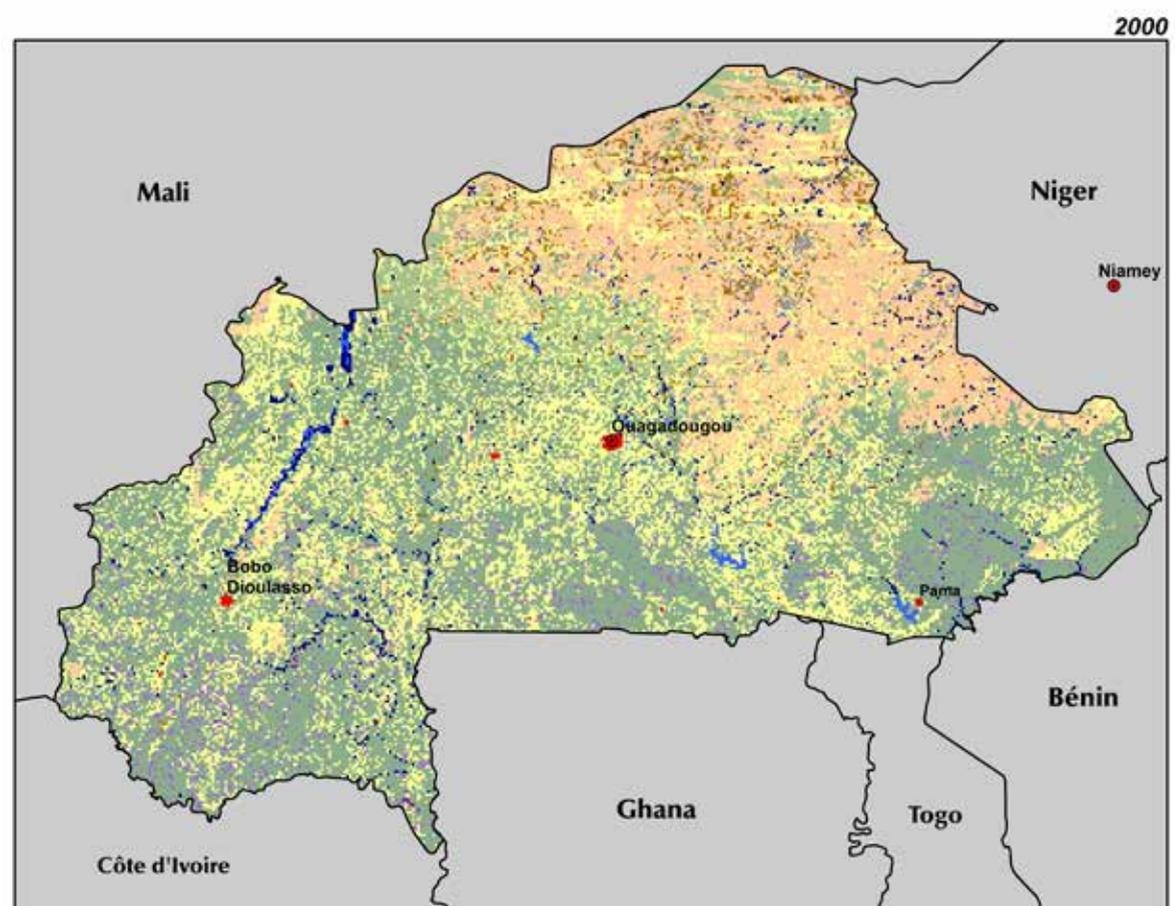
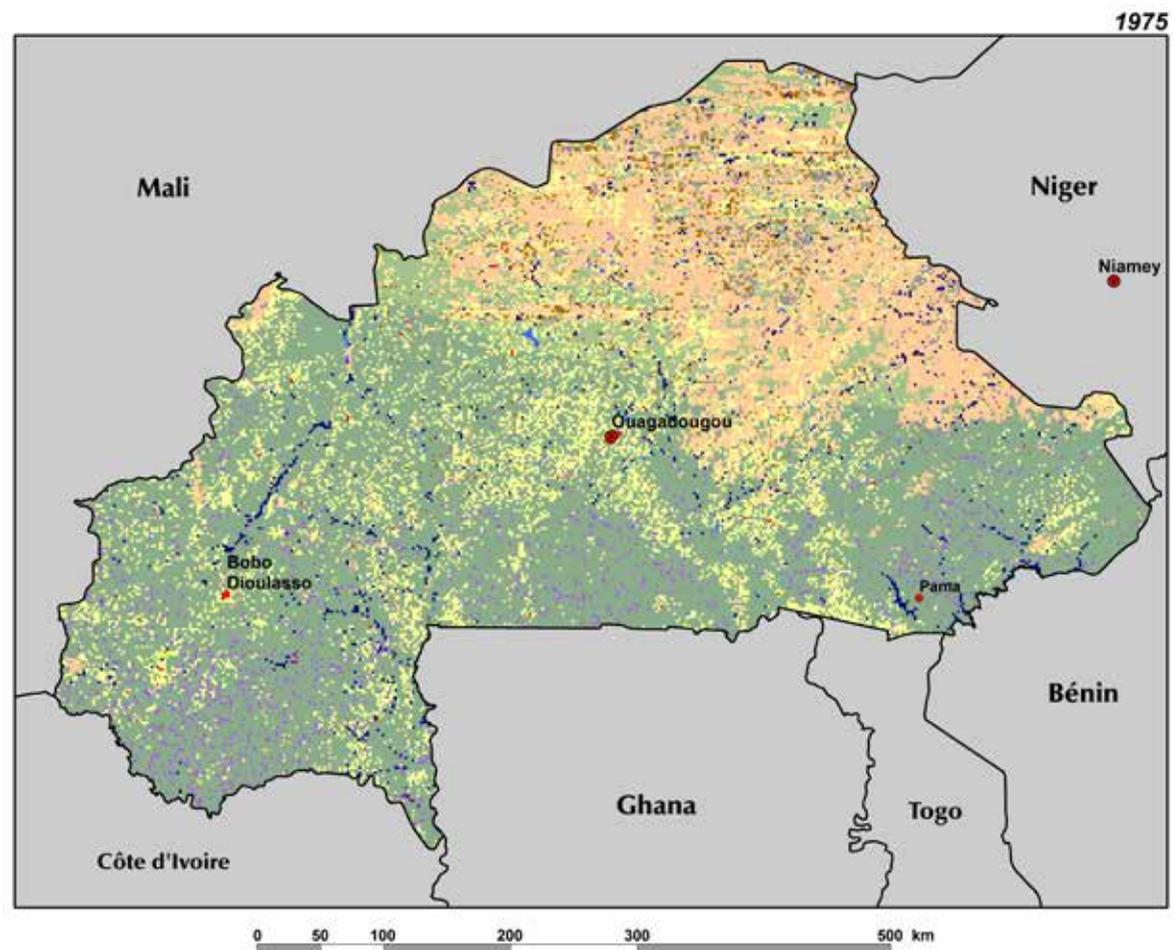
Village of Oursi on the edge of the Mare d'Oursi, a wetland of international importance for Palearctic bird migrations.

