Executive Summary

*N*ature's Benefits in Kenya: An Atlas of Ecosystems and Human *Well-Being* integrates spatial data on poverty and the environment in Kenya, providing a new approach to examining the links between ecosystem services (the benefits derived from nature) and the poor. This publication focuses on the environmental resources most Kenyans rely on to earn their livelihoods, such as soil, water, forest, rangeland, livestock, and wildlife. The atlas overlays georeferenced statistical information on population and household expenditures with spatial data on ecosystems and their services (water availability, wood supply, wildlife populations, and the like) to yield a picture of how land, people, and prosperity are related in Kenya.

In Kenya's national development plans, improving the health and prosperity of Kenyan families while also safeguarding the natural environment and the many important economic and spiritual benefits it provides are identified as top priorities. Attaining these multiple development goals means that policymakers and civil society groups need to access information and analysis on the numerous interconnections among environmental resources, human well-being, and economic expansion. The maps and analyses presented in this atlas are a first attempt to provide such information.

This information can be used in developing poverty reduction programs and in designing policies for water resources management, agriculture production, biodiversity preservation, and charcoal production, among others. The maps and analyses presented here will not provide easy answers to questions concerning the causes of poverty in Kenya and how ecosystems can best be managed to increase economic growth and improve livelihoods. But they are a first step toward stimulating more informed dialogue and provoking questions for which answers may be found. With up-to-date data and additional analyses, the implementation of Kenya's *Economic Recovery Strategy* (and its successor strategy) can be targeted to specific geographic areas of the country, focusing on the poor, and making better use of Kenya's natural resources.

CHAPTER 1: ECOSYSTEMS AND ECOSYSTEM SERVICES

Kenyans—like all people on Earth—depend on nature to sustain their lives and livelihoods. Not only does it provide the basic goods needed for survival such as water, food, and fiber, people also rely on nature to purify air and water; produce healthy soils; cycle nutrients; and regulate climate. Collectively, these benefits derived from nature's systems are known as *ecosystem services*.

About 80 percent of Kenyans derive their livelihoods from agricultural activities; agriculture contributes, directly and indirectly, about 53 of the nation's Gross Domestic Product. Other contributions of ecosystem services to the economy come from tourism based on Kenya's natural endowment of wildlife, mountains, rangelands, beaches, and coral reefs; as well as timber production from forests; and fish catches from lakes, rivers, and the Indian Ocean.

For a given ecosystem service, the supply is often concentrated in specific areas. Understanding where such key resource areas are located, the ecosystem processes operating to create and maintain these areas, and the services produced and valued by the community is essential for managing resources for improved livelihoods and sustained use.

The maps in Chapter 1 give an overview of Kenya's physical geography; rainfall patterns; major ecosystem types; and densities of wildlife, livestock, and people. They provide a synoptic view of Kenya as a context for the subsequent chapters on poverty and selected ecosystem services.

Savanna and grassland ecosystems, and bushland and woodland ecosystems cover 39 and 36 percent of Kenya, respectively. Agroecosystems extend over another 19 percent and closed forests make up about 1.7 percent of Kenya's land area. Urban ecosystems cover only about 0.2 percent of the country.

CHAPTER 2: SPATIAL PATTERNS OF POVERTY AND HUMAN WELL-BEING

Chapter 2 presents a geospatial profile of poverty and human well-being in Kenya. Human well-being has many elements, including: sufficient income to obtain adequate food and shelter; security; good health; social acceptance; access to opportunities; and freedom of choice. Poverty is defined as a lack of these elements. Human well-being relies fundamentally on the ability to access a wide variety of ecosystem services.

Official Kenyan poverty statistics are based on surveys of household expenditures. They use a rural poverty line of Ksh 1,239 per month (US$ 0.59 per day) and an urban poverty line of Ksh 2,648 per month (US$ 1.26 per day). Given these poverty lines, about 53 percent of rural and 50 percent of urban Kenyans were poor in 1997.

Poverty rate (i.e., the percentage of the population below the poverty line) and *poverty density* (the number of poor in a given area) provide two distinct ways to depict the spatial distribution of poverty. Understanding the relationship between *poverty rate* and *poverty density* is important for designing and implementing poverty reduction interventions.

