Landscapes of West Africa

A Window on a Changing World

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A Window on a Changing World

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To be cited as:
CILSS (2016). *Landscapes of West Africa – A Window on a Changing World*. U.S. Geological Survey EROS, 47914 252nd St, Garretson, SD 57030, UNITED STATES.

*SGT Inc., Contractor to the U.S. Geological Survey, Contract G15PC00012

PHOTOS (COVER): GRAY TAPPAN/USGS; ROBERT WATREL/SDSU; ERIC LANDWEHR/SDSU; RICHARD JULIA

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.

Source: NASA, Lunar Reconnaissance Orbiter

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.

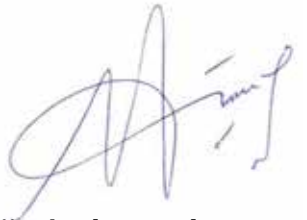
The West Africa Land Use Dynamics (LULC) Project is emblematic of this cooperation. Initiated in 1999, the LULC project has had several phases including training national experts to extract pertinent information from satellite images to characterize vegetation cover and producing tools and supporting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

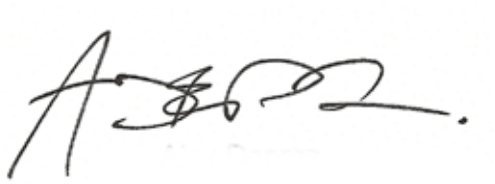
Rapid changes are occurring across West Africa's natural and human landscapes and balancing the need to preserve natural ecosystems with the need to grow more food, together with ensuring resilience in the same ecosystems, is a challenge. USAID West Africa's (USAID/WA) Environmental Threats and Opportunity 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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Acknowledgments

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:

The U.S. Agency for International Development/West Africa (USAID/WA) which financed, encouraged and contributed actively to the review of this atlas;

The Resilience in the Sahel Enhanced (RISE) Program managed from USAID/Senegal's Sahel Regional Office, which supports the work of mapping best practices and re-greening, and promotes soil and water conservation in the Sahel;

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;

The AGRHYMET Regional Center under CILSS for its role in the technical coordination of the work and processing of satellite imagery;

The Directors of the Centre National de Télédétection et de Suivi Ecologique (CENATEL) in Cotonou, the Agence Nationale de Gestion de l'Environnement (ANGE) in Lomé, and the Centre de Suivi Ecologique (CSE) in Dakar who hosted mapping validation workshops , and;

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

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In West Africa, we would also like to acknowledge the invaluable advice, insights and assistance from:

Amadou Hadj, Geographer and Land Use Planner, Dakar, Senegal, for many fruitful years of field work and reflecting on natural resource management;

Samba Laobé Ndao, besides being part of the Senegal National Team, provided considerable support to field work, geographic databases, and logistical support to the project team;

Moussa Sall and Assize Touré at the Centre de Suivi Ecologique (CSE) in Dakar, for assistance with field work, studies on biomass and carbon sequestration, and many long years of collaboration;

Bienvenu Sambou and Assane Goudiaby, Université Cheikh Anta Diop de Dakar/Institut des Sciences de l'Environnement (ISE), for many years of exchanges with the USGS EROS team on long-term monitoring of Sudanian ecosystems.

At the USGS EROS Center, we extend special thanks to Jan Nelson and Tom Holm for guiding the publication process. Thanks also to the manuscript reviewers, Tom Adamson and Mike Budde, and to Aaron Neugebauer for his artwork on vegetation profiles. Many thanks to Melissa Mathis for her help with GIS training, and for her major role in developing the Rapid Land Cover Mapper. We are indebted to Anne Gellner for translating much of the manuscript into French.

At the World Resources Institute (WRI), we would like to thank Chris Reij and Robert Winterbottom, and Michael McGahuey at the USAID, for their many decades of work and insight into the natural resources of the Sahel, and their tireless work on landscape restoration and re-greening for the benefit of people across the region. We are also grateful for the many landscape and cultural photographs contributed by Michiel Kupers in the Netherlands, and Robert Watrel and Eric Landwehr at South Dakota State University (SDSU). Many thanks also to Scott Benton for his excellent contribution to the study of vegetation changes on the Island of Santo Antão, Cabo Verde.

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;

Kevin Dalsted, Soil Scientist and Land Resource Specialist, South Dakota State University, for his support to the land use mapping;

Richard Julia, friend and pilot based in Ouagadougou who made it possible for the project team to acquire thousands of aerial photographs in numerous countries of West Africa, and for his own photography of landscapes, wildlife and cultures of the Sahel.

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.

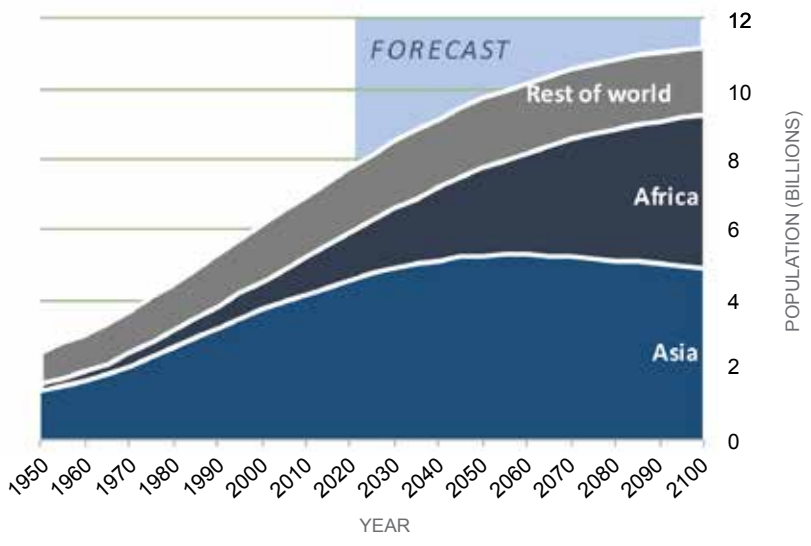
When humankind appeared on Earth around 200,000 years ago the influence of human activity on the environment must have been small and localized. The influence of scattered small groups of people on the global ecosystem would have been overwhelmed by the forces of natural systems (Steffen and others, 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

