Mapping a Better Future

How Spatial Analysis Can Benefit Wetlands and Reduce Poverty in Uganda

The Republic of Uganda

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MINISTRY OF WATER AND ENVIRONMENT, UGANDA

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Wetlands Management Department, Ministry of Water and Environment, Uganda
Uganda Bureau of Statistics
International Livestock Research Institute
World Resources Institute

World Resources Institute: Washington DC and Kampala

PHOTO CREDITS

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Foreword

Wetlands affect the lives of every one of Uganda's citizens. We depend on wetlands for food and clean water, for building materials and fuels, for livestock grazing and medicines, and for water flow regulation. They provide a powerful engine for our country's development, with wetland services and products contributing hundreds of millions of dollars a year to the national economy.

The critical importance of Uganda's wetlands has already been acknowledged by the government, and Uganda is widely recognized for taking a lead in Africa on wetlands management policy. Over the past decade, $2 million has been invested in building a database unique in Africa to support efforts to protect and sustainably use wetlands. The National Wetlands Information System inventories 13 main uses of wetlands in 30 districts around the country and records their impacts on each individual site.

The Ugandan government is also very committed to its poverty reduction strategy. To support poverty reduction efforts, the Uganda Bureau of Statistics has recently published detailed, high resolution poverty maps which provide information on household income at a local (subcounty) level.

This publication combines and analyzes these two sets of data—on wetlands use and poverty levels—to generate information that can be used to strengthen national and local anti-poverty strategies and resource management plans. The collaboration between the Wetlands Management Department and the Uganda Bureau of Statistics to link wetlands and poverty is a first-of-its-kind effort.

Mapping a Better Future: How Spatial Analysis can Benefit Wetlands and Reduce Poverty in Uganda marks the next step forward in our efforts to reconcile environment and development. It presents an innovative mapping approach to integrating efforts to reduce poverty while sustaining ecosystems, such as wetlands, which we believe offers significant potential for improving wetland management policy and pro-poor outcomes both in Uganda and beyond.

We value the lessons learned from this pioneering effort, and we intend to act on them. Going forward, we will use and build on the knowledge gained through this publication and leverage them into future decision-making processes on how individual wetlands should be managed. We will further develop a more systematic and comprehensive inventory and assessment of wetlands and the economic opportunities they offer to protect wetland health while optimizing the services they offer poor communities.

We hope and believe that the data and analyses presented in these pages will indeed help to "map a better future" for Uganda.

Finally, we would like to extend our sincere thanks to our international partners in this effort, the International Livestock Research Institute and the World Resources Institute.

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Preface

Mapping a Better Future: How Spatial Analysis can Benefit Wetlands and Reduce Poverty in Uganda represents an exciting step forward in both combating poverty and protecting vital ecosystems in Uganda.

The pioneering spatial analysis contained in the report provides valuable insights aimed at helping decision-makers across government target and prioritize anti-poverty efforts and wetland protection interventions. This report is the product of an ongoing partnership between national and international organizations to develop and combine maps of poverty incidence and ecosystems use. Its approach has potential application in other developing countries which share high poverty levels and an abundance of natural resources.

The geographic approach inherent in the report can enable Ugandan decision-makers to literally "see" and "value" the nation's ubiquitous wetlands in a new light. We hope that decision-makers will use the maps and analytical examples to develop further analyses and apply their findings to policies and interventions in the field.

To this end, the report's target audiences include the following: The Ministry of Finance, Planning and Economic Development; the Budget Monitoring and Accountability Unit; the Uganda Bureau of Statistics; the Wetlands Management Department; planning experts; and—to hold decision-makers accountable for wetland conservation and poverty reduction efforts—civil society representatives and nongovernmental organizations.

In particular, we hope that the Ministry of Finance, Planning and Economic Development will use the wetland and poverty maps to refine its budgeting and planning to reflect the importance of healthy wetlands to local livelihoods and the national economy. We also hope that all areas of government involved in wetlands management will use the data to inform sustainable use of wetlands that optimizes poverty reduction. Such efforts should include leveraging increased funding that targets needy subcounties based on their poverty and wetland use profiles.

The high quality datasets and maps on which this publication is based were developed and recorded by the Ugandan government. The Wetlands Management Department of the Ministry of Water and Environment produced the comprehensive wetlands database or National Wetlands Information System, which is unique in Africa. The Uganda Bureau of Statistics, which is affiliated to the Ministry of Finance, Planning and Economic Development, produced the detailed and highly localized poverty maps. Both the World Resources Institute and the International Livestock Research Institute supplied technical support to derive new maps and analyses. The collaboration of a team of authors from all four institutions is the first of its kind, and one on which we plan to build.

This publication encapsulates an area of critical importance at the interface of people and the natural world. It builds on pioneering poverty and ecosystem mapping work undertaken in Kenya and points the way toward further work in East Africa aimed at informing national strategies and plans to reduce poverty.

We hope that the poverty-wetland use linkages and the policy pathways illuminated by this publication will be effectively applied by government, and used by other audiences, both in Uganda and beyond.

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Executive Summary

INTRODUCTION

Uganda has abundant natural wealth. Its varied wetlands, including grass swamps, mountain bogs, seasonal floodplains, and swamp forests, provide services and products worth hundreds of millions of dollars per year, making them a vital contributor to the national economy. Ugandans use wetlands—often called the country's "granaries for water"—to sustain their lives and livelihoods. They rely on them for water, construction material, and fuel, and use them for farming, fishing, and to graze livestock. Wetlands supply direct or subsistence employment for 2.7 million people, almost 10 percent of the population. In many parts of the country, wetland products and services are the sole source for livelihoods and the main safety net for the poorest households. Sustainable management of Uganda's wetlands is thus not only sound economic policy, it is also a potent strategy for poverty reduction.

Recognizing this, Uganda's Government was the first to create a national wetlands policy in Africa. Over the past decade, Uganda has also instituted the National Wetlands Information System, a rich database on the use and health of Uganda's wetlands which in its coverage and detail is unique in Africa.

This publication builds on those initiatives by combining information from the wetlands database with pioneering poverty location maps developed by the Uganda Bureau of Statistics. The new maps and accompanying analyses will help policy-makers classify wetlands by their main uses, conditions, and poverty profile and identify areas with the greatest need of pro-poor wetland management interventions. The information generated can also be fed into national poverty reduction strategies and resource management plans.

This is an innovative, pragmatic approach to integrating efforts to reduce poverty while sustaining ecosystems which has implications for improving policy-making in Uganda and beyond.

The publication is aimed at high level decision-makers and has two key purposes:

- To show decision-makers responsible for Uganda's wetlands where sustainable wetland management can have the greatest impacts on reducing poverty, and how community profiles derived from poverty maps can facilitate wetland interventions which better serve the poor. Maps of poverty and wetland indicators can serve as a bridge between different government sectors as they consider opportunities for achieving multiple socioeconomic and environmental objectives.
- To show decision-makers involved in poverty reduction how maps derived from Uganda's National Wetlands Information System can help to identify wetlands with degradation risks or economic potential, and show how these areas coincide with different poverty levels. Such knowledge can improve efforts to integrate wetland issues into poverty reduction strategies.

Mapping a Better Future: How Spatial Analysis Can Benefit Wetlands and Reduce Poverty in Uganda uses an innovative approach to integrate spatial data on poverty and wetlands use. Drawing on Uganda's rich baseline of wetland data and poverty mapping, the report provides a detailed examination of the links between ecosystem services and the location of poor communities and presents practical lessons for policy-makers across government. The report covers the following issues:

Background: A Brief History of Wetlands Management in Uganda gives an overview of the Ugandan government's efforts to date on wetlands management and its relation to poverty.

Managing Wetlands and Reducing Poverty: Issues and Challenges highlights the many benefits wetlands provide to Uganda's people, and introduces the latest poverty maps. It then summarizes how wetlands and poverty issues are addressed in Uganda's Poverty Eradication Action Plan and Wetlands Sector Strategic Plan.

Wetland Characteristics and Uses presents maps of permanent and seasonal wetlands and of wetland area per capita. It also examines main wetland uses as inventoried in the National Wetlands Information System.

KEY FINDINGS AND RECOMMENDATIONS

Findings

The maps and analyses in this publication are primarily illustrative, but do support the following conclusions:

- Detailed mapping of previously unused data confirms that wetlands provide multiple benefits in every district, and to every citizen of Uganda.
- The diversity of products obtained from wetlands in specific locations ranges widely, from a handful to up to 24 products; levels of harmful impacts on wetlands by people also vary greatly across the country.
- Spatial analyses of selected poverty-wetland indicators reveal no clear pattern at the subcounty level--despite popular belief that the poorest areas are always the most degraded.
- The overlay analyses of poverty and wetland maps are most useful for identifying subcounties that share similar poverty and wetland characteristics, and thus may lend themselves to similar wetland management approaches and intervention strategies. Economic studies that quantify the value of wetland products and services can be linked to poverty and wetland maps to gauge the economic potential of specific wetland uses in reducing poverty.

Recommendations

Further strengthening Uganda's supply of data and analytical capacity will provide major returns for the country's people and natural resource base by improving wetland management planning and prioritization efforts, especially in these two areas:

- Complete data entry and collection for the National Wetlands Information System, improve data consistency, and update wetland and land cover information.
- Strengthen analysis, mapping, and economic valuation efforts within the Wetlands Management Department.

Improvements in lives, livelihoods, and wetland health could result directly from this supply of new maps and analyses. Specifically, government agencies could use the information to act on decision-making opportunities in these four areas:

- Incorporate poverty information into the existing system for selecting wetlands for priority management interventions.
- Consider wetland management as part of local poverty reduction efforts, such as creating new livelihood strategies.
- Promote "win-win" collaboration to support poverty, wetland health, and other goals between agencies responsible for health, water, sanitation, agriculture, energy, and environment.
- Make poverty and wetland maps and their analyses a central component of local decision-making at district level.

Spatial Analysis of Wetland and Poverty Indicators demonstrates how combining spatial analyses of such indicators can improve the information and analytical basis for decision-making. These comparisons incorporate the diversity of wetland products and the impacts of wetland use.

Adding Value: Combining Wetland and Poverty Maps with Economic Analysis illustrates how the depth and benefits of these analyses can be further advanced by augmenting wetland and poverty maps with findings from economic valuation studies. A case study of papyrus harvesting's potential to reduce poverty is included.

Moving Forward: Lessons Learned and Recommendations looks ahead, describes lessons learned, and makes recommendations for stakeholders involved in poverty reduction and the sustainable use of wetlands in Uganda and around the world.

Background: A Brief History of Wetlands Management in Uganda

The economic and ecological wealth represented by Uganda's wetlands, which cover 15 percent (31,406 sq km) of its land area and are found in almost every subcounty, is well recognized by both its people and its leaders. Wetlands provide no less than 37 valuable services and products, and contribute hundreds of millions of dollars per year to the national economy (WID, 2001). Over 70 percent of all wetlands in Uganda are used for three purposes simultaneously: water collection, livestock grazing, and natural tree harvesting. In addition, they play a key role in filtering pollutants and in regulating water flows, which in turn influence groundwater recharge, flood impacts, and water availability during the dry season.

Uganda's policy-makers have acknowledged the importance of wetlands in the country's Constitution (1995), which commits the government to hold them, along with other natural resources, in trust for the common good of all citizens. Over the past 15 years, innovations including Uganda's Wetland Policy and decentralized wetlands management have established a firm foundation for more sustainable wetland management. Environmental and wetland concerns are also integrated into several of the government's other primary policies, including the Poverty Eradication Action Plan, Plan for Modernization of Agriculture, and District Development Plans. The ten-year Wetlands Sector Strategic Plan, launched in 2001, identifies eight key strategies to achieve sustainable wetlands management.

Between 1995 and 2005, the Wetlands Inspection Division spent about $US 2 million to carry out wetland inventories for 30 Districts and build the National Wetlands Information System (WID and IUCN, 2005). The system tracks 13 main uses of wetlands: beekeeping, cultivation of food and fiber, fishing, harvesting of natural herbaceous vegetation, human settlement, hunting, livestock grazing, mineral excavation, natural tree harvesting, tree plantations, tourism, wastewater treatment, and water collection. It also classifies each wetland use according to its level of impact on the individual grassland, swamp forest, or other wetland system. This information can then be converted into an index that classifies each wetland according to the combined impacts of all uses, thus helping to manage wetland resources more optimally.

The result is a rich baseline of wetland data, which in its coverage and detail is unique in Africa. At the same time, the Uganda Bureau of Statistics has expanded its technical expertise to produce poverty maps for small administrative areas, which in turn relies on regular investments in high quality and geographically referenced censuses and household surveys.

BALANCING HUMAN AND ECOSYSTEM NEEDS

Poor people, especially those in rural areas, generally rely directly on the benefits of nature—referred to as ecosystem services—for subsistence and income-generating activities or to obtain water and medicines because of lack of affordable alternatives. Wetlands are also an important source of cash income, especially in emergencies. High dependence on ecosystem services combined with few assets and capabilities makes poor people particularly vulnerable to ecosystem degradation. Consequently, the condition of wetlands and the way they are managed can have a disproportionate impact on the well-being of poor families.

Both Uganda's Poverty Eradication Action Plan and the Wetlands Sector Strategic Plan have emphasized balancing poverty reduction efforts and wetlands management interventions.

However, frequent media reports of wetlands under threat from human activities such as agriculture and settlements indicate that implementing these goals, policies, and laws is far from easy. Achieving them requires strong political will, considerable human and financial resources, vigilant monitoring, and detailed knowledge of poverty and wetland issues. Too often, at present, short-term gains from wetland use are obtained at the cost of the long-term benefits to be had from keeping wetland services intact, benefits such as water purification or the regulation of water flow. Such long-term benefits are easy to overlook since they are not fully valued economically. To safeguard their wetlands patrimony, Uganda's decision-makers need information and analytical tools that capture these trade-offs and support more evidence-based efforts to manage wetlands and reduce poverty.

Today, decision-makers have access to a growing body of work about Uganda's wetlands. Some of this consists of local case studies determining the economic value of the multiple benefits they provide. These include, for example,

a study of the rural wetlands in Pallisa District (Karanja et al., 2001) and another on the urban Nakivubo wetland in Kampala District (Emerton et al., 1999). However, knowledge about the intricate inter-relationships between wetlands and poverty is still limited. Only a few local case studies, such as one focusing on wetlands around Lake Bunyonyi in Kabale District (Maclean et al., 2003), have examined this relationship. Moreover, information that provides a national view of poverty levels and wetland use has been absent. Specifically, decision-makers have faced two key barriers: a lack of subnational data about poverty and wetlands; and a lack of analytical approaches to integrate these datasets.

FILLING THE DATA GAP

Over the past years, two relevant but uncoordinated efforts have begun to fill this data gap. The first has been the production of poverty maps by the Uganda Bureau of Statistics and its collaborators. The second has been the collection of wetland data by the Wetlands Inspection Division (upgraded to the Wetlands Management Department in 2007). Since 1997, the Department has led the efforts to compile detailed data on wetlands, including their ecological attributes, main uses, human-induced threats, and land tenure regimes. Information from approximately 5,000 sample points covering most of Uganda's districts has been integrated into a single, geographically referenced database, the National Wetlands Information System. To date, these data have not been analyzed to support national and local wetland planning efforts.

This publication, for the first time, combines these two datasets and demonstrates how to produce maps and interpret spatial overlays of the information they contain. The goal is to motivate analysts and planners to develop their own maps to fill an analytical gap with new information in order to align wetland management and poverty reduction strategies. By integrating more detailed wetland and poverty data, planners can then design and target wetland management interventions so that the benefits reach a greater proportion of poor communities and the costs associated with land-use changes or new restrictions on wetland use do not disproportionately affect the poor.

Differentiating subcounties by their poverty and wetland profiles is a first step to formulate questions and hypotheses to better integrate environmental and development objectives into planning. That said, this report is not intended to explain causal relationships between poverty and specific wetland uses. For that, other factors need to be examined that reflect different poverty dimensions and measure poverty not just at the subcounty level but also at other scales such as parish, village, and household levels.

AUDIENCE

The geographic approach used in this publication will help Ugandan decision-makers "see" their wetlands in a new light, and visualize ways to manage and use them more optimally to alleviate poverty. Moreover, better and more detailed spatial analyses of poverty-wetland relationships can then be used to scrutinize existing government priorities and examine whether current policies and programs target crucial issues and localities.

The maps, analytical examples, and ideas for future analyses are intended to be of value to a variety of audiences for the following purposes:

- *Ministry of Finance, Planning, and Economic Development and decision-makers at all levels of government:* to change budgeting and planning so that it reflects the importance of wetlands in livelihoods and the national economy, and to support investments that boost the benefits of wetlands such as water filtration and flood control.
- *Budget Monitoring and Accountability Unit:* to recognize the important role wetlands play in the livelihoods of poor households and to monitor performance in implementing the Poverty Eradication Action Plan (and the upcoming National Development Plan) through sustainable use of wetlands.
- *Uganda Bureau of Statistics:* to account for the many products and services provided by wetlands in future environmental data collection.
- *Wetlands Management Department and all levels of government involved in wetland management (National Wetlands Advisory Group, Environment and Natural Resource Sector Working Group, wetland officers in local governments, community-based wetland resource user groups):* to help plan more sustainable use of wetlands that optimizes poverty reduction, and to leverage increased funding that targets subcounties with specific poverty and wetland use profiles.
- *Analysts and planning experts:* to provide decision-makers with more integrated analyses of wetland uses and poverty indicators.
- *Civil society and nongovernmental organizations:* to hold decision-makers accountable for wetland conservation and poverty reduction efforts.