The *poverty gap* measures how far below the poverty line the poor in a given area are. On average, each rural Kenyan would require an additional Ksh 239 (US$ 3.41) per month to move out of poverty.

Measures of *inequality* look at the distribution of economic welfare across the population. Areas of highest inequality in Kenya are found near urban areas. Inequality is low in rural areas with the highest poverty rates. *Housing quality*, a measure reflecting overall wealth of a household, is higher in the central regions of the country.

The maps indicate some convergence in spatial patterns of poverty, showing that a great number of administrative areas in central Kenya are better off than the rest of the country. The maps also highlight the exceptions to this trend: some areas with low poverty rates nonetheless retain a significant density of poor people. At the same time, not all areas with high poverty rates and high poverty densities have high levels of poor housing or high inequality. A careful analysis of the spatial patterns of *multiple* indicators of well-being is therefore needed to describe and understand the poverty situation and to design effective poverty reduction interventions.

CHAPTER 3: WATER

Water is the lifeblood of Kenya's ecosystems; the hydrological cycle sustains all life. Kenyans use water for drinking, energy generation, livestock production, agriculture, tourism, industry, and many other essential activities. Unfortunately, water is not always plentiful, and Kenya is characterized as *water scarce* based on average per capita water availability.

This chapter's maps show that Kenya's annual rainfall is distributed unevenly over the land: about 15 percent of the country receives sufficient rain to grow maize and other non-drought-resistant crops; another 13 percent has more marginal rainfall sufficient only to grow selected drought-resistant crops; and the remaining 72 percent has no agronomically useful growing season. Rainfall amounts also show distinct seasonal patterns. Areas east of the Rift Valley have two rainy seasons per year, but neither is quite long enough to allow high crop yields. Rainfall amounts vary greatly from year to year as well. Major droughts and floods have occurred regularly in each decade over the past 30 years.

Open surface water is the major source of drinking water for 29 percent of Kenyan households, almost all of them in rural areas. About 32 percent of households rely on groundwater for their drinking water. The same proportion uses piped water (71 percent of urban households and 19 percent of rural households). Families using untreated surface water are relying completely on the regulating services of ecosystems to provide uncontaminated water in sufficient quantities.

Hydropower is the largest source of electricity providing 55 percent of the total installed grid capacity. A number of new hydropower facilities are either under construction or in the planning stages. Ninety-eight percent of Kenya's cropping is rainfed; just 2 percent is irrigated and only 19 percent of potentially irrigable land is currently being irrigated. In almost all of the subdrainage areas in Kenya's rangeland Districts, water demand for livestock is significantly greater than for wildlife. Water demand from livestock is projected to increase as demand for livestock products rises, and may comprise 15 percent of national water demand by 2010.

Decision-makers will face an increasingly difficult challenge in allocating the nation's water resources to accommodate the multitude of demands for agriculture, hydropower, tourism, industry, and drinking water, while still supporting plant and animal life. It will also be increasingly important to address the links between poverty and lack of access to improved water supply and sanitation services.

CHAPTER 4: FOOD

Obtaining food, the most basic human need, is an activity that is always closely linked to natural resources. This chapter covers four dominant sources of food and livelihoods in rural Kenya: crop production, livestock, fishing, and hunting-gathering, and explores how different livelihood strategies are influenced by ecosystems and the resources they provide.

In terms of total area and numbers, smallholders dominate Kenya's rainfed agriculture. Most rural households grow maize to help feed their families *and* rely on the market for food security (between 25 and 70 percent of smallholder income is from non-farm sources). Maps of cropping intensities show that Kenya's rainfed agriculture reflects the country's rainfall patterns, with a significant proportion of farmers being exposed to the risks of unreliable rainfall or prolonged drought.

A mix of dairy cattle, food, and cash crops dominates high-potential agricultural lands in central and western Kenya, where 90 percent of croplands occur. Similar mixed farming along Lake Victoria and large parts of Laikipia, Machakos, Mwingi, Kitui, Makueni, Taita Taveta, Kwale, Kilifi, and Malindi Districts is more marginal. Here rainfall is more erratic or soils are less fertile, resulting in lower yields and incomes.

Livestock production in Kenya also displays distinct spatial patterns: high dairy output and surpluses primarily in central Kenya; milk deficits in large parts of Nyanza and Western Provinces; and pastoral and agropastoral livestock rearing in the arid and semi-arid lands.