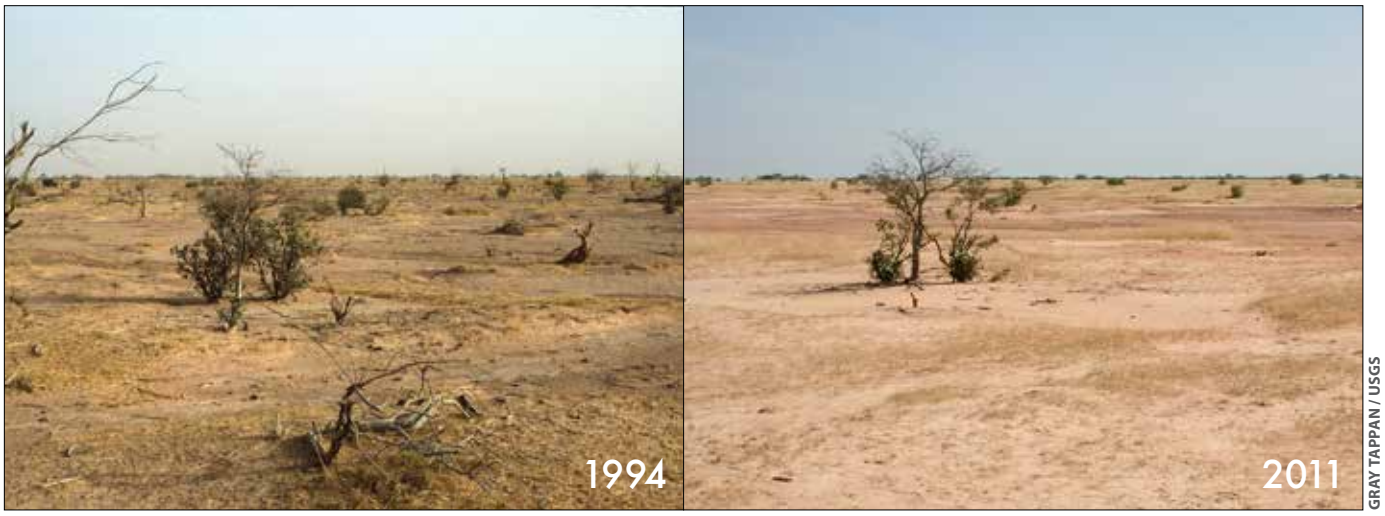
Wooded landscape fragmented by agriculture expansion in western Burkina Faso

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.

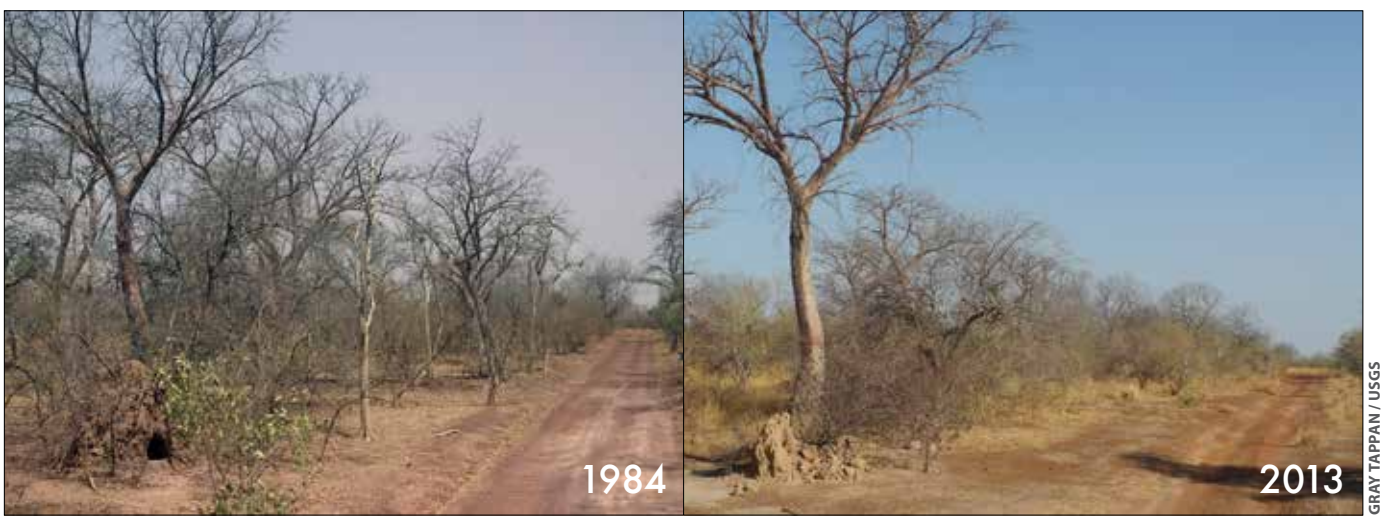
Conversion of the natural landscapes of West Africa to agriculture greatly reduces the natural biodiversity, and exposes the soil to wind and water erosion. The savanna, woodland, forest, and wetland ecosystems that are lost have some relatively tangible impacts such as the loss of natural ecosystem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

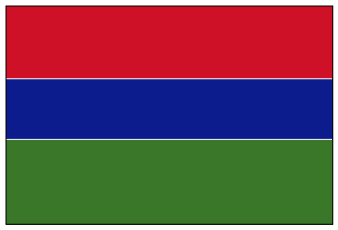
It is in the hands of today's decision makers to formulate wise, well informed choices about how to manage West Africa's land, to ensure that vital ecosystem services and agricultural productivity are able to support tomorrow's people. To make good choices the governments of West Africa need good information 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.