Managing Wetlands and Reducing Poverty: Issues and Challenges

WETLAND BENEFITS TO PEOPLE

Wetlands provide a large array of ecosystem services—defined as the benefits people derive from nature—to Ugandans in urban and rural areas (see Table 1). They are used for farming, fishing, and livestock grazing. They supply families with basic needs such as water, construction material, and fuel. In addition to these local uses, the system of interconnected wetlands plays a crucial role at a regional level by filtering pollutants and regulating water flows (influencing groundwater recharge, flood impacts, and water availability during the dry season). Of a total population of 28 million Ugandans, it is estimated that wetlands provide about 320,000 workers with direct employment and provide subsistence employment for over 2.4 million (MFPED, 2004).

Uganda's wetlands also provide important ecological benefits that reach beyond the region. They are the home of globally endangered species including birds such as the Shoebill *(Balaeniceps rex)* and Fox's weaver *(Ploceus spekeoides)*, and fish species of the Cichlidae family. Many wetlands are an important stopover for large congregations of migratory water birds. Wetlands can act as a reservoir to store carbon dioxide, mitigating climate change impacts. National and international visitors seek out wetlands as tourist attractions and educational opportunities to learn about their unique animals and plants.

In Uganda, there are no recent, exact countrywide statistics on changes in wetland area—the latest national land cover map with detailed wetland information was produced in 1996 (NFA, 1996). However, local observations cited in Uganda's recent State of the Environment report indicate a reduction in wetland coverage, mostly due to conversion to cropland (for example, in Iganga District and southwestern Uganda) and the spread of urban settlements, as in Kampala (NEMA, 2007).

While such conversions provide economic benefits from agricultural crops and real estate development, they are also associated with social costs primarily due to reduced or total loss of hydrological functions, habitat benefits, or other ecosystem services. One of the factors driving these conversions is that the immediate economic returns to individuals appear to outweigh the costs to the wider society associated with the loss of important ecosystem benefits. However, in most cases, the economic costs are

Table 1 ECOSYSTEM SERVICES PROVIDED BY OR DERIVED FROM WETLANDS

Services	Examples
PROVISIONING ECOSYSTEM SERVICES *Products obtained from ecosystems*	
Food	Production of fish, wild game, fruits, and grains
Fresh Water	Storage and retention of water for domestic, industrial, and agricultural use
Fiber and Fuel	Production of logs, fuelwood, peat, and fodder
Biochemicals	Extraction of medicines and other materials from biota
Genetic Materials	Genes for resistance to plant pathogens, ornamental species, etc.
REGULATING ECOSYSTEM SERVICES *Benefits obtained from regulation of ecosystem processes*	
Climate Regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water Regulation (Hydrological Flows)	Groundwater recharge and discharge retention
Water Purification and Waste Treatment	Retention, recovery, and removal of excess nutrients and other pollutants
Erosion Regulation	Retention of soils and sediments
Natural Hazard Regulation	Flood control and storm protection
Pollination	Habitat for pollinators
CULTURAL ECOSYSTEM SERVICES *Nonmaterial benefits obtained from ecosystems*	
Spiritual and Inspirational	Source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Source of beauty or aesthetic value in aspects of wetland ecosystems
Educational	Opportunities for formal and informal education and training
SUPPORTING ECOSYSTEM SERVICES *Services necessary for the production of all other ecosystem services*	
Soil Formation	Sediment retention and accumulation of organic matter
Nutrient Cycling	Storage, recycling, processing, and acquisition of nutrients

Source: MA, 2005.

UGANDA'S DEFINITION OF WETLANDS

Uganda's National Policy for the Conservation and Management of Wetland Resources (1995) defines wetlands as areas "where plants and animals have become adapted to temporary or permanent flooding." It includes permanently flooded areas with papyrus or grass swamps, swamp forests or high-altitude mountain bogs, as well as seasonal floodplains and grasslands. While all wetlands are characterized by impeded drainage, the length of their flooding period, depth of water, soil fertility, and other environmental factors vary with different wetland types. Wetlands are home to distinctive plant and animal communities that are well adapted to the presence of water and flooding regimes.

Source: MNR, 1995.

not fully accounted for because some ecosystem services—mostly regulating services such as groundwater recharge, water purification, waste treatment, or flood control—are not factored into conventional economic analysis. Instead they are considered as non-monetary bounties of nature that are "free-of-charge." They are what economists call "public goods," which have virtually no agreed value in the market place.

As a result, the financial incentives driving land use are often not aligned with the goal of managing and conserving these services for the broader public good. The economic benefits from marketed products of converted wetlands are often greater than returns from subsistence use and small-scale resource extraction in the unconverted wetlands. However, when both the marketed and non-marketed values of ecosystem services are accounted for, the total economic value of unconverted wetlands can be greater than that of converted wetlands. For example, conservative economic valuation estimates put the direct annual productive value of wetlands at 450,000-900,000 Uganda Shillings (US$ 300-600) per hectare (MFPED, 2004).

WETLANDS AND WATER SUPPLY

Women and girls come to fetch water for the day, or come to wash their clothes. Approximately 5 million people in rural areas get their daily freshwater supply from wetlands. The economic value of this service alone has been estimated at US$ 25 million per year in Uganda.

Source: UN-WWAP and DWD, 2005.

Economic valuation studies that include a broader set of non-marketed regulating services, such as water purification and carbon sequestration, suggest a per hectare-value as high as 15 million Uganda Shillings (US$ 10,000) (MFPED, 2004). Unfortunately, despite their high economic value, wetlands are not yet managed as environmental capital, worthy of protection and investment. In the Nakivubo wetland, an urban wetland in Kampala, the value of water treatment and purification services from a fully used and intact wetland are estimated at 2.3–4.3 million Uganda Shillings (US$ 1,500-2,900) per hectare per year (Emerton et al., 1999). However, over the past decade, the potential of the wetland to remove nutrients and pollutants has been greatly reduced by growing human settlements, industrial establishments, and drainage channels for crop production (NEMA, 2008). More than half of the wetland has been modified with only the lower parts remaining in fair condition. Consequently, water quality in the discharge area of Inner Murchison Bay of Lake Victoria has steadily deteriorated leading to higher treatment costs for Kampala's drinking water pumped from this area. The environmental and social impact assessment of the planned expansion of the Kampala Sanitation Programme has proposed a two-pronged approach to improve water quality in Lake Victoria: reduce the pollutant load by expanding sewage treatment facilities in Kampala and rehabilitate Nakivubo wetland (including a substantial increase of the active wetland area) to reestablish its original treatment capabilities (NEMA, 2008).

POVERTY MAPS

The 2005-2006 Uganda National Household Survey, which estimated the national poverty rate at 31.1 percent or 8.4 million Ugandans, provided the foundation for the poverty maps used in this publication (UBOS, 2006b).

The Uganda Bureau of Statistics (UBOS) used the previous Uganda National Household Survey (2002-2003) to produce two versions of poverty maps—for 1999 and 2002—in order to address the lack of poverty data for small administrative areas in the country.

The 1999 poverty maps (UBOS and ILRI, 2004) provided, for the first time, spatially detailed poverty data for 320 counties. The 2002 poverty maps (UBOS and ILRI, 2007) increased the level of spatial resolution even further, providing data for 958 subcounties. The 2005 poverty maps provide data for all rural subcounties except for those in Kotido, Kaabang, and Abim Districts (UBOS and ILRI, 2008).

The 2002 and 2005 poverty maps rely on a statistical estimation technique (small area estimation) that combines information from the 2002 population and housing census and the 2002–2003 and 2005-2006 household survey, respectively. The level of detail obtained at subcounty permits more meaningful spatial overlays of poverty met-

WETLANDS AND FISHERIES

In the very early morning, fisherfolk return from their night's work. Their catch will not only be sold in the market but also feed their family. Fisherfolk know firsthand that they will find more fish where a healthy wetland provides a nursery and safe haven for young fish. Local people are aware of the linkages among the different benefits they derive from nature. In Lake Bunyonyi, most people interviewed (64 percent) recognized that the swamps sustain fisheries. Consequently, fishers rarely harvest papyrus or cultivate near to where they fish.

Source: Maclean et al., 2003.

rics and wetland indicators. Such spatial comparisons can help target poverty reduction and wetland conservation efforts and provide first insights into relationships between poverty, wetland status, and use of wetland resources.

Map 1 (page 6) displays the 2005 poverty rates for rural subcounties. Other poverty measures such as the poverty density (number of poor per square kilometer), poverty gap, and poverty severity are also available for these subcounties, as are estimates of inequality related to household expenditures.

Rural poverty rates in Uganda's subcounties range from less than 15 percent to more than 60 percent of the population, with brown areas indicating higher and green areas representing lower poverty levels. Map 1 shows a high geographic concentration of poverty in northern districts (e.g., Gulu, Amuru, Kitgum, Pader, Moroto, and Nakapiripirit Districts) and low poverty in the southwest and central part of the country (e.g., in parts of Mbarara, Bushenyi, Isingiro, Kibaale, and Wakiso Districts). The reasons for this spatial pattern are complex, and include factors such as rainfall and soil quality (which determine agricultural potential), land and labor availability, degree of economic diversification, level of market integration, and issues of security and instability (the latter is especially relevant for the northern parts of Uganda).

WETLANDS AND POVERTY LINKS

Poor people, especially in rural areas, generally rely on ecosystem services directly for subsistence and income-generating activities or to obtain water and medicines because of lack of affordable alternatives. Wetlands are also an important source of cash income, especially in emergencies. One of the few studies about the relationship between poverty and wetlands in Uganda showed, for example, that an overwhelming majority of papyrus harvesters in the Lake Bunyonyi wetlands sold raw papyrus or crafts made from papyrus to bridge income shortfalls for periodic high expenses such as school fees or end-of-the-year festivities (Maclean et al., 2003).

High dependence on ecosystem services combined with few assets and capabilities make poor people particularly vulnerable to ecosystem degradation (MA, 2005). Consequently, the condition of wetlands and the way they are managed can have a disproportionate impact on the well-being of poor families (Maclean et al., 2003). In 1997, Uganda set up the Poverty Eradication Action Plan (PEAP) to guide public action to eradicate poverty (MFPED, 2004). This national planning framework, revised in 2000, acknowledges the role of wetlands in reducing poverty and in preventing people from falling further into poverty. Recognizing this important role, the PEAP supports priority actions in six areas related to wetland management:

- Assess the economic and environmental benefits of different wetland uses more comprehensively;
- Further develop and disseminate guidelines for sustainable use of wetland resources;
- Improve community skills and diversify the range of products obtained from wetlands to increase wetland revenues;

ECOSYSTEM SERVICES FROM WETLANDS ARE INTERDEPENDENT

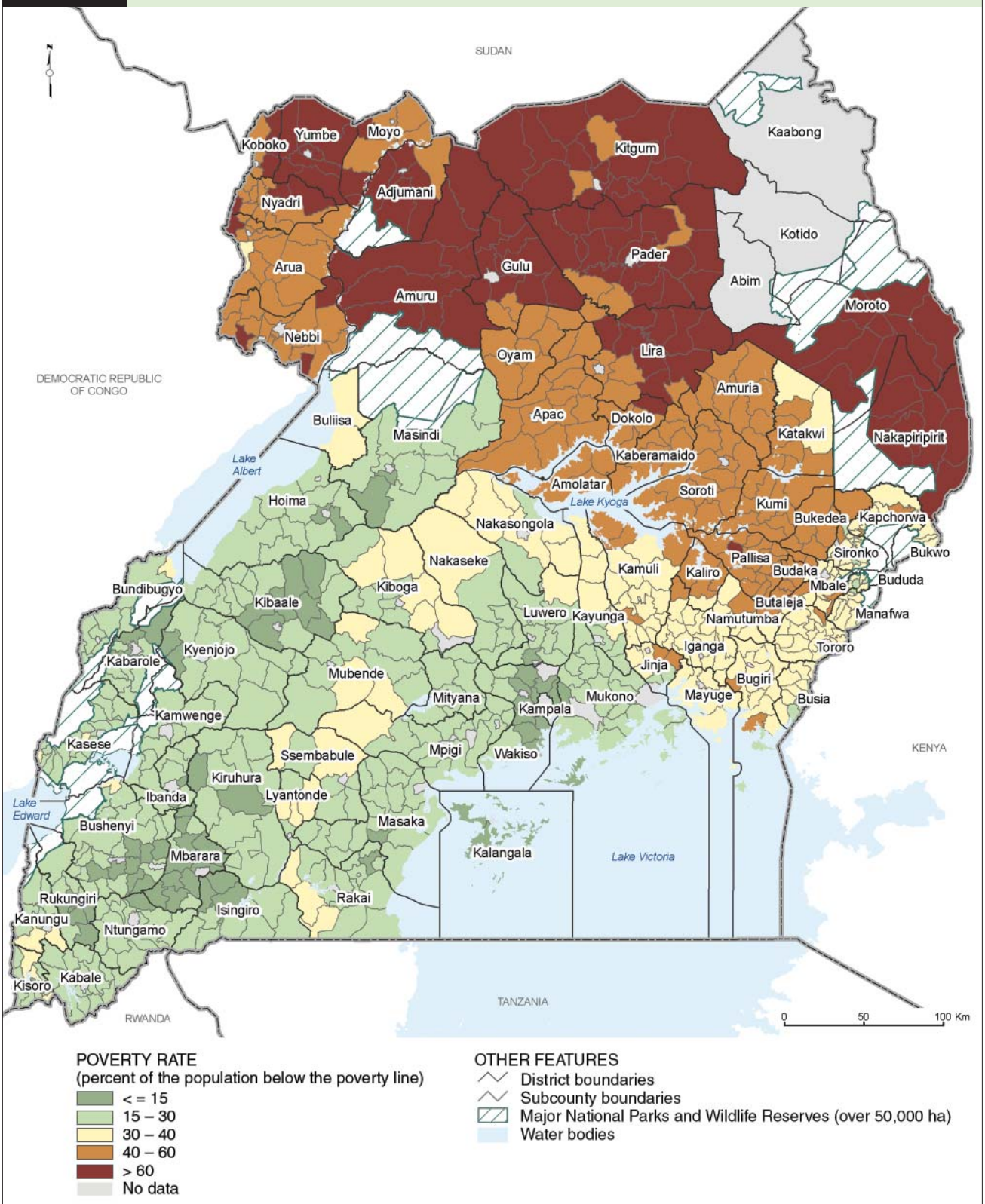
Papyrus is a common plant in permanent wetlands. It provides a combination of provisioning services (fuelwood, furniture, construction material, and craft material), regulating services (water purification, wastewater treatment, soil erosion regulation, and carbon sink through its dense network of roots), and aesthetic services (bird watching, beautiful landscapes). The overharvest of papyrus (a provisioning service) can endanger its other services in that location, for example by weakening its root network and its function as habitat for wildlife.

NAKIVUBO WETLAND: SERVICES TO LOCAL COMMUNITIES AND KAMPALA CITY

In Nakivubo wetland, 20 minutes from downtown Kampala, farmers grow cocoyam and sugarcane. About eight percent of the residents around Nakivubo wetland, which includes a high number of urban poor, are engaged in subsistence or commercial activities related to the wetland. In addition to supporting these local activities, Nakivubo wetland functions as a natural waste treatment plant for Kampala. It filters industrial effluents and domestic wastewater from 465,000 people (about 40 percent of Kampala's population), resulting in the discharge of less polluted water into Inner Murchison Bay of Lake Victoria.

Source: Emerton et al., 1999.

Map 1 POVERTY RATE: PERCENTAGE OF RURAL SUBCOUNTY POPULATION BELOW THE POVERTY LINE, 2005



Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), subcounty administrative boundaries (UBOS, 2002a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), and rural poverty rate (UBOS and ILRI, 2008).

- Enforce appropriate policies, laws, procedures, and regulations to curtail degradation of wetland resources;
- Assess wetland resources to determine resource availability and trends; and
- Support community initiatives that promote sustainable use of wetlands.

The ten-year Wetlands Sector Strategic Plan, adopted in 2001, commits the country to implement eight key strategies to achieve sustainable wetlands management. Cognizant of the importance of wetlands to the well-being of poor people, the Wetland Sector Strategic Plan's mission states that the wise exploitation of wetlands shall contribute to economic development and poverty alleviation (WID, 2001).

Box 1 POVERTY MEASURES USED IN THE 2005 POVERTY MAPS

Human well-being has many dimensions. Sufficient income to obtain adequate food and shelter is certainly important, but other dimensions of well-being are crucial as well. These include good health, security, social acceptance, access to opportunities, and freedom of choice. Poverty is defined as the lack of these dimensions of well-being (MA, 2005).

The poverty indicators produced by the Uganda Bureau of Statistics (UBOS) are based on household consumption and cover some but not all dimensions of poverty. Consumption expenditures include both food and a range of nonfood items such as education, transport, health, and rent. Households are defined as poor when their total expenditures fall below Uganda's rural or urban national poverty lines. These lines equate to a basket of goods and services that meets basic monthly requirements (UBOS and ILRI, 2007).

In 2005, the national poverty line (an average of the poverty lines in Uganda's four regions) was 20,789 Uganda Shillings (US$ 12) per month in rural areas and 22,175 Uganda Shillings (US$ 13) per month in urban settings. With these poverty lines, the 2005 poverty rate (percentage of the population below the poverty line) was 31.1 percent at the national level, translating to about 8.4 million Ugandans in poverty (UBOS, 2006b). Rural and urban poverty rates differed significantly, at 34.2 percent for rural areas and 13.7 percent for urban areas.

