

Connecting poverty & ecosystem services

A series of seven country scoping studies

Focus on Uganda



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Connecting poverty and ecosystem services: A series of seven country scoping studies

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United Nations Environment Programme

United Nations Avenue, Gigiri

PO Box 30552

Nairobi, Kenya

Tel: (254-2) 621234

Fax: (254-2) 624489/90

E-mail: eisinfo@unep.org

Web site: <http://www.unep.org>

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International Institute for Sustainable Development

161 Portage Avenue East, 6th Floor

Winnipeg, Manitoba

Canada R3B 0Y4

Tel: +1 (204) 958-7700

Fax: +1 (204) 958-7710

E-mail: info@iisd.ca

Web site: <http://www.iisd.org/>

Authors: Carissa Wong, Marlene Roy, Dr. Anantha Kumar Duraiappah

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Background

Ecosystems provide more than the resources needed for material welfare and livelihoods. In addition to supporting all life and regulating natural systems, they specifically provide health and cultural benefits to people. Moreover, their loss is a significant barrier to the achievement of the Millennium Development Goals related to reduction of poverty, hunger and disease. The Millennium Ecosystem Assessment (MA),¹ released in 2005, reported, though, that 15 of the 23 ecosystem services assessed were being degraded or used unsustainably.

In light of these findings, this report sets out to provide a preliminary review of ecosystem services in Uganda and the corresponding constituents and determinants of well-being related to the availability of these services. This paper is one of seven scoping studies prepared by the International Institute for Sustainable Development for the United Nations Environment Programme. Other countries examined in this series are Kenya, Mali, Mauritania, Mozambique, Rwanda and Tanzania. All of the papers are available online at <http://www.iisd.org/economics/>

The objective of the series is not to provide a detailed assessment of the poverty-environment linkages, but to identify the regions within the countries where critical ecosystem services for human well-being are stressed, signalling the need for immediate attention. This information is expected to inform and guide the selection of potential areas where a more detailed local-scale integrated assessment of the links between ecosystem services and human well-being can be carried out.

These reports do not cover previous policy interventions, as the local-scale integrated assessment would gather such information and report on the impacts these policies have had in the past. Lessons learned can then be used together with new knowledge gathered on the links between ecosystem services and human well-being to design more finely-tuned intervention strategies that would seek to promote the reduction of poverty and improve well-being while protecting and enhancing vital ecosystem services.

¹ The Millennium Ecosystem Assessment was a four-year study requested by the United Nations Secretary General in 2001 to provide an overview of the state of the global ecosystems and the consequences of ecosystem changes on human well-being.

Executive Summary

1. The rate of deforestation and wetland degradation stand out as these two services underpin most of Uganda's biodiversity and the level of stress appears to be quite high.
2. Water quality in urban and rural centres, coupled with poor sanitation facilities is rapidly becoming a problem. Present deforestation rates will inadvertently cause watershed catchments to disappear causing deterioration in the Internal Renewable Water Resource level.
3. Dropping agricultural yields are a serious issue that needs addressing if economic entitlements are to be improved. Increasing energy costs caused by dwindling fuel wood sources will put even greater pressure on household budgets.
4. Uganda may be facing a severe food nourishment problem if it does not increase its agricultural productivity and produce more protein based food. The high population growth rate implies an increasing demand for food which cannot be met under present conditions.

Ecosystem services stressed and constituents of well-being threatened, by region

Region	Ecosystem services stressed	Constituents of human well-being threatened
Central	Biodiversity loss: mainly deforestation Food provision: soil degradation, drought and control of pests Water supply, regulation and purification: wetland degradation, low groundwater supply Fuel (energy): deforestation and wood deficit districts	Adequately nourished: almost 50 per cent of children stunted and severely stunted Adequate and clean water: prevalence of diarrhea Energy: wood deficit in many regions Ability earn a livelihood: incidence of poverty mainly 20–25 per cent range
Eastern	Biodiversity loss: habitat fragmentation and land degradation Food provision: soil degradation, tsetse fly and control of pests Water supply, regulation and purification: wetland degradation, droughts and floods Fuel (energy): deforestation and some wood deficit districts	Adequately nourished: generally food insecure Adequate and clean water: prevalence of diarrhea Energy: wood deficit in a few regions Ability earn a livelihood: Low – high areas poverty across districts
Northern	Biodiversity loss: land degradation, overgrazing and poaching Food provision: soil degradation, drought Water supply, regulation and purification: recurring droughts and floods Fuel (energy): large number of displaced persons	Adequately nourished: generally food insecure, most underweight children Adequate and clean water: drought, least access to water; diarrhea Energy: woodfuel shortage in two districts Ability earn a livelihood: highest incidence of poverty
Western	Biodiversity loss: habitat fragmentation, deforestation, hunting and poaching Food provision: land and soil degradation and control of pests Water supply, regulation and purification: wetland degradation, water pollution Fuel (energy): wood deficit in many districts	Adequately nourished: high incidence of child stunting Adequate and clean water: incidence of river blindness, drought, prevalence of diarrhea Energy: wood deficit in many districts Ability earn a livelihood: lower incidence of poverty with higher pockets

Ecosystem services

The literature review of Uganda's ecosystem services revealed four critically stressed ecosystem services: maintenance of biodiversity; food and fibre provision; water supply, purification and regulation; and fuel provision.

Maintenance of biodiversity

Uganda boasts a high biodiversity including 11 per cent of the world's bird species and more than half of the world's mountain gorilla population. Uganda also has critically important wetlands which not only support habitat but also provide materials for housing. However, Uganda's biodiversity richness has been declining with 25 per cent of wildlife becoming extinct. This loss has been attributed to deforestation, population growth and human encroachment, poaching and agricultural. As well, resource management policies have been put in place that abandon traditional village-based knowledge as the country becomes more urban and industrialized.

Food and fibre provision

Nearly 88 per cent of Ugandans live in rural areas and practice subsistence agriculture, and small-holder farms own about 90 per cent of all cattle. Per capita food production has declined due to rapid population growth, fragmentation, over-cultivation, soil degradation, land tenure and political instability. Uganda's soils were once among the most fertile in the tropics, however, signs of degradation are increasing with soil erosion caused by overstocking and deforestation. Drought and animal disease also negatively impact the ecosystem services of food and fibre provision.

Water supply, purification and regulation

Uganda is expected to experience water stress by 2025 due to the continuing degradation of the country's wetlands which provide indispensable ecosystem and regulating services including maintenance of the water table, water filtration, flood control, groundwater recharge and microclimate regulation. Water quality in Uganda is deteriorating as domestic, industrial and agro-chemicals run-off into water courses and rapid increases in urban population and rural-urban migration has led to unplanned settlement slums.

Fuel provision

Firewood and charcoal and agricultural wastes are the primary source of energy in Uganda and comprise 93 per cent of energy consumption. Rapid deforestation coupled with an increasing population has resulted in over-exploited forest areas. Charcoal is the primary fuel among urban dwellers and charcoal manufacturing accelerates deforestation more than firewood.

Human well-being

Human well-being is multi-dimensional with many constituents and is closely linked with the state of ecosystem services. This report focuses on those well-being determinants which are affected by the state of ecosystems services which include: ability to be adequately nourished; ability to access adequate clean water; ability to have energy and to keep warm; and ability to earn a livelihood.

Ability to be adequately nourished

The main factor causing segments of the population to be inadequately nourished is their inability to grow food. In Uganda, food supply is characterized by declining per capita production, human-induced soil degradation, highly variable precipitation and the lack of entitlements to purchase food. While the economic entitlements of the majority of people in Uganda are low, most do earn enough money to compensate for low agricultural productivity by buying their food at the market.

Ability to have adequate and clean drinking water

Eighty-seven per cent of urban and 52 per cent of the rural population had access to improved drinking water sources. Overall, sanitation has declined since 1990 mostly due to a decrease in coverage in rural areas. The long-term future of this human well-being constituent is highly dependent on the protection of wetlands, which provide cost effective water filtration and storage services.

Ability to have energy to keep warm and cook

Currently in Uganda, there is a deficit of sustainable fuel supply, consequently wood is increasingly scarce and requires more time and effort to collect. This well-being constituent is highly dependent on Uganda's ability to continue to encourage agro-forestry to supply woodfuel.

Ability to earn a livelihood

Most of Uganda's rural areas saw a decline in poverty (38 per cent of the population lives below the poverty line), but there is still a high incidence of poverty distributed throughout the country. Subsistence

agriculture and cash crops are the basis of Uganda's economy and people's livelihoods. This well-being constituent is highly dependent on the ecosystem services of food and fibre provision and these services are in decline which will impact on Ugandans' ability to earn a living.

Table of Contents

Background	1
Executive Summary	2
Introduction	6
1. Uganda in Brief	7
1.1 Physical geography and natural environment	7
1.2 Demographics	8
1.3 Economy: Observable constraints	9
2. State of Ecosystem Services	11
2.1 Maintenance of biodiversity	11
2.2 Food and fibre provision	13
2.3 Water supply, purification and regulation	16
2.4 Fuel provision	18
2.5 Summary of ecosystem services stressed	21
3. State of Human Well-being	22
3.1 Ability to be adequately nourished	22
3.2 Ability to have adequate and clean drinking water	23
3.3 Ability to have energy to keep warm and cook	24
3.4 Ability to earn a livelihood	24
3.5 Summary of constituents of well-being under threat	25
4 Linking ecosystem services to human well-being	27
References	29
Appendix: Districts and Regions	35

Introduction

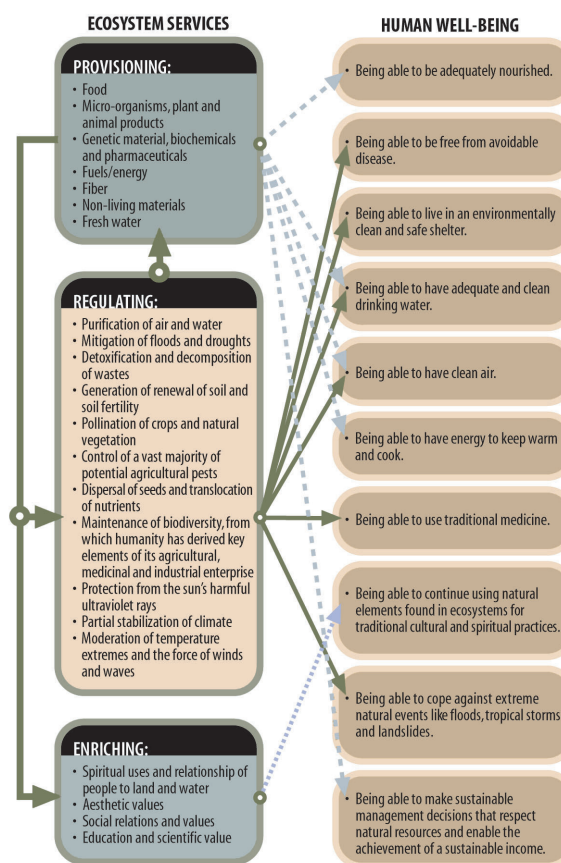
The primary objective of this report is to identify regions within Uganda where critical ecosystem services for human well-being are stressed. These regions were identified through an extensive literature review and research which spatially connected ecosystem services and human well-being within Uganda. The framework of ecosystem services and human well-being categories developed by the Millennium Ecosystem Assessment, illustrated in Figure 1, was used (Alcamo *et al.* 2003; Duraiappah 2002; Daily 1997). This review does not intend to be an exhaustive description of all ecosystem services. Instead, it identifies those ecosystem services in Uganda found to be deteriorating or in danger of deteriorating in the near future—in other words, ecosystem services that are stressed. Furthermore, when considering human well-being, we broaden our attention beyond the traditional constituent of material wealth (economic growth and livelihood) to also include other constituents: the ability to be adequately nourished; the ability to have access to freshwater; and the ability to have access to energy to keep warm and to cook, among others (Duraiappah 2004). Like ecosystem services, we only report on human well-being constituents directly or indirectly related to ecosystem services and, hence, this report should not be viewed as a comprehensive survey of all constituents of human well-being.

While not exhaustive, this overview does point out what ecosystem services and constituents of human well-being are most in need of attention and where they are located at the regional level. By taking this unique approach and using a finer spatial lens, areas where well-being and ecosystems are stressed emerge and clarify difficult trade-offs being made at the local level.

This report is organized into four sections with the first briefly describing the people and landscape of Uganda, thus providing a backdrop for the rest of the overview. Section 2 scopes out the main ecological

services stressed and pinpoints their locations. Section 3 then discusses the related constituents of well-being that are increasingly being threatened by these deteriorating ecosystem services, and, as with ecosystem services, locates them. The concluding section collocates those regions where ecosystem services are stressed with those where the constituents of human well-being are threatened and then briefly outlines the more outstanding trade-offs being made.

Figure 1. The links among ecosystem services and human well-being



(Source: Duraiappah 2002)

1.