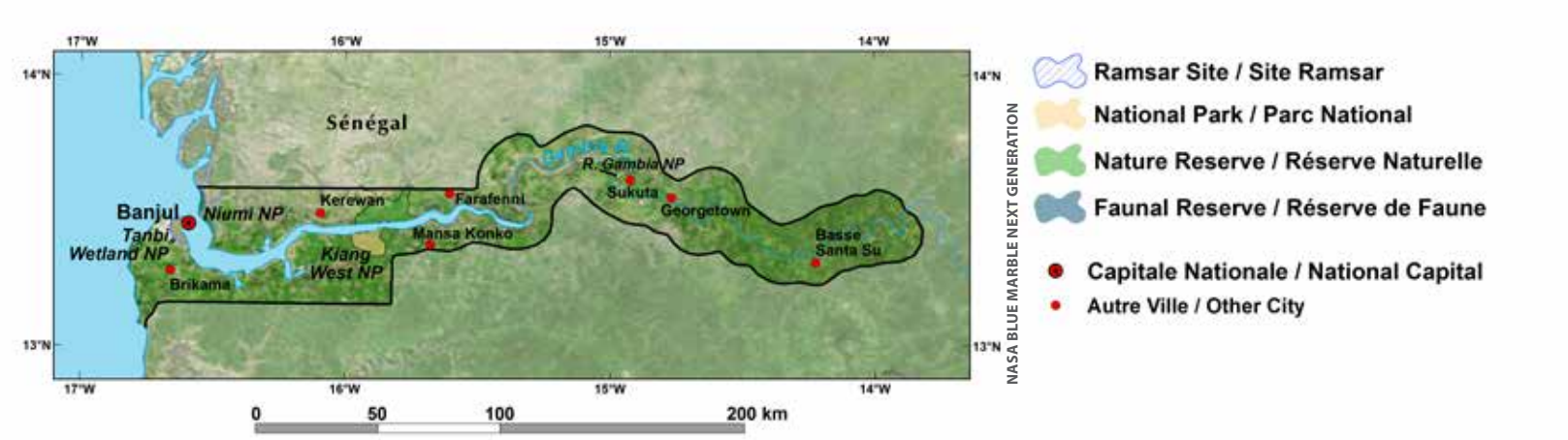
Chapter II

Country Profiles, Land Use and Land Cover, and Trends



Republic of

The Gambia



Total Surface Area: 11,295 km²
Estimated Population in 2013: 1,867,000

The Gambia is the smallest country on mainland Africa, with an extent of about 330 km east to west, and less than 50 km north to south. It is a former British colony, forming an enclave within Senegal, a former French colony. The Gambia is one of the most densely populated countries in West Africa. The highest concentration of people is around the increasingly urbanized landscape spreading outward from The Gambia's capital, Banjul. The city is built on a small peninsula tucked between mangrove-lined estuaries and the broad mouth of the Gambia River, which rises out of the Fouta Djallon Highlands of Guinea. With its natural port, Banjul is an important trading post between West Africa and the world. The main ethnic groups are the Mandinka, the Wolof and the Fula.

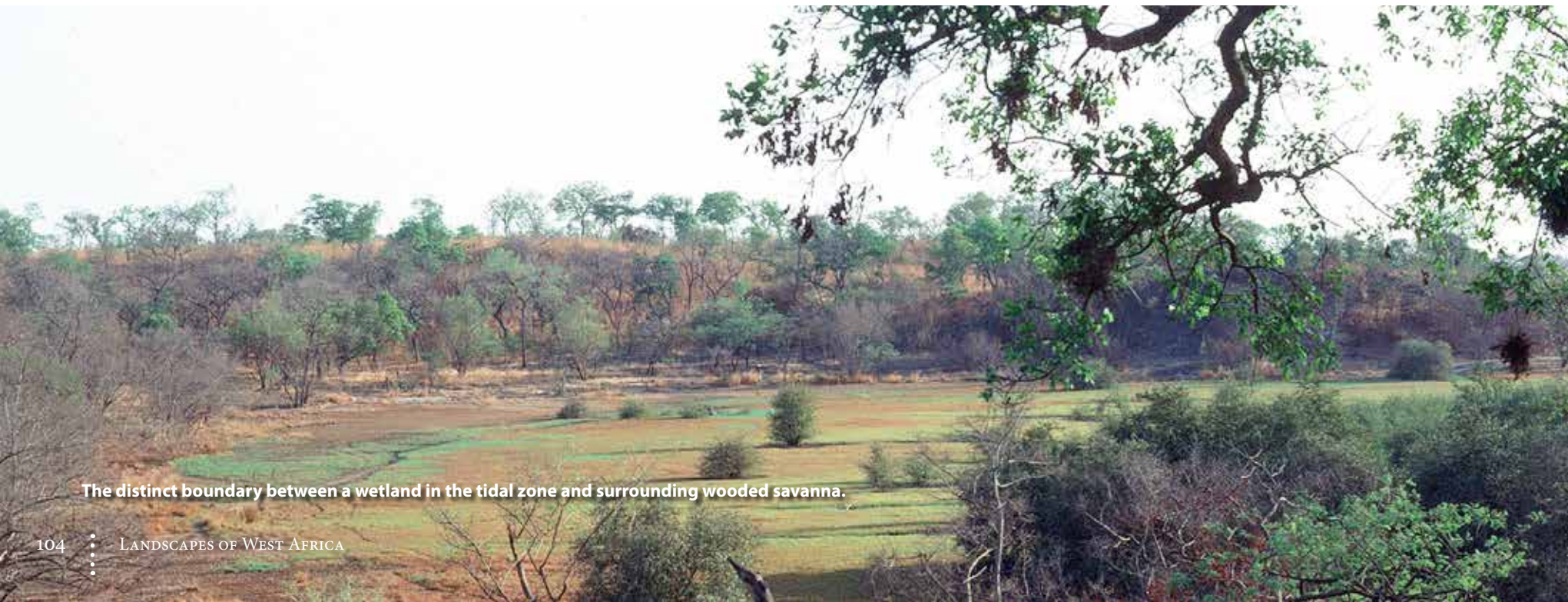
The Gambia's economy is dominated by agriculture. About two-thirds of the population is engaged in raising livestock or growing crops, such as rice, maize, millet, sorghum, and cassava. Small-scale manufacturing includes processing peanuts, fish, and hides. The country lies within the Sudanian climatic region, with a distinct short rainy season and a long dry season. The Gambia has also found a niche in tourism, taking advantage of its beautiful beaches, warm water, and nature retreats. It is well known for bird watching, with over 540 species of birds recorded (Barlow and Wacher, 1997).