Nearly 40,000 people fish for a living—sometimes combined with livestock raising or food cropping—in selected areas along Lake Victoria, Lake Turkana, and the Indian Ocean. About 92 percent of the fish landed in Kenya is from Lake Victoria.

Gathering nuts, fruits, and tubers; collecting honey; and hunting wildlife—including rodents, guinea fowl, and other birds, as well as larger animals such as antelope—are also important sources of food.

CHAPTER 5: BIODIVERSITY

Biodiversity—the full variety of plants, animals, and microorganisms found on Earth—provides the underlying conditions necessary for the delivery of ecosystem services. The maps in this chapter depict both the breadth of Kenya's biodiversity and current pressures and trends affecting it.

Of the 60 Important Bird Areas set up to ensure the survival of local and migratory bird species, half were in decline, about a quarter were improving, and eight were stable, as indicated in a 2003-04 assessment.

Agriculture is a significant factor in Kenya's biodiversity decline, but not all cropping is detrimental to biodiversity. In large parts of Kenya's agroecosystems, farmers' fields are interspersed with patches of forests, woodlands, and other vegetation types. This suggests that farmers could manage their lands in ways that support biodiversity. Average field size, extent of tree cover in croplands, and average number of crops grown represent important components of agrobiodiversity in a landscape. Maps of these three indicators show the following: Throughout central and western Kenya, field sizes are small (less than 2 hectares). Croplands with high levels of tree cover are east of the Aberdare Range; south of Mount Kenya; as well as in Gucha, Central Kisii, and Nyamira Districts. Kirinyaga, Meru Central, and Gucha are the Districts where farmers grow the greatest number of crops at one time.

Kenya's rangelands support primarily livestock and grazing mammals such as gazelle, wildebeest, zebras, and other wildlife species—an important source of tourism revenues. In 1994-96, livestock dominated the rangelands, representing about 84 percent of all the grazing animals in that area. The total population of large grazing wildlife species in the rangelands declined by 61 percent between 1977-78 and 1994-96. Competition for land and water from humans and their livestock, as well as illegal hunting, have been behind these declines. For example, maps of water sources, wildlife, and livestock distribution in the northern rangelands show that livestock near water points is "pushing" wildlife away from water.

Despite these overall and local declines of large grazing mammals, there was an increase in density in some areas between 1977-78 and 1994-96. Such gains were near the Masai Mara Game Reserve and Amboseli National Park, as well as in Lamu and Laikipia Districts. In the latter District, private and communal landowners have been a major contributor to this trend reversal, rather than initiatives based on new government protection policies.

CHAPTER 6: TOURISM

Tourism in Kenya is based primarily on the country's natural attractions, including wildlife in its native habitat as well as some of Africa's finest beaches. This natural endowment has turned Kenya's tourism industry into a leading economic sector, generating revenues of almost Ksh 49 billion (US$ 700 million) in 2005 and directly employing 176,000 people—about 10 percent of all jobs in the formal sector. This chapter shows that the tourism economy depends on a foundation of healthy ecosystems.

Viewing wildlife in its natural habitat is the primary objective for about 80 percent of the international visitors who come to Kenya for holidays. Wildlife is broadly distributed across Kenya, but particular species with high 'viewing value' exhibit specific patterns of spatial distribution. For example, the rangelands of Laikipia District as well as Amboseli, Marsabit, and Tsavo National Parks all have large elephant populations; the massive annual migration of wildebeest and zebra occurs in the plains of Kajiado District close to the Mara-Serengeti ecosystem. But declining wildlife numbers are undermining one of Kenya's principal tourist attractions. For instance, the wildebeest population in the Masai Mara ecosystem has fallen from 120,000 in 1977 to 31,000 in 2002.

In 2005, Kenya's protected areas welcomed 2.1 million visitors, the highest number ever registered. Of the country's 84 parks and reserves, Nairobi National Park (including the Animal Orphanage and Safari Walk), Lake Nakuru National Park, and Masai Mara National Reserve, together accounted for more than half of all visitors. International tourists accounted for more than 90 percent of revenues for all national parks where such revenue data are available. However, Kenyans are also heavy users of parks, particularly those near Nairobi, where they account for more than 70 percent of all revenues collected.