Uganda in Brief

Uganda is a land-locked country located in East Africa along the equator. It is bordered by the Democratic Republic of Congo (DRC) to the west, Sudan to the north, Kenya to the east, Tanzania in the south and Rwanda in the southwest. To the southeast, the country occupies most of the Lake Victoria basin compared to its neighbours—Kenya and Tanzania. The country’s physical landscape is characterized by numerous small hills and valleys, savannah plains, and mountains such as Rwenzori in the west, Elgon in the east, and Mufumbira ranges in the southwest. Wetlands and open water bodies cover 17 per cent, or 51,000 sq km, of the country’s area. Most of the country receives abundant rainfall and is blessed with fertile tillable land, a major determinant for human settlement. In addition, the country has a diversity of vegetation as a result of many different micro-climates. The country’s vegetation zones can be roughly classified according to the rainfall zones as the Lake Region, Northern Region and the Highlands of the Southeast. (Uganda Development Gateway 2005).

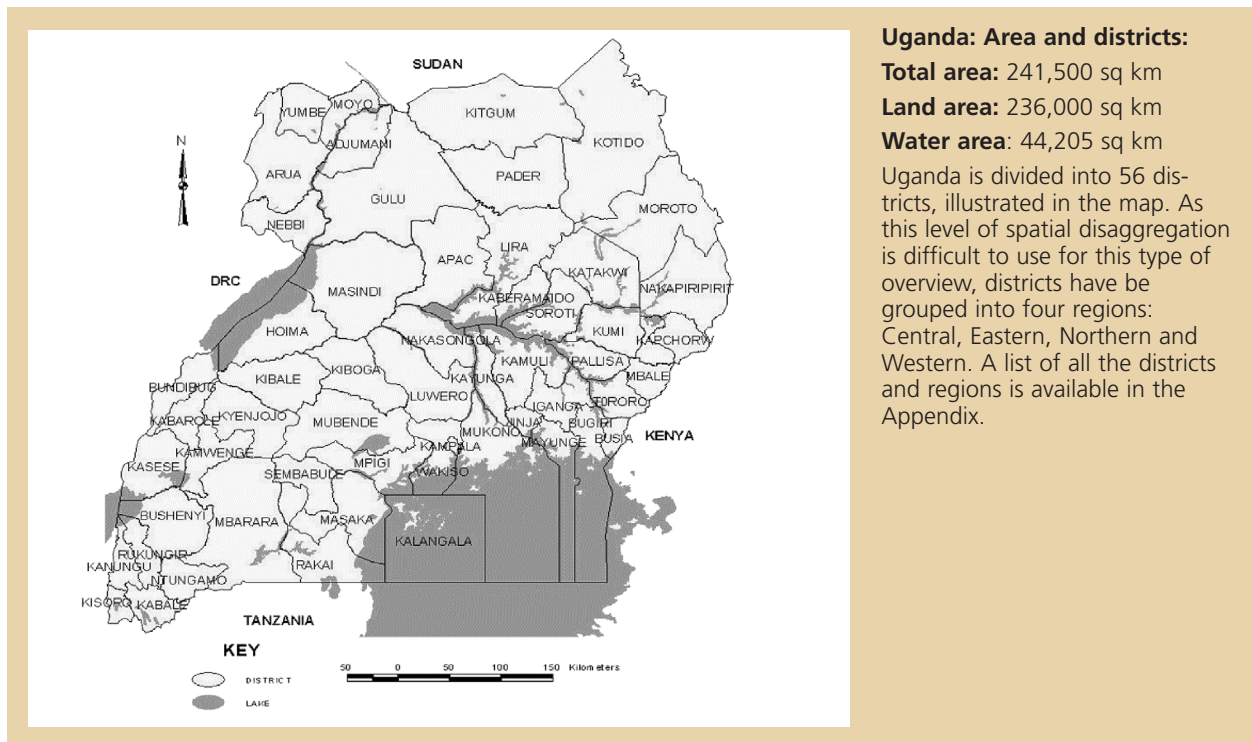
1.1 Physical geography and natural environment

Uganda consists mostly of tropical moist deciduous forest in the north and rainforest throughout the central to southern regions with smaller areas of tropical mountain ecosystems in the northeastern and southwestern corners (FAO Forestry Department 2000). There are four distinct ecosystem types: shrub lands, savannah and grasslands covering 44 per cent of the total land area, cropland/natural vegetation mosaic covering 35 per cent, wetlands and water bodies covering 16 per cent and forests covering four per cent with one per cent of the land being barren or with sparse vegetation (World Resources Institute 2003d).

Climate

Mean annual rainfall is approximately 1,180 mm; precipitation ranges from 750 mm/year in the north-east Karamoja pastoral areas to 1,500 mm/year in the

Map 1. Uganda districts (Uganda Bureau of Statistics 2005)



east along the shores of Lake Victoria, in the highlands of Mount Elgon, in the southwest Ruwenzori Mountains, in the west in Masindi district and in the north in Gulu district (FAO Land and Water Development Division 2005). In southern areas, rainfall peaks from March to May and August to November, but with no dry season. On the other hand, the north experiences a marked dry season from November to March (FAO Land and Water Development Division 2005).

The climate is tropical but mild because of the high altitude and temperatures range from about 16° to 29°C. Generally, the climate is favourable for agricultural production, making it possible to grow two crops a year under rain-fed conditions (Uganda National Environment Management Authority 2001, 13; FAO Forestry Department).

Topography

Much of the country has an altitude of 900–1,500 m, and is on average 1,200 m above sea level (FAO Land and Water Development Division 2005). The country's topography consists of a plateau, rolling hills, flatlands and a few mountains which are dissected by numerous streams, rivers, lakes and wetlands (Uganda National Environment Management Authority 2001; Gowa 2003). The highest mountain is Mount Rwenzori in the west, at the border of the Democratic Republic of Congo, which reaches a height of 5,109 m (FAO Land and Water Development Division 2005).

Hydrology

Uganda has several lakes, rivers and streams, including the River Nile and Lake Victoria, the second largest freshwater lake in the world. Wetlands cover 13 per cent, or 24,000 sq km, of the country's area, of which two-thirds are permanently flooded, primarily in the south (FAO Land and Water 2005). Most of Uganda—98 per cent—is drained by the Nile, with only a small portion (4,500 sq km) along the border with Kenya lying to the Rift Valley Basin (FAO Land and Water Development Division 2005). The Nile Basin is divided into eight sub-basins: Lake Victoria Basin (southeast); Lake Kyoga Basin (central); Victoria Nile Basin (south central); Lake Edward Basin (southwest); Lake Albert Basin (west); Albert Nile Basin (northwest); Achwa Basin; and Kipedo Basin (FAO Land and Water Development Division 2005). Apart from the lakes, there are over 160 minor water bodies, covering 1,707 sq km (FAO Land and Water Development Division 2005).

Arable land

Uganda has 7.2 million ha of arable land and land under permanent crops or approximately 30 per cent of the country's territory (FAO Land and Water Development Division 2005; Gowa 2003). This is down from the 16.8 million ha of cultivable area in 1991 (FAO Land and Water Development Division 2005).

1.2 Demographics

Box 1. Demographics of Uganda

Population (2004):

Total:	24.7 million
0–14 years:	50.6%
15–64 years:	47.1%
65 years and over:	2.4%

Life expectancy at birth (2002):

Average:	45.7 years
Male:	44.9 years
Female:	46.4 years

Fertility rate (2000–2005):

Number of births per woman:	7.1
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Annual population growth rate (1991–2002):

Per cent of population:	3.4%
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Population density (inhabitants per sq km):

Average:	124
Most dense district: Jinja	587
Least dense district: Moroto	22

Ethnic groups:

Baganda	17%
Banyankole	8%
Basoga	8%
Iteso	8%
Bakiga	7%
Langi	6%
Banyarwanda	6%
Bagisu	5%
Acholi	4%
Lugbara	4%
Batoro	3%
Bunyoro	3%
Alur	2%
Bagwere	2%
Bakonjo	2%
Jopodhola	2%
Karamojong	2%
Rundi	2%
Non-European, Asian, Arab	1%
Other	8%

Languages:

English is the official national language while Swahili is the business language. There are also various dialects spoken by the different ethnic groups indicated above.

(Uganda Bureau of Statistics 2002; United Nations Development Programme 2004; United States Central Intelligence Agency 2005; FAO Land and Water Development Division 2005)

The 2002 Uganda census tracked a 7.7 million increase in population since 1991 and a total population of 24.7 million. The Northern Region has the least at 22 per cent of the population with the Central Region having the most at 27 per cent, followed by the Western Region at 26 per cent and the Eastern Region at 25 per cent (Uganda Bureau of Statistics 2002). Kalangala district, which consists of islands in Lake Victoria, was the least populated with a total of 34,766 persons. The most densely populated areas are near or bordering Lake Victoria with this Eastern Region having the highest population density of 226 persons per square kilometer while the “Northern Region had the lowest population density of 65 persons per square kilometre” (Uganda Bureau of Statistics 2002). Only 12 per cent of the population in 2002 was living in urban areas, an amount that is lower than the 22 per cent and 20 per cent for Tanzania and Kenya respectively.

1.3 Economy: Observable constraints

Between 1991 and 2000, Uganda realized six per cent average annual growth in GDP, exceeding population growth and resulting in a three per cent increase in per capita real GDP (World Resources Institute 2003c). During this time, the economy performed solidly based on continued investment in infrastructure rehabilitation, improved incentives for production and exports, reduced inflation, gradually improved domestic security, and the return of exiled Indian-Ugandan entrepreneurs (United States Central Intelligence Agency 2005). Growth for 2001–2002 was solid despite a continued decline in the price of coffee, Uganda’s principal export. In 2003, Uganda’s economy grew approximately five per cent, reflecting an upturn in Uganda’s export markets, particularly coffee (United States Department of

Box 2. Development and macro-economic indicators

Natural resources:

Minerals, freshwater, forests, fertile soils, pasture.

Allocation of GDP by sector (2005):

Agriculture (as of financial year 2004/05):	36.3%
Industry:	20.4%
Services:	43.3%

Trade account:

Imports (2000): US\$1,587 million current dollars

Capital equipment, vehicles, petroleum, medical supplies and cereals.

Exports (2000): US\$626 million current dollars:

Coffee, fish, fish products, tea, gold, cotton, flowers, horticultural products.

Main employment sector: (per cent of paid work force):

Agriculture	80%
Services	13%
Industry	5%

GDP (2003):	6.3 billion
Per capital income (per year):	US\$250
Income distribution (Gini-coefficient; 0=perfect equity; 100=perfect inequity):	37
Per cent of total income earned by richest 20% of population:	44.9%
Per cent of total income earned by poorest 20% of population:	7.1%
Adult literacy rate (per cent of ages 15 and above), 2002:	68.9%
Human Development Index (HDI), 2002:	0.493
Human Development Index (HDI) rank (out of 177), 2002:	146

(Gowa 2003; United Nations Development Programme 2004; United States Central Intelligence Agency 2005; World Resources Institute 2003c; Uganda National Environment Management Authority 2001, 13; World Bank 2005; Uganda. Bureau of Statistics 2005)

Energy 2004; United States Central Intelligence Agency 2005). However, corruption within the government presents serious problems for the implementation of social and economic growth programs. Another contributing factor was the removal of subsidies under the World Bank's structural adjustment programs that has increased the cost of fertilizers and lowered its use among the small-scale farmers (Nkedi-Kizza *et al.* 2002). In 2000, Uganda qualified for

enhanced Highly Indebted Poor Countries (HIPC) debt relief valued at \$1.3 billion and Paris Club debt relief worth \$145 million. Combined with the original HIPC relief, total debt relief adds up to about \$2 billion (United States Central Intelligence Agency 2005). Despite strong economic growth, the large debt points to problems related to actual internally-driven economic growth, an issue worth researching further.

2.

State of Ecosystem Services

The literature review identified maintenance of biodiversity, food and fibre provision, water supply, purification and regulation, and energy resources as the four critical ecosystem services deteriorating in Uganda. We discuss each in detail below, outline some of the main factors influencing their deterioration and, where possible, identify the regions in which they are declining. We start with biodiversity, which is both maintained by ecosystems and unpins ecosystem functioning and hence availability of ecosystem services overall.

2.1 Maintenance of biodiversity

Only very recently, have theoretical and empirical work identified linkages between changes in biodiversity and the way ecosystems function (Schulze and Mooney 1993; Loreau, Naeem and Inchausti 2002). The common perception of the value of biodiversity is limited to specific uses of a limited number of specific species by humans. However, there is increasing theoretical and empirical evidence of a much more complex relationship between biodiversity—defined as the variability among living organisms; this includes diversity within species, between species and of ecosystems—and ecosystem services. Species perform numerous services for ecosystems; for example, in many ecosystems, there are a variety of species that fix nitrogen in the soil. The importance of the composition of the species is determined by how much of a loss in the ecosystem service is experienced when one or more of the species is lost. The lower the impact of a loss of a species on ecosystem functions, the higher is the level of redundancy in the system.

“Functional biodiversity (the variety of different ecological functions in a community independent of its taxonomic diversity) shows patterns of association (biota typical of wetlands, forests, grasslands, estuaries and so forth) with geography and climate known as biomes with ecosystems and ecoregions being smaller divisions of biomes (Duraiappah and Naeem 2005, 21).