Environmental Highlights:

- Overfishing
- Coastal erosion
- Deforestation
- Rapid urbanization
- Tourism, bird watching

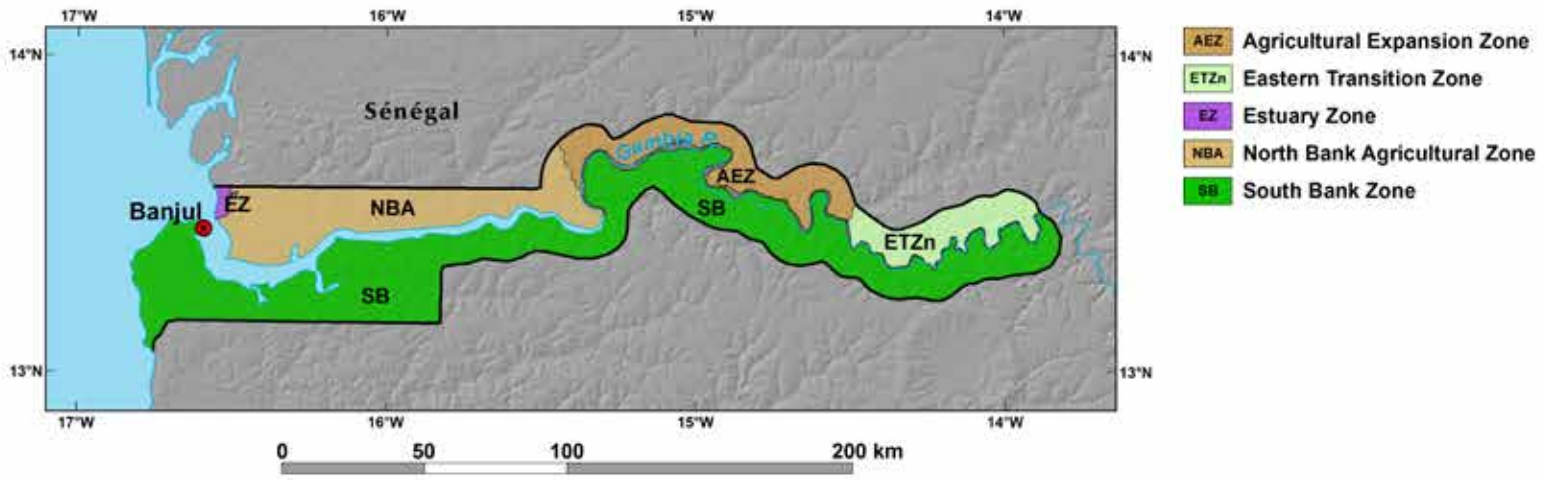
Malachite kingfisher

MELISSA MATHIS/SGT



The distinct boundary between a wetland in the tidal zone and surrounding wooded savanna.

Ecoregions

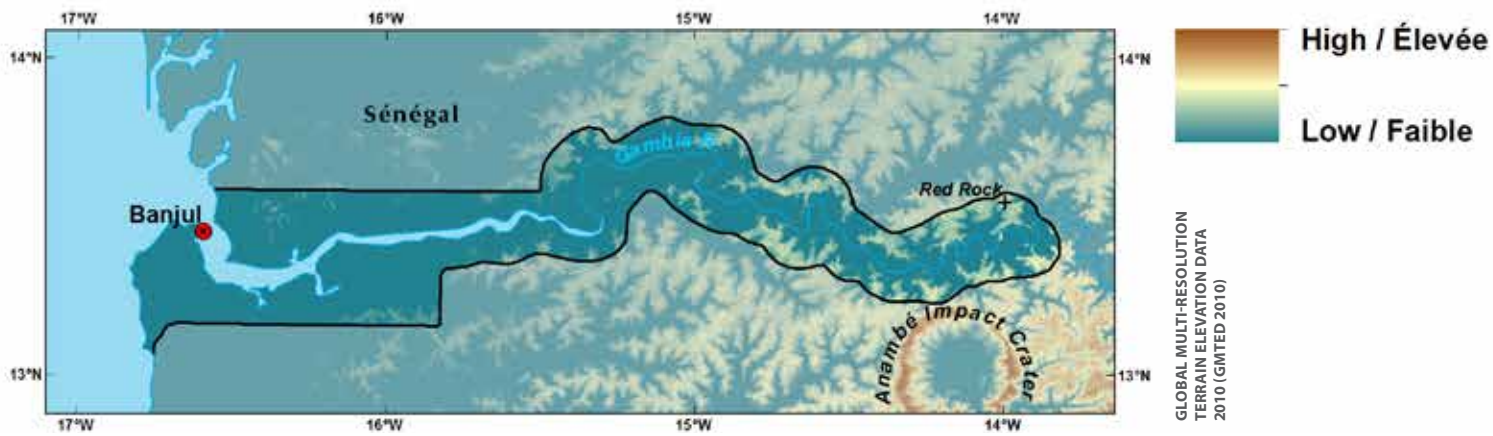


The Gambia lies entirely within the drainage basin of the Gambia River, a basin that extends well into Senegal and Guinea. The river's channel only descends10 m as it flows from The Gambia's eastern border to its mouth at Banjul. The river's flow is very seasonal, and sea water intrudes some 200 km upriver during the dry season. The land is also flat, especially in the western half. In the eastern part of The Gambia, the river carves a meandering path through laterite-capped plateaus; terraces and shallow valleys characterize the terrain. The highest point is Red Rock, at only 53 m above sea level.

The Gambia's five ecoregions are all transboundary areas that have their counterparts in Senegal. The Gambia River forms a natural boundary between the northern ecoregions and the one in the south — the South Bank Zone (SB). Over a century ago, most of the country was blanketed by Sudanian woodlands, wooded savannas, and gallery forests. Today, most of the more wooded landscapes are found on the south side of the river, where the South Bank Zone extends seamlessly into Senegal's Casamance (CAS) ecoregion. The woodlands nearer the coast are denser and have much higher biodiversity than those in the east.

Major systems of mangroves and mudflats are found along the coast near the mouth of the river, extending nearly half way up the length of the country. These constitute the Estuary Zone (EZ), an ecoregion that extends well into the Saloum River complex in Senegal. North of the Gambia River, three ecoregions reflect the varying degrees of human transformation of natural landscapes into agricultural ones. The North Bank Agricultural Zone (NBA) is almost entirely devoted to groundnut, millet, and maize cultivation on sandy soils. The Agricultural Expansion Zone (AEZ) is a mix of broad cultivated valleys among laterite plateaus with shrub and tree savannas. In the east, the Eastern Transition Zone (ETZ) is more sparsely populated, and the predominance of lateritic plateaus has spared the region from the more intensive human pressures of the western regions.