In this publication, poverty rate (percent of the population below the poverty line) was selected to portray the geographic distribution of the poor. While there are other useful poverty indicators, this indicator was chosen as a first approximation to show how poor each subcounty is and where poor subcounties are spatially concentrated. With this information, decision-makers can gain first insights to develop more effective support and services for the poor. In most cases, additional analyses using metrics that capture the number of poor per area (poverty density), the depth and severity of poverty (e.g., poverty gap and squared poverty gap), and other dimensions of well-being will be needed to better understand poverty patterns and examine cause-and-effect relationships.

Wetland Characteristics and Uses

Wetlands cover about 15 percent (31,406 square kilometers) of Uganda's total land area (205,212 square kilometers) and can be found in almost every subcounty. Most individual wetlands are linked to other wetlands through a complex network of permanent and seasonal streams, rivers, and lakes (Map 2), making them an essential part of the entire drainage system in Uganda (UN-WWAP and DWD, 2005).

While such a dispersed geographic coverage provides wetland benefits to a greater number of people, it also increases the likelihood of overexploitation and degradation. Uganda's high level of political and administrative decentralization adds to this risk. Most wetland systems cross administrative boundaries, which, because of compartmentalization of decision-making at the local level, makes it more difficult to manage wetlands in an integrative manner.

With 11 sites designated as Wetlands of International Importance, Uganda is internationally recognized for leading the effort in Africa to conserve wetlands that are regionally and globally important for migratory bird species and biodiversity (Ramsar, 2006). Nonetheless, besides those wetlands that have international or national protection status, the great majority of wetlands lie outside the national protected area system (Map 2). Establishing a solid information base on wetland resources, their use, and condition is therefore essential to identifying successful wetland management approaches for the future.

WETLAND CHARACTERISTICS

To describe and categorize these resources, wetland managers often begin with three basic characteristics of wetlands: the permanence and seasonality of their moisture regime, the main vegetation and land cover types, and the resource pressure from human use. The following section categorizes Uganda's wetlands by these key characteristics.

About 75 percent of Uganda's wetlands are seasonal, meaning they are not flooded for part of the year. In many locations, this dry period extends over most of the year.

As Map 2 shows, seasonal wetlands can be found in almost every corner of Uganda. The great majority of these are narrow and elongated in shape, following valley bottoms and streams. These wetlands form densely branched networks, especially around Lake Kyoga. But they are also found in other areas such as Ssembabule, Lyantonde, and Kiruhura Districts. Large seasonal wetlands are located in various extensive floodplains, such as Katakwi, Nakapiripirit, and Moroto Districts (northeastern Uganda); at the southern end of Lake Albert; in Kasese District; and in Rakai District, bordering Tanzania.

Permanent wetlands are mostly located near open water bodies such as lakes and rivers. The largest permanent wetlands are directly connected to Lake Kyoga and Lake Victoria. Others follow the banks of the Nile River from Lake Albert to the Sudanese border.

Wetlands in Uganda are covered by a variety of vegetation types and occur in all of Uganda's main land cover classes: tropical high forest, woodland, bushland, grassland, papyrus (including other sedges, reeds, and floating plants), and small and large-scale farmland. As Figure 1 indicates, the most common wetlands in Uganda are seasonally wet grasslands, covering 49 percent (about 15,326 square kilometers) of Uganda's total wetland area. Seasonally wet woodlands are the second most common with 16 percent (5,136 square kilometers). Permanent wetlands consisting of papyrus and other sedges, reeds, and floating plants are the third most common wetland type and represent 15 percent (4,840 square kilometers) of Uganda's wetland area. A significant share of seasonal wetlands is used for crops, with 7 percent (2,322 square kilometers) of Uganda's wetland area covered by small-scale farmland.

The economic and subsistence uses of wetlands vary with land cover and whether they are seasonal or permanent. The type and level of use in turn determine how vulnerable each wetland is to becoming permanently degraded.

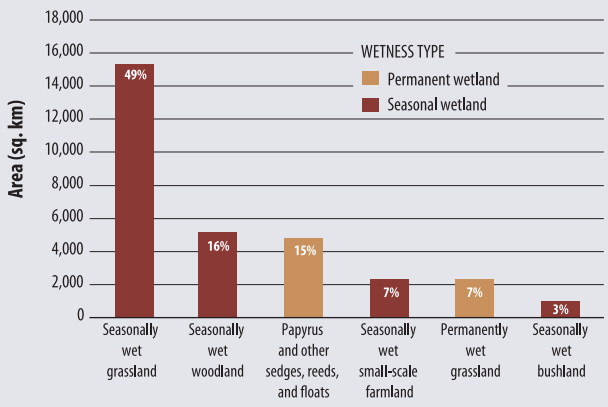
Grasslands, for example, are primarily used for livestock grazing. If they have the right soils and water regime, they are also very desirable for growing crops. In the context of Uganda's heavy dependence on agriculture (UBOS, 2007) and its growing demand for agricultural land, these wetlands are often prime targets for agricultural expansion.

Woodland and papyrus wetlands, on the other hand, provide raw materials, the former for construction and fuel, and the latter for crafts and mats. Both woodland and papyrus wetlands are very vulnerable to over-harvesting of these products, especially if they are close to high demand centers or located along major transport routes.

Map 2 DISTRIBUTION OF PERMANENT AND SEASONAL WETLANDS, 1996

Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), wetness type (NFA, 1996), and major national protected areas (NFA, 2007).

Figure 1 DISTRIBUTION OF MAIN LAND COVER TYPES IN UGANDA'S PERMANENT AND SEASONAL WETLANDS, 1996



Source: Authors' calculation based on NFA, 1996.

Note: Percentage share of Uganda's total wetland area.

While Map 2 provides a view of the national wetlands distribution and shows their location in every district, local governments and community-based resource user groups need more specific information. First and foremost, local decision-makers need to know what wetland resources they have and the pressure these resources are under.

A simple indicator for a local decision-maker, for example, would measure wetland area per capita, which is the total wetland area of an administrative unit divided by its total population. Such an indicator assumes the following: the more numerous the population in an administrative area, the higher the potential demand on wetland resources, which can lead to a greater number of people fishing, withdrawing water, collecting vegetation, growing crops, extracting clay, constructing houses, or releasing pollutants. Wetland area per capita can therefore be interpreted as a first proxy to measure potential resource usage, and thus pressure on wetlands.

Map 3 displays wetland area per capita by subcounty, represented by the height of the red bar. Wetland area per person varies broadly among the 938 subcounties with data. (The data for the 20 subcounties of Kotido, Kaabong, and Abim Districts are not shown because the census data were deemed unreliable.)

Most subcounties in Uganda have less than 0.2 hectares of wetland area per person (very short red bars). This implies either that wetlands in these areas are sparse (such as in subcounties of Mbale, Arua, and Mbarara Districts) or that they have to be shared among a large number of people (such as in the subcounties of Pallisa, Iganga, and Tororo Districts).

Subcounties with high wetland area per capita (long red bars) are in Kapchorwa, Katakwi, and Moroto Districts (northeastern Uganda). They are also very common in subcounties lying within the triangle formed by Masindi, Kiboga, and Nakasongola Districts, southwest of Lake Kyoga. In general, most subcounties with high wetland area per capita are distinguished by the presence of a specific type of wetland—seasonally wet grasslands—and lower population densities (NFA, 1996; UBOS, 2002b).

Map 3 clearly indicates that the potential demand pressure on wetlands varies across the country but few areas have low pressure (long red bars). Most subcounties have potentially high demand pressure on their wetlands.

A decision-maker in a subcounty with high wetland area per capita can formulate the following hypotheses based on this map:

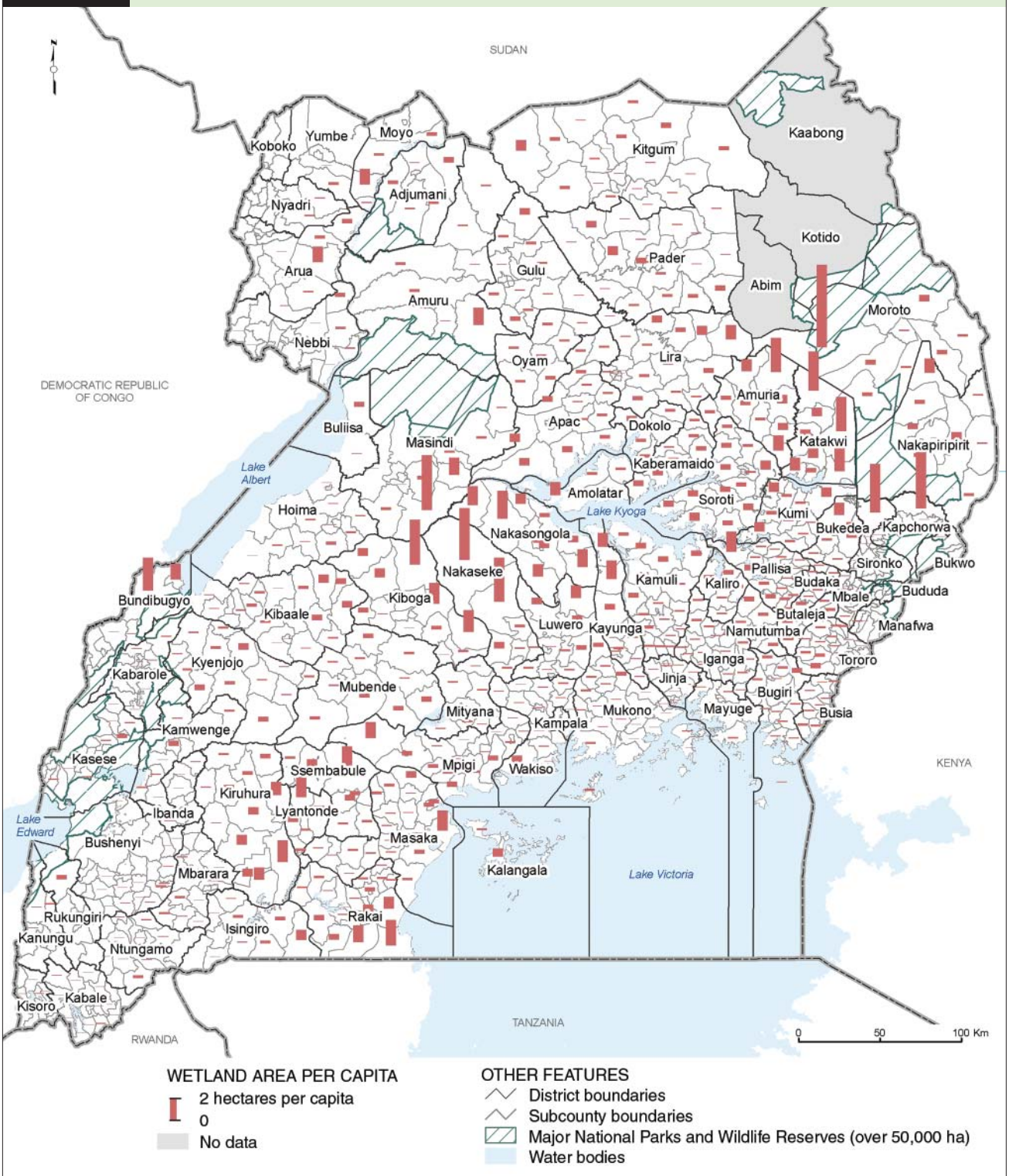
- Pressure on these wetlands from resource demand is likely to be lower than the rest of the country.
- These wetlands should be able to make a larger per capita contribution both with marketable wetland products and non-marketable wetland ecosystem services.

On the other hand, a decision-maker responsible for a subcounty with low wetland area per capita—resulting from a very large number of people sharing a relatively small wetland area—can gain the following insights from this map:

- Competition between different wetland uses has to be carefully managed.
- Special attention has to be paid so as not to undermine the capacity of the wetland to provide its products and services.
- There is a more urgent need to establish well-functioning management plans and zoning of land uses because of the potential for high demand pressure.
- These wetlands will need to be more closely monitored for their resource use.
- Economic returns from resource extraction of marketable products potentially have to be shared among a larger number of people, resulting in low average per capita values.
- While the wetland area per person may be low, these wetlands may still be of great importance locally, for example as a dry season grazing refuge, or nationally, for example to provide habitat for rare species.

In subcounties with large wetlands but very low per capita wetland area—for example wetlands close to an urban center—it is especially important to evaluate a comprehensive set of ecosystem services provided by these wetlands. For such wetlands, it may make little sense to promote increased harvesting of low-return wetland products, especially if this carries the risk of undermining other ecosystem services. Such increases may not provide

Map 3 WETLAND AREA PER CAPITA BY SUBCOUNTY



Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), subcounty administrative boundaries (UBOS, 2002a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), and wetland area per capita (authors' calculation based on NFA, 1996 and UBOS, 2002b).

sufficient additional income to each household to justify the heightened risk of overharvesting.

Maintaining these wetlands so that they can continue to filter pollutants for a large number of people living in close proximity may be a more optimal use for such wetlands. This may require prohibiting extractive uses of wetland resources that undermine filtering functions, such as excavation of clay for bricks. Similarly, such wetlands may be most valuable for their role as a temporary reservoir for flood water. The total value of avoided flood damage to nearby establishments with high property values may be considerably greater than the economic returns from consumptive use of a few wetland products.

WETLAND USES

A more advanced understanding of wetland conditions and benefits requires detailed information on the way people use and impact wetlands. Such information is available in geographically referenced format from the National Wetlands Information System (see Box 2).

Uganda's National Wetlands Information System is tracking 13 main wetland uses. They can be ranked according to their increasing potential to undermine the capacity of a wetland to provide its ecosystem services (Table 2).

The least damaging uses for a wetland imply no or very minor modification of its plants, animals, or hydrology. These include tourism and beekeeping.

Box 2 UGANDA'S NATIONAL WETLANDS INFORMATION SYSTEM

The National Wetlands Information System, maintained by the Wetlands Management Department, contains detailed data on different wetland uses, the level of use, and the impact of these uses on wetland systems. It is based on a standardized inventory of wetlands carried out for approximately 5,000 wetland sample points between 1997 and 2001. Each sample point reflects the uses and impacts observed in the field of vision at that location. Field teams inventoried 37 different wetland products, which they aggregated to 13 different main uses (Table 2).

It is important to point out that most of the products and uses inventoried for the National Wetlands Information System focus on provisioning ecosystem services of wetlands (see Table 1). These provisioning services are easier to measure and observe, and provide useful information to understand subsistence and commercial livelihood strategies.

On the other hand, the important contribution of regulating services such as erosion control, fish breeding, flood water retention, and carbon storage were not assessed comprehensively in this first round of data collection. Regulating services were captured in a limited way. Wetlands' contribution to water purification, for example, was counted only when the wetlands were specifically designated for that purpose as part of a wastewater treatment facility. Or the uses were categorized broadly, for example "water collection and use," which is linked to both provisioning services (the quantity of fresh water) and regulating services (water purification and timing of hydrological flows).

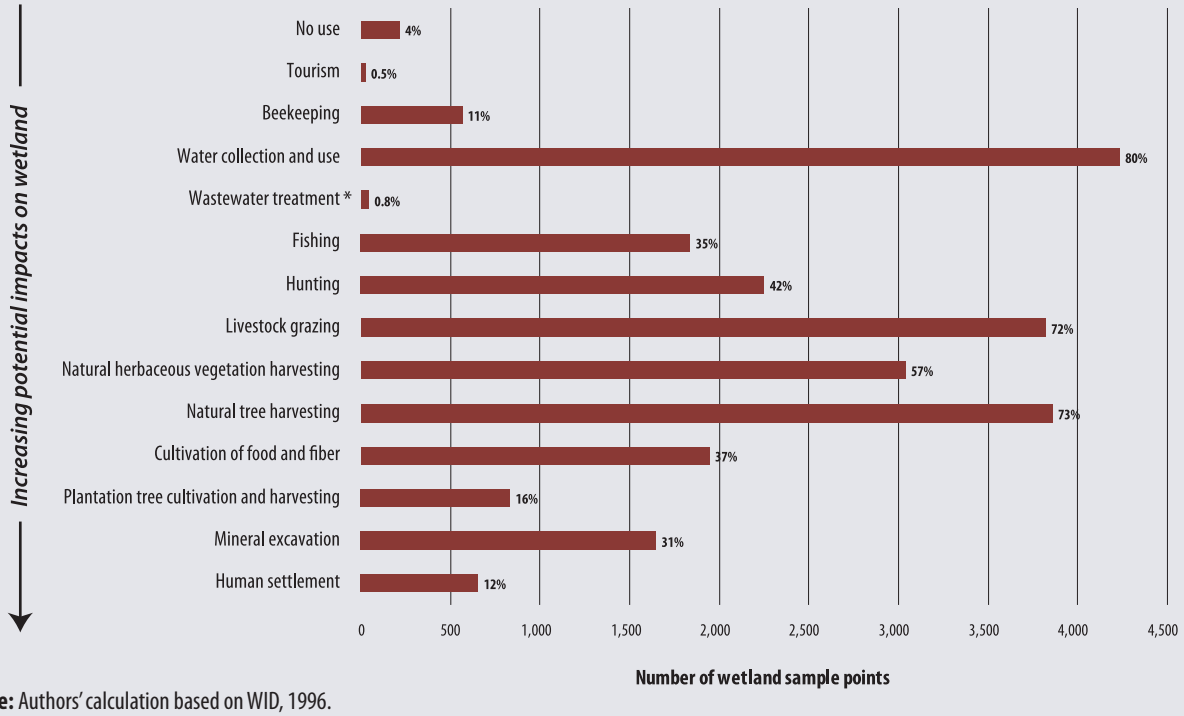
Table 2 MAIN WETLAND USES INVENTORIED IN UGANDA'S NATIONAL WETLANDS INFORMATION SYSTEM

Increasing potential impacts on wetland ↓

Main Wetland Uses	Examples of Products and Services
Tourism	Bird watching, nature walks, education
Beekeeping	Honey and wax; pollination
Water Collection and Use	Rural domestic water, urban domestic water, water for livestock, industrial water, and irrigation water
Wastewater Treatment*	Sewage treatment
Fishing	Food and skins
Hunting	Meat, skins, and craft materials
Livestock Grazing	Meat, milk, and other livestock products
Natural Herbaceous Vegetation Harvesting	Food, fuel, building materials, craft materials, mulch, and medicines
Natural Tree Harvesting	Food, fuel/firewood, craft materials, building poles or timber, and medicines
Cultivation of Food and Fiber	Food and fiber
Plantation Tree Cultivation and Harvesting	Food, fuel/firewood, craft materials, building/fencing materials, and medicines
Mineral Excavation	Salt, clay, sand, gravel, gold, gemstones, and other minerals
Human Settlement	Housing and industrial development

Source: WID, 1996
Note: For ranking criteria, see text, p. 12.
* Wastewater treatment only refers to those wetlands that are part of an established human wastewater treatment plant.