Based on this and according to a classification system of terrestrial ecoregions developed by the World Wildlife Fund, the four prominent ecoregions² and their approximate location in Uganda are:

1. Northern Acacia-Commiphora bushlands and thickets (AT0711): North and northern districts in Eastern Region
2. East Sudanian savannah (AT0705): North Region
3. Victoria Basin forest-savannah mosaic (AT0721): Eastern and Central regions
4. Albertine Rift montane forests (AT0101): Western Region

Status of maintenance of biodiversity

Uganda boasts high biodiversity including 11 per cent of the world’s bird species and more than half of the world’s population of mountain gorillas. There are 682 forest reserves, nine National Parks (including portions of Bwindi Impenetrable Forest), 11 game reserves, two forest parks, 21 nature reserves, 10 sanctuaries, two wetlands of international importance and one UNESCO Biosphere Reserve in the country (Gowa 2003). These areas protect about 17 per cent of tropical forests, and 65.2 per cent of sparse trees and parkland (World Resources Institute 2003d). Uganda’s IUCN protected areas are concentrated in the northeast in Kotido, Moroto and Kapchorwa districts, northwest in Arua, Moyo, Gulu, Masindi districts and in the west in Kibaale, Kabarole, Kasse, Bushenyi and Mbarara districts (Gowa 2003). Two main closed forest areas remain, namely the forests surrounding Lake Victoria in Eastern Region and those of the Western Rift Escarpment in the Western Region (FAO Forestry Department 2000). Kabarole District in Western Region contains the most fully stocked tropical high forest, covering 999.2 sq km (FAO Forestry Department 2000).

Uganda has 150 sq km of internationally important wetlands. These two Ramsar protected areas are along the western border in Bundibugyo, Kabarole, Kasese,

2 For the purposes of this discussion, ecoregions and ecosystems are considered synonymous.

Bushenyi and Rukungiri districts (World Resources Institute 2003a; Gowa 2003). Not only are wetlands centres of high biodiversity, providing indispensable habitat, but they are also used by people to make such things as papyrus and fences, soundproof houses and thatch for outdoor kitchens and bathrooms (Uganda National Wetlands Programme 2004; Maclean *et al.* 2003).

From the 1960s to the 1990s, biodiversity richness declined steeply and 25 per cent of wildlife has become extinct; losses of biodiversity have been registered for forests and woodlands, wildlife-protected areas, wetlands and aquatic ecosystems (Uganda National Environment Management Authority 2001). Now, some 372 animal species face some level of threat and, of these, 15 species are critically endangered, 33 are endangered and 44 are vulnerable. Moreover, 16 species are extinct (Gowa 2003; IUCN *et al.* 2004). Insufficient data exists for 15 animal species and details of threatened status are lacking for 1,373 species (IUCN *et al.* 2004; Gowa 2003). Of plant species, 50 are critically endangered, endangered and vulnerable; in the 1990s 32 tree species already were threatened (IUCN *et al.* 2004). Freshwater fish are also endangered or threatened. Nine critically endangered freshwater cichlidae³ are located in Lake Nawampasa, two are in Lake Nabugabo, and one is in Lake Victoria (IUCN *et al.* 2004).

Factors influencing biodiversity loss

In general, biodiversity loss is caused by deforestation; wetland degradation due to population growth and encroaching human settlements; selective tree harvesting for wood products; poaching; and inappropriate fishing gears and techniques such as use of poisonous chemicals (Uganda National Environment Management Authority 2001). Short fallow periods and vegetation clearing affect the occurrence, distribution and richness of plant species (Eilu *et al.* 2003). Moreover, Uganda's critically endangered plants are threatened by habitat loss and degradation from small-holder farming, large-scale plantations, clear-cutting wood extraction, infrastructure development, and local and international harvest and trade (IUCN *et al.* 2004).⁴

Another factor has been the wide array of resource management policies put in place that have con-

tributed to the gradual loss of indigenous knowledge, particularly in agriculture, forestry and wildlife (Uganda National Environment Management Authority 2001). People have abandoned traditional, village-based knowledge systems as the country becomes more urban and industrialized (Uganda National Environment Management Authority 1995).

Regions most affected by biodiversity loss

Central Region:

- Mukono District in Central Region has the most degraded tropical high forest;
- Forest habitats mostly replaced by savannah, farmland and pasture;
- Within protected areas, the remaining forests patches are small and fragmented; and
- Trees cut for woodfuel, timber and building materials; wild game is hunted for food; and wild plants are collected for food and medicines.

Eastern Region:

- Forest habitats mostly replaced by savannah, farmland and pasture;
- Within protected areas, the remaining forest patches are small and fragmented;
- Trees cut for woodfuel, timber, and building materials; wild game is hunted for food; and wild plants are collected for food and medicines;
- In more northern districts, unsustainable water use, frequent grassland burning and overgrazing by domestic livestock have led to habitat fragmentation, increased land degradation and desertification; habitats are moderately fragmented in areas of higher human population; and
- Notable biodiversity loss in Kapchorwa and Mbale Districts.

³ Examples of IUCN red listed cichlidae are: *Astatotilapia* "shovelmouth," *Haplochromis* "ruby," *Harpagochromis* "frogmouth" and *Lipochromis* "backflash cryptodon."

⁴ The tea industry draws some 50,000 migrant workers of Bakiga and other ethnic descents from Kabale (near the Rwandan border) to Kabarole. Settling migrant workers tend to clear more land than local Batoro residents (Mulley *et al.*, 2004). The tea industry, however, appears to have had a positive or neutral effect on forestation, and may provide a buffer between wildlife and encroaching small-scale agriculturalists (Mulley *et al.*, 2004).

Northern Region:

- Threatened by the agricultural and herding activities of the local populations. Threats include seasonal “shifting” cultivation; over-grazing by livestock; cutting trees and bushes for wood; burning woody material for charcoal; and uncontrolled wild fires;
- Climatic desiccation is a further threat;
- Poaching of wildlife is particularly pronounced in politically unstable districts;
- Unsustainable water use, frequent grassland burning and overgrazing by domestic livestock have led to habitat fragmentation, increased land degradation and desertification;
- Habitats are moderately fragmented in areas of higher human population; and
- Notable biodiversity loss in Nebbi District.

Western Region:

- Farming activities of rural people are destroying and fragmenting habitats;
- Hunting and poaching are causing major problems as is woodfuel collection;
- Populations of elephant (*Loxodonta africana*), as well as many other large mammal species, have been decimated during the region’s turbulent political past;
- Along the Albertine Rift, deforestation is highest around the southwestern Bugoma, Budongo and Kagombé forests in Masindi and Hoima districts; and
- Biodiversity loss from deforestation is also a problem in Bundibugyo, Bushenyi, Kabale, Kabarole, Kisoro, Mbarara and Rukungiri districts.

(FAO Department of Forestry 2000; Uganda National Environmental Management Authority 2001; Magin 2001; World Wildlife Fund 2001; Blom and Rowie 2001; Rowen and Seymour 2001)

2.2 Food and fibre provision

Ecosystems provide the medium for growing the food on which humans and domesticated animals depend; this includes the vast range of food products derived

from plants, animals and microbes. If the cultivation of plants for food and livestock is to succeed, then natural factors such as fertile soils, adequate soil moisture, suitable climatic conditions, and a rich source of plant and animal species are necessary. Deficiencies in some of these elements or attributes can be augmented by technology through the use of fertilizers, irrigation, high-yield seeds and domesticated animals over the short term and for longer periods if managed sustainably.

Close to 88 per cent of Ugandans live in rural areas and practise subsistence agriculture, primarily growing roots and tubers (61 per cent) and cereals (30.5 per cent), followed by pulses (4.9 per cent) and meat (3.6 per cent) (Uganda National Environment Management Authority 2001, 13; World Resources Institute 2003). Plantain bananas cover approximately 28 per cent of cultivated area, while cereals such as maize and rice comprise 25 per cent, roots 17 per cent, pulses 14 per cent, oil seeds eight per cent, with a smaller area devoted to vegetables and fruits. Several crops such as plantains, cassava, sweet potato, millet and sorghum are rain-fed largely due to their high drought resistance (FAO Land and Water Development Division 2005). Informal, small-scale irrigation for rice, vegetable and fruit production is practiced mainly in southeast Uganda (FAO Land and Water Development Division 2005). Farmers use organic banana-based cropping to improve soil fertility and support more plant species by incorporating banana stalks and other crop residues into the soil (Eilu *et al.* 2003). Mixed cropping of legumes with other crops is common in Uganda and is practiced by over 70 per cent of farmers (National Agricultural Research Organization 2002). Ugandans also use wetlands for shifting cultivation including rice growing (Uganda National Environment Management Authority 2001).

Other sources of protein are fish and livestock. Ugandans eat on average nine kg of fish products per person per year (World Resources Institute 2003a). Livestock contributes over eight per cent of the GDP, but is not widely exported (FAO Livestock Information Sector Analysis and Policy Branch. 2004). Small-holder farmers own about 90 per cent of all cattle and nearly 100 per cent of goats, sheep and poultry, and annual meat consumption in 1998 was 11 kg per person (FAO Emergency Relief and Rehabilitation 2004; World Resources Institute 2003b). Pastoralists are located mainly in the north-east districts where human populations and rainfall

are low (FAO Emergency Relief and Rehabilitation 2004). Rangelands occupy approximately 84,000 sq km in a corridor from Moroto and Kotido in the northeast, through the flat areas of Lake Kyoga down to Masaka District and Ankole. In the northwest and southwest, agro-pastoralism and mixed farming systems dominate and in Mbarara District and around Kampala, there are roughly 50 beef ranches and 1,000 small to medium dairy farms (FAO Emergency Relief and Rehabilitation 2004).

The practice of urban agriculture is also increasing. In Kampala, slightly more than 50 per cent of the land is used for agriculture and an estimated 30 per cent of all households within a five-km radius of the city centre engage in agricultural production of some sort (Maxwell 1994, 2003). Farming in the city is an important means of ensuring food self-sufficiency, maintaining food security, supporting households which have “no other means,” as well as for commercial production (Maxwell 1994, 2003).

Fibre and cash crops

Several crops including coffee, cotton, vegetables, fruits, cocoa, vanilla, sugarcane, tea and flowers are exported, with the most important ones being coffee and tea. Coffee is grown in the southeast in Mukono, Kayunga, Masaka and Mpigi districts while tea is grown in highland conditions, particularly Kabarole District (Uganda Communications Commission District Information Portal 2003; FAO Land and Water Development Division 2005). Fish and fish products are also exported, employing 57,862 Ugandans and generating exports of US\$30,986,000 annually (World Resources Institute 2003a).

State of food and fibre provision service

The primary natural constraint to food and fibre provision is seasonal and spatial variation in precipitation resulting in unpredictability in the on-set and timing of seasons, rainfall and hence stream flow (FAO Land and Water Development Division 2005). During December–February and June–September, even high rainfall areas around Lake Victoria face moisture deficits (FAO Land and Water Development Division 2005).

Even though food production has been increasing by 1.5 per cent annually, it is not enough to meet the needs of Uganda’s population, which is growing at a rate of 3.4 per cent per year (FAO Land and Water Development Division 2005). Since 1981, average

cereal production increased 88 per cent, but per capita production grew by only one per cent and during the same period, average crop yield rose only three per cent (World Resources Institute 2003). Unfortunately, agricultural productivity does not mirror the increase in production; for example, in three years, cereal production increased from 1,600,000 to over 2,300,000 mt, however, the area of cereal cultivation also increased, from 1,300,000 to over 1,400,000 ha (Gowa 2003). In addition, domestic cereal production varies on average 7.7 per cent from the mean, an amount that is considerably higher than the average variability in Sub-Saharan Africa, which is 6.5 per cent and for that of the world, which is 3.5 per cent (FAO Land and Water Development Division 2005). Consequently, even if in some years Uganda has a cereal surplus, on average imports and food aid comprises 5.9 per cent of total cereal consumption and the government also imports at least 4,000 tons of rice/year (United States Agency for International Development 2003; World Resources Institute 2003; FAO Land and Water Development Division 2005).

Between 1980 and 2000, the annual growth in meat, milk and egg production declined along with annual per capita production, resulting in decreasing annual consumption of these products to 10.1 kg/person annually (FAO Emergency Relief and Rehabilitation 2004; Gowa 2003). Since 1996, however, total freshwater fish catch increased to over 220,000 mt and total aquaculture production has also steadily grown to 350 mt annually (Gowa 2003). Even with these increases, fish protein only comprises five per cent of Uganda’s total protein supply (World Resources Institute 2003a). On balance, from 1992 to 1997, Uganda’s overall per capita calorie supply from animal products fell to 138 kilocalories (Gowa 2003).

Non-timber forest products (NTFP) such as vegetables, edible fruits, mushrooms and grasses provide both food and fibre services (Naluswa 1993, FAO Forestry Department 2004). About 80 per cent of the population in Uganda depend on traditional plant medicines derived from at least 300 plant species (Kanabahita 2001, 21; Naluswa 1993). In Bushwere Parish, Mbarara District, southwestern Uganda, farmers reported commonly using 120 plant species for food (20 per cent), medicine (20 per cent), craft (seven per cent), grazing (four per cent), construction (three per cent), brewing (two per cent), commerce (two per cent), cropping (one per cent) and cultural purposes (one per cent) (Eilu *et al.* 2003).