Beaches and coastal ecosystems also account for a large share of tourism earnings, including more than half of all nights spent by tourists in hotel accommodations in 2005. Coastal tourism includes both high-density beach tourism in and around Mombasa and tourism requiring lower visitor densities, such as snorkeling and diving.

To protect wildlife and ecosystems from serious damage caused by overly high visitor densities, tourism planners need to promote underutilized areas and spread visitor numbers more widely across destinations. This would also help to distribute tourism-related costs and benefits more evenly across the country. Improved spatial diversification of visitors will require increased and sustained investments in the transport system, safe water supplies, communications services, tourist accommodations, protected areas, and targeted marketing efforts. It will also require greater control and participation of local communities in wildlife management and tourism enterprises.

CHAPTER 7: WOOD

This chapter provides a brief overview of the ecosystems that provide Kenya with wood and how Kenyans use this resource. Estimates put Kenya's 1995 closed forest area at 984,000 hectares (1.7 percent of the land area). Other natural woody vegetation includes 2.1 million hectares of woodlands, 24.6 million hectares of bushlands, and 10.6 million hectares of wooded grasslands. Agricultural land can also have a high percentage of tree cover as reflected in the high tree density in the croplands of Central Province, for example. Woodlands, bushlands, and wooded grasslands contain most of Kenya's woody biomass. Closed canopy forests are only a minor contributor of wood fuel at the national level.

Kenyans use 80–90 percent of the wood from these ecosystems for energy (firewood and charcoal), and the remaining 10–20 percent for timber, posts, and poles. Biomass is Kenya's dominant fuel, accounting for over 80 percent of total energy consumption in 2000. Burning firewood and charcoal account for roughly equal percentages of total wood consumption.

About 89 percent of rural Kenyans rely on firewood for their energy needs. About 8 percent of the supply came from Trust Land, and another 8 percent from gazetted forests. The remaining 84 percent was supplied by agroforestry systems and on-farm sources. More than 80 percent of households obtain firewood within a 5-kilometer radius of their home.

Approximately 82 percent of urban households and 34 percent of rural households use charcoal regularly. Some 200,000 people are producers and another 300,000 transport and vend charcoal. Gross revenues from production are estimated at Ksh 17.5–32 billion per year (about US$ 250–457 million), putting them somewhere between revenues from horticulture exports and revenues from livestock products. Because the charcoal industry is not fully legalized, the government is foregoing tax revenues as high as Ksh 5.1 billion (US$ 72.9 million) per year.

The high-yield areas of theoretically harvestable biomass growth from natural vegetation closest to Nairobi would be the rangelands south of the city (in Narok and Kajiado Districts), but also in the southeast (in parts of Machakos District). For Mombasa, the closest areas would be the woodlands of Kwale and Kilifi Districts. These areas may be well suited for sustainable charcoal production once the industry becomes fully legalized and more transparently managed.

CHAPTER 8: THE UPPER TANA: PATTERNS OF ECOSYSTEM SERVICES AND POVERTY

This chapter examines maps of various ecosystem services and poverty patterns in a single region—the upper watersheds of the Tana River—to demonstrate how such maps can help to highlight the relationships among people, ecosystems, and poverty.

Home to 3.1 million people, this region represents an important supplier and consumer of ecosystem services. Smallholder agriculture is the dominant land use and is concentrated in the foothills of the Aberdare Range and Mount Kenya. The government has set aside a significant portion of the land for biodiversity and watershed protection, most of it in the mountainous areas. The area contains a broad cross-section of very poor and less poor communities, with the poorest communities located in drier plains downstream of the Aberdare Range and Mount Kenya.

After examining maps of selected ecosystem services (covering water-, food-, wood-, and biodiversity-related ecosystem services) in the upper Tana, Map 8.20 summarizes the poverty patterns in areas delineated by six indicators: high share of piped drinking water, presence of small-scale irrigation efforts, high share of food crops in cropland, high milk production, high number of crops grown, and high share of woodlots in cropland. These indicators reflect either investment areas for water infrastructure, or represent important supply areas of food-, wood-, and biodiversity-related ecosystem services. Such a side-by-side comparison of different ecosystem services is useful for describing poverty-ecosystem relationships and identifying locations where key supply areas and poverty patterns coincide. The maps show that for some of the selected indicators distinct spatial patterns emerge such as the poorest areas not benefiting in a major way from piped drinking water supplies, or high milk production being more prevalent in communities with lower poverty rates. However, they also show that for many of the selected indicators the key supply areas are not automatically associated with lower or higher poverty rates, suggesting determinants that are outside of the selected variables and not necessarily related to geography. This indicates the complexity of the poverty-environment relationship and the need for more detailed analysis that factors in the economic and social context in each subregion.