Figure 2 FREQUENCY OF MAIN WETLAND USES INVENTORIED IN UGANDA'S NATIONAL WETLANDS INFORMATION SYSTEM, 1997–2001



Source: Authors' calculation based on WID, 1996.

Note: For ranking criteria, see text, p. 12. Percentage represents share of Uganda's wetlands.

* The percentage related to wastewater treatment only refers to those wetlands that are part of an established human wastewater treatment plant.

The next uses listed in Table 2—water extraction and harvesting of native animals and vegetation (fishing, hunting, livestock grazing, harvesting of natural herbaceous vegetation, and harvesting of trees)—are all activities that could potentially have greater negative wetland impacts at very high use levels. On the other hand, these uses can be sustainable if harvesting does not exceed natural regeneration rates, water withdrawals are adequately replenished, and no other changes occur such as pollution and diseases. Under such a scenario, most other ecosystem services such as water filtration and flood control can be maintained.

The next two wetland uses involve replacing natural wetland vegetation with food, fiber, or tree crops. Such conversions generally lower species composition and biodiversity levels in a wetland. The impact of these uses on regulating services such as water regulation or water purification cannot be determined *a priori* and depends on location and specific circumstances. In some cases, these regulating services are only slightly impacted, and tend to stabilize after an initial disturbance phase. In other cases, they can be greatly affected.

The last two uses are the most destructive to wetlands and negatively affect many ecosystem services. They include removal of soil and plants for mineral extraction (in most cases, excavating clay to produce bricks) or the complete destruction of a wetland by human settlements.

As expected, the impact of these activities is also related to the magnitude of the use. Once the magnitude of use outstrips the capacity of the wetland to sustain it, any use can be destructive and permanently damaging.

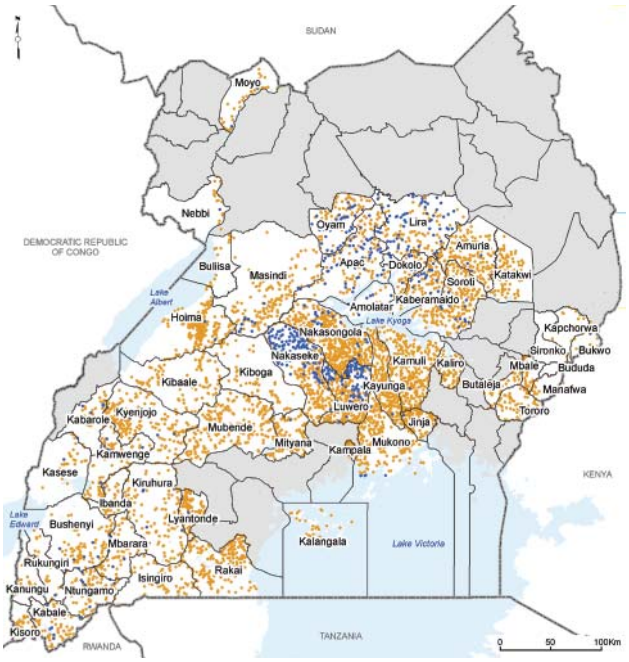
These 13 main wetland uses occur with differing frequency throughout Uganda's wetlands, as shown in Figure 2.

Based on the 13 categories of wetland use inventoried for the National Wetlands Information System, there are very few wetlands that are not used (4 percent). Wastewater treatment and tourism have been identified as uses in less than 1 percent of Uganda's wetlands. The percentage related to wastewater treatment in the National Wetlands Information System only refers to those wetlands that are part of an established human wastewater treatment facility in urban areas. However, all wetlands in Uganda can provide water purification and waste treatment benefits by retaining, recovering, or removing excess nutrients and other pollutants.

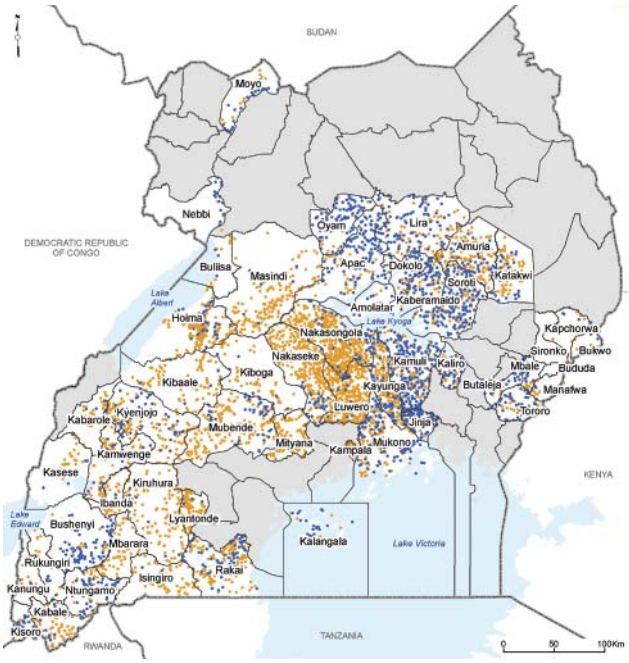
Over 70 percent of all wetlands in Uganda are locally used for three simultaneous purposes: water collection and use (80 percent), livestock grazing (72 percent), and natural tree harvesting (73 percent). The ubiquity of these uses is directly related to the wide geographic spread of wetlands and the distribution of Uganda's main vegetation types: grasslands and woodlands.

Map 4 SPATIAL DISTRIBUTION OF SELECTED WETLAND USES, 1997–2001

Beekeeping



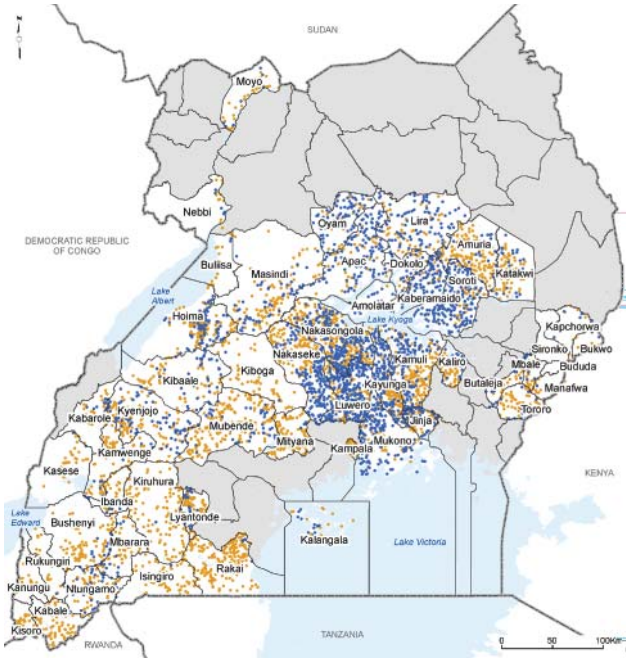
Fishing



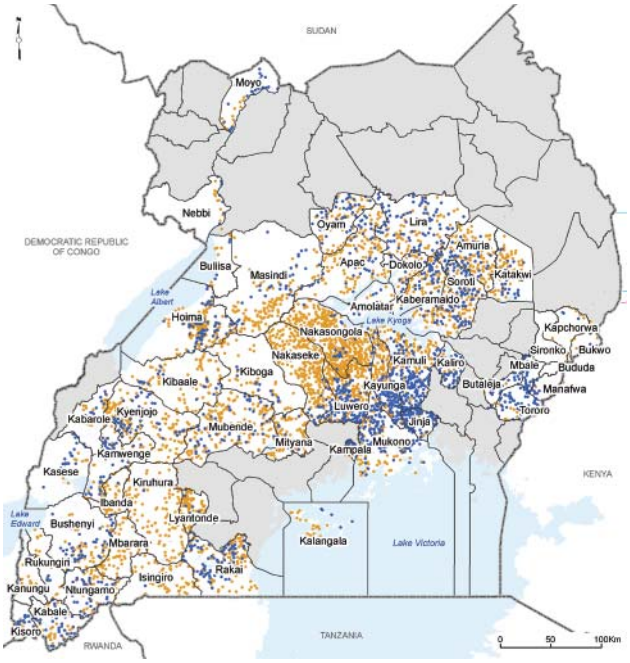
PRESENCE OR ABSENCE OF USE
- Use takes place
- Use does not take place
- No data

OTHER FEATURES
- District boundaries
- Water bodies

Hunting



Cultivation of Food and Fiber



Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), and presence or absence of use (WID, 2006).

Mineral (mostly clay) excavation, with its high negative impact on other wetland functions, occurs in almost a third of Uganda's wetlands (31 percent). Destructive human settlements, even though less widespread (12 percent), usually occur close to urban agglomerations. Demand for land and high property values are typically the drivers for the conversion to human settlement. However, many of these conversions do not take into account the economic contribution that wetlands make in treating wastewater from these population centers.

National maps of each use can be produced, because each sample point in the National Wetlands Information System is geographically referenced. Such maps can inform decision-makers where specific uses take place and help them determine where these uses should be further expanded or stopped. These maps can also be compared to those showing other economic activities (such as oil exploration) or levels of legal protection (such as a forest reserve or a national park). This could improve environmental impact assessments and land-use planning. Map 4 highlights four different uses—beekeeping, fishing, hunting, and cultivation—which occur in less than 50 percent of Uganda's wetlands.

Beekeeping (which occurs in 11 percent of all wetlands) is a localized activity. It is concentrated in Nakaseke and Luwero Districts and in parts of Apac and Lira Districts. For the past seven years, beekeeping has spread more widely than shown in this map (which summarizes data from 1997–2001), mainly because of its commercial success (WMD, 2007).

Fishing (occurs in 35 percent of all wetlands) and cultivation of food and fiber (occurs in 37 percent of all wetlands) have very similar spatial patterns. They cluster within the triangle formed by the districts of Jinja, Kayunga, and Kamuli. Both uses are extensive activities in wetlands in Bushenyi and Ntungamo Districts in southwestern Uganda and in communities northeast of Lake Kyoga.

Hunting is more widespread (occurs in 42 percent of all wetlands) and spatially less concentrated than the other three uses. It occurs simultaneously with agriculture and fishing (such as in Jinja, Kayunga, and Kamuli Districts), but is also highly concentrated in the seasonal wetlands around Lake Kyoga.

Spatial Analysis of Wetland and Poverty Indicators

In order to sustainably manage wetland resources, decision-makers need to know how they are being used and how these uses affect their capacity to provide products and services now and in the future. In addition, managing wetlands for the purposes of poverty reduction requires information on the location of wetland resources (and their use and condition) in relation to the location of people and poor communities.

This section explores how maps of poverty distribution can be combined with maps of selected wetland indicators to improve the information and analytical base for such decision-making. It relies on two indicators capturing different aspects of wetland use, namely: diversity of wetland products and combined impacts of wetland uses.

Even though the analysis was limited mostly to provisioning services (regulating services are not well accounted for in the National Wetlands Information System, see Box 2), the importance of spatial analysis of wetland regulating services is introduced in Box 3.

DIVERSITY OF WETLAND PRODUCTS

Over 70 percent of all wetlands in Uganda are used for three purposes: water collection, livestock grazing, and natural tree harvesting. This and other analyses of the 13 main uses provided a first broad overview of the varied benefits Ugandans obtain from their wetlands and highlighted national use patterns. However, more detailed wetland use data from the National Wetlands Information System can advance these analyses and contribute additional insights for wetlands management and poverty reduction. For example, harvesting of natural herbaceous vegetation, which is one of the 13 main uses, can be disaggregated into 6 products: harvesting of food, fuel, building material, craft material, mulch material, and medicines (see Table 2 for examples of products for each wetland use). The National Wetlands Information System has documented up to 24 different products in selected wetlands (out of a possible 37 products listed in the standardized wetlands inventory). The average number of products obtained from a wetland in Uganda ranges between 7 and 8 different products.

Examining the number of wetland products provides an analyst with information to gauge the level of product diversification from a wetland. Product diversification is one way of increasing the environmental income from wetlands. Typically, options to raise income from wetland resources are limited:

- Harvest larger quantities of the same marketable product;
- Harvest a new marketable product;
- Increase the returns from a product by adding value: for example by converting raw papyrus to a craft product; or improving the quality: for example by improving the processing of honey;
- Introduce payment for ecosystem services such as pollution removal or water regulation (hydrological flows).

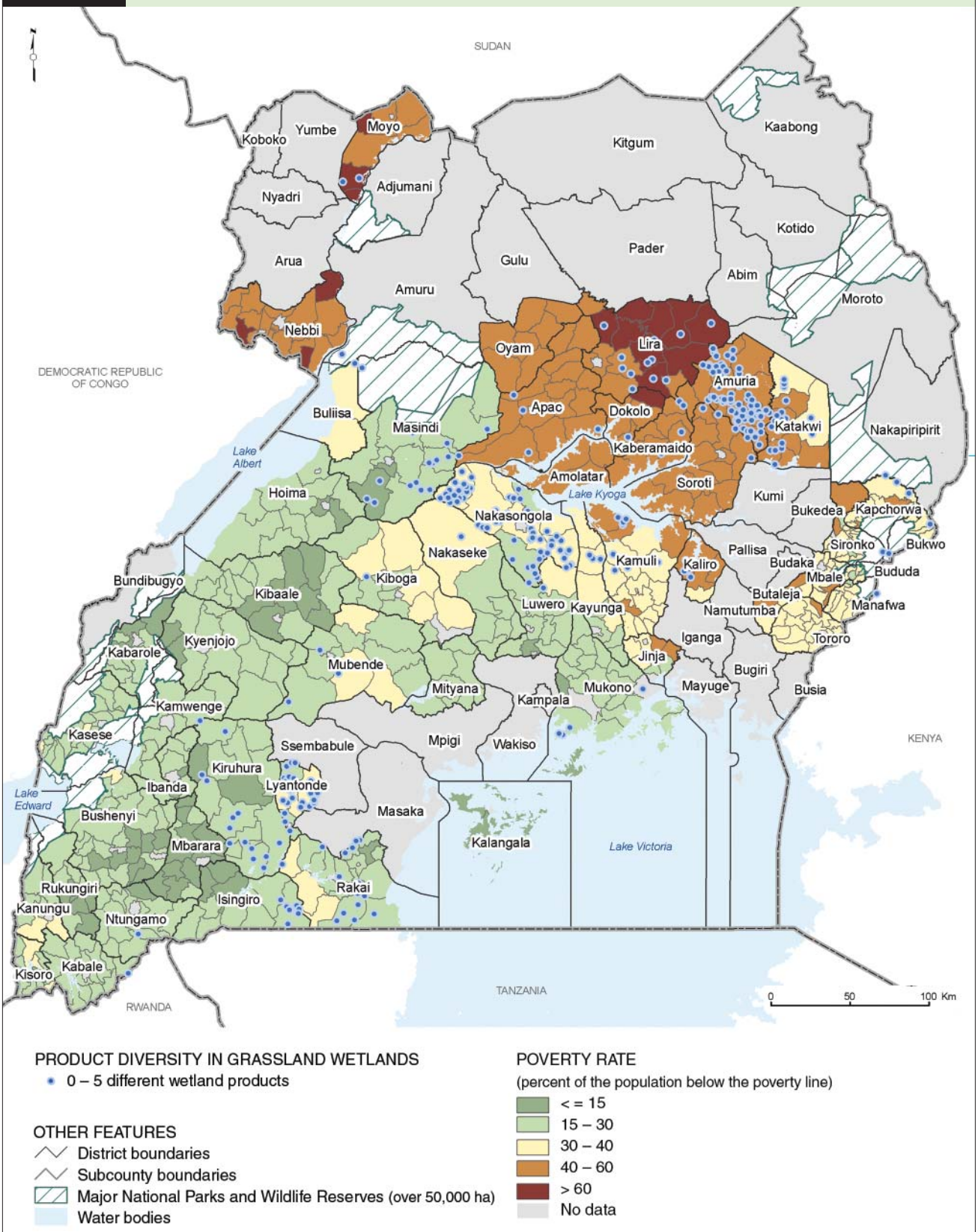
Decision-makers can use indicators that measure the diversity of wetland products to pinpoint areas where further product diversification can provide new economic opportunities and where diversification appears to have reached an upper limit.

The number of different products that could be potentially obtained from a wetland is closely related to the type of vegetation cover and level of wetness. For example, wetlands in grasslands can supply a much broader array of products than shrublands (WID, 2006). For this reason, the following analysis comparing the diversity of wetland products to the level of poverty in the surrounding communities is focused on such grassland wetlands. They are the most common wetland type, representing more than half of all wetlands in Uganda (see Figure 1). Most of these grassland wetlands are located north and south of Lake Kyoga. A smaller number are further south clustering in Rakai, Kiruhura, and Lyantonde Districts.