Generally, biodiversity supports agriculture; elephant grass is used as an integrated management tool against stem borers, it provides livestock fodder and is used in soil conservation (National Agricultural Research Organization 2002). Similarly, a nitrogen-fixing legume “desmodium” is used for livestock fodder and for increasing soil fertility (as well as for its high commercial value). In addition, inter-cropping with different plants has proven helpful in avoiding pest problems inevitably encountered in monoculture crop production. Wild host plants on uncultivated land adjacent to crop fields also provide extremely important refuge for natural enemies of pests. These areas are also sources of nectar, pollen and host/alternate prey (National Agricultural Research Organisation 2002).

Factors influencing food and fibre provision service

Per capita food production has declined primarily due to rapid population growth, fragmentation, over-cultivation, soil degradation, land tenure problems and political instability (FAO Land and Water Development Division 2000, 2005; FAO GIEWS 2004). Uganda’s soils were once among the most fertile in the tropics, however, nutrient depletion, erosion and other signs of degradation are increasing. Many traditional agricultural systems, such as shifting cultivation, that were sustainable 50 years ago have been abandoned in highly populated areas; farmers use greatly shortened fallow periods and practice continuous cultivation without soil fertility improvement, which removes soil nutrients from the soil with harvested crops and systematically mines natural soil fertility (FAO Land and Water Development Division 2000).

Soil erosion from water is the most serious and extensive form of land degradation and is especially severe in Kotido, Moroto, Mbarara and northern Luwero districts where overstocking and over-grazing have obliterated fragile vegetation cover (FAO Land and Water Development Division 2000). Water erosion is also severe in Mbale,⁵ Kabale, Kabarole, Kapchorwa, Bundibugyo and Kasese districts where mountain slopes have been heavily deforested for crop production (FAO Land and Water Development Division 2000; Gowa 2003). It is particularly evident in the highland regions which are more favourable agricultural areas

and in rangelands (FAO Land and Water Development Division 2000). With Uganda’s two growing seasons a year, the depletion rates of crucial nutrients such as nitrogen, phosphorous and potassium are among the highest in Sub-Saharan Africa. Moreover, agro-chemical input to overcome soil nutrient loss has polluted the land (Uganda National Environment Management Authority 2001). Deforestation also promotes soil erosion and is a primary cause of landslides during seasons of intense rainfall, causing damage to crops (Kitutu 2002; Uganda National Environment Management Authority 2001). Sedimentation of water courses has also limited livestock watering (FAO Land and Water Development Division 2005). Overgrazing is yet another factor contributing to soil degradation; it causes soil compaction, erosion and the emergence of low-valued grass species and vegetation, subsequent declines in carrying capacity and, hence, low productivity (Uganda National Environment Management Authority 1995). Soil structural deterioration plagues the over-cultivated and heavily populated districts of Kisoro, Kabale, Kapchorwa, Bushenyi, Mukono and Arua (FAO Land and Water Development Division 2000).

Drought is another problem, especially in the north and northeastern regions; one major drought occurs each decade contributing to crop failures, famine and food shortages and affecting up to 1.8 million people in 16 districts. In these areas, drought reduces access to pasture for 90,000 pastoralists who migrate through this region to Kitgum and northeastern Lira and sparks inter-clan conflicts and cross-border raids between Uganda and Kenya pastoralists (U.S. Agency for International Development, Office of U.S. Foreign Disaster Assistance, Uganda 2000).

Animal diseases pose a significant problem to livestock keepers (FAO Emergency Relief and Rehabilitation 2004). Animal health services are generally inaccessible and, when available, are expensive due to the cost and transport of drugs (FAO Emergency Relief and Rehabilitation 2004). Agricultural pest problems are aggravated by the expansion of crop monocultures and the lack of naturally vegetated areas around cultivated land which act as refuges for natural pest enemies, and host/alternate prey (National Agricultural Research Organization 2002).

⁵ Mbale has a combined high risk of landslides and large population (National Environmental Management Authority 2001).

Regions most affected by stressed food and fibre provisioning services

Central Region:

- Severe soil degradation in Rakai, Mubende, Kiboga, Luwero and Mukono;
- Soil and soil fertility are stressed in Kalangala;
- Drought affects livestock production in Kiboga; and
- Control of agricultural pests is a problem in Kalangala, Kiboga, Luwero, Mpigi, Masaka, Mukono, Nakasongola and Rakai.

Eastern Region:

- High proportion of degraded lands in Mbale District;
- Severe soil degradation Iganga, Tororo and Mbale, Kamuli, Soroti, Pallisa, Kumi and Kapchorwa;
- Livestock tsetse fly sleeping sickness in Soroti district; and
- Control of agricultural pests is a problem in Bugiri, Busia and Iganga.

Northern Region

- Severe soil degradation in Moroto, Kotido, Lira, Apac and Moroto;
- Soil and soil fertility stressed in Nebbi; and
- Drought affects livestock production in Kotido and Moroto.

Western Region:

- High proportion of degraded lands in Kabale and Kisoro districts;
- Soil and soil fertility are also stressed in Ntungamo;
- Severe soil degradation in Kisoro, Kabale, Rukungiri, Bushenyi, Mbarara, Kabarole, Kibaale and Hoima; and
- Control of agricultural pests is a problem in Kabarole and Kasese.

(FAO Land and Water Development Division 2000; FAO⁶ NEAP 1993 in Uganda National Environmental Management

Authority 2001, 21; U.S. Agency for International Development, OFDA Uganda 2000; Gould 2002; Uganda National Environmental Management Authority 2001).

2.3 Water supply, purification and regulation

Ecosystems play a key role in the provisioning of clean freshwater and regulating the flow of water. The effectiveness of ecosystems to provide these services is determined largely by the quality of the country's watersheds (see Box 3).

Box 3. What is a watershed?

A watershed is the area of land that catches rain and snow (if applicable) and drains or seeps these into a marsh, stream, river, lake or groundwater. Their primary function is to capture, store and safely release water. This function is indicated by The Internal Renewable Water Resource (IRWR). For example, as snow melts on mountain peaks in the spring, much of the water soaks into the ground, replenishing soil moisture and ground water. This water will be a source of flow to local streams and rivers during dry seasons. Healthy soils and vegetation in the watershed are essential to proper watershed functioning (Donaldson and Swanson 2001).

The eight sub-basins of the Nile Basin are relatively small contributors to the Nile's flow but dominate the water resources potential in Uganda (FAO Land and Water Development Division 2005). Uganda has an Internal Renewable Water Resources (IRWR) level of 39 cu km or 1,574 cu m per capita (World Resources Institute 2003; FAO Land and Water Development Division 2005). Tanzania by comparison has an internal renewable water resource value of 82 cu km per year and a per capita level of 2,227 cu m. It is also below the 5,705 cu m per capita average for Sub-Saharan Africa (World Resources Institute 2003). Including inflows from other countries, Uganda receives 66 cu km of total annual renewable water resources, or 2,663 cu m of water available per person/year (World Resources Institute 2003e; FAO Land and Water Development Division 2005).

⁶ Map Human Induced Soil Degradation, FAO <http://www.fao.org/landandwater/agll/glasod/glasodmaps.jsp?country=UGA&search=Display+map+%21National>

State of water supply, purification and regulation service

Total water withdrawal is approximately 300 million cu m, representing only 0.4 per cent of total renewable resources (FAO Land and Water Development Division 2005). This low withdrawal rate suggests that, currently, there is little pressure on Uganda's water system in meeting demands. Many factors, however, determine the country's renewable water resources. The literature does not indicate whether the internal capacity of Uganda's watersheds to capture, store and safely release water is deteriorating and we could not source any literature on the condition of this ecosystem service. But we know that the United Nations' minimum standard is 1,000 cu m of water per person annually (Biggs *et al.* 2004). Thus, in order for the ecosystem to meet population demands, Uganda requires an internal renewable water resource of approximately 27 cu km annually. While the current data suggest that water supply may not be a problem for Uganda, this will only be true if the present recharge rates do not deteriorate and that supply from external sources are not reduced. Estimates by the National Wetlands Program show, however, that Uganda is expected to experience water stress by the year 2025, possibly due to the continuing degradation of the country's wetlands which are a major source for water capture and storage and, therefore, a principal factor in determining the country's IRWR (Uganda National Wetlands Programme 2004).

The domestic sector uses 45 per cent of the water, followed by irrigation and livestock at 40 per cent and industry at 15 per cent (FAO Land and Water Development Division 2005). Groundwater is the main source of domestic water supply for rural Uganda and for livestock, especially in drier areas; it is generally free of sediment and biological impurities that affect surface water (Taylor and Howard 1995). Rates of groundwater extraction are low and most water boreholes are fitted with hand pumps that extract between 0.6–1.2 cu m of water/hour (FAO Land and Water Development Division 2005). Productive aquifers are found in Uganda's bedrock, mountain areas and volcanic formations, and occur in the form of springs (FAO Land and Water Development Division 2005). In addition, some five million people consume at least 50 million litres of water daily from wetlands (Uganda National Wetlands Programme 2004).

Unfortunately, surface water is frequently plagued by sediment and organic impurities and diarrhea is most

prevalent among children whose households use surface water and least prevalent in households with piped water (Taylor and Howard 1995; Uganda Bureau of Statistics 2001). Shallow groundwater also commonly exhibits levels of coliform bacteria and nitrate that exceed WHO guidelines (Taylor and Howard 1995). Water regulation is a serious concern as well. In 2000, drought affected 190,000 people (U.S. Agency for International Development, OFDA Uganda 2000). Then, in 2001 and 2002, floods affected Kabale, Kayunga (Kangulumira), Mbale, Sironko, Bundibugyo, Kapchorwa and Buhweji districts (Asian Disaster Reduction Center 2002).

Wetlands provide indispensable ecosystem and regulating services, including maintenance of the water table, water filtration, flood control, groundwater recharge and microclimate regulation (Uganda National Wetlands Programme 2004). Even though Uganda is the only African country with a National Wetland Policy and a National Wetland program to implement it, most of its wetlands face reclamation and degradation (Uganda National Environment Management Authority 2001). Between 1990 and 1992, Ugandans converted 7.3 per cent or 2,376 sq km of the total original wetland area (Uganda National Wetlands Programme 2004).

Factors influencing water supply, purification and regulation

Despite the abundance of freshwater, disparities exist in supply due to its uneven distribution and poor investment in water resources (Uganda National Environment Management Authority 2001). Water quality is deteriorating as domestic, industrial and agro-chemicals run off into water courses. Rapid increases in urban population and rural-urban migration has led to unplanned settlement slums, and water, sanitation and solid waste management problems (Uganda National Environment Management Authority 2001). As well, industrial chemical waste dumped with municipal refuse is significantly contaminating water (FAO Land and Water Development Division 2000). On-site siltation, waste disposal and mineral wastes threaten groundwater (Uganda National Environment Management Authority 2001).

Water pollution from agricultural run-off is another serious concern. Ugandans annually apply 4,000 mt of fertilizer, or approximately one kg per ha of cropland and use 17 kg of pesticides/ha of cropland (World Resources Institute 2003). The emissions of

organic water pollutants have increased from 3,000 kg/day to roughly 17,000 kg per day, increasing per capita emissions of organic water pollutants (BOD) from 0.19 kg in 1986 to 0.40 kg in 1989 (Gowa 2003).

Wetlands throughout Uganda are plagued by multiple threats including conversion and drainage for agriculture, which is taking place in Iganga and Pallisa districts; in the east where nearly all seasonal wetland valley bottoms appropriate for rice cultivation have been converted, and in some parts of the southwest where large areas of wetlands have been converted for grazing pasture and cultivation (Tiega 2001; Uganda National Environment Management Authority 2001). Wetlands also are degraded by sand-mining excavation and clay extraction for brick-making, notably in Kampala district. Another factor contributing to wetland degradation is their transference from common property to private ownership; they are being converted to privately-owned eucalyptus plots for the tea industry (Mulley *et al.* 2004). In urban areas, particularly Kampala, wetlands are the only remaining free or inexpensive areas for infrastructure development. Thus, many sections have been converted to industrial use or have gradually been taken over by semi-slum residential housing and associated uses, e.g., cultivation, waste disposal, “jua kali”⁷ commerce (Uganda National Wetlands Programme 2004). Wetlands are also subject to direct solid waste dumping (notably in Kampala, Jinja and Iganga districts) and industrial pollution (Uganda National Environment Management Authority 2001). Swamp forest deforestation occurs in Mukono, Mpigi, Rakai and Masaka districts and escalating soil erosion, decreasing soil fertility and desertification are also problems (Uganda National Environment Management Authority 2001).

Regions most affected by stressed water supply, regulation and purification services

Central Region

- Groundwater supply is lowest in Kalangala, Kiboga, Luwero/Nakasongola, Masaka/Sembabule, Mpigi, Mubende, Mukono and Rakai districts;

- Lost 40.8 per cent of original wetland area;
- Water pollution is a considerable problem in Kampala;
- Intense shallow-well development where water quality is often poor in Mukono District; and
- Freshwater purification is stressed from wetland degradation in Kampala, Masaka, Mpigi, Mukono and Rakai.