Land Use, Land Cover and Trends

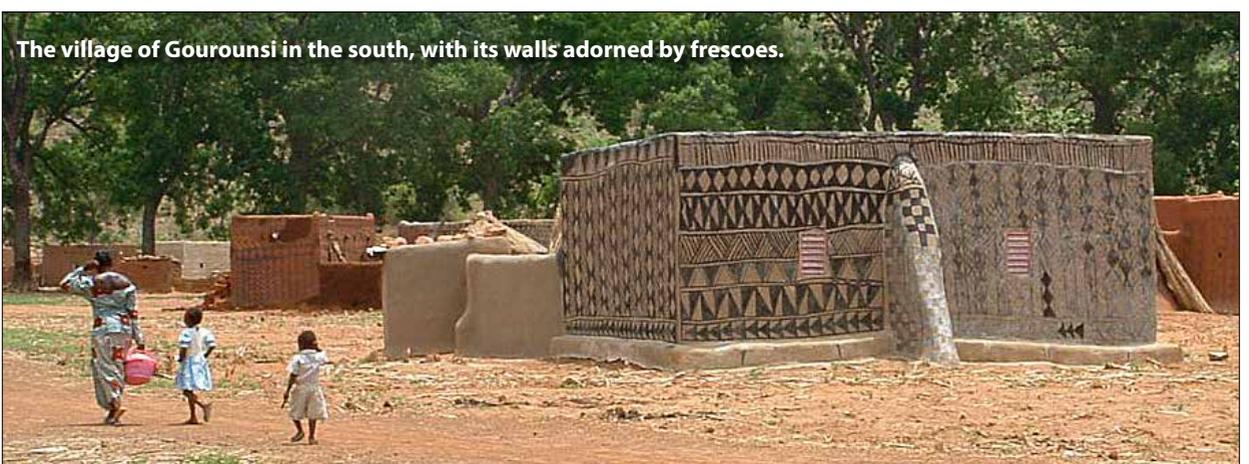
The most obvious change in Burkina Faso's land cover is the major expansion of croplands. In 1975, when the population was just over 6.1 million, savannas were still the dominant landscape. Even then, agricultural development was beginning to fragment the wooded savannas in central areas of the country. Agricultural expansion started along the main roadways. Similarly, agriculture was increasing along the Ouagadougou-Pama corridor in the southeast, and small isolated patches of cropland were appearing among extensive natural areas. However, a large portion of the country's southern ecoregions remained relatively untouched. The majority of protected areas could not yet be distinguished from the surrounding natural savanna landscapes.