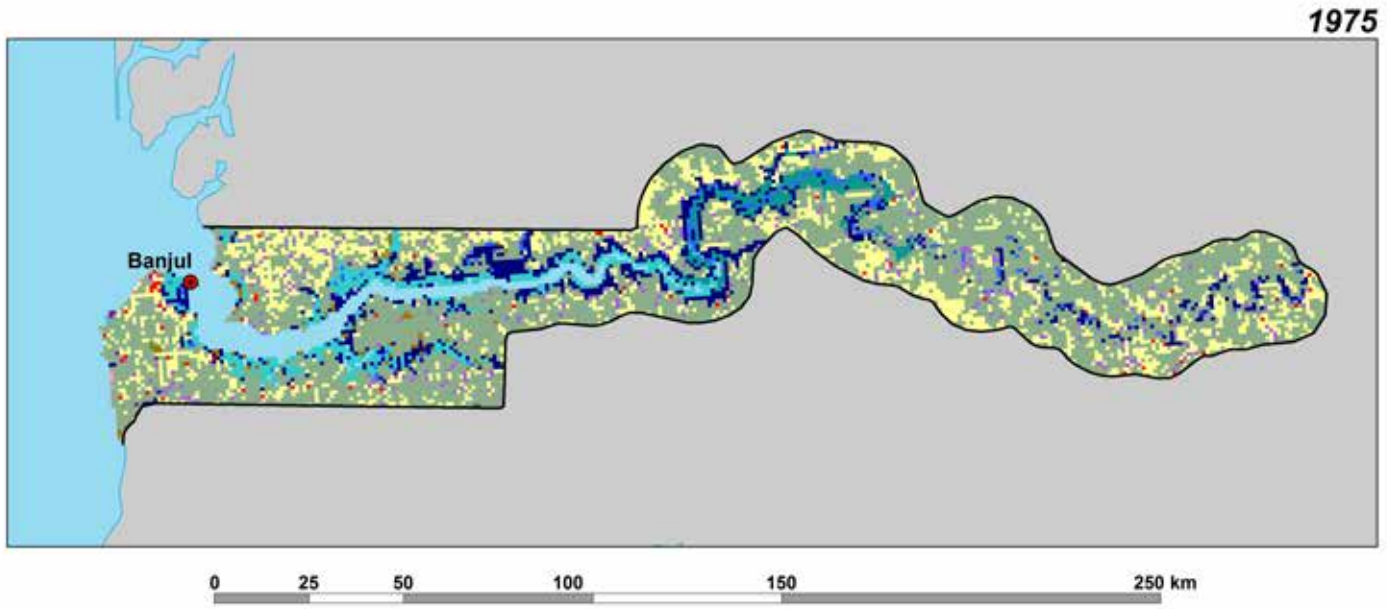
Shaded Relief

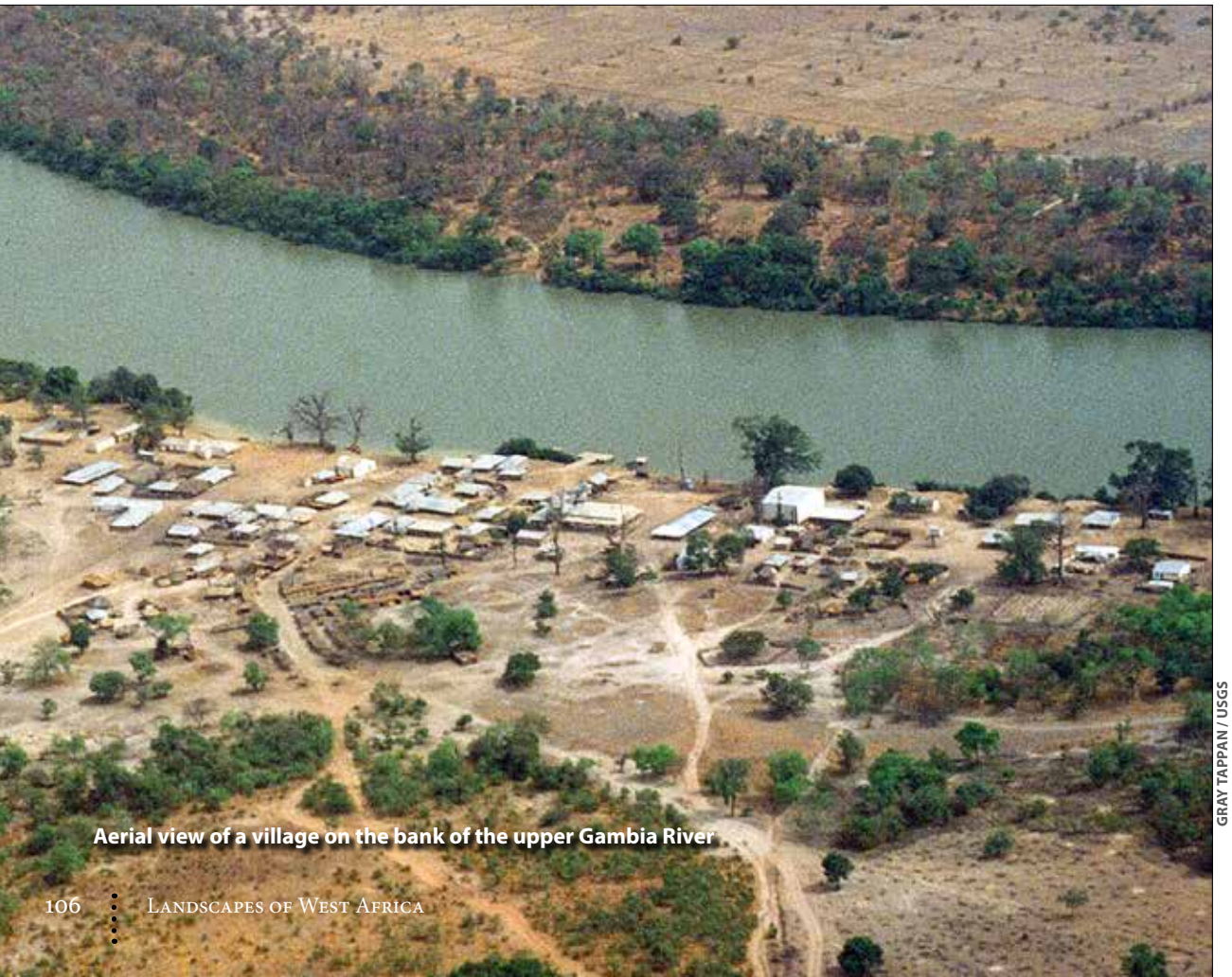


A beach near Banjul

GRAY TAPPAN / USGS

PHOTO (OPPOSITE PAGE): GRAY TAPPAN /USGS



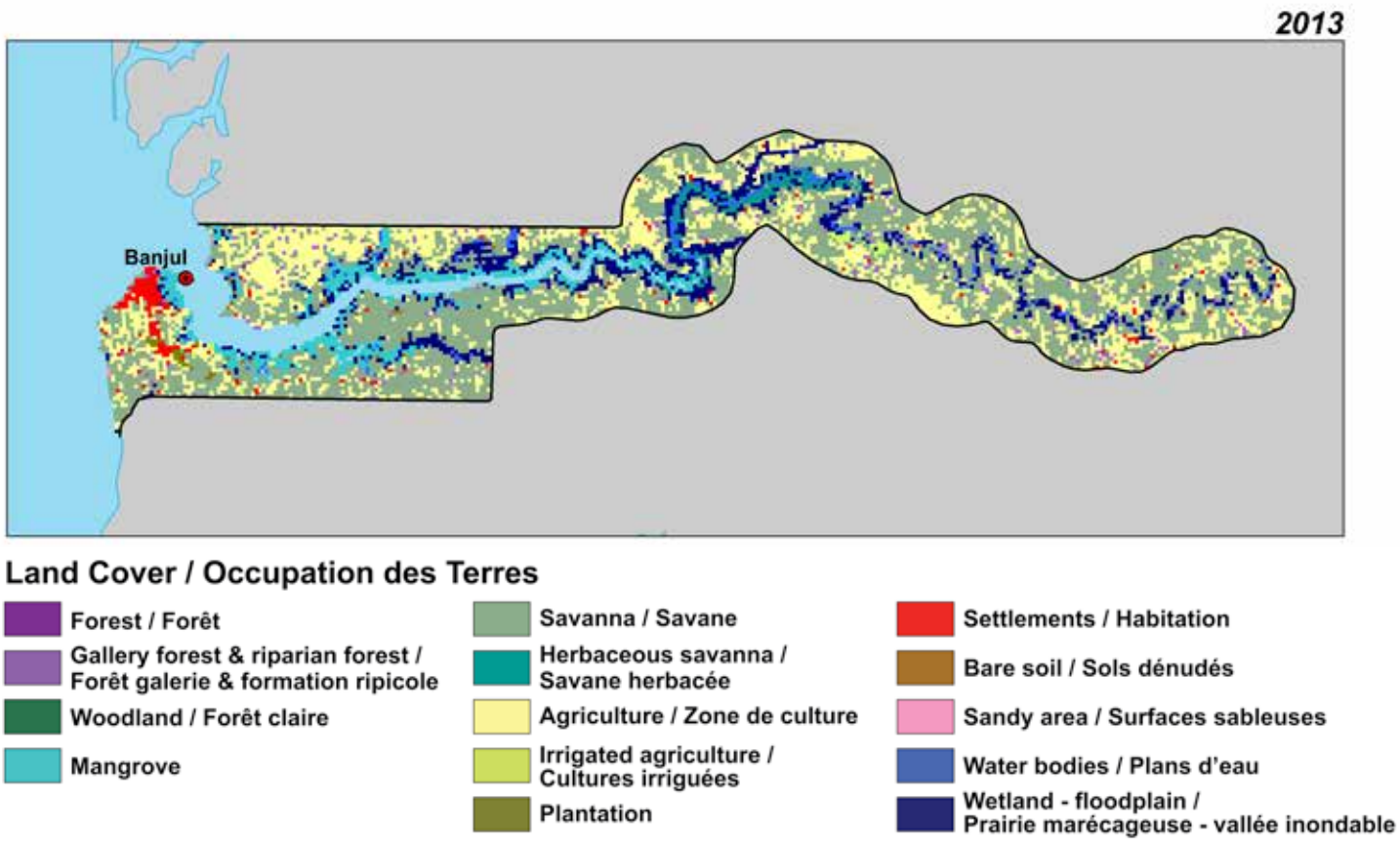


Aerial view of a village on the bank of the upper Gambia River

GRAY TAPPAN / USGS

Until the middle of the 20th century, The Gambia's landscapes were extensively wooded, as part of the broad Sudanian wooded savannas that sweep across this latitude of West Africa. Today, vegetation density and diversity increases from east to west, as well as from the relatively drier north to the moister south. The Gambia's land cover has changed dramatically. The first