LESSONS LEARNED ON MAPPING ECOSYSTEM SERVICES AND POVERTY

1. By combining existing maps and data on ecosystem services and human well-being, analysts can create new ecosystem-development indicators.

2. Decision-makers can examine the spatial relationships among different ecosystem services to shed light on possible competition (i.e., tradeoffs) and synergies among various ecosystem services.

3. Decision-makers can examine the spatial relationships between poverty and combinations of ecosystem services.

4. In spite of the usefulness of overlaying maps of ecosystem services and poverty, there are limitations to this approach. These include: lack of data to map a comprehensive set of ecosystem services for all of Kenya; inherent limitations of spatial analyses (i.e. map overlays); limitations in the fundamental knowledge of ecosystems and their value; and the complexity of measuring and monitoring poverty and livelihoods.

5. There are important institutional barriers to measuring and mapping poverty-ecosystem relationships and using this information to inform national policies and decision-making. These include: lack of awareness about ecosystems and ecosystem processes; a sectoral mandate among government institutions that works against cross-cutting analyses involving multiple ecosystem services and poverty; and insufficient promotion of interdisciplinary analysis.

NEXT STEPS

Using the data and concepts demonstrated in this atlas, analysts and decision-makers in Kenyan institutions can initiate a comprehensive accounting of ecosystem services for the country. They can continue to develop new approaches to better integrate poverty-ecosystem relationships in national policies and decision-making. They can foster a better understanding among legislators of these poverty-ecosystem links. And they can apply ecosystem principles and the approach taken in the Millennium Ecosystem Assessment to national and local environmental reporting.

Accomplishing this would result in programs for poverty reduction that take into account where the poor live and what ecosystem services are available to them. It would improve the targeting of social expenditures and ecosystem interventions so that they reach areas of greatest need. And it would make available to decision-makers—in both the public and private sectors—an array of spatial information that could inform their decisions on a range of resource and social issues.

To achieve such outcomes will require leadership by the Ministry of Planning and National Development and the Ministry of Environment and Natural Resources, as well as creative contributions from actors outside of government. It will require actions in four areas:

1. Use and communicate the atlas.
▶ Make the underlying spatial data in this atlas publicly available. Encourage development of additional dissemination products.
▶ Incorporate maps and information on ecosystem services in Kenya's next state of the environment report and other environmental reporting efforts.
▶ Introduce poverty and ecosystem services maps into sectoral reporting.
▶ Inject maps and information on ecosystem services into future poverty analyses.
▶ Integrate maps and information on ecosystem services into higher education coursework.
▶ Prepare guidance and training materials to enable other countries to develop their own maps.

2. Build the knowledge base for mapping ecosystem services and for examining the relationships between poverty and ecosystem services.
▶ Expand mapping and spatial analyses to include more ecosystem services.
▶ Integrate ecological processes into future mapping of ecosystem services and use more sophisticated tools to analyze patterns and spatial relationships.

3. Use geospatial information to inform policy, planning, and implementation.
Efforts in three general areas would particularly benefit from the approach used in this atlas:
▶ Shaping national strategies and plans such as the *Economic Recovery Strategy* and the *Millennium Development Goals (MDGs)*.
▶ Formulating cross-sectoral policies.
▶ Improving local land use planning, zoning, and management plans.

4. Strengthen institutions to research and study poverty-ecosystem relationships.
▶ Continue to develop technical and analytical skills for spatial analyses within Kenyan institutions.
▶ Establish a technical working group to promote integrated spatial analyses for implementing the MDG needs assessment and the *Economic Recovery Strategy* (and its successor strategy).
▶ Establish a new technical unit that could spearhead more integrated and cross-cutting work involving multiple ecosystem services and poverty.
▶ Seek better integration of spatial information in monitoring and evaluation efforts.