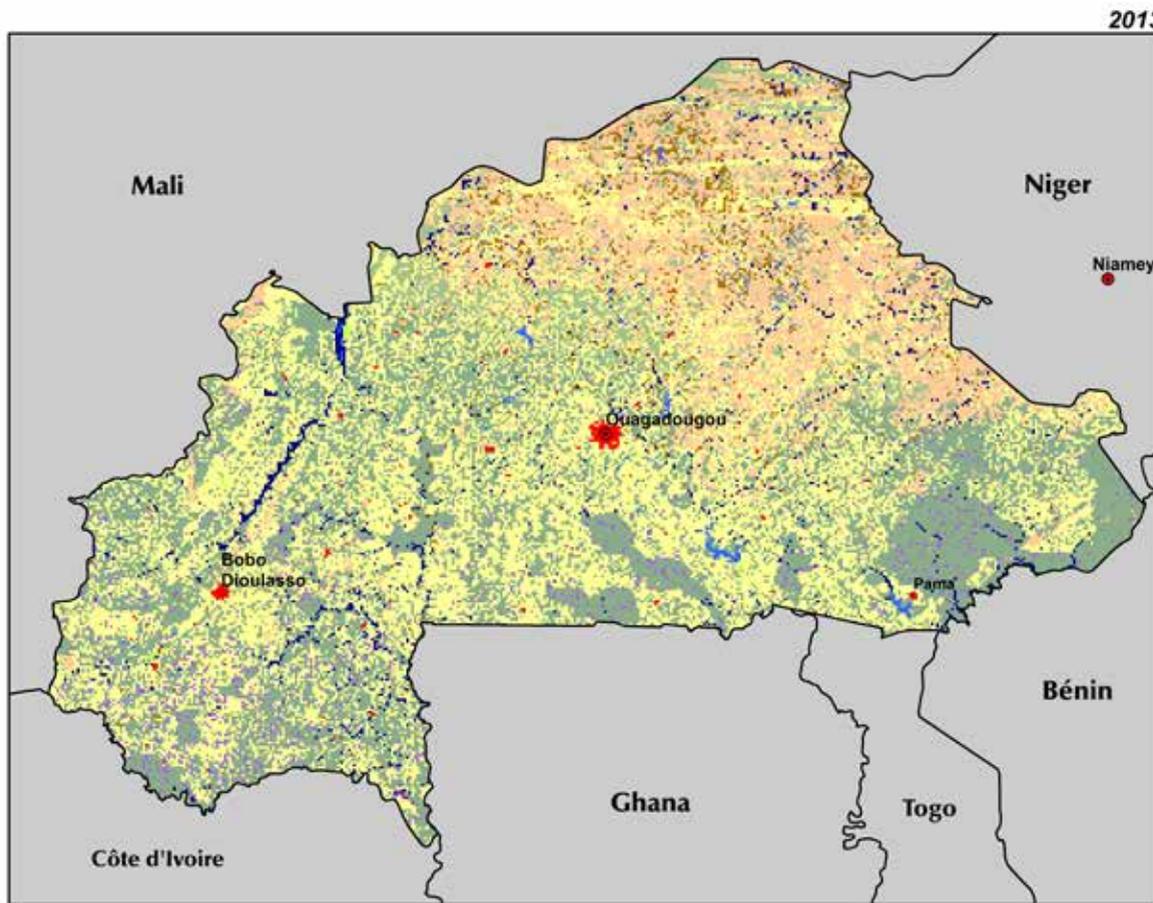
In 2013, the population of Burkina Faso reached 17 million and changes in land cover shown by the maps are striking. Burkina Faso's natural landscapes have been rapidly altered by human activity. Conversion into croplands represents a major transformation, leaving few remnants of the former vegetation structure and diversity. In the north, steppe areas have remained fairly stable because this land cover class occurs in the more arid Sahel, where more marginal soils and lower rainfall severely limit crop cultivation. In 1975, 82.5 percent of Burkina Faso's land was still covered by natural land cover classes (forest, gallery forest, savanna, steppe, or rocky land). In 2013, only 57.4 percent of the country's land was occupied by these land cover classes. Between 1975 and 2013, savannas (Sahelian and Sudanian) shrank by 39 percent. The country's land area covered by rainfed agriculture increased from only 15 percent in 1975 to 39 percent in 2013, an overall increase of 160 percent. This agricultural expansion exceeds 4 percent per year on average, which corresponds to 1,720 sq km of cropland added each year.