change is the expansion of agriculture as the savannas are cleared for farming. The second is the rapid urban sprawl of Greater Banjul and beyond.

Among The Gambia's semi-natural landscapes, savanna — which ranges from open shrub and tree savanna to dense wooded savanna — is still the predominant class by area. However, the maps show that it is giving way to agriculture. In 1975, savanna occupied 51.3 percent of the total land area, whereas in 2013 it occupied 43.4 percent. In the eastern and southern regions of the country,

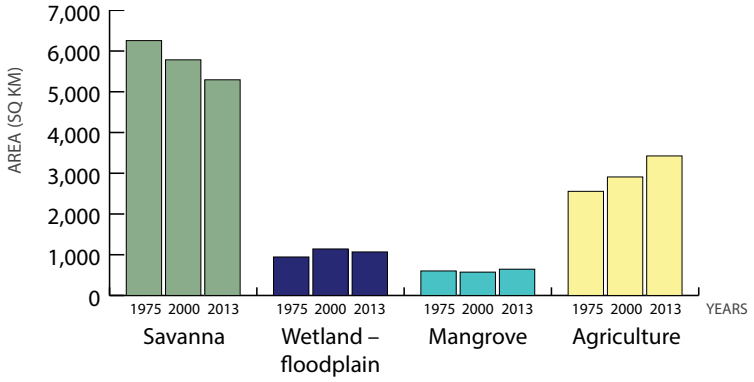


the savanna land cover is also becoming more fragmented as village lands devoted to agriculture coalesce.