Eastern Region

- Wetland conversion in Iganga/Bugiri, Jinja, Kamuli, Kapchorwa, Kumi, Mbale, Pallisa, Soroti/Katakwi and Tororo/Busia districts where 73.8 per cent of Uganda’s converted wetland areas are located;
- Freshwater purification is stressed from wetland degradation in Iganga, Jinja and Pallisa;
- Water regulation is low in the Northern and Eastern regions, which are affected by droughts and floods; and
- Region is affected by recurring droughts and floods suggesting that water regulation is poor.

Northern Region

- Region is affected by recurring droughts and floods suggesting that water regulation is poor.

Western Region

- Water pollution problem in Kasese District; and
- Freshwater purification is stressed from wetland degradation in Kabale.

(FAO Land and Water Development Division 2005;⁸ Uganda. National Wetland Programme 1992; Uganda National Environmental Management Authority 2001; Taylor and Howard 1995).

2.4 Fuel provision

Firewood and charcoal (woodfuel) and agricultural wastes are the primary source of energy in Uganda

⁷ Swahili for “hot sun.” It refers to the outdoor stalls or markets where many Ugandan small retail businesses operate. It is the only source of income for a large part of the country’s population (United Nations Industrial Development Organization 2003).

⁸ In contrast, in the southwest, southeast, northwest and along the eastern borders, potential yield from aquifers is steadily three cu m/hr (FAO Land and Water Development Division, 2005).

and comprise 93 per cent of energy consumption (Uganda Ministry of Energy and Mineral Development 2001, 6). Furthermore, 95 per cent of the wood supply is used for energy consumption and it constitutes 88 per cent of energy consumed (Uganda Ministry of Energy and Mineral Development 2001, 6, 11). Woodfuel is obtained from bush land (30 per cent), woodland (20 per cent), agricultural land and fallow land (48 per cent), and natural forests (two per cent) (Kanabahita 2001). Moreover, 86 per cent of Uganda's total annual round wood production, amounting to 15,236,000 cu m, is for domestic fuel consumption (World Resources Institute 2003b). Woodfuel is also used in the production of lime, processing fish, agro-processing, tobacco curing, tea production and brick making (Kanabahita 2001). In 1996, total woodfuel consumption including fuel wood, charcoal and black liquor⁹ was 15,410,000 cu m (Amous 1999). Annual round wood production steadily increased from 5,000 cu m in 1961 to 17,000 cu m/year in 1998, and has since remained at this level (Gowa 2003).

In rural areas, cooking and heating water also depends on crop residues and animal dung (HEDON Household Energy Network 2004). Around two million tonnes (less than 1 million toe) of dung and crop residue is used per year, usually when wood is in short supply, but their supply depends on the availability of livestock and crop residue after harvests. There are no real estimates, however, of the proportion of household demand being met by these resources (Amous 1999). The constraints listed earlier for food provision will also be constraining factors for the availability of dung and crop residue as a fuel.

The majority of urban households use charcoal, some 3.12 million tonnes (2.31 million toe) annually (HEDON Household Energy Network 2004). Charcoal and wood are transported into the cities from rural areas where it is sold at many small outlets (HEDON Household Energy Network 2004). For the urban poor, biomass is the main source of fuel energy, but there is increasing use of charcoal (HEDON Household Energy Network 2004). Liquefied petroleum gas (LPG) and electricity are used by only a small minority for cooking (HEDON Household Energy Network 2004).

State of fuel provision ecosystem service

Uganda has 49,500 sq km of forest, of which 99 per cent are tropical high forests and savannah woodlands

and the remainder are plantations; "Kibale, Kabarole and Bundibugyo districts have more than 60 per cent of the country's closed forests, while the central region has a little more than 20 per cent" (Uganda National Environment Management Authority 2001, 27). Forests and woodlands declined from 45 per cent coverage of land area in 1890 to just 20 per cent in 2000 and tropical high forest declined from 12.7 per cent of total land area in 1900 to about three per cent by 2000. Furthermore, the current estimated rate of deforestation is 0.8 per cent per year (Uganda National Environment Management Authority 2001, 31)

Of total natural forestland in Uganda, 30 per cent or about 1.5 million ha is state owned while the remainder, amounting to about 3.5 million ha is on private land (Kanabahita 2001, 20). At present rates of deforestation, the government estimates that, by 2020, 1.2 million ha of state-owned forests will be intact and natural private forest will be reduced to 700,000 ha, based on a worst case scenario (Kanabahita 2001, 20). A biomass study using 1995 data found that there was a negative balance of 3.8 million tons of biomass for that year alone (Uganda Ministry of Energy and Mineral Development, 2001, 16). In part, to meet growing domestic and agricultural woodfuel demand, which is accelerating at a rate one per cent higher than population growth, small-scale, non-industrial plantations of conifer and eucalyptus species are being established at a rate of 1,300 ha annually (FAO Department of Forestry).

Factors influencing biological fuel sources

Unacceptable levels of deforestation and increasing demand fueled by population growth indicate over-exploitation of forest areas. In addition to unsustainable wood harvest, deforestation is caused by urbanization, industrialization and agricultural land conversion (Uganda National Environment Management Authority 2001). Large-scale farming along the Albertine Rift has led to the greatest amount of forest loss in southwestern Uganda, about two–three km from the protected area border of Bugoma (Plumptre *et al.* 2003).

Urbanization increases deforestation by increasing the demand for charcoal production, the primary fuel among urban dwellers. Charcoal manufacturing accelerates deforestation more than firewood,

⁹ An indirect woodfuel recovered from paper manufacture (FAO Database in Amous 1999).

because, unlike firewood which can be obtained from dead branches and stems in the rural countryside, it involves felling live trees (Kanabahita 2001). Urbanization is also increasing the consumption of sawn timber and poles for construction and furniture leading to further deforestation (Kanabahita 2001).

In conjunction with urbanization, migration and industrialization also contribute to deforestation. Even though 200,000 ha of land are cleared annually for agriculture and grazing, over 1.6 million people are homeless (Anderson, Sewankambo and Vandergrift 2004). Many landless people migrate from the densely populated highlands to forest areas such as Lake Victoria to engage in charcoal production and pit sawing for charcoal and timber sale in urban markets, thus accelerating deforestation (Kanabahita 2001). In the Busoga district and the islands in Lake Victoria, particularly, pit sawing has a significant role in deforestation and the selective depletion of Uganda's prize hardwood species including mvule (*Chlorophora excelsa*) and mahogany (*Entandrophragma cylindricum*) (EASD 2004). In addition, in western Uganda, Kalinzu forest degradation from mechanized logging is more prominent than disturbance from agricultural conversion (Plumptre *et al.* 2003). Another compounding factor is the thousands of refugees and internally displaced persons living in Uganda felling trees near their camps (Kanabahita 2001).

In addition to all the factors listed above, the lack of wood substitutes¹⁰ and favourable land policy also encourage deforestation (Kanabahita 2001). In general, plantations face lack of appropriate silviculture management due to scarce funding and private-sector investment (Kanabahita 2001).

Regions most affected by stressed biological fuel services

- Central Region: Deforestation in Rakai, Masaka, Mpigi, Kampala and Mukono districts; wood deficit in many districts.
- Eastern Region: Deforestation in Jinja, Iganga, Busia, Soroti as well as large number of displaced persons in Katakwi and Kaberamaido districts; wood deficit in Mbale, Bugiri, Jinja and Mayuge districts.
- Northern Region: Large number of internally displaced persons Apac Gulu, Kitgum Lira and Pader districts; wood deficit in Arua districts.
- Western Region: Wood deficit in many districts.

(United States Central Intelligence Agency 2005; FAO Emergency Relief and Rehabilitation 2004; Turyareeba and Drichi 2001; Uganda Ministry of Energy and Mineral Development 2001, 18).

¹⁰ Traditional agriculture modernization implies an increase in energy consumption in this sector, and likely of environmental degradation, pollution, de-vegetation and waste-disposal. Thus, modern renewable energy sources should be encouraged in agriculture. Further developing the modern renewable forms of energy would improve the lives of the rural poor (Turyareeba 2001).

2.5 Summary of ecosystem services stressed

By using the region level of aggregation, ecosystem services stressed at the district level are not apparent in the summation. For district level information, readers are encouraged to read the “Regions Affected” sub-section at the end of each section describing the various ecosystem services where districts are identified when data were found to support this.

As would be expected, all four ecosystem services are stressed in all four regions. The rate of deforestation and wetland degradation stand out, as these two services underpin much of Uganda’s biodiversity and the level of stress appears to be quite high. Uganda already has done much to protect biodiversity through a well developed system of protected areas and by encouraging agro-forestry, partly to supply woodfuel, an approach that may take the pressure off these protected areas. Food provision also faces many challenges, as many products are derived from dwindling forests. Increasing food production, though, appears to be a struggle given the level of soil degradation and problems in controlling agricultural pests.

Table 1. Summary: Ecosystem services stressed by region

Region	Ecosystem services stressed
Central	Biodiversity loss: mainly deforestation Food provision: soil degradation, drought and control of pests Water supply, purification and regulation: wetland degradation, low groundwater supply Fuel (energy): deforestation and wood deficit districts
Eastern	Biodiversity loss: habitat fragmentation and land degradation Food provision: soil degradation, tsetse fly and control of pests Water supply, purification and regulation: wetland degradation, droughts and floods Fuel (energy): deforestation and some wood deficit districts
Northern	Biodiversity loss: land degradation, overgrazing and poaching Food provision: soil degradation, drought Water supply, purification and regulation: recurring droughts and floods Fuel (energy): large number of displaced persons
Western	Biodiversity loss: habitat fragmentation, deforestation, hunting and poaching Food provision: land and soil degradation and control of pests Water supply, purification and regulation: wetland degradation, water pollution Fuel (energy): wood deficit in many districts

3.

State of Human Well-being

Human well-being is multi-dimensional with many constituents and determinants closely determined by the state of ecosystem services (Duraiappah 2004). However, not all constituents may be under serious threat in a country and not all of these constituents are directly dependent on the state of ecosystem services. Therefore, as emphasized in the beginning, only constituents and/or determinants of well-being directly affected by the state of ecosystem services are covered in this report. Our preliminary review identified the following critical constituents which appear to be under serious threat among many social groups within Uganda.

3.1 Ability to be adequately nourished

The ability to be adequately nourished is dependent on two factors; the ability to grow food and the ability to buy food. While the supply of food is critical, economic entitlements that individuals are able to secure, such as income from non-farm labour, are also important (Sen 1990). There are several measures of the ability to be adequately nourished including that of food (in)security as well as incidence of malnutrition, among others.

Since the majority of the agricultural population is engaged in subsistence farming, the main factor causing segments of the population to be inadequately nourished is their inability to grow sufficient food. In Uganda, food supply is characterized by declining per capita production, human-induced soil degradation, highly variable precipitation and the lack of entitlements to purchase food. Protein energy malnutrition continues to be a serious health and welfare problem, particularly affecting children for whom it is a significant cause of mortality (Bachou 2000). Between 1995 and 2000, 26 per cent of children were underweight, an increase of eight per cent over the late 1980s (Bachou 2000; World Resources Institute 2003). Moreover, malnutrition rates among displaced children range from seven to 21 per cent (Anderson, Sewankambo and Vandergrift 2004). Despite a decline in the percentage of the population that is undernourished from 23 per cent in 1990–1992 to 19 per cent in 1999–2001, 25 per cent of the popu-

lation still cannot meet its daily food needs and lives below the food poverty line (United Nations Development Programme 2004; Uganda Ministry of Agriculture, Animal Industry and Fisheries, and Uganda Ministry of Finance, Planning and Economic Development 2000, 2). A 1998 study on household food security found that, even though food security varied with amount of rainfall, pests and diseases, at any one point in time, “at least 40 per cent of households in Uganda do not have enough food to feed themselves” (Bahiigwa 1999, 1). Generally, Uganda is considered self-sufficient in food production; yet per capita food production in 1997 was “44 per cent less than what it was in 1970, indicating the food production is not keeping up with increases in population” (Bahiigwa 1999, 5). Another indicator is average daily per capita calorie supply, which in Uganda is currently 2,238 calories; this compares to the amount for Sub-Saharan Africa, which is also 2,238 calories per capita but is much less than the amount for the world, which is 2,808 calories per capita (World Resources Institute 2003).

Table 2. Nutritional status of children/region

Region	Height for age (stunting) Percentage of children 0–5 yrs. (stunted and severely stunted)	Weight for age (underweight) Percentage of children 0–5 yrs.
Central	47.2	24.3
Eastern	47.4	26.6
Northern	51.5	31.5
Western	68.5	28.9

(After Uganda Bureau of Statistics 2001, 155)

The economic entitlements of the majority of people in Uganda are low and most do earn enough money to compensate for low agricultural productivity by buying their food at the market. Fortunately, in 2001, the price of beans and maize remained stable and again, the following year, wholesale prices for staple crops remained adequate and low, supporting trade and enabling inter-district movement of commodities from production areas to consumption centres (par-

ticularly urban) including Kampala, Jinja and others (ReliefWeb 2001; Famine Early Warning System Network 2002). Between January 2001 and 2002, matooke (plantain) prices decreased 42 per cent; sweet potato prices decreased 37 per cent; beans 12 per cent; cassava chips 60 per cent; maize 57 per cent; and millet 18 per cent (Famine Early Warning System Network 2002).