Agricultural areas increased only slightly in the north and central plateau, where unfavorable rainfall and rocky soils have kept agricultural expansion to a minimum, but the other two-thirds of the country has experienced considerable agricultural development. Tree and wooded savannas and the gallery forests of the Sudanian zone have been heavily altered



● Capitale Nationale / National Capital





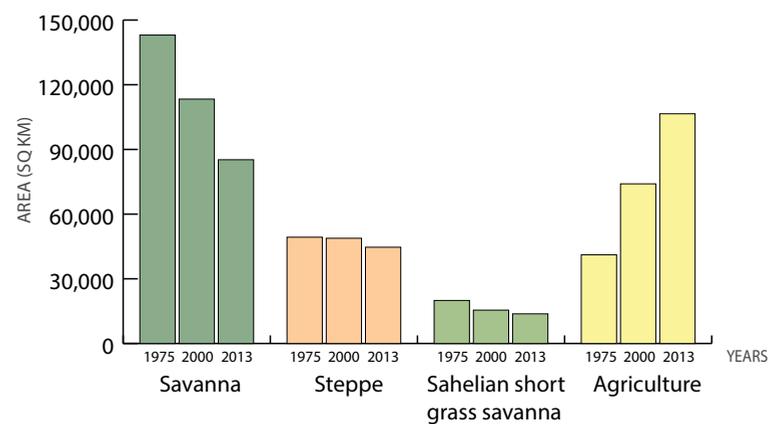
Occupation des Terres / Land Cover

- Forêt / Forest
- Forêt galerie & formation ripicole / Gallery forest & riparian forest
- Savane / Savanna
- Savane sahélienne / Sahelian short grass savanna
- Steppe
- Zone de culture / Agriculture
- Cultures irriguées / Irrigated agriculture
- Cultures des bas-fonds et de décrue / Agriculture in shallows and recession
- Plantation
- Habitation / Settlements
- Sols dénudés / Bare soil
- Terrains rocheux / Rocky land
- Surfaces sableuses / Sandy area
- Carrière / Open mine
- Plans d'eau / Water bodies
- Prairie marécageuse - vallée inondable / Wetland - floodplain

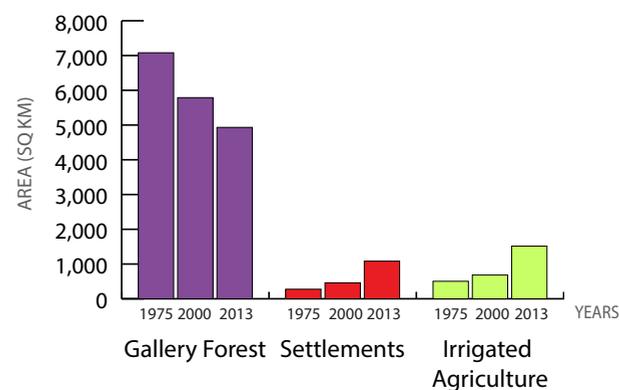
to make room for rainfed crops. The progression of croplands across Burkina Faso during the last four decades has replaced natural landscapes with crop fields and fallows. The only natural landscapes of significant size are restricted to protected areas, and these now stand in sharp contrast against the dominant surrounding agricultural landscape. In 2013, Burkina Faso ranked second in West Africa behind Nigeria as the most agricultural country (in percent of land covered by crops). Burkina Faso is close to reaching the point where human-shaped landscapes cover over half of the country. It seems possible that, in the near future, savannas, woodlands, and forests may only exist in isolated, protected areas that will no longer be connected by natural corridors.