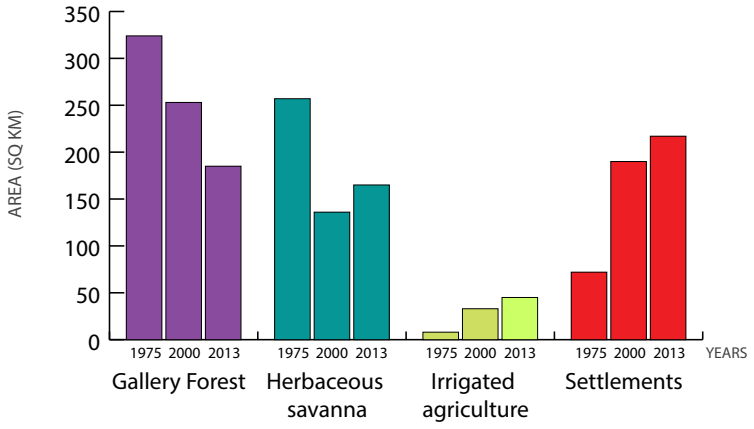
The Gambia's forests offer a more mixed picture of change. Majestic gallery forests (and fringing riparian forests along humid bottomlands) once lined most of the streams and drainage ways. They often occur on deeper soils with shallow water tables. These areas are also favored for rice cultivation and other uses. As a result, gallery forests are being seriously depleted by clearing, or degraded by selective logging of large trees for high value wood. In 1975, 324 sq km of gallery forest were mapped. By 2013, only 185 sq km remained, a loss of over 42 percent. In contrast, The Gambia's mangrove forests have been fairly stable, with a slight increase in area from 602 sq km in 1975 to 654 sq km in 2013 (see mangrove regeneration story, page 69).

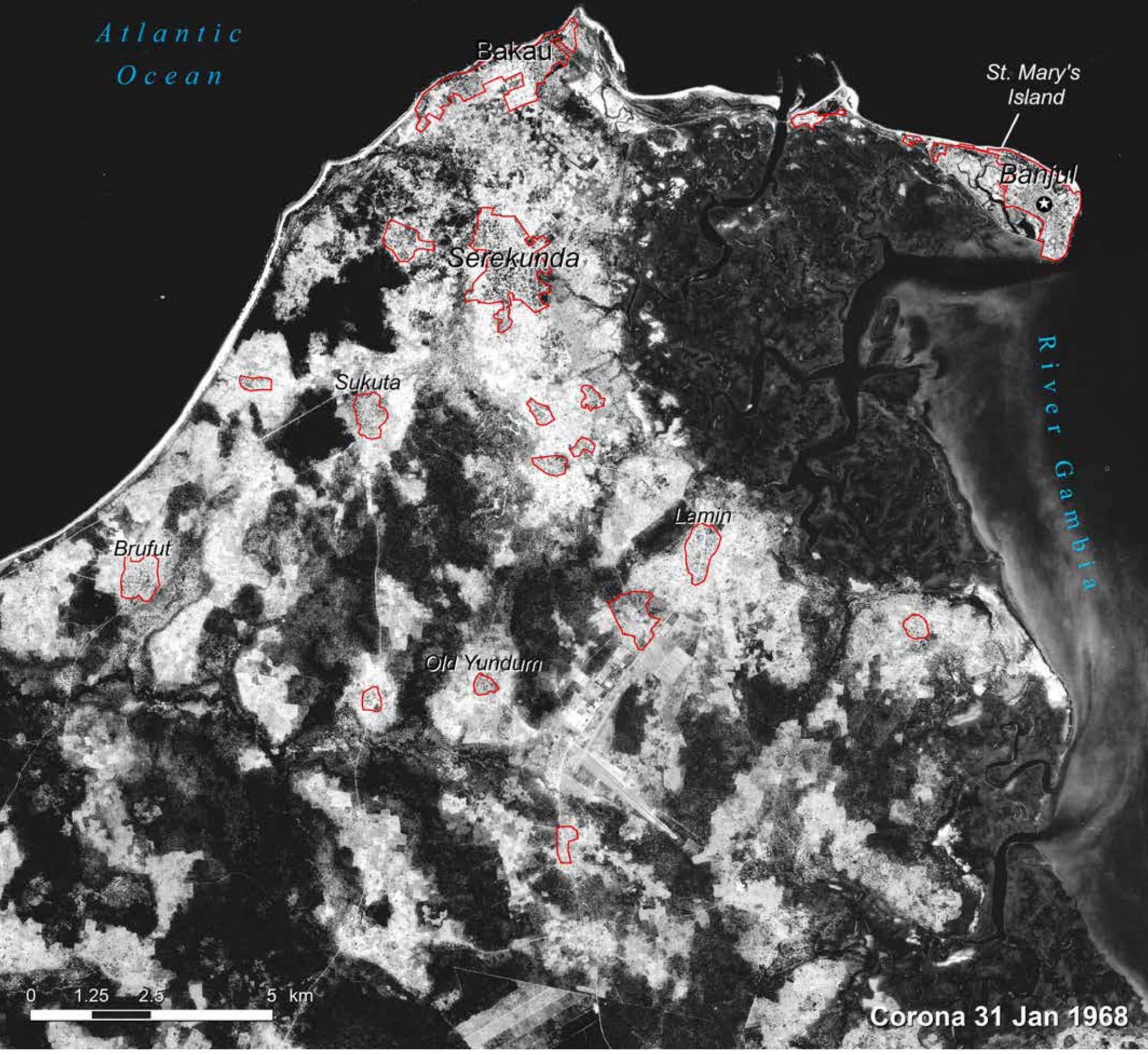
With the French introduction of groundnuts as a cash crop in Senegal in the 1800s, the production of groundnuts gradually spread across the border into western The Gambia. The northern half of The Gambia was the first to embrace large-scale groundnut cultivation because of its proximity to the major groundnut producing region of Senegal. By the 1930s, this area had become The Gambia's main agricultural region. Patches of savanna used for grazing and forest resources were still present, as seen in the 1975 map. By 2013, The Gambia's western portion, north of the river, had become almost continuously cultivated, and the traditional system of bush fallow largely abandoned. Agricultural expansion continues in all regions. In the east, where it was once found mainly on deeper soils in valleys, rainfed cultivation has now expanded into the terraces and plateaus. At the national level, agriculture in 1975 was found on 21 percent of The Gambia's land area. The area increased to 23.9 percent in 2000, and 28.1 percent in 2013.