Regions most affected by inability to be adequately nourished

- Central Region: Almost 50 per cent of children stunted and severely stunted.
- Eastern Region: Generally food insecure.
- Northern Region: Area is generally food insecure; many displaced people are located here; has the most underweight for age children at 31.5 per cent.
- Western Region: High incidence of child stunting at 68.5 per cent.

(Uganda Bureau of Statistics 2001; Famine Early Warning System Network 2004; Uganda National Environmental Management Authority 2001; Bachou 2000; Bahiigwa 1999, 12).

3.2 Ability to have adequate and clean drinking water

Access to adequate and clean drinking water is essential for a healthy life. The minimum standard set by the United Nations as required by an individual to satisfy human needs is 1,000 cu m per year (Biggs *et al.* 2004, 13). Clean water can be provided in a number of ways. Filtration plants using modern technology provide clean water, but watersheds in pristine condition can offer the same quality of water. In a well known example, the city of New York was able to provide clean water to its habitants by restoring and preserving the Catskill watershed which basically captures, stores, purifies and releases water. The cost saved by preserving the watershed vis-à-vis building a modern water filtration plant was about \$4 billion (Daily and Ellison 2002; Duraipah 2005).

In 2002, 87 per cent of the urban and 52 per cent of the rural population had access to improved drinking water sources (FAO Land and Water Development

Division 2005). Approximately 30 per cent of rural residents have access to potable water, and in urban areas this ranges from 17 per cent in Lira to 92 per cent in Entebbe (Uganda National Environment Management Authority 2001). The percentage of water coverage has declined in urban areas and increased in rural areas. For the displaced, anywhere from 1,052 to 15,000 people share a single water source (Anderson, Sewankambo and Vandergrift 2004). Overall, water sanitation has declined since 1990, mostly due to a decrease in percentage coverage in rural areas (WHO/AFRO Water Supply and Sanitation Sector Assessment 2000).

In urban low-income communities, households often used multiple sources of water of variable quality depending on what is available and many collect rain-water for domestic use (Howard *et al.* 2002). Although Tororo¹¹ and Kampala have well-organized, fairly reliable water supply, Iganga Town has failed to provide adequate water for its 20,000 inhabitants (Tumwine 2002, 2003). Due to inaccurate water meters and high cost of water, some people have disconnected their piped water source to minimize expenses (Tumwine 2002). Kamuli has a largely unreliable system, and most households have no connection (Tumwine 2002). In Masaka District, most urban households use piped water, but unprotected and unclean sources provide a common subsidiary supply. Households rarely purchase supplemental water (Howard *et al.* 2002). In Soroti District, urban households have even worse accessibility to clean water; they are more likely to use point sources and boreholes for drinking water rather than piped water (Uganda National Environment Management Authority 2001).

Table 3. Distance from water by region

Region	Percentage households water on premises	Percentage households water source up to 1 km	Percentage households water source over 1 km
Central	9.5	73.5	17.0
Eastern	4.5	71.0	24.5
Northern	3.2	70.7	26.1
Western	4.7	73.4	21.9
Uganda	5.8	72.3	21.9

(After Uganda Bureau of Statistics 2002, Annex 2)

¹¹ Tororo obtains its piped water from a treatment plant on Malaba River, seven km south of Tororo town (<http://www.nwsc.co.ug/tororo.php>).

Regions most affected by inability to have adequate and clean drinking water

Central Region: Prevalence of diarrhea at 15–16 per cent.

Eastern Region: Higher prevalence of diarrhea (23 per cent).

Northern Region: Lack of water in drought years; high prevalence of diarrhea (27 per cent); least number of households with water on premises (3.2 per cent); and highest number of households with the nearest water source being over one km (26.1 per cent).

Western Region: Incidences of river blindness; lack of water in drought years; prevalence of diarrhea at 15–16 per cent.

(Uganda Ministry of Finance, Planning and Economic Development 2001; Uganda Bureau of Statistics 2001; United Nations Office for the Coordination of Humanitarian Affairs 2005.)

3.3 Ability to have energy to keep warm and cook

A reliable source of energy is a necessary component of human well-being, as it is required for daily activities like cooking and keeping warm. Only three to five per cent of the population has regular access to electricity, hence traditional fuel consumption meets the majority of Uganda's energy needs (Karekezi *et al.* 2004). There is a deficit of sustainable fuel supply; Ugandans use a total of 13.5 million tonnes (5.23 million toe) of wood for cooking and space heating, outstripping supply by 3.8 million tonnes of wood per year (HEDON Household Energy Network 2004). Consequently, wood is increasingly scarce and requires more time and effort to collect (HEDON Household Energy Network 2004). In fact, most households cook only twice per day (HEDON Household Energy Network 2004).

In addition, there is no likelihood that demand for forest products and services will significantly decline in the short to medium term (Kanabahita 2001). Rather, wood biomass demand increases by an average three per cent per annum, while the demand for charcoal increases by about six per cent per annum and a 2001 biomass energy demand study done by the government found a negative biomass balance of 3.8 million tons/year in 1995, creating serious challenges for developing sustainable use of this resource

(Uganda Ministry of Energy and Mineral Development 2001, 16).

The price of wood in urban areas ranges from 16 to 38 Euro per toe (HEDON Household Energy Network 2004). Charcoal, which is used more extensively in urban areas, is also more expensive at 200 Euro/toe. (HEDON Household Energy Network 2004).

Regions most affected by inability to have energy to keep warm and cook

Central Region: Woodfuel shortages in Masaka; wood deficit in many districts.

Eastern Region: Woodfuel shortages in Kumi, Soroti and Tororo; wood deficit in Mbale, Bugiri, Jinja and Mayuge.

Northern Region: Woodfuel shortage in Arua and Moroto.

Western Region: Woodfuel shortage in Mbarara; wood deficit in many districts.

(Uganda National Environment Management Agency 1995; Uganda Ministry of Energy and Mineral Development 2001, 18).

3.4 Ability to earn a livelihood

Uganda's economic entitlements are low; 38 per cent of the population were found to be living below the poverty line in 2002–2003 (Uganda Bureau of Statistics 2002). Agriculture is the basis of both Uganda's economy and people's livelihoods, engaging roughly 76.5 per cent of the total labour force, but only generating 36.3 per cent of GDP in 2004–2005 (Uganda Bureau of Statistics 2005). Although average household incomes increased by 50 per cent in the 1990s, per capita income is only now approaching that previously achieved in 1970 (Robinson *et al.* 2002).

Cash crops such as coffee are another source of rural household income. Coffee accounts for the majority of export revenues, which in 2000 only accounted for 10 per cent of GDP (World Resources Institute 2003c). The recent decline in the price of coffee led to a balance of trade in 2000 of US\$-962 million (Robinson *et al.* 2002; World Resources Institute 2003c).

Trade in livestock and livestock products is limited and constrained by the prevalence of disease and lack

of export standard abattoirs (FAO Livestock Information Sector Analysis and Policy Branch 2004). Exports from unprocessed hides and skins, however, have displayed positive growth, and account for over three per cent of export earnings (FAO Emergency Relief and Rehabilitation 2004).

Ugandans weave handicrafts, carpets, mats, trays and baskets from thin strips of wetland papyrus stem, sell primarily domestically, but increasingly to tourists (Maclean *et al.* 2003). Households report harvesting papyrus from swamps to pay for school costs, and those with children in school harvested more papyrus than those without children in school (Maclean *et al.* 2003).

State of ability to earn a livelihood

While most of Uganda's rural counties saw a decline in poverty between 1992 and 1999, there are still many areas where there is a high incidence of poverty distributed throughout the country. The most recent published data available from the 1999–2000 household survey show poverty rates were greatest in the Northern and parts of the Eastern regions. Moreover, the proportion of the population in poverty rose from 61 per cent to 67 per cent from 1997 to 2000 in the Northern Region (Uganda Bureau of Statistics and International Livestock Research Institute 2005). Data collected by the Uganda Bureau of Statistics for 1999, and published in 2005, showed the incidence of poverty in rural Uganda. See Table 4.

Table 4. Poverty levels by region

Region	Headcount index: percentage of individuals below poverty line
Central	25%
Eastern	34%
Northern	67%
Western	32%

Note: data derived from a fairly small sample so should be interpreted with caution.

(Uganda. Bureau of Statistics and International Livestock Research Institute 2005)

3.5 Summary of constituents of well-being under threat

Uganda has had limited success in improving the four main constituents of well-being linked with ecosystem services. Although the average daily per capita calorie supply is approximately 2,238 calories (the minimum daily requirement is 2,100 calories), the problem of malnourishment is prevalent, especially among children. The prevalence of stunted children is high in Uganda especially among rural children. The problem may lie in the drop in contribution of protein towards the daily diet. However, even the supply of calories is expected to come under increasing pressure if the present trend of decreasing agricultural productivity continues.

Moreover, a combination of factors including declining prices for cash crops of coffee and tea, declining crop yields and the lack of infrastructure for marketing crops has caused a drop in the economic entitlements of farmers. Therefore, even if incomes had increased as reported earlier, their purchasing power has dropped forcing many to have difficulty in keeping up with the cost of living.

The supply of water in Uganda varies across districts with water shortages being more frequent in the North and Western districts which face periodical droughts (Uganda Ministry of Finance, Planning and Economic Development 2001, 22; United Nations Office for the Coordination of Humanitarian Affairs 2005). Access to water also varies across the rural and urban centres in these districts with the latter having better water delivery mechanisms. While there has been improvement in water services, more can be done especially in the rural sector. The quality of water, however, is increasingly becoming a problem in both rural and urban centres. Poor sanitation facilities coupled with a rapidly growing population has put a lot of stress on the existing sanitation systems in Uganda.

A majority of the population depends on the agricultural sector for their livelihood. The dropping yields are a serious issue that needs immediate attention if economic entitlements are to be improved. Increasing energy costs, caused by dwindling fuel wood sources, will put even greater pressure on household budgets leaving less for other household necessities.

Table 5. Summary of constituents of human well-being threatened

Region	Constituents of human well-being threatened
Central	Adequately nourished: almost 50 per cent of children stunted and severely stunted Adequate and clean water: prevalence of diarrhea Energy: wood deficit in many regions Ability to earn a livelihood: incidence of poverty mainly 20–25 per cent range
Eastern	Adequately nourished: generally food insecure Adequate and clean water: prevalence of diarrhea Energy: wood deficit in a few regions Ability to earn a livelihood: variable incidence of poverty across districts – high to low
Northern	Adequately nourished: generally food insecure, most underweight children Adequate and clean water: drought, least accessibility to water; prevalence of diarrhea Energy: woodfuel shortage in two districts Ability to earn a livelihood: highest incidence of poverty
Western	Adequately nourished: high incidence of child stunting Adequate and clean water: incidence of river blindness, drought, prevalence of diarrhea Energy: wood deficit in many districts Ability to earn a livelihood: lower incidence of poverty with higher pockets

4.

Linking Ecosystem Services to Human Well-being

There are a number of close links between the deteriorating ecosystem services and the stress placed on some of the human well-being constituents. For example, the ability to be adequately nourished is declining. The proportion of calories provided by proteins has dropped and has been compensated by a shift to tubers and cereals. Moreover, although total food production has increased, this has come from expanded cultivation to new areas and not from increased agricultural productivity. Uganda may be facing a severe food nourishment problem if it does not increase its agricultural productivity and also start producing more protein-based food. The high population growth rate implies an increasing demand for food which cannot be met under present conditions. Agricultural productivity is connected to soil degradation through soil erosion caused by high rates of water run-off exacerbated by the rapid rate of deforestation.

Another factor of concern is the loss of wetlands which are primary reservoirs of aquatic biodiversity and water as well as serving as natural water filtration plants. The implications of their loss are many. Their

decrease may have dire consequences on the presently abundant fish resources in the country that will not only cause a big loss in income but also diminish a potential source of protein. In addition, when coupled with an increase in pollutants in the country's water systems, such a loss could increase water quality problems.

Although water supply is not presently a major problem in most districts in Uganda, the potential for a water crisis is high. The present deforestation rates will inadvertently cause watershed catchments to disappear causing deterioration in the Internal Renewable Water Resource (IRWR) level.

Although there is little information on the impact of dwindling fuel sources on well-being, the literature does cite reduced numbers of meals cooked a day and the lack of heating in the higher altitudes. This report is not in a position to make any substantive claims on the impact of dwindling fuel wood on health but is an area worth further exploring. Table 6 attempts to cross link the regions with stresses in ecosystem services and well-being constituents.