Analysis of the number of products obtained from grassland wetlands reveals that 25 percent of such wetlands supply up to 6 products; another quarter supply 6 to 9 products; the third quarter supply 10 or 11 products; and the last quarter supply 12 to 24 products (as calculated from the National Wetlands Information System).

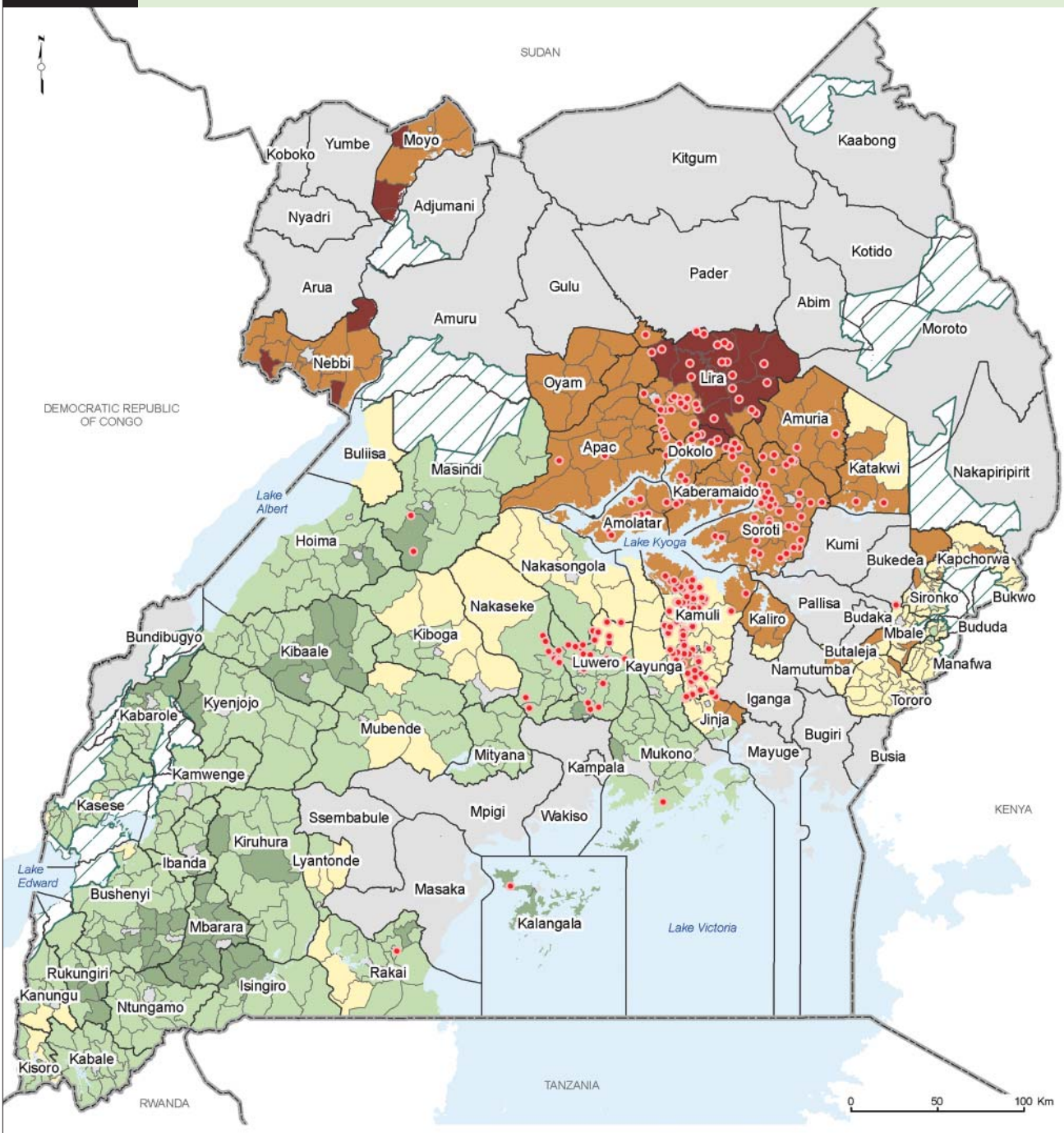
Map 5 displays all the sample points in grassland wetlands with the lowest product diversity (0–5 different products), with the purpose of identifying locations where boosting wetland product diversity is an option that could benefit a large number of poor. In contrast, Map 6 (page 18) shows the sample points with the highest product diversity (12–24 different products) to indicate locations where product diversification may be close to an upper limit. Both maps also display the poverty rate for each rural subcounty.

Map 5 POVERTY RATES IN GRASSLAND WETLANDS WITH LOW PRODUCT DIVERSITY



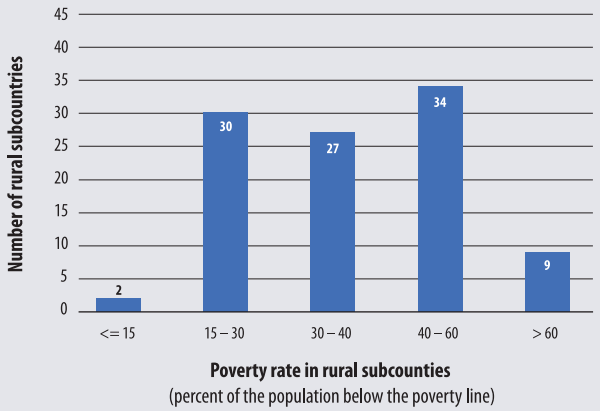
Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), subcounty administrative boundaries (UBOS, 2002a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), product diversity in grassland wetlands (WID, 2006), and rural poverty rate (UBOS and ILRI, 2008).

Map 6 POVERTY RATES IN GRASSLAND WETLANDS WITH HIGH PRODUCT DIVERSITY



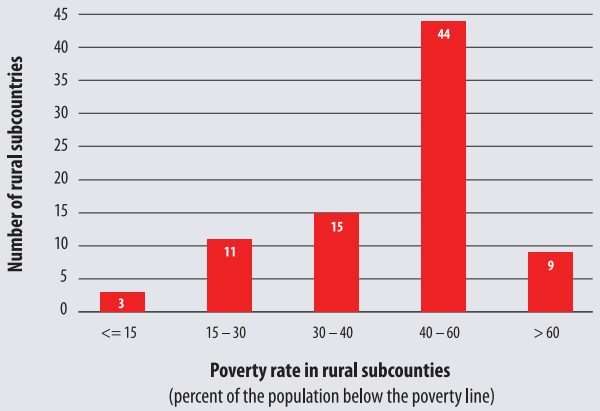
Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), subcounty administrative boundaries (UBOS, 2002a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), product diversity in grassland wetlands (WID, 2006), and rural poverty rate (UBOS and ILRI, 2008).

Figure 3 POVERTY DISTRIBUTION FOR GRASSLAND WETLANDS WITH LOW PRODUCT DIVERSITY



Source: Authors' calculation based on WID, 2006 and UBOS and ILRI, 2008.

Figure 4 POVERTY DISTRIBUTION FOR GRASSLAND WETLANDS WITH HIGH PRODUCT DIVERSITY



Source: Authors' calculation based on WID, 2006 and UBOS and ILRI, 2008.

Emerging Patterns

Comparing both maps, a number of patterns emerge:

- Wetlands with low product diversity (blue points) spread across all regions where grassland wetlands have been documented in the National Wetlands Information System.
- Grassland wetlands with highest product diversity (red points), however, are almost exclusively located north and south of Lake Kyoga.
- Poverty rates in the surrounding communities for both subsets of wetlands cover the full range of values from the lowest to the highest poverty levels.
- However, those wetlands with the highest product diversity (red points) are mostly in the poorest subcounties (shaded in brown) northeast and southeast of Lake Kyoga.

Figures 3 and 4 summarize the relationship between levels of poverty and product diversity from these two maps. The number of subcounties in each of the five poverty rate classes varies between the low and high diversity set of wetlands. Subcounties that have wetlands with low product diversity show predominantly poverty rates between 15 and 60 percent. On the other hand, the subcounties with highest product diversity of wetland products are concentrated in the 40–60 percent poverty rate class.

Decision-makers can draw the following conclusions from the overlays in Maps 5 and 6:

- *Coincidence of high poverty rates (brown subcounties) with high wetland product diversity (red points, Map 6).* The wetlands in a large number of the poorer subcounties northeast of Lake Kyoga appear to be close to the observed upper limits of product diversification, making it a less viable option to reduce poverty. Wetlands with high product diversity need close monitoring to ensure their sustainable use. This is especially important in subcounties with very high poverty rates. If the high number of different products obtained is found to go beyond the capacity of wetlands to provide products and services, decision-makers and communities need to find alternatives to overexploitation. For example, this could involve training in more sustainable resource use or facilitating efforts to provide value-added products (e.g., organizing papyrus harvesters and providing technology to produce papyrus briquettes for energy supply).
- *Coincidence of high poverty rates (brown subcounties) with low wetland product diversity (blue points, Map 5).* Sustainable product diversification could be an option for poverty reduction in the grassland wetlands further away from Lake Kyoga, most of them in northeastern Uganda in Amuria and Katakwi Districts.
- *Coincidence of low poverty rates (green subcounties) with low wetland product diversity (blue points, Map 5).* Boosting product diversification is also an option for grassland wetlands west of Lake Kyoga, in Masindi District; and in the southern half of the country, in Kiruhura, Isingiro, and Rakai Districts. To achieve pro-poor benefits, however, interventions need to target poor households more precisely, since poverty rates of the surrounding subcounties are just 15–30 percent (compared to 40–60 percent in the northern wetlands).
- *Coincidence of low poverty rates (green subcounties) with high wetland product diversity (red points, Map 6).* If monitoring shows that wetlands are being pushed beyond their capacity to provide products and services

Box 3 MAPPING CASE STUDY: COORDINATING WETLANDS MANAGEMENT AND HEALTH INTERVENTIONS TO IMPROVE SANITATION, DRINKING WATER, AND HEALTH

An important contribution of wetlands to human well-being is their ability to function as a natural wastewater treatment facility. Due to a combination of substrate, plants, litter, and a variety of micro-organisms, wetlands can help treat human waste (Langergraber and Haberl, 2004). Given that in 2006-07, 41 percent of rural households in Uganda lacked adequate sanitation facilities and 37 percent of rural Ugandans did not have access to a safe water source within 1.5 kilometers (MWE, 2007), the contribution of wetlands in filtering pollutants is crucial to public health. For example, the consumption of contaminated water often leads to outbreaks of water-related diseases, resulting in illness and deaths. Water-related diseases accounted directly for eight percent of deaths in 2002 (WHO, 2006), and unclean water can be especially deadly for infants and young children. Diarrheal diseases are a major killer of children, and were responsible for 17 percent of all deaths of children under 5 years in Uganda (WHO, 2006).

Lack of proper sanitation facilities introduces human pollutants into the vicinity of a household's living space. It increases the risk of disease, especially if contaminants are transported via hydrological flows to nearby households relying on open sources of drinking water such as lakes, streams, or shallow uncovered wells. If households do not have access to water treatment facilities, they have to rely exclusively on ecosystems to clean their water, either through dilution or filtering of pollutants.

In many cases, a wetland can mitigate the risk of contamination. The capacity of a wetland to filter human pathogens and improve drinking water supplies depends on a number of factors, including the type of pollutant, the overall pollutant load, the hydrological flows, the type of wetland, and the health of the wetland. These relationships are generally examined in specific studies that incorporate detailed information on pollutant sources, drinking water withdrawals, and hydrological models reflecting water flows and filtering functions of wetlands.

The Ministry of Health and the Wetlands Management Department can combine their respective data to identify communities at risks of water-borne diseases because of unsafe drinking water sources and lack of proper sanitation. Together they can locate wetlands neighboring such communities and explore the contribution of these wetlands in filtering human pollutants. The following example showcases such data integration and analysis.

The Sezibwa wetland system is one of the four proposed sites to monitor long-term ecological and socioeconomic trends in Uganda's wetlands. Map 7A shows the location and extent of this system. It is located south of Lake Kyoga and composed of two permanent wetlands (shown in orange) following the Victoria Nile River and the Sezibwa River and a multitude of smaller seasonal wetlands (shown in purple), the latter representing two-thirds of the total area of the system. The map also displays where people collect or use water from their wetland (based on data from the National Wetlands Information System). Similar to the national picture, both seasonal and permanent wetlands are used for water provision but that source of water is defined as unsafe (MWE, 2007).

Map 7B shows the density of households without sanitation facilities (based on data from the 2002 Uganda Population and Housing Census) for each parish neighboring this wetland system. This density indicator can be interpreted as a proxy to delineate source areas of higher potential pollutant loads (bacteria, pathogens, etc.). The upper reaches of the Sezibwa system following the boundaries of Kayunga, Jinja, and Mukono Districts have the highest density of households without sanitation facilities (shades of dark green).

Map 7C combines Map 7A and Map 7B. This simple overlay provides the following insights:

- People relying on open water sources in the vicinity of high pollutant source areas are at higher risk of contracting water-borne diseases (blue points on dark green parishes). This risk is greatest in the southern parts of Kayunga District.
- The filtering function of wetlands may be most valuable in areas with the highest pollutant loads and a high number of unsafe water withdrawal sources (although more detailed hydrological studies may suggest other locations and only selected wetlands).

It is important to point out that wetland management alone cannot substitute for investing in adequate sanitation facilities, safe sources of drinking water, and efforts to promote better hygiene behavior. However, closer collaboration between wetland management and environmental health interventions could help mitigate the risk of vulnerable communities:

- Wetland management interventions may need to prioritize conservation of wetlands where their water treatment function is most valuable and thus support the Ministry of Health in its fight against water-borne diseases.
- On the other hand, the water and sanitation sector may want to prioritize new sanitation infrastructure and safe drinking water sources where the pollutant load is too high for the carrying capacity of wetlands to filter pollutants.

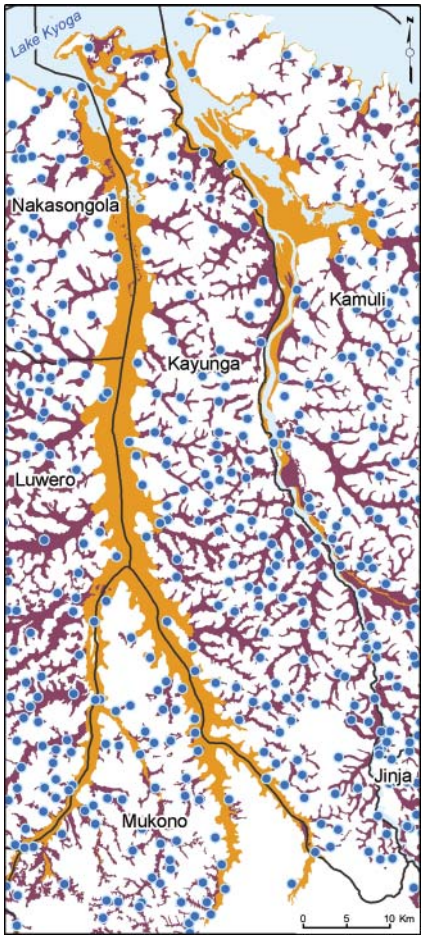
in some areas, decision-makers should study the possibility of restricting access to wetland resources and carefully managing current use in those areas. Wetland users from non-poor households may be more tolerant of such management interventions because they may have alternative and multiple livelihood options.

MEASURING THE COMBINED IMPACTS OF WETLAND USES

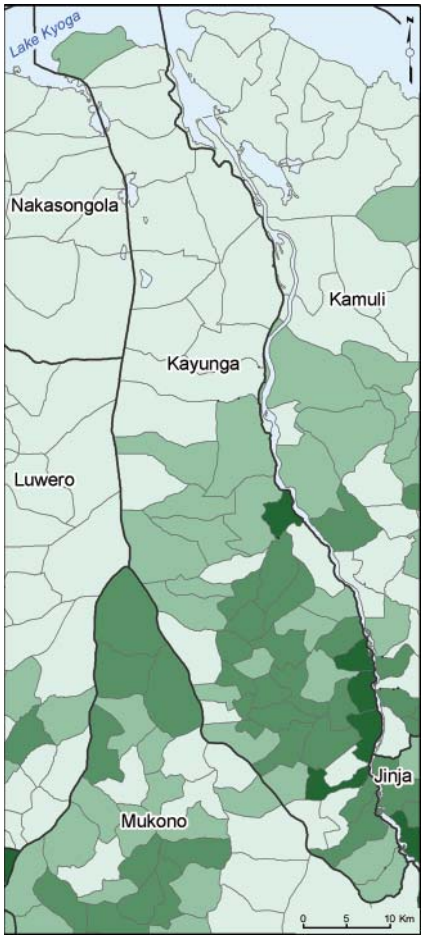
The Uganda National Wetlands Policy commits the Government to "the conservation of wetlands in order to sustain their ecological and socio-economic functions for the present and future well-being of the people" (MNR, 1995). Government agencies and community-based wetland resource user groups thus need to know where existing exploitative practices undermine productivity and threaten future supplies of wetland products and services.