Large area classes



Small area classes

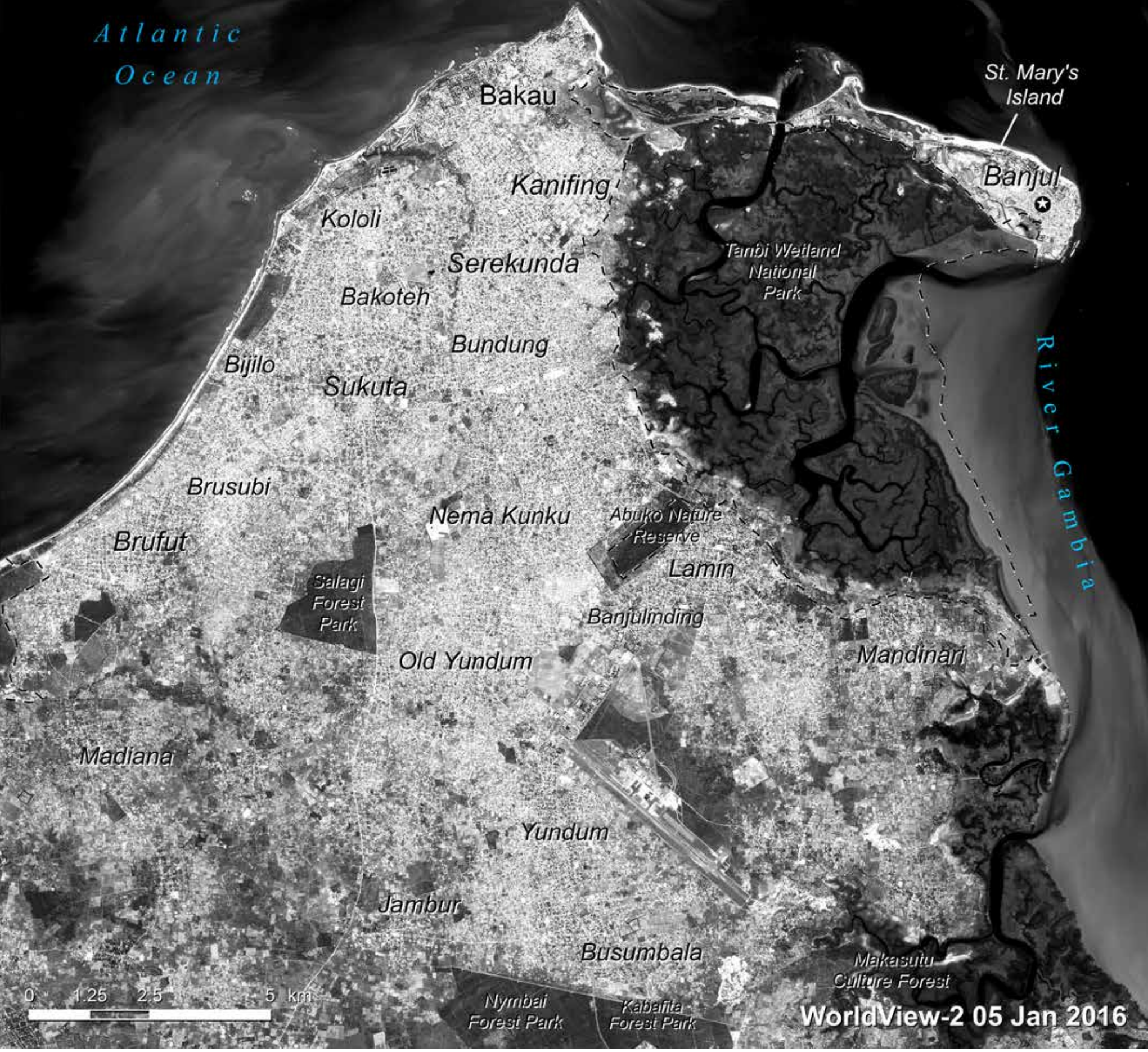




The urban sprawl of Greater Banjul

Banjul is the capital and the largest city in The Gambia. In the 1960s the built up area of the city and surrounding towns covered only St. Mary's Island and a small part of the north end of the cape area. The villages that would later grow and be absorbed into the Greater Banjul metropolitan area (many outlined in red) across the rest of the cape were separated by areas of farming and savanna woodland in the 1968 Corona image. Over the next four decades the urban development spread west and south across the cape, swallowing up villages, farms and woodlands as it grew. By 1990 the population had reached roughly half a million for the area shown in the images above. By the time of the 2016 image, it had grown to an estimated 1.39 million (CIESIN, 2005).

The rapidly growing population presents a serious challenge to sustainable use of The Gambia's land resources (FAO, 2010). The sprawling urban growth (seen as brighter areas in the images) between 1968 and 2016 is needed to house Greater Banjul's rapidly growing population, but displaces other essential land uses. Demand for agricultural products grows with the population and drives conversion of natural landscapes to farm fields. Roughly 97 percent



of The Gambia's household energy is from fuel wood (UNDP, 2012). In addition to loss of wooded areas, the pressure on remaining forests has led to their serious degradation (UNDP, 2012).

The land use and land cover maps (see pages 106–107) show that the settled areas have grown from less than 8 percent of the image area in 1975 to about 29 percent of that area in 2013. During the same time, the area of savanna has been cut in half, going from about 43 percent of the image in 1975 to just over 18 percent in 2013. Some agricultural areas were lost to the expanding urban footprint as well, but because some of the savanna was converted to agriculture the overall area being farmed in the images shown above was slightly greater in 2013 than in 1975.

The remaining patches of wooded savanna are clearly visible in the 2016 image (dark patches in the inland areas) as are the mangroves of Tanbi Wetland National Park and the Makasutu Culture Forest. The Gambian Forestry Department has emphasized community management of forests for over two decades as a way to build stronger buy-in from local communities to meet goals, which include a long-term target of maintaining a minimum of 30 percent permanent forest cover (Thoma and Camara, 2005). The Gambia has an established ecotourism trade that depends on healthy natural areas for its survival and growth, giving them a stake in preserving the remaining forested areas and mangroves as well (Wally, 2001). Balancing the pressure to meet short-term needs of a growing population against the long-term goals of sustainable land use will challenge The Gambia over the decades ahead.