Table 6. Ecosystem services stressed and constituents of human well-being threatened by region

Region	Ecosystem services stressed	Constituents of human well-being threatened
Central	Biodiversity loss: mainly deforestation Food provision: soil degradation, drought and control of pests Water supply, purification and regulation: wetland degradation, low groundwater supply Fuel (energy): deforestation and wood deficit districts	Adequately nourished: almost 50 per cent of children stunted and severely stunted Adequate and clean water: prevalence of diarrhea Energy: wood deficit in many regions Ability to earn a livelihood: incidence of poverty mainly 20–25 per cent range
Eastern	Biodiversity loss: habitat fragmentation and land degradation Food provision: soil degradation, tsetse fly and control of pests Water supply, purification and regulation: wetland degradation, droughts and floods Fuel (energy): deforestation and some wood deficit districts	Adequately nourished: generally food insecure Adequate and clean water: prevalence of diarrhea Energy: wood deficit in a few regions Ability to earn a livelihood: Low – high areas poverty across districts
Northern	Biodiversity loss: land degradation, overgrazing and poaching Food provision: soil degradation, drought Water supply, purification and regulation: recurring droughts and floods Fuel (energy): large number of displaced persons	Adequately nourished: generally food insecure, most underweight children Adequate and clean water: drought, least access to water; diarrhea Energy: woodfuel shortage in two districts Ability to earn a livelihood: highest incidence of poverty
Western	Biodiversity loss: habitat fragmentation, deforestation, hunting and poaching Food provision: land and soil degradation and control of pests Water supply, purification and regulation: wetland degradation, water pollution Fuel (energy): wood deficit in many districts	Adequately nourished: high incidence of child stunting Adequate and clean water: incidence of river blindness, drought, prevalence of diarrhea Energy: wood deficit in many districts Ability to earn a livelihood: lower incidence of poverty with higher pockets

References

- Alcamo, Joseph *et al.* 2003. *Ecosystems and human well-being: a framework for assessment*. Washington, D.C.: Island Press, 2003, xiv, 245 p
- Amous, S. 1999. "Appendix 3.1." in *The role of wood energy in Africa*. FAO. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/x2740e/x2740e07.htm
- Anderson, Rory E., Fortunate Sewankambo, and Kathy Vandergrift. 2004. "Pawns of Politics: Children, Conflict and Peace in Northern Uganda." [html]. *AfricaFocus Bulletin* (September 30, 2004) Retrieved from the World Wide Web, April 2005. <http://www.africafocus.org/docs04/ugan0409.php>
- Asian Disasters Reduction Center. 2002. GLIDE record number 2002-000272. Retrieved from the World Wide Web, April 2005. <http://www.glide.number.net/glide/public/search/details.jsp?glide=11370&record=1&last=5>
- Bachou, H. 2000. "The Nutrition Situation in Uganda." *South African Journal of Clinical Nutrition* 13 (August 3, 2000). <http://www.saspen.com/2000/uganda.htm>
- Bahiigwa, Godfrey B. A. 1999. *Household food security in Uganda: an empirical analysis*. Kampala: Economic Policy Research Center. 22 p. http://www.eldis.org/fulltext/EPRC_Bahiigwa.pdf
- Biggs, R. *et al.* 2004. *Nature supporting people: the southern African millennium ecosystems assessment: integrated report*. Harare: Southern African Sub Global Assessment, SAfMA, 2004, 68 p.
- Blom Allard and Rauri Bowie. 2001. *Albertine Rift montane forests (AT0101)* [html]. Retrieved from the World Wide Web, April 2005. http://www.world-wildlife.org/wildworld/profiles/terrestrial/at/at0101_full.html
- Cunningham, M., Cunningham, A.B. and Schippmann, U. 1997. *Trade in Prunus africana and the implementation of CITES*. Bonn German Federal Agency of Nature Conservation.
- Daily, Gretchen C. 1997. *Nature's services: societal dependence on natural ecosystems*. Washington, D.C.: Island Press, 1997, xx, 392 p.
- Daily, Gretchen C. and Katherine Ellison. 2002. *The new economy of nature: the quest to make conservation profitable*. Washington, D.C.: Island Press. 260 p.
- Donaldson, Susan and Sherman Swanson. 2001. "Water Quality." *Modified from Living on the Land 2001: Stewardship for Small Acreages*. University of Nevada, Cooperative Extension and University of Nevada, Reno.
- Duraiappah, A. K. 2002. *Poverty and ecosystems: a conceptual framework*. UNEP Division of Policy and Law paper. Nairobi: UNEP. 49 p.
- Duraiappah, Anantha Kumar. 2004. *Exploring the links: human well-being, poverty & ecosystem services*. Winnipeg, MB: IISD/UNEP-DPDL, 2004, 44 p.
- Duraiappah, Anantha Kumar. 2005. *An economic approach for evaluating health and environment linkages*. Geneva: WHO/UNEP. 40 p.
- Duraiappah, Anantha Kumar and Shahid Naem. 2005. *Ecosystems and human well-being: biodiversity synthesis: a report of the Millennium Ecosystem Assessment*. Washington, D.C.: World Resources Institute. 86 p.
- Eilu, G, J. Obua, J. K. Tumuhairwe and C. Nkwine. Traditional farming and plant species diversity in agricultural landscapes of southwestern Uganda. *Agriculture, Ecosystems and Environment*. Vol. 99, no. 1-3, pp. 125-134. Oct 2003.
- Famine Early Warning System Network. "Review of continuing humanitarian and food crises." *Monthly newsletter on food security and vulnerability in Uganda* (2, 13 February 2002): 1-5. http://www.fews.net/centers/files/Uganda_200201en.pdf
- FAO. 2005. *Country profiles and mapping information system: Uganda: general information* [html]. Rome: FAO. Retrieved from the World Wide Web, April 2005. <http://www.fao.org/countryprofiles/index.asp?lang=en&ISO3=UGA>

- FAO. Emergency Relief and Rehabilitation. 2004. Uganda [html]. Rome: FAO. Retrieved from the World Wide Web, April 2005. http://www.fao.org/reliefoperations/en/appeals/2004/highlight_40535.html
- FAO. Forestry Department. 2000. *Country file: Uganda: ecological zones* [html]. Retrieved from the World Wide Web, April 2005. www.fao.org/forestry/site/19971/en/uga
- FAO. Land and Water Development Division. 2000. *Extent and causes of land degradation: Uganda* [html]. Retrieved from the World Wide Web, April 2005. <http://www.fao.org/ag/agl/agll/madsseal/topic2.htm#uganda>
- FAO. Land and Water Development Division. 2002. *Farmer Field Schools for Soil Productivity Improvement, conservation agriculture and nutrient monitoring in Eastern Uganda* [html]. http://www.fao.org/ag/agl/agll/farmspi/ffs_uga.stm
- FAO. Land and Water Development Division. 2005. *Aquastat: Uganda* [html]. Retrieved from the World Wide Web, April 2005. <http://www.fao.org/ag/agl/aglw/aquastat/countries/uganda/index.stm>
- FAO. Land and Water Development Division. 2005a. *National Soil Degradation Maps, based on GLASOD (UNEP/ISRIC): Uganda: severity of human induced soil degradation* [map]. Retrieved from the World Wide Web, April 2005. <http://www.fao.org/landandwater/agll/glasod/glasodmaps.jsp?country=UGA&search=Display+map+%21National>
- FAO. Livestock Information Sector Analysis and Policy Branch. 2004. *Livestock Sector Brief: Uganda*. Rome: FAO. 20 p. http://www.fao.org/ag/againfo/resources/en/publications/sector_briefs/lsb_UGA.pdf
- Gladwin, Christina. "Gender and Soil Fertility in Africa: An Introduction." *African Studies Quarterly* 6, no. 1&2: [online] URL: <http://web.africa.ufl.edu/asq/v6/v6i1a1.htm>
- Goldman, Abe and Kathleen Heldenbrand. 2001. "Gender and Soil Fertility Management in Mbale District, Southeastern Uganda." *African Studies Quarterly* 6, no. 1&2: [online] URL: <http://web.africa.ufl.edu/asq/v6/v6i1a3.htm>. <http://web.africa.ufl.edu/asq/v6/v6i1a3.htm#AbeGoldman>
- Gould, Simon. 2002. *Present status of the Uganda component of the Farming in Tsetse Controlled Areas Project*. ICVTP. 3 p. <http://www.icptv.org/Newsletters/Newsletter8/Page9-11.pdf>
- Gowa, Elizabeth. 2003. *Uganda environmental profile: national environment outlook* [html]. UNEP.net. Retrieved from the World Wide Web, April 2005. <http://www.Gowa,2003/profile/index.cfm?countrycode=UG>
- HEDON Household Energy Network. 2004. Uganda country overview [html]. Draft version. HEDON. Retrieved from the World Wide Web, April 2005. <http://www.hedon.info/goto.php/UgandaCountrySynthesis>
- Institute for Security Studies. 2003. Uganda: population [html]. Pretoria: The Institute. Retrieved from the World Wide Web, April 2005. <http://www.iss.co.za/AF/profiles/Uganda/Population.html>
- IUCN *et al.* 2004. *2004 IUCN red list of threatened species*. Gland: IUCN. <http://www.iucnredlist.org>
- Kanabahita, Charlotte. 2001. *Uganda. Forestry outlook studies in Africa (FOSA)*. [s.l.] Uganda Ministry of Water, Lands & Environment Forestry Department. 32 p. <ftp://ftp.fao.org/docrep/fao/004/AC427E/AC427E00.pdf>
- Karekezi, Stephen *et al.* eds. 2004. *African energy data and terminology handbook: year 2003–2004*. Nairobi: African Energy Policy Research Network, AFREPREN, 2004, iv, 120 p. <http://www.afrepren.org/datahandbook2/databk.htm>
- Kitutu, M. 2002. Effects of land use change on the stability of slopes in the Mount Elgon area, Mbale, Eastern Uganda: a study of landslides in the Manjia County Area: research abstract [html]. Physical and Regional Geography Research Group. <http://www.kuleuven.ac.be/geography/frg/staff/5214/index.php?lab=leg>
- Lonely Planet. 2005. *Uganda: culture* [html]. Retrieved from the World Wide Web, April 2005. <http://www.lonelyplanet.com/destinations/africa/uganda/culture.htm>
- Loreau, Michel, Shahid Naeem and Pablo Inchausti. 2002. *Biodiversity and ecosystem functioning: synthesis and perspectives*. Oxford: Oxford University Press. 306 p.

- Maclean *et al.* 2003. *Social and Economic use of wetland resources: a case study from Bunyonyi, Uganda*. CSERGE Working paper ECM 03-09. http://www.scholar.google.com/scholar?hl=en&lr=&q=cache:-CDfPBlFvr8J:www.uea.ac.uk/env/cserge/publications/wp/ecm/ecm03_09.pdf+wetland+degradation+uganda+.
- Magin, Chris. 2001. *East Sudanian savanna (AT0705)* [html]. Retrieved from the World Wide Web, April 2005. http://www.worldwildlife.org/wildworld/profiles/terrestrial/at/at0705_full.html
- Maxwell, Daniel. 1994. "Chapter 3: Uganda, The household Logic of Urban Farming in Kampala." In *Cities feeding people: an examination of urban agriculture in East Africa*, by Axuite G. Egziabher *et al.* Ottawa: IDRC. 146 p. http://web.idrc.ca/en/ev-42935-201-1-DO_TOPIC.html
- Michael, Nsamba. 2004. "Provision of safe water to drought-affected people in Kooki County, Rakai District, Uganda" [html]. *Network for Water and Sanitation newsletter* (January 2004). <http://www.netwasgroup.com/newsletter/articles/2004/01/8>
- Mol, A. The success of household sand filtration. *Waterlines*. Vol 20, no. 1, pp. 27–30, Jul 2001.
- Namara, Agrippinah and Xavier Nsabagasani. Decentralization and Wildlife Management: Devolving Rights or Shedding Responsibility? Bwindi Impenetrable National Park, Uganda. *Environmental Governance in Africa: Working Paper Series*. February 2003. Jesse C. Ribot and Peter G. Veit, Series Editors. http://pdf.wri.org/ea_wp9.pdf
- National Agricultural Research Organisation. 2002. *Push-Pull Strategies in Uganda* [html]. NARO. Retrieved from the World Wide Web, April 2005. <http://uganda.push-pull.net/purpose.html>
- Naluswa, J. T. 1993. A report on a pilot country study of non-wood forest products in Uganda. In Commonwealth Science Council and FAO, eds. *Non-wood forest products: A regional expert consultation for English-speaking African countries*, 17–22 October 1993, Arusha, Tanzania.
- Nkedi-Kizza, Peter, Jacob Aniku and Christina Gladwin. 2002. "Gender and Soil Fertility in Uganda: A Comparison of Soil Fertility Indicators for Women and Men's Agricultural Plots." *African Studies Quarterly* 6, no.1: [online] URL: <http://web.africa.ufl.edu/asq/v6/v6i1a2.htm>
- Norbert, Henninger. 1998. "Poverty map of Uganda." In *Mapping and Geographic Analysis of Human Welfare and Poverty – Review and Assessment*, Washington, D.C.: World Resources Institute. <http://www.fao.org/geonetwork/srv/en/metadata.show?id=3776&currTab=simple>
- Ogwang, Joshua, J. Owor and Phil Bartle. A Community Perspective in Land Management; The CMP Experience in Uganda. Uganda Community Management Programme (CMP) <http://www.scn.org/cmp/uganda/landmgt.htm>
- Place, Frank and Keijiro Otsuka. *Population pressure, land tenure and tree resource management in Uganda*. Environment Protection Technology Division Discussion Paper No. 24, International Food Policy Research Institute and International Centre for Research in Agroforestry, Mar 1997. <http://www.ifpri.org/divs/eptd/dp/papers/eptdp24.pdf>
- Plumptre, A. J., N. Laporte and D. Devers. "The Biodiversity of the Albertine Rift," *Wildlife Conservation Society*, 2003.
- ReliefWeb September 10, 2001. FAO/GIEWS-Foodcrops and Shortages 4/01 – Uganda <http://www.reliefweb.int/rw/rwb.nsf/0/5517d92b64b845a185256b1800741037?OpenDocument>
- ReliefWeb August 31, 2003. *Maize and bean flows in the Greater Horn of Africa*. <http://www.reliefweb.int/rw/RWB.NSF/db900LargeMaps/SKAR-64GC6E?OpenDocument&cc=uga&rc=1>
- Robinson, Andy *et al.* 2002. *Water and sanitation sector reform in Uganda: a government-led transformation*. Nairobi: World Bank. Water and Sanitation Program Africa Region, 2002, 8 p.
- Rowen, Mary and Colleen Seymour. 2001. *Northern Acacia-Commiphora bushlands and thickets (AT0711)* [html]. Retrieved from the World Wide Web, April 2005. http://www.worldwildlife.org/wildworld/profiles/terrestrial/at/at0711_full.html
- Ruecker, G. R. *et al.* 2003. *Strategic targeting of development policies to a complex region: a GIS-based stratification applied to Uganda*. ZEF discussion papers on development policy. Bonn: ZEF Bonn. 41 p.
- Schulze, E.-D. and H. A. Mooney. 1993. "Ecosystem function of biodiversity: a summary." Pages 497–510 in E.-D. Shulze and H. A. Mooney, editors. *Biodiversity and ecosystem function*. Springer-verlag, Berlin, Germany.