Map 7 LINKING WETLANDS AND SANITATION IN THE SEZIBWA WETLAND SYSTEM

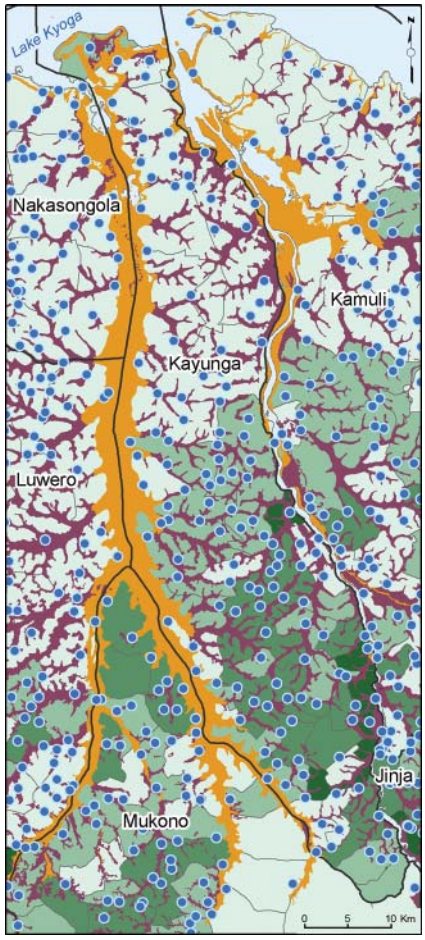
A – Sezibwa wetland system and water collection and use



B - Lack of sanitation facilities



C - Integration of wetland and health considerations



USE OF WETLAND
- Water collection and use

WETNESS TYPE
- Permanent wetland
- Seasonal wetland

DENSITY OF HOUSEHOLDS WITHOUT SANITATION FACILITIES
(number of households without latrine per sq. km)
- < = 10 (low pollutant load)
- 10 – 15
- 15 – 30
- 30 – 370 (high pollutant load)

OTHER FEATURES
- District boundaries
- Parish boundaries
- Water bodies

Sources: District administrative boundaries (UBOS, 2006a), parish administrative boundaries (UBOS, 2002b), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), use of wetland (WID, 2006), wetness type (NFA, 1996), and density of households without sanitation facilities (authors' calculation based on UBOS, 2002b).

The standardized wetlands inventory for the National Wetlands Information System can provide these data because it classifies each wetland use according to its level of impact on the wetland system. This information can be converted into an index to classify each wetland according to the combined impacts of all wetland uses (see Box 4).

This index can help to manage wetland resources more optimally. Wetlands with an index reflecting no or low impacts from their use are closer to a sustainable use pattern and more likely to continue to provide benefits to Ugandans, now and in the future. In contrast, wetlands classified as being highly impacted by use are at greater risk of undermining their future supply of wetland products and services. Depending on the range of different wetland uses and the level of associated impacts, wetland degradation can lead to decreased water quality, depleted fuel sources, curtailed crop yields, or diminished fish catches.

Map 8 highlights the wetlands with a combined impact from all uses of no or low impact. Almost 8 percent of the wetlands inventoried in the National Wetlands Information System show no impacts from current use and are shown as dark blue points in Map 8. These used but non-impacted wetlands are concentrated in Amuria, Katakwi, Soroti, and Kaberamaido Districts, areas with more traditional land use and lower population densities (NFA, 1996; UBOS, 2002b).

In contrast, Map 9 (page 24) displays all those wetlands whose index value indicates medium to very high impacts resulting from wetland use. Lira District has the greatest number of wetlands with very high impact use (red points). A large number of these wetlands can also be found in Dokolo, Amolatar, and Jinja Districts. High wetland impacts can also be found in the districts of Ntungamo, Kisoro, Kyenjojo, Kamwenge, Tororo, Mbale, and Moyo.

Comparing Map 8 and Map 9 reveals that the great majority of wetlands in the districts of Kiruhura and Mubende and the eastern parts of Kamuli District are exposed to low impacts (turquoise points, Map 8). These districts have fewer wetlands with medium to very high impacts (green and yellow points, Map 9). On the other hand, most wetlands in Luwero District are highly impacted (yellow points, Map 9) with very few no or low level impact (blue and turquoise points, Map 8). Wetlands in Kayunga and Nakasongola Districts are represented by a mix of turquoise, yellow, and green points, reflecting low, medium, and high level impact.

While these maps showing the impacts from all wetland uses can help planners to locate potential wetland resources at risk and identify those that are more sustainably used, they can also be combined with Uganda's poverty maps to illuminate the linkages between poverty and potential wetland degradation. Map 10 (page 26) is an example of this approach. Here, all the wetlands at greatest risk of degradation are selected (shown as red points in Map 9) and overlaid with the poverty level in the surrounding subcounties. It displays the location of these wetland sample points and the poverty rate for the neighboring 60 rural subcounties.

Box 4 CONSTRUCTING AN INDEX OF COMBINED IMPACTS OF WETLAND USES

The field surveys for Uganda's National Wetlands Information System assigned for each of the possible 37 wetland products an impact level (defined as high, moderate, low, or no impact on the wetland system). This information provides the foundation for an index that measures the combined impacts of all wetland uses.

To calculate this index, scores of 3, 2, 1, and 0 were assigned to the respective impact levels on the wetland system and then summed for all documented wetland products for each wetland sample point. These sample points can then be mapped to indicate which wetlands are highly impacted by use and which are less so.

Index values for the 5,000 sample points range between 0 and 41. For the purpose of the analysis, these index values were grouped into five classes: no impact (index value of 0), low impact (index value between 1 and 5), medium impact (index value between 6 and 10), high impact (index value between 11 and 20), and very high impact (index value between 21 and 41). For a wetland to fall in the "no impact" category (index value of 0), wetland inspectors had to assign the "no impact on the wetland system" to all documented products.

Each impact category can reflect various use patterns: For example, a community may extract five different products, each assigned as being "low impact" (associated with an impact score of 1) and resulting in an index value of 5 for the sampled wetland. Another community may extract three different products, one assigned as being "high impact" (impact score of 3) and the other two as being "low impact" (each with an impact score of 1) resulting also in an index value of 5.

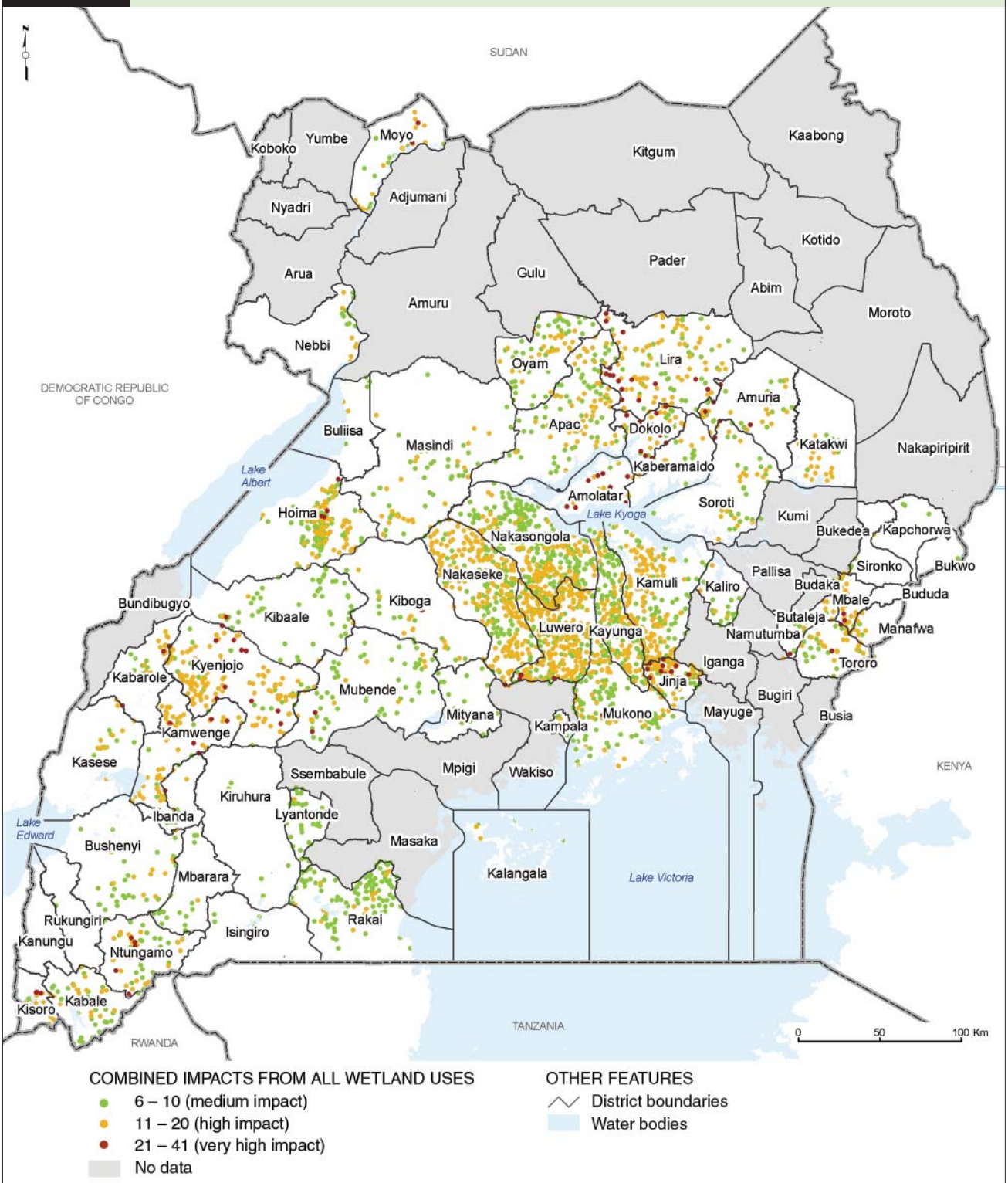
One limitation of this index of combined impacts comes from the fact that it weighs impacts equally even though a number of wetland uses, such as mineral extraction or conversion to cropland, affect ecosystem functions very broadly and often irreversibly, undermining the supply of other ecosystem services. Future revisions of the index could apply different weights to these uses to reflect their greater impact on a wetland's capacity to provide products and services (see Table 2).

A second limitation lies in the timeliness of the data, which were collected between 1997 and 2001. In urban areas such as Kampala, property values and population size—all important drivers influencing wetland use—have been changing rapidly, making the collected data quickly obsolete. To reflect the current situation on the ground, data collection for the National Wetlands Information System has to be carried out more frequently, especially in peri-urban and other areas prone to rapid land-use change.

Map 8 WETLANDS WITH NO OR LOW IMPACTS FROM ALL WETLAND USES, 1997–2001

Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), and combined impacts from all wetland uses (authors' calculation based on WID, 2006).

Map 9 WETLANDS WITH MEDIUM TO VERY HIGH IMPACTS FROM ALL WETLAND USES, 1997–2001



Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), water bodies (NFA, 1996; NIMA 1997; Brakenridge et al., 2006), and combined impacts from all wetland uses (authors' calculation based on WID, 2006).

As Map 10 shows, highly impacted wetlands are spread widely across Uganda, and the proportion of the subcounty population falling below the rural poverty line includes all poverty levels. Wetlands with very high impacts from use are located in subcounties with lower poverty levels (shaded in green) mainly in the southwestern part of the country. But highly impacted wetlands are also situated within poorer subcounties, mostly north of Lake Kyoga in Lira, Amuria, Dokolo, and Amolatar Districts (shades of brown and yellow), but also in Jinja District, where farmers grow rice in wetlands.

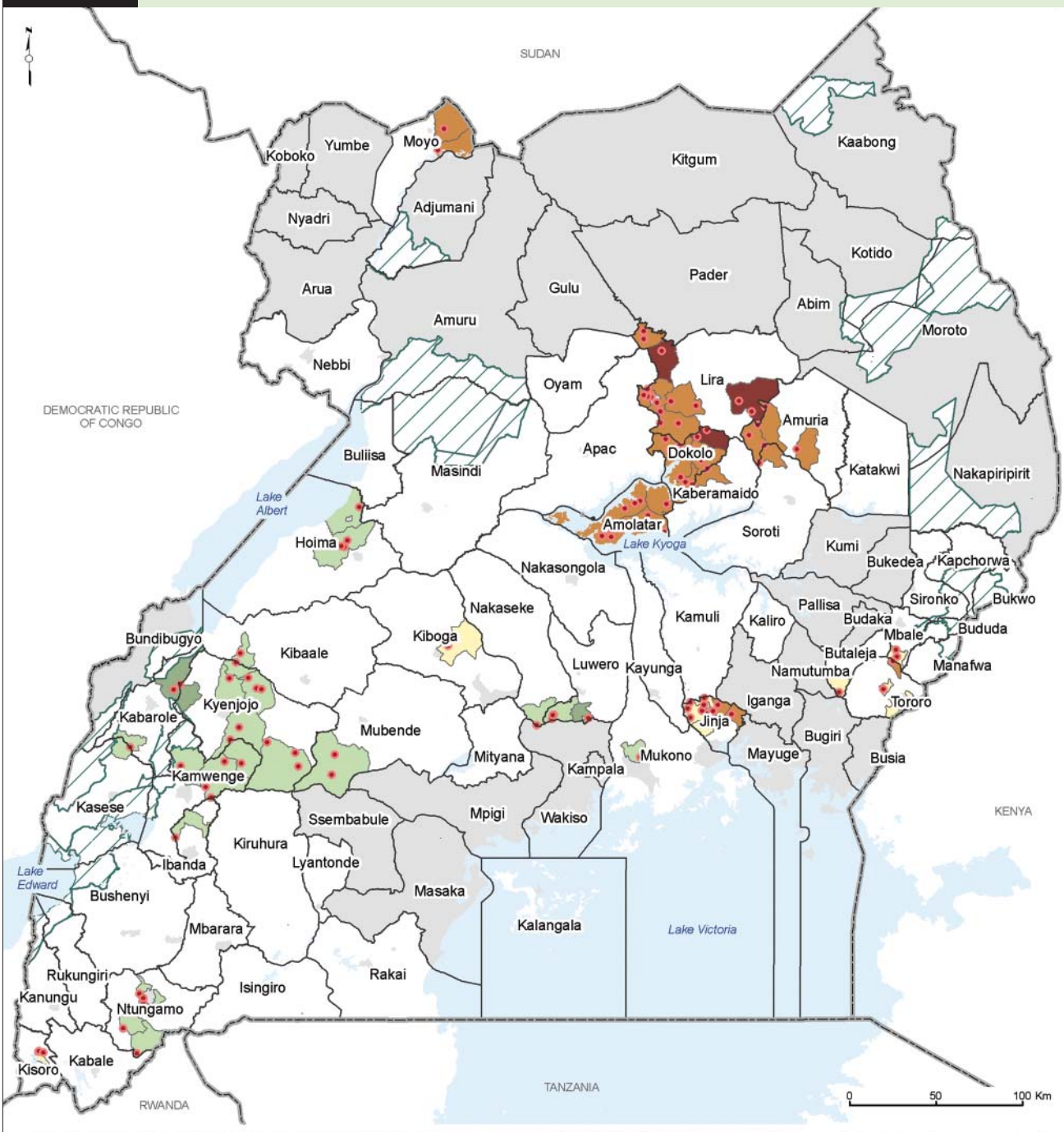
This means that based on the existing data from the National Wetlands Information System and the most recent poverty map, there is no straightforward relationship between poverty levels and potential wetland degradation. High impact from wetland use occurs in both poor and better-off subcounties.

Nevertheless, Map 10 can be useful to flag certain subcounties where close coordination between wetlands management and poverty reduction efforts could be beneficial for both wetlands and human well-being. For example, in subcounties with high poverty rates of 40-60 percent (shaded in light brown) and a great number of highly impacted wetlands, additional or more intensive use could threaten the future supply of benefits. This in turn could negatively impact poor families who depend on wetlands for their livelihoods or fall back on these resources in emergencies. Improved wetlands management that results in a more optimal combination of products and services (one that lowers the overall impact on the wetland system while maximizing the revenue) could reduce the risk of resource degradation and negative well-being impacts for poor households. Conversely, creating new economic opportunities outside of the wetland sector may permit some families to reduce dependence on resource extraction with low returns and high impacts, resulting in both improvements in well-being and lower resource pressure on wetlands.

In subcounties with highly impacted wetlands but low poverty rates, the presence of alternative income-generating activities and livelihood strategies is more likely. This suggests that any strategy to change and optimize the combination of wetland uses or to restore a wetland could build on greater assets and capabilities of households in these subcounties.

Map 10 represents just one example that analyzes the relationship between wetland use impacts and poverty. Other useful analyses are also possible. For example, a different map overlay could pinpoint where wetlands exposed to no or low impacts coincide with high poverty levels and could lead to further investigation of the reasons behind this pattern.

Map 10 POVERTY RATES IN SUBCOUNTIES WITH VERY HIGH WETLAND USE IMPACTS



Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), subcounty administrative boundaries (UBOS, 2002a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), combined impacts from all wetland uses (authors' calculation based on WID, 2006), and rural poverty rate (UBOS and ILRI, 2008).

Adding Value: Combining Wetland and Poverty Maps with Economic Analysis

The map overlays highlighted in the previous chapter represent only the first step in analyzing the benefits wetlands provide to people in general and to poor communities more specifically. Additional analyses are needed to manage wetlands in a more sustainable manner, identify and plan development interventions better, and target poverty reduction efforts more precisely. Combining three types of data can greatly enhance these analyses: location of specific wetland uses, extent of use, and economic value of use.

To manage wetlands sustainably, it is important to know not only the type and location of each use, but also to track the exact quantity of each product or service obtained from a wetland. This could include the quantity of papyrus harvested, fish caught, water withdrawn, wood collected, fodder obtained, or wastewater filtered. These data can then be compared to the capacity of a wetland to provide these products and services (e.g., regeneration rate of plants, or the total filtering and waste assimilation capacity) to determine a sustainable use pattern.