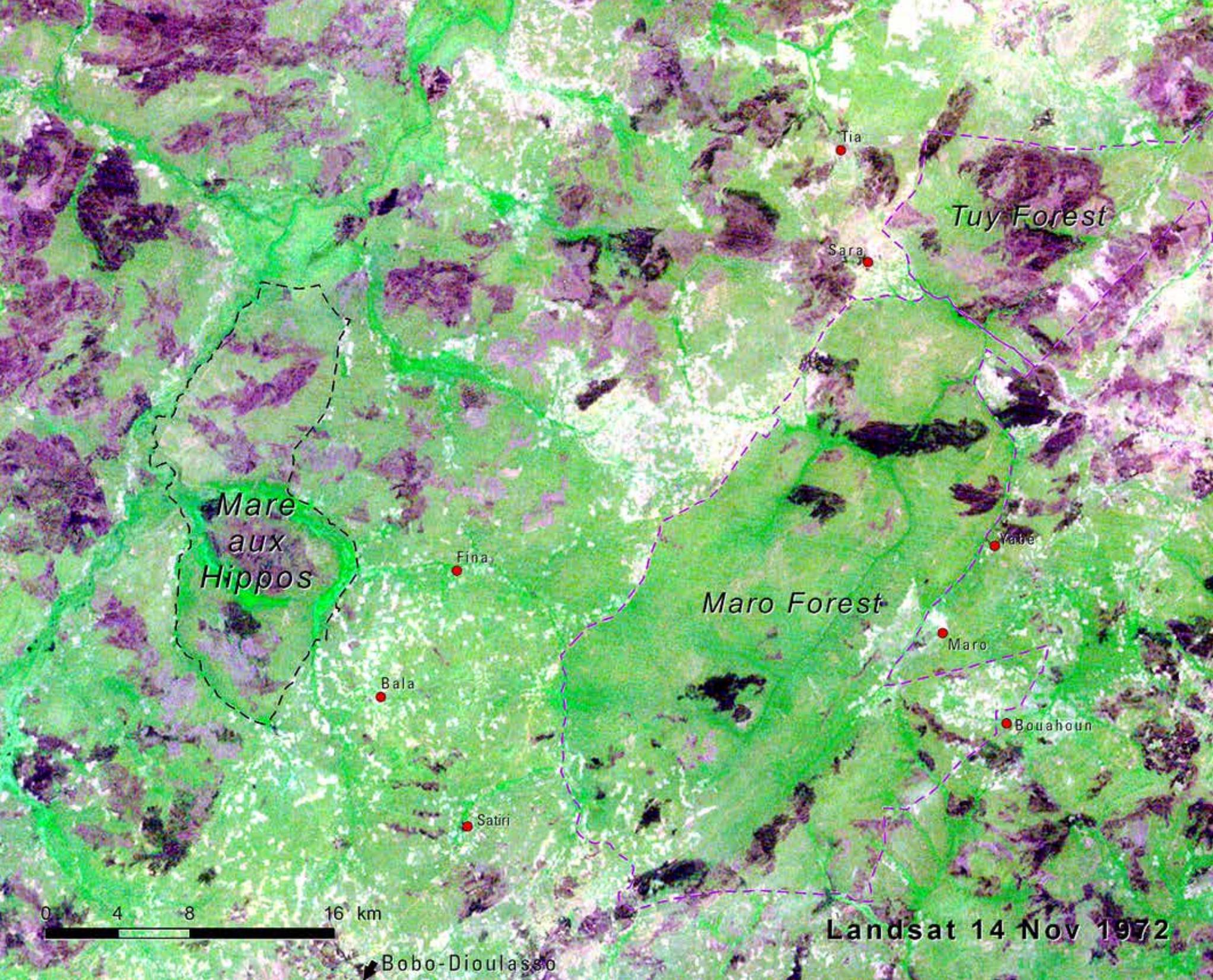
Another critical land cover class is gallery forest. Gallery forests are easily spotted because they stand out from the surrounding savanna vegetation. Although gallery forests are limited to a narrow strip of dense tree cover along streams, their overall area widely exceeds the few remnants of forest (only 48 sq km in 2013). In 1975, gallery forest occupied 7,000 sq km, or about 2.6 percent of the Burkinabe land area. Agricultural expansion decreased this to about 5,000 sq km in 2013, which corresponds to a 30 percent reduction within 38 years. Gallery forests host a wide variety of plant and animal species, making them a conservation priority.