- Sen, A. 1990. "Food entitlements and economic chains." In *Hunger in history*, edited by L.R. Newman, pp. 374–385. Cambridge, MA: Basil Blackwell.
- Taylor, Richard and Ken Howard. 1995. *Averting shallow-well contamination in Uganda*. WEDC Conference. <http://wedc.lboro.ac.uk/publications/pdfs/21/taylor.pdf>
- Taylor, Richard and Ken Howard. 1995a. *Groundwater in rural Uganda: hydrochemical considerations for the development of aquifers within the basement complex of Africa*. University of Toronto. <http://www.geog.ucl.ac.uk/~rtaylor/pubs/gwqual.stm>
- Tiega, A. 2001. *Priorities for wetland biodiversity conservation in Africa*. Gland: Ramsar Conservation Bureau, 9 p. <http://www.deh.gov.au/ssd/publications/ssr/pubs/biodiversity-africa-ssr161.pdf>
- Tumwine, James K. 2002. *Drawers of water II: 30 years of change in domestic water use & environmental health in East Africa: Uganda country study*. London: IIED, 2002, xix, 84 p. <http://www.iied.org/sarl/pubs/drofwater.html#9050IIED>
- Turyareeba, Patience and Paul Drichi. 2001. *Plan for development of Uganda's biomass energy strategy*. Kampala: Ministry of Energy and Mineral Development. 35 p. <http://uneprioe.org/SEAF/PlanDevelopBioEnergyStrategy.pdf>
- Uganda. Bureau of Statistics. 2001. *Uganda demographic and health survey 2001/2001*. Entebbe: The Bureau. <http://www.measuredhs.com/pubs/pdftoc.cfm?ID=346>
- Uganda. Bureau of Statistics. 2002. *2002 Uganda population and housing census* [html]. Retrieved from the World Wide Web, April 2005. <http://www.ubos.org/2002cenresults/2002censusresults.htm>
- Uganda. Bureau of Statistics. 2005. *Uganda districts* [map]. Retrieved from the World Wide Web, April 2005. <http://www.ubos.org>
- Uganda. Bureau of Statistics. 2005. *Uganda Info* [web site]. Retrieved from the World Wide Web, July 2005. <http://www.ugandainfo.co.ug/>
- Uganda. Bureau of Statistics and International Livestock Research Institute. 2005. *Where are the poor? Mapping patterns of well-being in Uganda*. Entebbe: The Bureau.
- Uganda. Communications Commission. 2003. *District Information Portal*. Retrieved from the World Wide Web, April 2005. <http://www.udg.or.ug/DIP/>
- Uganda. Ministry of Agriculture, Animal Industry and Fisheries; Uganda. Ministry of Finance, Planning and Economic Development. 2000. *Plan for modernization of agriculture: eradicating poverty in Uganda*. The Ministries. 69 p. <http://www.finance.go.ug/prsp/PMAFINAL.DOC>
- Uganda. Ministry of Energy and Mineral Development. 2001. *National biomass energy demand strategy 2001–2010*. Kampala: The Ministry. 36 p. <http://www.energyandminerals.go.ug/BEDS-Contents.pdf>
- Uganda. Ministry of Finance, Planning and Economic Development. 2000. *Poverty reduction strategy paper: Uganda's poverty eradication action plan: summary and main objectives*. The Ministry. Online. <http://www.imf.org/external/NP/prsp/2000/Uga/01/index.htm>
- Uganda. Ministry of Finance, Planning & Economic Development. 2001. *Uganda poverty status report 2001: summary*. Kampala: The Ministry. 53 p. <http://www.imf.org/external/NP/prsp/2001/uga/01/030201.pdf>
- Uganda. Ministry of Finance, Planning and Economic Development. 2004. *Poverty eradication action plan: executive summary*. The Ministry. Online. <http://www.finance.go.ug/peap.html>
- Uganda. National Environment Management Agency. 1995. *National environment action plan for Uganda: chapter 2: state of the environment* [html]. Kampala: NEMA. Retrieved from the World Wide Web, April 2005. <http://easd.org.za/afenstr/Uganda/n952.htm#Table%202.1>
- Uganda. National Environment Management Authority. 2001. *State of the environment report for Uganda 2000/2001*. Kampala. NEMA. 153 p. <http://www.nemaug.org/SOE/SOE2000.pdf>
- Uganda. National Wetlands Programme. 1992. *Approximate wetland area (km²) and area converted per district [Biomass 1990–1992 satellite imagery]*. http://www.ugandawetlands.org/wetland_area_per_district.pdf

- Uganda. National Wetlands Programme. 2004. *Wetlands in Uganda* [html]. Retrieved from the World Wide Web, April 2005. <http://www.ugandawetlands.org/overview.htm>
- Uganda Development Gateway. 2005. *Country guide* [html]. Retrieved from the World Wide Web, April 2005. <http://www.udg.or.ug/viewCategory.php?option=sitePages&id=3&l=>
- United Nations. Office for the Coordination of Humanitarian Affairs. 2005. "Uganda: 600,000 drought-affected people to get food aid in the north-east." IRIN News.org 16 March 2005. http://www.irinnews.org/report.asp?ReportID=46129&SelectRegion=East_Africa&SelectCountry=UGANDA
- United Nations Development Programme. 2004. *Human Development Report: Uganda*. http://hdr.undp.org/statistics/data/cty/cty_f_UGA.html
- United Nations Environment Programme, World Conservation Monitoring Centre. 2004. <http://www.unep-wcmc.org/index.html>
http://www.unep-wcmc.org/protected_areas/transboundary/somersetwest/somersetwest-46.html-main
- United Nations Industrial Development Organization. 2003. *From market to stall...to mainstream* [html]. Vienna: UNIDO. September 30, 2003. <http://www.unido.org/en/doc/3827>
- United States. Agency for International Development. 2003. "Maize and bean flows in the Greater Horn of Africa." *ReliefWeb* (August 31, 2003) <http://www.reliefweb.int/rw/RWB.NSF/db900LargeMaps/SKAR-64GC6E?OpenDocument&cc=uga&rc=1>
- USAID's Food For Peace (FFP). FFP support for capacity building and sustainable resource use of Batwa communities around Mgahinga and Bwindi Impenetrable Forests, South West Uganda. Overview – August 2002 http://forestpeoples.gn.apc.org/Briefings/Africa/uganda_batwa_overview_aug02_eng.htm
- United States. Agency for International Development. Office of U.S. Foreign Disaster Assistance, Uganda. 2000. *Civil strife and ebola hemorrhagic fever* [html]. Information bulletin #1, Fiscal Year (FY) 2001. OFDA, December 29, 2000. <http://www.cid.org/humanitarian/hsr/00b/0031.html>
- United States. Central Intelligence Agency. 2005. *CIA: the world factbook: Uganda*. <http://www.cia.gov/cia/publications/factbook/geos/ug.html>
- United States Department of Energy – Energy Information Administration. *Great Lakes Country Analysis Brief*. <http://www.eia.doe.gov/emeu/cabs/eafrica.pdf>. February 2004.
- World Bank. 2005. *Uganda data profile* [html]. Retrieved from the World Wide Web, April 2005. <http://devdata.worldbank.org/external/CPProfile.asp?SelectedCountry=UGA&CCODE=UGA&CNAME=Uganda&PTYPE=CP>
- World Health Organization/AFRO. 2000. *Water Supply and Sanitation Sector Assessment 2000*. <http://www.afro.who.int/wsh/countryprofiles/uganda.pdf>
- World Health Organization. 2001. *Legal Status of Traditional Medicine and Complementary/Alternative Medicine: A Worldwide Review* [html] Retrieved from the World Wide Web, April 2005. <http://64.233.167.104/u/who?q=cache:kOhWJy1jtm8J:www.who.int/medicines/library/trm/who-edm-trm-2001-2/legal-status.doc+uganda+traditional+medicine+protected&hl=en&ie=UTF-8>
- World Health Organization. Regional Office for Africa. 2002. *Malaria country profiles: Uganda*. Brazzaville: WHO AFRO. 4 p. <http://www.afro.who.int/malaria/country-profile/uganda.pdf>
- World Wildlife Fund. 2001. *Victoria Basin forest-savanna mosaic (AT0721)* [html]. Retrieved from the World Wide Web, April 2005. <http://www.national-geographic.com/wildworld/profiles/terrestrial/at/at0721.html>
- World Resources Institute. 2003. *Earthtrends: Country Profile: agriculture and food: Uganda*. http://earthtrends.wri.org/pdf_library/country_profiles/Agr_cou_800.pdf
- World Resources Institute. 2003a. *Earthtrends: Country profile Coastal and Marine Ecosystems: Uganda*. http://earthtrends.wri.org/pdf_library/country_profiles/Coa_cou_800.pdf
- World Resources Institute. 2003b. *Earthtrends: Country profile: Energy and Resources: Uganda*. http://earthtrends.wri.org/pdf_library/country_profiles/Ene_cou_800.pdf

World Resources Institute. 2003c. *Earthtrends: Country Profile, Economic Indicators: Uganda*. http://earthtrends.wri.org/pdf_library/country_profiles/Eco_cou_800.pdf

World Resources Institute. 2003d. *Earthtrends, Country Profile: Forests, Grasslands and Drylands: Uganda*. http://earthtrends.wri.org/pdf_library/country_profiles/For_cou_800.pdf

World Resources Institute. 2003e. *Earthtrends, Country Profile: water resources and freshwater ecosystems: Uganda*. http://www.earthtrends.org/pdf_library/country_profiles/wat_cou_800.pdf

Appendix: Districts and Region

Adjumani	Northern	Kapchorwa	Eastern	Moyo	Northern
Apac	Northern	Kasese	Western	Mpigi	Central
Arua	Northern	Katakwi	Eastern	Mubende	Central
Bugiri	Eastern	Kayunga	Central	Mukono	Central
Bundibugyo	Western	Kibale	Western	Nakapiripirit	Northern
Bushenyi	Western	Kiboga	Central	Nakasongola	Central
Busia	Eastern	Kisoro	Western	Nebbi	Northern
Gulu	Northern	Kitgum	Northern	Ntungamo	Western
Hoima	Western	Kotido	Northern	Pader	Northern
Iganga	Eastern	Kumi	Eastern	Pallisa	Eastern
Jinja	Eastern	Kyenjojo	Western	Rakai	Central
Kabale	Western	Lira	Northern	Rukungiri	Western
Kabarole	Western	Luwero	Central	Sembabule	Central
Kaberamaido	Eastern	Masaka	Central	Sironko	Eastern
Kalangala	Central	Masindi	Western	Soroti	Eastern
Kampala	Central	Mayuge	Eastern	Tororo	Eastern
Kamuli	Eastern	Mbale	Eastern	Wakiso	Central
Kamwenge	Western	Mbarara	Western	Yumbe	Northern
Kanungu	Western	Moroto	Northern		

Source: <http://www.statoids.com/uug.html>