To identify and plan development interventions better, an analysis of wetland uses needs to identify the beneficiaries (socioeconomic profile of wetland users) and incorporate livelihood perspectives, economic costs, and economic benefits of different wetland uses. Knowing the economic value of these uses enables analysts to calculate the economic returns per area or labor input and to assess their contribution to household incomes. For a wetland product with an existing market, an economist will multiply the quantity of a harvested product by its market price. For a wetland service without an existing market such as water filtration, economists rely on special valuation tools such as the Replacement Cost Method that estimates the amount of money that could be saved by not building a wastewater treatment facility (Ranganathan et al., 2008).

To target poverty reduction efforts more precisely, decision-makers need to know whether specific wetland uses provide sufficient new revenues to move a poor person above Uganda's poverty line. The analysis generally compares the economic value of a specific wetland product or service to the amount of shillings needed to move that person out of poverty.

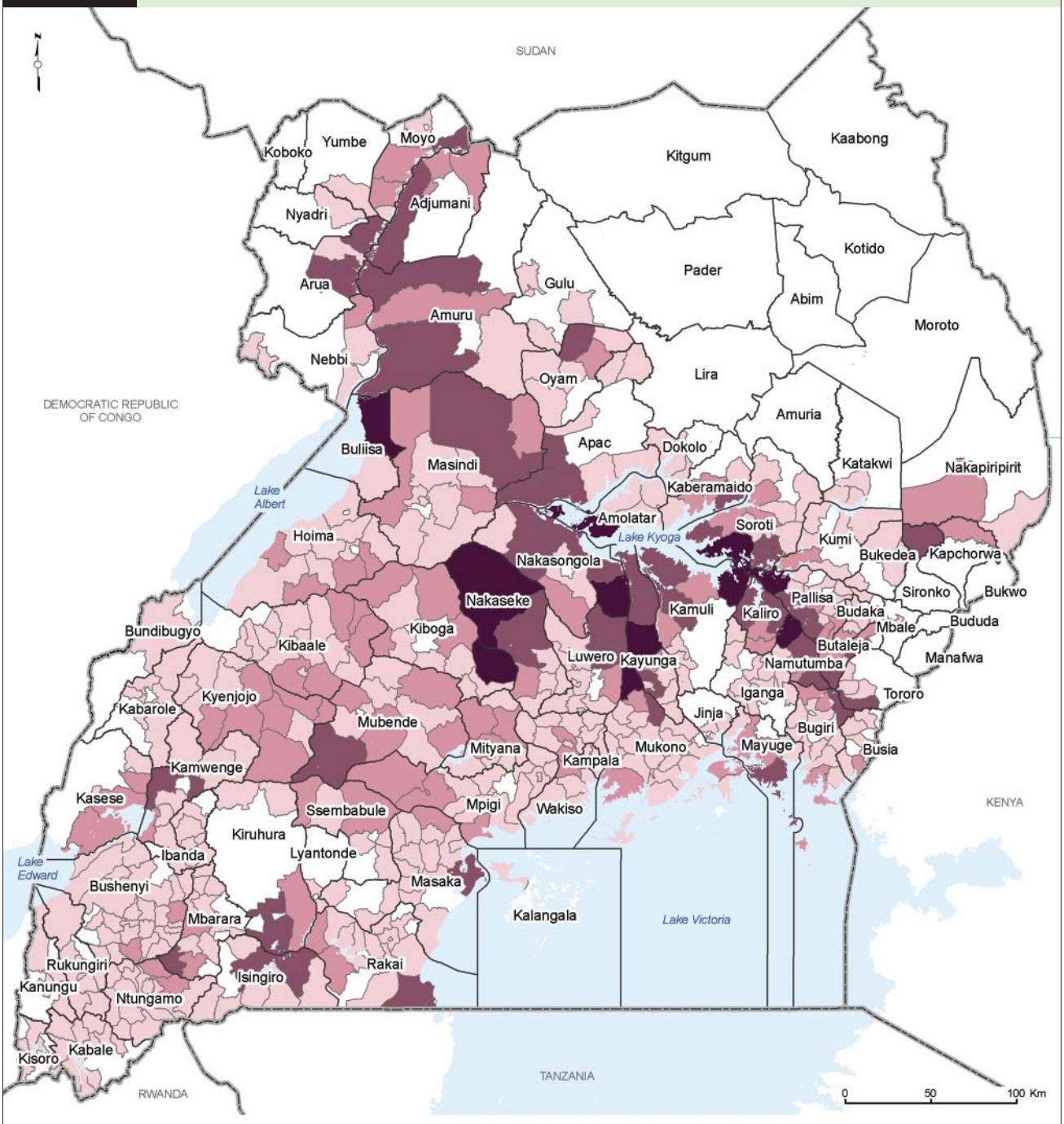
The following analysis integrates these different types of data and looks at one wetland use—papyrus harvesting. The main purpose is to show how the spatial analysis of poverty and wetland indicators can be strengthened with information from economic valuation studies. This analysis will estimate the quantity of papyrus that could be sustainably harvested in each subcounty (based on the area and location of papyrus wetlands), calculate the potential economic value that is associated with this harvest, and compare the potential papyrus revenue to the total amount of money needed to move all poor persons in that subcounty above the poverty line (see Box 1 for the definition of poverty used in this publication).

The theoretical total annual potential papyrus harvest for all subcounties was calculated from detailed maps of papyrus wetlands (NFA, 1996). The total papyrus area for each subcounty was multiplied by the quantity of papyrus that could be sustainably harvested per year (400 bundles per hectare of papyrus wetland based on Karanja et al., 2001). It was assumed that all papyrus stems were accessible in the subcounty and that their quality was homogeneous and high enough to be harvested and sold.

Map 11 (page 28) presents the total annual revenue that could be obtained from harvesting all papyrus areas in each subcounty. The potential revenue for each subcounty was obtained by multiplying the annual harvest quantity by its average sales price. The data are based on an economic study of papyrus harvest and sales in Pallisa District (Karanja et al., 2001) which determined an average sales price of 500 Uganda Shillings for each bundle of harvested papyrus. (This translates to an annual theoretical return of 200,000 Uganda Shillings per year for each hectare of papyrus wetland, equivalent to about US$ 118 per hectare per year with 1US$ = 1,700 Uganda Shillings.)

Map 11 shows 444 subcounties without any papyrus revenues (areas in white). These subcounties have no papyrus wetlands and most of them are in the northern districts. Other subcounties without papyrus revenues are in southeast Uganda (Manafwa, Sironko, and Bukwo Districts), the southwestern highlands (parts of Bundibugyo, Kanungu, and Kasese Districts), and parts of Kiruhura and Lyantonde Districts. The other 514 subcounties have papyrus wetlands and could realize revenues from papyrus harvests (subcounties shown in shades of purple). The subcounties with the largest potential total annual papyrus revenues (shaded in dark purple) are in the districts of Buliisa, Nakaseke, Luwero, Kayunga, Kamuli, Pallisa, and

Map 11 THEORETICAL ANNUAL REVENUE FROM PAPYRUS HARVEST BY SUBCOUNTY



THEORETICAL ANNUAL REVENUE FROM PAPYRUS HARVEST
(million Uganda Shillings/year (thousand US$/year))

- Subcounty without papyrus
- 0 – 150 (0 – 88)
- 150 – 400 (88 – 235)
- 400 – 1,000 (235 – 588)
- 1,000 – 2,200 (588 – 1,295)

OTHER FEATURES

- District boundaries
- Subcounty boundaries
- Water bodies

Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), and theoretical annual revenue from papyrus harvest (authors' calculation based on NFA, 1996 and Karanja et al., 2001).

Box 5 CALCULATING THE THEORETICAL AMOUNT OF CASH NEEDED TO CLOSE THE POVERTY GAP

To calculate the theoretical cash transfers needed to raise the entire poor population in a subcounty above the poverty line, economists require three metrics: number of poor in an administrative area, poverty line, and poverty gap. The following example showcases the calculation using rural data for one of Uganda's regions.

Poverty data for the Northern Region

Total rural population: 5.4 million

Rural poverty line: 20,872 Uganda Shillings per month (US$ 12 per month)

Rural poverty rate (percentage of people falling below the poverty line): 66 percent of population

Poverty gap in percent of poverty line (how far below the poverty line the poor in a given area are): 27 percent of poverty line

Calculation

Total rural poor population = Total rural population × Poverty rate

= 3.5 million

Poverty gap in Uganda Shillings = Poverty gap in percent of poverty line × Rural poverty line

= 7,723 Uganda Shillings per poor person per month (US$ 4.50 per poor person per month)

Theoretical amount of cash needed monthly to close the poverty gap for the region

= Total rural poor population × Poverty gap

= 19.7 billion Uganda Shillings per month (US$ 11.6 million per month)

Theoretical amount of cash needed annually to close the poverty gap for the region

= Theoretical amount of cash needed monthly to close the poverty gap × 12

= 237 billion Uganda Shillings per year (US$ 139 million per year)

This estimate is a minimum based on assumptions of perfect targeting, no corruption, and no program costs. In practice, more resources and different approaches will be required because perfectly targeted cash transfers are neither feasible nor the best intervention to move the entire poor population above the poverty line.

Source: UBOS and ILRI, 2007.

Soroti. All of these districts have large papyrus wetlands neighboring Lake Victoria, Lake Albert, Lake Kyoga, and other smaller open water bodies.

To determine what contribution papyrus wetlands can make to poverty reduction, the revenue from papyrus harvest can be compared to the amount of money needed to move all poor persons in that subcounty above the poverty line. Box 5 provides an example of how to calculate this amount.

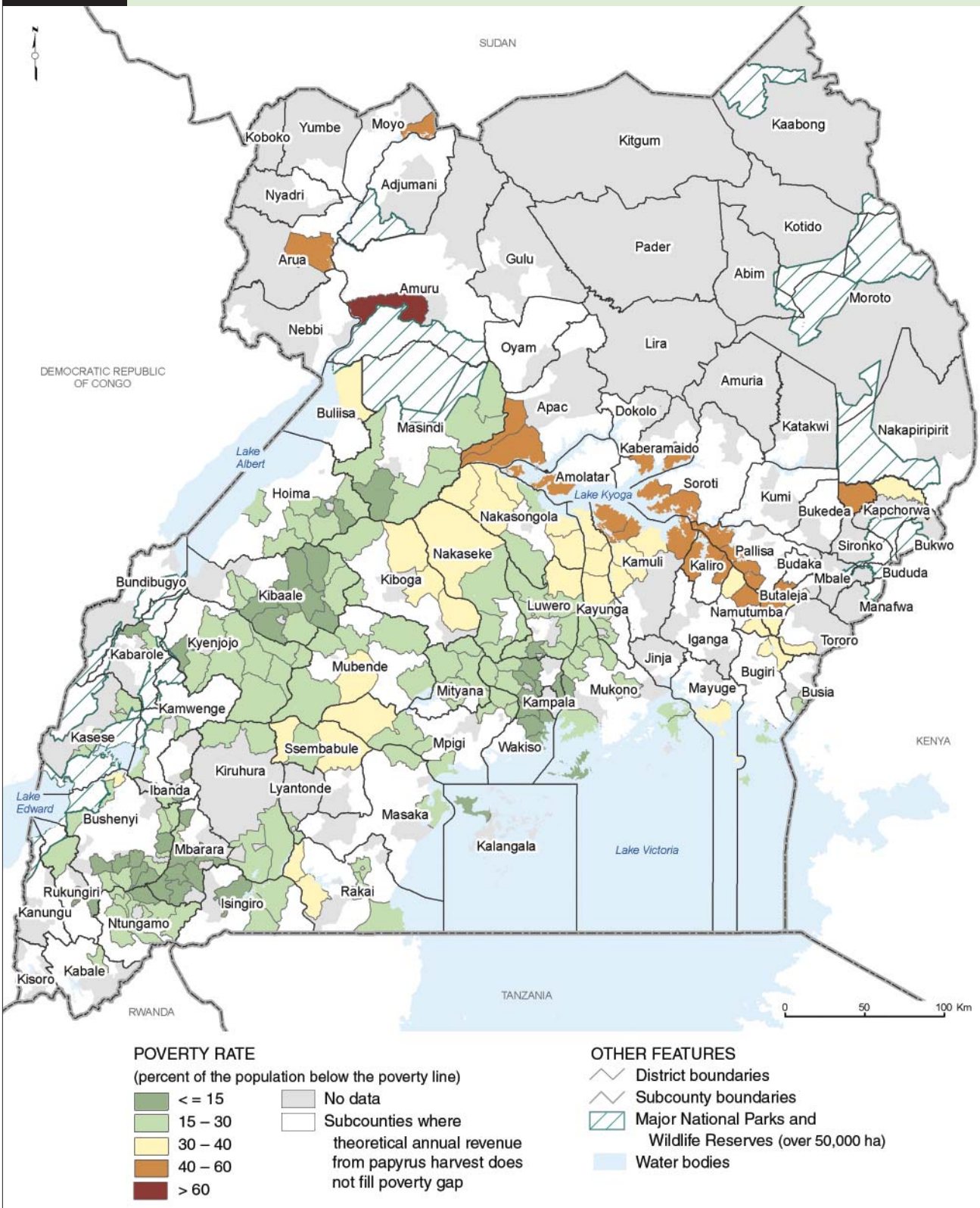
Of the 514 subcounties with papyrus wetlands, 210 could harvest and sell enough raw papyrus to theoretically close the poverty gap within their administrative unit. Map 12 (page 30) highlights these 210 subcounties and shows their corresponding rural poverty rates. The great majority of them represent better-off subcounties with poverty rates of 15-30 percent. Only a few, in the proximity of Lake Kyoga, are an exception to this pattern and have higher poverty levels of 40-60 percent.

For 304 subcounties, sales of raw papyrus are insufficient to close the poverty gap and are shown as white areas in Map 12. These subcounties either need to increase papyrus returns by adding value to the raw material (for example, developing and selling papyrus mats, crafts, or briquettes) or obtain other wetland revenues. Almost twice as many subcounties would be able to close their poverty gap, for example, if they produced mats that sell at 3,500 Uganda Shillings a piece (calculation based on Karanja et al., 2001). The poverty reducing effects of wetlands could be even greater if communities could capture higher revenues from other marketable wetland products or from new markets that provide payment for ecosystem services.

Maps 11 and 12 support the following observations:

- Papyrus harvesting, a more accessible source of income for poor families with fewer capabilities, is labor intensive and has low economic returns. It cannot provide enough income in the aggregate to close the poverty gap. The potential revenues from all papyrus wetlands in Uganda (based on a sustainable harvest rate) is close to 88 billion Uganda Shillings (US$ 51.8 million) per year, which translates to an annual average return of 10,000 Uganda Shillings (US$ 6) for each poor Ugandan.
- At the individual level, however, harvesting of papyrus can be an important source of cash for poor families.
- Because of its low returns, harvesting of papyrus should be seen as a source of income that prevents people from sliding further into poverty rather than as a means of escaping poverty.
- In 210 subcounties, the potential revenues from harvesting and selling raw papyrus are larger than the cash needed to close the poverty gap for all the poor families

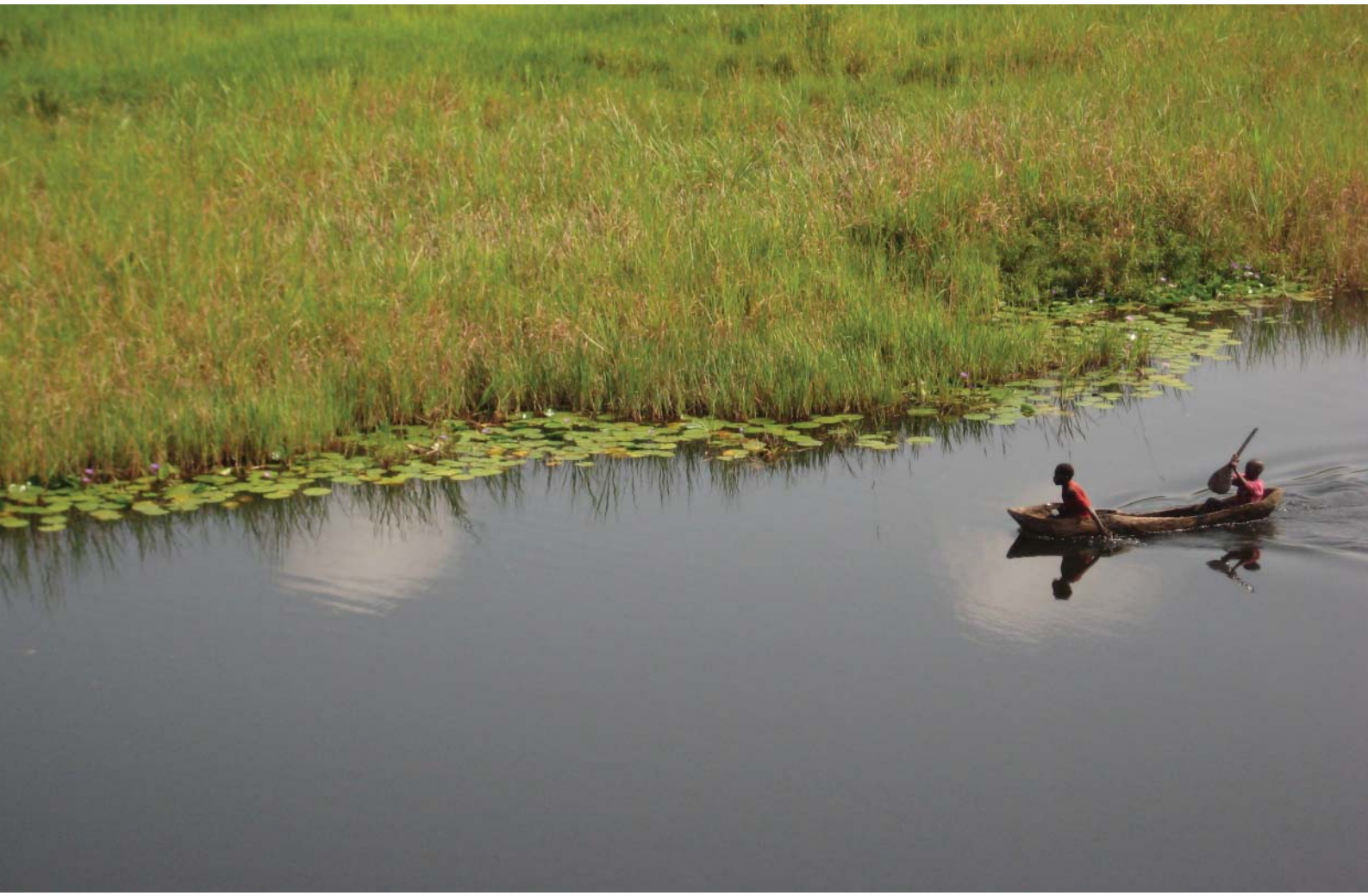
Map 12 POVERTY RATE FOR THE 210 SUBCOUNTIES WHERE THEORETICAL ANNUAL REVENUES FROM PAPYRUS HARVEST EXCEED POVERTY GAP



Sources: International boundaries (NIMA, 1997), district administrative boundaries (UBOS, 2006a), subcounty administrative boundaries (UBOS, 2002a), water bodies (NFA, 1996; NIMA, 1997; Brakenridge et al., 2006), rural poverty rate (UBOS and ILRI, 2008), no papyrus (NFA, 1996), and subcounties where theoretical annual revenue from papyrus harvest does not close the poverty gap (authors' calculation based on NFA, 1996 and Karanja et al., 2001).

of the subcounty (based on the most optimistic assumptions). All of these subcounties have large papyrus wetlands. The great majority of them have comparably low poverty rates of 15–30 percent, requiring very specific targeting of poor households to realize poverty reduction impacts. Only a dozen subcounties around Lake Kyoga have high poverty levels of 40–60 percent requiring less precise targeting of poor households. Further investigation at more local and household levels is needed to explore where papyrus harvest could help to reduce poverty, where it may represent a trap that keeps people in poverty, and where new efforts are needed to capture greater revenues from other wetland products and services.