Large area classes



Small area classes



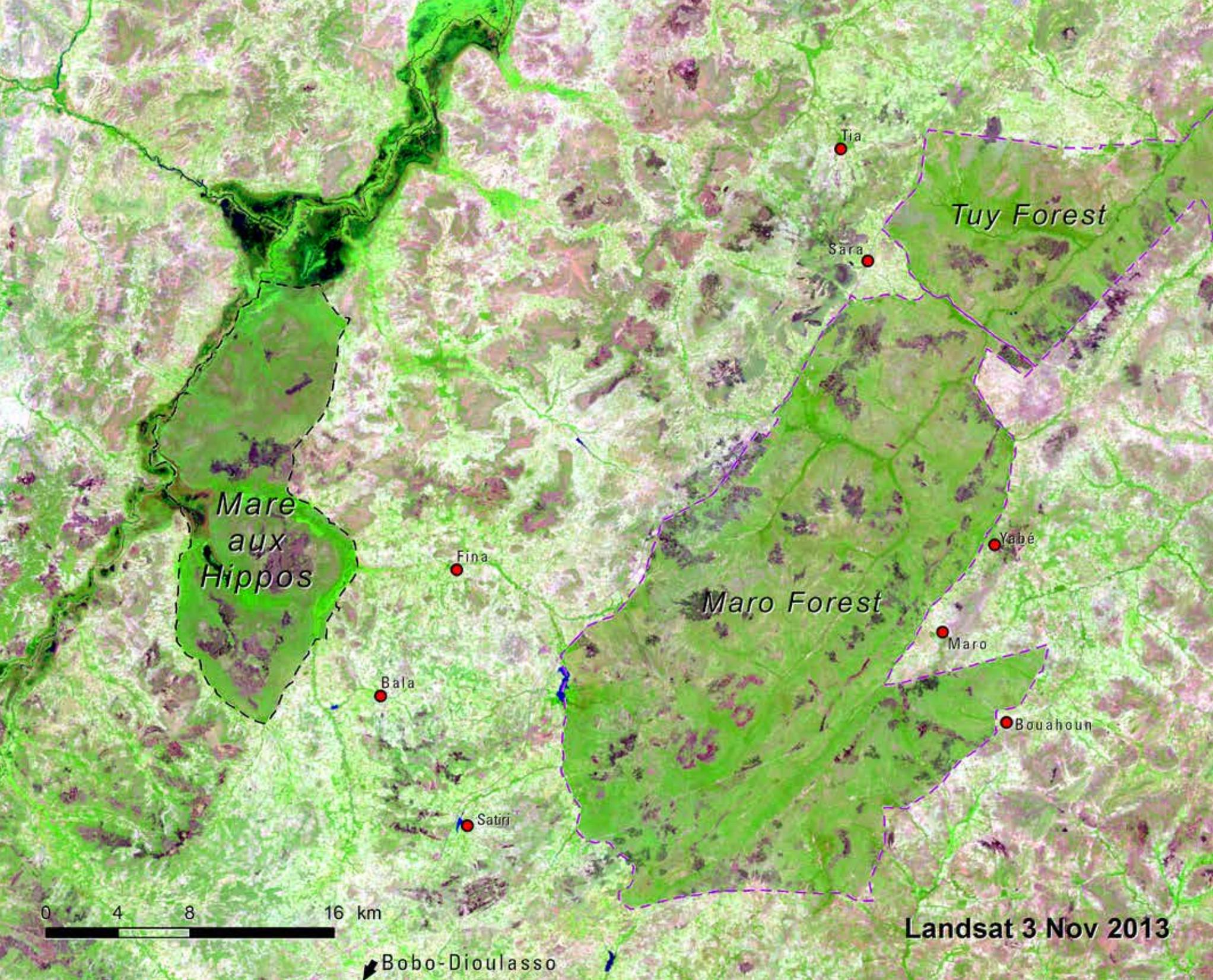


The Mare aux Hippopotames National Park and Biosphere Reserve

The Mare aux Hippopotames National Park was designated as a Biosphere Reserve by UNESCO in 1987 and a Ramsar site in 1990. It is a natural habitat that has remained fairly intact thanks to community protection efforts. This park is a crucial ecosystem for the preservation of regional biodiversity and for local people who rely on its resources. Yet the reserve faces increasing pressure due to a growing population and resulting agricultural expansion, which together threaten its ecological integrity.

Located in the Houet province about 60 km north of Bobo-Dioulasso, the Mare aux Hippopotames is in the Sudanian bioclimatic region, with annual rainfall approaching 1,000 mm. Overall, the reserve encompasses 192 sq km, of which 1.40 sq km is covered by a permanent water body that can reach 6.60 sq km during flooding periods. The reserve is well known for its freshwater lake ("mare" in French), linked to a network of swamps and floodplains and fed by the Volta Noire River.

This complex of wetlands has high ecological value. In addition to its importance as a wintering ground for migrating birds, the Mare aux Hippopotames helps to recharge the water table, prevent or control floods, control erosion, and maintain a more moderate climate. The lake's diverse habitats abound in wildlife unique to the region, including the famous hippopotamuses that inhabit the lake. Protection efforts have increased the number of hippopotamuses



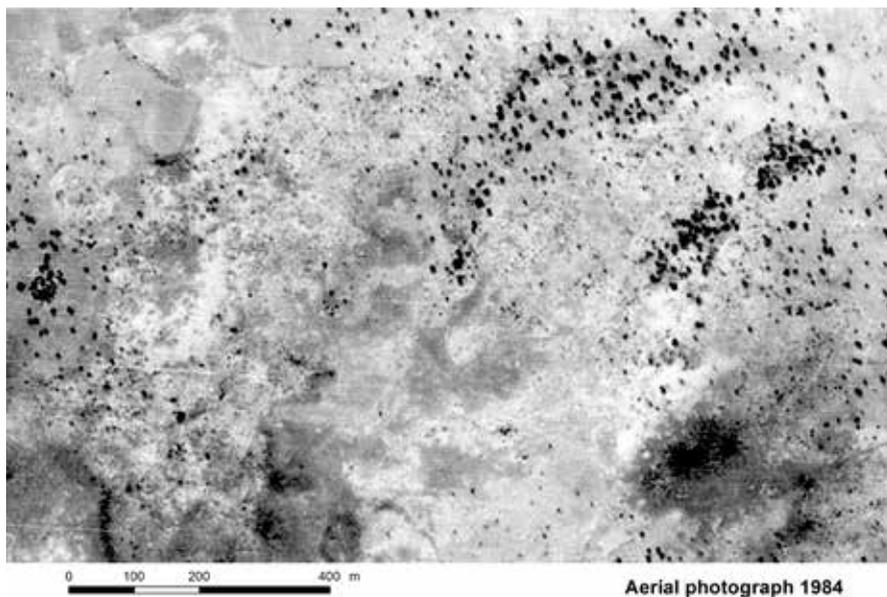
from about 30 animals in 2006 to about 100 in 2010 (SP/CONEDD, 2012). Other mammals also live in the reserve, especially elephant, bushbuck, and roan antelope. The reserve also contains 17 sq km of gallery forest and 110 sq km of tree and shrub savannas.

For local people, the reserve serves as a fishery and provides critical resources, such as fruits, honey, wood fuel and ecotourism (about 1,000 visitors per year) (Pagen, 2006). The satellite image from 1972 shows the beginning of agriculture encroachment into savannas. Croplands appear as light patches; the dark spots are burn scars from natural bush fires. In 1972, the reserve boundaries are hardly discernable within the surrounding savanna. By 2013, the Mare aux Hippopotames reserve's natural savannas sharply contrast with the widespread transformation to agriculture. At least for now, the reserve boundaries are being respected by farmers. However, careful management and monitoring will be needed to preserve this ecosystem into the future.

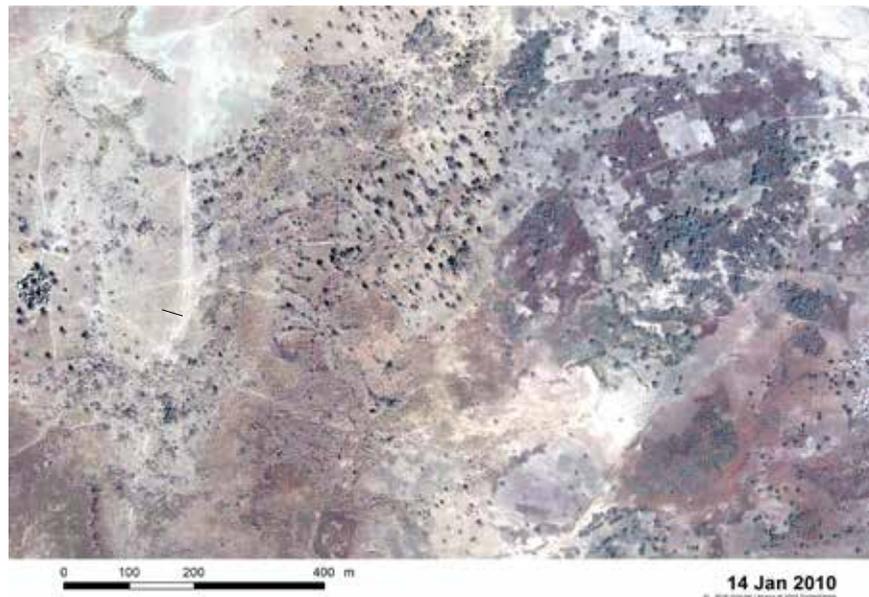


JAMES ROWLAND/USGS

Aerial view of the Mare aux Hippopotames area



INSTITUT GEOGRAPHIQUE DU BURKINA FASO



A comparison of a 1984 aerial photograph (left) and a 2010 satellite image (right) showing the dramatic rehabilitation of barren land by farmer innovator Ali Ouédraogo.



Land rehabilitation and community forests on Burkina Faso's Central Plateau

The landscapes of the northern Central Plateau are known for their harshness, dominated by rocky plateaus and unproductive soils. Despite this, approximately 50 percent of Burkina Faso's rural population lives here, coping with unreliable rainfall. The major droughts of the 1970s and 1980s exacerbated the difficult living conditions of rural people across this region, compelling many farm families to leave their villages and to settle in regions of higher rainfall to the south.