This preliminary analysis demonstrates that information from economic valuation studies provides analysts with an opportunity to gauge more precisely how a specific wetland use could contribute to poverty reduction in a specific location. Future studies should expand on this example and map the economic value of all major wetland uses—both those with a market (beekeeping, fishing, livestock, etc.) and those that do not have a market yet (ecosystem services such as water filtration and carbon sequestration). Such maps and analyses would allow a more comprehensive economic evaluation of different wetland uses. They would provide wetland managers with stronger arguments for encouraging a specific wetland use or for optimizing the returns from a comprehensive bundle of wetland products and services.



Moving Forward: Lessons Learned and Recommendations

This publication is based on innovative mapping techniques and analyses with potentially far-reaching implications for sustainable wetland management and poverty reduction in Uganda and around the world.

It demonstrates how poverty and wetland maps can be combined to generate new information relevant to designing and implementing poverty reduction strategies, wetland management efforts, and national development plans. These new maps and analyses can in turn help to classify wetlands by their main uses, conditions, and poverty profile in order to identify regions or communities with greater need for pro-poor wetland management interventions.

Such analyses are only possible because of the substantial and consistent investments the Uganda government has made to collect wetland and poverty data. By advancing the integration and spatial analyses of these data, Ugandan analysts can take advantage of this investment to strengthen wetland management and poverty reduction efforts. The examples presented illustrate how an examination of the spatial relationships among poverty, wetland use, and wetland conditions can provide new information to assist in more effective wetland management and poverty reduction efforts.

Mapping a Better Future also highlights the need for Ugandan decision-makers to demand additional analytical returns for their data investments. Examples show that maps and spatial analyses can contribute to the understanding of poverty-wetland interactions in specific locations and provide the foundation for more evidence-based wetlands management and poverty reduction efforts.

LESSONS LEARNED

The primary goal of this publication has been to encourage readers to carry out their own improved examinations of poverty and wetland maps. Nevertheless, the collaboration of national and international organizations to produce this report provides some general lessons. A number of more specific conclusions can also be drawn from the spatial analyses of the maps presented, despite the exploratory nature of these examples.

Observations

Based on the process of compiling the data, producing the maps, and analyzing map overlays, the following observations can be made:

- Analysts working with the Wetlands Management Department and the National Forest Authority can integrate land cover data from Uganda's National Biomass Study and the National Wetlands Information System in a geographic information system to produce national maps that show the location of wetlands, the array of benefits local communities obtain from them, and the level of impacts these uses have on larger wetland systems.
- National and local decision-makers can, for the first time, access these wetlands data and produce their own maps to inform future wetlands management efforts.
- These wetland use and impact data can then be combined with maps of poverty and population density to create new wetland-poverty indicators and explore the relationships among wetland use, their condition, and levels of poverty in specific locations.
- Analysts can use these indicators and maps to select geographic areas with certain poverty and wetland characteristics for pro-poor targeting.
- Decision-makers can use these new indicators and maps to make more informed and transparent choices when designing and implementing wetland management plans and poverty reduction efforts.

Conclusions

While the maps and analyses are primarily illustrative in nature, they support the following more specific conclusions:

- ***Maps of wetlands show that they provide multiple benefits throughout Uganda.***

  Wetlands exist in every district of Uganda, and all Ugandans benefit from the products and services they provide. Over 70 percent of all wetlands in Uganda are used for three simultaneous purposes: water collection and use, livestock grazing, and harvesting of wood (for fuel and other purposes). Some uses such as hunting, fishing, and beekeeping are geographically more concentrated.

- ***The diversity of products obtained from wetlands and the levels of wetland impacts vary greatly across Uganda.***

  Grassland wetlands where users obtain few different wetland products (low product diversity) are spread across all regions of the country. However, grassland wetlands with the highest product diversity are almost exclusively located south and north of Lake Kyoga.

  Wetlands with low impacts from local use are concentrated in Amuria, Katakwi, Kaberamaido, and Soroti Districts. On the other hand, Lira District has the greatest number of wetlands with very high impacts from local use. Clusters of wetlands in the Districts of Jinja, Dokolo, Amolatar, Keyenjojo, and Kamwenge also show very high impacts. Very highly impacted wetlands occur in other Districts as well, but are less concentrated.

- ***Spatial analyses of selected poverty-wetland indicators reveal no clear pattern at the subcounty level.***

  The map overlays show no clear spatial pattern for the two selected indicators (namely, the diversity of wetland products and the combined impacts of wetland uses). Both poor and better-off subcounties can be found that exhibit high diversity of wetland products; likewise, both poor and better-off subcounties can be found that exhibit low diversity of wetland products, and both poor and better-off subcounties can be found that exhibit high wetland impacts from local use. It is likely that these simple overlays only partially capture the complex relationships among the selected poverty indicator, wetland use, and wetland condition. More detailed follow-up analyses looking at specific regions, other poverty indicators, and additional variables such as agroclimate, land-use pattern, access to land and markets, and political economy are needed to examine these relationships more comprehensively.

- ***The overlay analyses of poverty and wetland maps are most useful for identifying subcounties that share similar poverty and wetland characteristics, and thus may lend themselves to similar wetland management approaches.***

  While these examples of overlay analyses do not reveal strong spatial associations, the maps can nevertheless be used for formulating questions and hypotheses to create intervention strategies. They can help, for instance, to identify areas where boosting diversification of wetland products would benefit the poorest communities or where preventing further wetland degradation could be beneficial to a large number of poor families. For example, they highlight locations with the following wetland and poverty profiles:

  - Lira District has the greatest concentration of highly impacted wetlands and communities with high poverty rates.
  - High diversity of grassland wetland products and high poverty coincide in Soroti, Kaberamaido, and Lira Districts.
  - Katakwi District includes a large cluster of wetlands with low product diversity surrounded by communities with high poverty levels.

- ***Economic valuation studies can be linked to poverty and wetland maps to enhance the analysis of wetland benefits.***

  Information from economic valuation studies that track the quantity and value of each product or service obtained from a wetland can be linked to these maps to gauge the potential economic contribution of different wetland uses on poverty levels. The example in this publication relies on the most readily available economic data of a wetland benefit—harvesting raw papyrus. It is an activity that is generally easily accessible to the poor but has low financial returns. The example shows that selling the raw material does not provide sufficient revenue in the aggregate to move all poor households above the poverty line for most subcounties.

  However, there are a number of subcounties where papyrus harvesting could make a significant contribution to reduce poverty, but this will require specific targeting of poor households. Further investigation at local and household levels is needed to explore where papyrus harvesting could help to reduce poverty, where solely harvesting papyrus may represent a poverty trap, and where support to promote other value-added papyrus products is most promising.

RECOMMENDATIONS

While the primary objective of this report is to highlight ideas on how wetland-poverty maps can be developed and analyzed, it also seeks to catalyze greater use of this type of information in decision-making. Central and local government agencies can increase the likelihood of this happening by intervening on the supply side of information and on the demand side for these kinds of maps and analyses.

Strengthening the supply of data and analytical capacity will provide large returns to future planning and prioritization of wetland management efforts. Improvements in the following two areas are the most promising:

- ***Complete data entry and collection for the National Wetlands Information System, improve data consistency, and update wetland and land cover information.***
  - Maintaining up-to-date wetland inventories is essential to ensure the policy relevance of the data and subsequent analyses. The Wetlands Management Department needs to finalize all data entry for the National Wetlands Information System for the Districts with completed wetland inventories. New wetland inventories need to be carried out for northern Districts that were not inventoried because of security issues. The Wetlands Management Department needs to secure funding and develop a long-term plan with regularly scheduled updates for the National Wetlands Information System.
  - Information on the location and extent of specific wetlands in the National Wetlands Information System still relies on a 1996 land cover map. The Wetlands Management Department in collaboration with other national institutions (National Forest Authority, Ministry of Lands, Housing and Urban Development, etc.) need to promote and invest in new land cover information to improve planning for wetland management, support gazetting of vital wetlands, and aid in analyzing potential pressures from land-use change.
  - A technical team consisting of wetland officers and other experts needs to reassess the consistency of methods used for wetland inventories, especially when investigators apply qualitative measures to gauge the level of use, impact, and threat.
  - The Wetlands Management Department, in collaboration with technical experts, needs to explore the best option to collect data on two new wetland indicators: the quantities of wetland products and services used, and the overall health of wetlands. The former indicator will help to determine more sustainable use patterns and provide the foundation for better economic valuation of wetlands. The latter indicator, although not easy to develop, could provide information on a wetland and its ability to provide desired ecosystem services over the long term, such as the capacity to supply a consistent quantity of fish, or the ability to filter additional loads of pollutants. The Department should also explore how to better account for and monitor regulating services of wetlands.
- ***Strengthen analysis, mapping, and economic valuation efforts.***
  - Compared to the financial resources spent on data collection and entry, few resources have been earmarked to analyze and communicate the data from the National Wetlands Information System. The in-house technical and analytical capacities within the Wetlands Management Department to extract, map, interpret, and communicate these data require strengthening.
  - The indicators described in this publication represent only a subset of possible indicators that have planning, policy formulation, and decision-making relevance. The Wetlands Management Department can lead efforts to create other relevant indicators, for example by incorporating information such as land ownership or pressures from land-use change into future maps.
  - There is a clear need to apply economic valuation to all major wetland products and services (particularly their importance in filtering drinking water supplies and regulating hydrological flows). Linking the economic value of wetlands ecosystem services to a map can provide decision-makers with a more complete picture of the relative value of all ecosystem services in that location. This makes it less likely that important ecosystem services will be overlooked in management decisions (e.g., converting wetlands to another land use).

Promoting the demand for such indicators and spatial analyses will require leadership from a few government agencies (discussed below). Actions in the following four areas will help in linking the supply of new maps and analyses with specific decision-making opportunities:

- ***Incorporate poverty information in wetlands management.***

  Poverty maps can improve wetlands management. The Wetlands Management Department has developed a framework (Kampala Matrix) to classify all wetlands by their ecological and social importance and their threat status in order to prioritize wetland management interventions (such as restoring wetlands, monitoring use more strictly, or encouraging more sustainable use). Future wetland classifications could incorporate poverty levels into this prioritization effort. For example, the Wetlands Management Department could work with

the Ministry of Finance, Planning and Economic Development to identify all critically important wetlands that are located within the poorest subcounties. These wetlands could then become priority areas for developing management plans that reflect the needs of poor communities. Resources from the Poverty Action Fund could support these planning efforts to ensure that the dependence of poor households on current and future wetland benefits is given adequate consideration.

- ***Consider wetland management in poverty reduction efforts.***

  Wetland management interventions can be designed to prevent families from falling further into poverty, or to create new economic opportunities. For example, the Ministry of Finance, Planning, and Economic Development could collaborate with the Wetlands Management Department to systematically evaluate the potential of wetlands to reduce poverty. Such an evaluation may include the following activities:

  - Identify all wetlands in the poorest communities (subcounties).
  - Identify all wetlands that are highly impacted by current use.
  - Identify all wetlands that have the potential for greater product diversification.
  - Carry out an economic valuation of the products and services from these different wetlands.

  Based on this analysis, districts and local communities could work with Central Government to lobby for changes in recurrent and development budgets (both from Central Government and District Local Government). Depending on the specific wetland profile, these new funds could support one or more of the following:

  - Boost product diversification in certain wetlands.
  - Restore or enhance the supply of wetlands products and services.
  - Establish new markets for ecosystem services to capture new wetland revenues.

- ***Promote cross-sectoral efforts that support poverty, wetland, and sectoral goals.***

  The short example in Box 3 (page 20) highlighted how collaboration between the health, water, sanitation, and environment sector could result in both environmental health and wetland benefits. The Wetlands Management Department and the Wetlands Advisory Group could explore other sectoral synergies, for example between wetlands and dry season grazing, or between general biomass supplies and fuelwood supplies in wetlands.

- ***Incorporate poverty and wetland maps and their analyses into local decision-making.***

  The underlying data and maps discussed in this publication are, in most cases, at a geographic scale detailed enough to inform local decision-making. However, many local decision-makers still have difficulty accessing these data, conducting such analyses, and incorporating the findings into their planning. The Wetlands Management Department can provide technical and analytical support to a few pilot districts. The efforts would concentrate on improving District Wetland Action Plans and making these action plans an essential component of District Development Plans.

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F.L. and N.H.

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The Wetlands Management Department (WMD) in the Ministry of Water and Environment promotes the conservation of Uganda's wetlands to sustain their ecological and socio-economic functions for the present and future well-being of the people.

Sound wetland management is a responsibility of everybody in Uganda. WMD informs Ugandans about this responsibility, provides technical advice and training about wetland issues, and increases wetland knowledge through research, mapping, and surveys. This includes the following activities:

- *Assessing the status of wetlands.* WMD continuously collects and collates wetland information and maintains the National Wetlands Information System.
- *Protecting vital wetlands and their functions.* WMD identifies vital wetlands and puts proper protective management systems in place.
- *Monitoring compliance.* WMD undertakes compliance monitoring of the National Wetlands Policy and evaluates Environmental Impact Assessments with a bearing on wetlands.
- *Empowering communities to manage wetlands.* WMD promotes community wetland management planning. With support from the Poverty Action Fund, WMD assists local governments in developing and implementing wetlands action plans.
- *Coordinating the Ramsar Convention.* WMD serves as the administrative authority and national focal point.
- *Reaching out to the public.* WMD raises awareness about wetland issues at local, national, and international level.

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- Provide high quality central statistics information services.
- Promote standardization in the collection, analysis, and publication of statistics to ensure uniformity in quality, adequacy of coverage, and reliability of statistics information.
- Provide guidance, training, and other assistance as may be required to other users and providers of statistics.
- Promote cooperation, coordination, and rationalization among users and providers of statistics at national and local levels so as to avoid duplication of effort and ensure optimal utilization of scarce resources.
- Promote and be the focal point of cooperation with statistics users and providers at regional and international levels.
- Be a source of official statistical information.

INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE
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www.ilri.org

The International Livestock Research Institute (ILRI) works at the intersection of livestock and poverty, bringing high-quality science and capacity-building to bear on poverty reduction and sustainable development.

ILRI's strategy is to place poverty at the centre of an output-oriented agenda. ILRI's strategy focuses on three livestock mediated pathways out of poverty: (1) securing the assets of the poor; (2) improving the productivity of livestock systems; and (3) improving market opportunities.

ILRI's research portfolio comprises four issue-oriented themes:

- Targeting and innovation.
- Improving market opportunities.
- Using biotechnology to secure livestock assets.
- People, livestock, and the environment.

ILRI also coordinates the Systemwide Livestock Programme of the Consultative Group on International Agricultural Research (CGIAR).

To achieve its goals, ILRI works in partnerships with other national and international organizations in livestock research, training, and information. ILRI works in all tropical developing regions of Africa, Asia, and Latin America and the Caribbean.

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The World Resources Institute (WRI) is an environment and development think tank that goes beyond research to find practical ways to protect the earth and improve people's lives. WRI's mission is to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations. Because people are inspired by ideas, empowered by knowledge, and moved to change by greater understanding, WRI provides—and helps other institutions provide—objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development.

WRI organizes its work around four key goals:

- People and Ecosystems: Reverse rapid degradation of ecosystems and assure their capacity to provide humans with needed goods and services.
- Access: Guarantee public access to information and decisions regarding natural resources and the environment.
- Climate Protection: Protect the global climate system from further harm due to emissions of greenhouse gases and help humanity and the natural world adapt to unavoidable climate change.
- Markets and Enterprise: Harness markets and enterprise to expand economic opportunity and protect the environment.

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