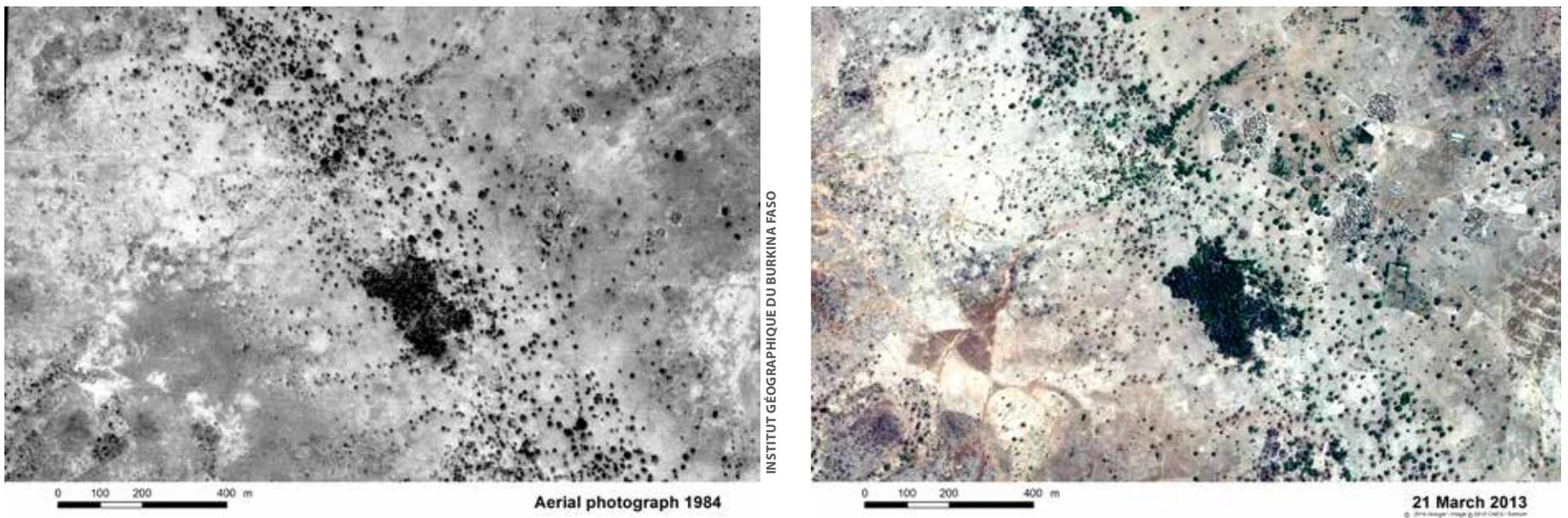
Faced with this situation, many villagers took initiatives to fight against environmental degradation and to improve rural living conditions. Few would have predicted that nearly 30 years after the last great drought, with a population density roughly double what it was then, that we would see many examples of land rehabilitation, including productive farming on formerly barren plateaus. Surprisingly, we also see scattered community-managed forests that show the potential of what can be done across the Sahel. Here, we present two examples of the many successes in land management on the Central Plateau.

The first site is an example of a farmer innovator, Ali Ouédraogo, who in 1983 began rehabilitating degraded, barren land west of Gourcy (see image pair above). The comparison of a 1984 aerial photograph and a 2010 satellite image clearly shows the dramatic results of Ali's work. The barren, laterite landscape (at the center and left of center of the photo) is the site of Ali's future fields. His efforts to rehabilitate this barren land had only just begun. Ali was trained in the layout and construction of contour stone bunds by the Oxfam-funded Agroforestry Project (Reij and Waters-Bayer, 2001). He soon discovered that trees started growing alongside the bunds in his fields because their seeds were deposited there by the runoff water. He protected this natural regeneration, and from 1986 onwards he decided to stimulate the establishment of trees. To grow his crops, he placed seeds in

Two recent views of Ali Ouédraogo's fields with tree regeneration along the rock lines he constructed beginning in 1983.



GRAY TAPPAN / USGS



Comparison of a 1984 aerial photograph (left) with a 2013 satellite image (right) showing the village of Pouima (right center), its community forest, and its agricultural parklands.

thousands of planting pits (also known as “zai”) — the revival of an old practice which also contributed to obtaining good yields of millet, sorghum and cowpea. In 2010, 26 years after Ali’s initial efforts, the barren land had been transformed into productive cropland accompanied by a diverse tree parkland. Ali’s fields and trees dominate the central part of the image, completely rehabilitating the laterite surfaces (top right, opposite page). The zebra stripe pattern is a testament to the vigorous regeneration of trees that take advantage of the favorable micro-environment created by his rock lines, which trap soil and seeds, and enhance water infiltration. Practices such as these have helped rehabilitate between 2,000 and 3,000 sq km of land and produce an additional 80,000 tons of food per year (Reij, Tappan and Smale, 2009).

The second site is one of dozens of community-managed forests widely scattered across the dry landscapes of northern Burkina Faso (see image pair above). These forests provide much inspiration, for they prove that forests can and do thrive in the harsh Sahelian environment. One of these community forests is associated with the village of Pouima, near Gourcy. The forest covers about 4.6 hectares, forming a dense woodland of indigenous trees and shrubs characteristic of the Sahel. The forest is quite old, and has been protected and managed by the villagers for at least several generations. A comparison of an aerial photograph taken in 1984 with a satellite image acquired in 2013 shows that the forest has increased in area.

The villagers of Pouima say that the forest continues to benefit from the protection placed upon it by their ancestors. They inherited the forest, and they feel that they must preserve it for future generations. It continues to serve the community in many ways. Fruit and firewood can be collected only by the older women in the village. However, anyone from the village may harvest fruit when it is ripe. No cutting of wood is allowed. The forest also serves as a site for sacrificial ceremonies, which explains the respect people have for it.



Recent views of the interior of the Pouima community forest.

GRAY TAPPAN / USGS