



NATIONAL ENVIRONMENTAL MANAGEMENT AUTHORITY (NEMA)

***ECOSYSTEMS, ECOSYSTEM SERVICES AND THEIR LINKAGE S TO  
POVERTY REDUCTION IN UGANDA***



**FINAL REPORT**

**Prepared by:**



Centre for Resource Analysis Limited (CRA),  
28-30 Bombo Road, Teachers' House 3rd Floor,  
P.O Box 5763 Kampala  
Tel + 256 41 255951  
[craconsult@yahoo.com](mailto:craconsult@yahoo.com)

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## **Executive Summary**

This report presents an analysis of the status and trends of ecosystems, ecosystem services and their linkages to poverty reduction in Uganda. The context of the report is grounded in the Government of Uganda (GoU) and United Nations Environment Programme (UNEP) project entitled “*strengthening environmental policy and management capacity at the national and local levels*” implemented by the National Environment Management Authority (NEMA). The preparation of this report has been inspired by the Millennium Ecosystem Assessment (MA)<sup>1</sup>, which takes stock of the conditions of ecosystems and their services. The report is based on a literature review of the available information on ecosystems, ecosystem services and human well-being. In the report we endeavour to identify the links between these aspects.

Uganda, by virtue of its location between the tropical high forests of Congo and the savannas of East Africa, is endowed with a variety of ecosystems. The ecosystems identified include forests, wetlands, rangelands, open water bodies, agricultural landscapes and wildlife protected areas. The range of services provided by these ecosystems can broadly be divided into provisioning, regulating, cultural and supporting services.

Examination of the available information revealed that all ecosystems are stressed. The level of stress varied with the level of dependency of the local communities on the ecosystem. This is because most communities’ livelihoods, especially in the rural area, are nature based.

Local communities depend on the ecosystems for food production. The areas with the most stressed agricultural landscapes are Rakai, Mubende, Kiboga, Luwero, Mukono, Kalangala, Mpigi, Masaka and Nakasongola in the Central region, Mbale, Iganga, Tororo, Kamuli, Soroti, Palisa, Kumi, Kapchorwa, Bugiri and Busia in the Eastern region, Moroto, Kotido, Lira, Apac and Nebi in the Northern region and, Kabale, Kisoro, Bundibugyo, Kasese, Ntungamo, Mbarara, Bushenyi, Rukungiri, Kabarore and Hoima in the Western region. The major issues affecting food production in these districts are soil degradation, loss of soil and soil fertility, agricultural pests, livestock pests and drought.

Another major need for the local communities is water. The areas most affected include Kalangala, Luwero, Nakasongola, Kiboga, Masaka, Smbabule, Mpigi, Mubende, Mukono, Rakai and Kampala in the central region, Iganga, Bugiri, Jinja, Kamuli, Kapchorwa, Kumi, Mbala Palisa, Soroti, Katakwi, Tororo and Busia in the Eastern region, the whole of northern region and, Kasese, Mbarara and Kabale in the western region. The major issues causing a stress in water supply are water pollution, intense shallow well development, wetland degradation and conversion, drought, declining water levels in water bodies and low ground water supply.

The third issue of concern is fuel provisioning. Areas most affected include Rakai, Masaka, Mpigi, Kampala and Mukono in the Central region, Jinja, Iganga, Busia, Soroti, Katakwi, Kaberamaido, Mbale, Bugiri and Mayuge in the Eastern region, Apac, Gulu, Kitgum, Lira, Pader and Arua in the Northern region and, many districts in the western region. The main causes of this deficit are deforestation and large numbers of internally displaced people.

The lack of these basic needs directly results into a negative influence on the human well-being. Although there was a constant increase in the area planted per year between 1980 and 2003, production of plantains, cereals, root crops and pulsed remained more or less constant. This indicates that maintaining food production levels during this period was mainly at the expense of opening up new agricultural lands. This resulted in a great loss of forest cover and conversion of wetlands. Poverty levels on the other hand slightly decreased in all regions between 1992 and 1999 but rose between 2000 and 2003. This could indicate that expansion of agricultural lands alone is not able to sustain human well-being. Other income sources will have to be considered.

A complex linkage exists between human well-being and ecosystem services. Although a

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<sup>1</sup> This is a four-year global effort to provide decision makers with information on the consequences of ecosystem change for human well-being. The first such assessment in Africa has been implemented in Southern Africa.

community may target an ecosystem for one major service e.g. clearing a forest for expansion of agriculture land, its degradation affects all other services provided by the resource. Although food production may be increased for a time, there may be a reduction in fuel wood supply and the water supply may be affected since forests often occur in catchment areas. Forest soil fertility depletes fast and so within a few years food production may go down. Other services like biodiversity conservation and carbon sequestration may also be lost. In the report, several examples of degraded ecosystems, and how human well-being was affected, have been included (Chapter 4). Also a schematic presentation of the interrelationship between ecosystems, ecosystem services and human well-being has specifically been presented for rangelands (Figure 9).

The degradation of ecosystems has triggered a number of responses both at the national and local level. These include policies and laws e.g. the Forestry policy 2001, the Water policy 1995, The wetland policy 1995, The Uganda Wildlife Authority policy 1995 and the Wildlife policy 2000. Interventions carried out at community level, in several districts, include Payment for Environmental Services, training communities in soil and water conservation strategies and benefit sharing between conservation organisations e.g. UWA and the communities living adjacent to the conservation areas. Examples of such interventions have been included in Chapter 5. A summary of responses to ecosystem stress, the areas most affected and the emerging challenges are presented in Table 11.

In conclusion, all critical ecosystems (forests, wetlands, fisheries; agricultural/ arable lands and rangelands) are severely stressed in all districts, albeit with some variations. The most affected ecosystems are those in areas of high population density. Poverty incidences are high; where ecosystems are naturally fragile, around urban areas; and where there has been conflict. In all these areas, interventions are required at both policy and local level.

Although many policies have been established, there is need to translate these policies to suite the prevailing conditions. This will require both political will and institutional strengthening. Basing on the information we were able to access, we have highlighted several emerging issues (Chapter 6; Section 6.2) that need to be addressed and several recommendations have been made. We here highlight but a few.

- There is need to diversify the rural economy from one that mainly depends on nature.
- Other than opening up new forest lands for agriculture, there is need for improved agricultural methods so as to improve crop production.

A lot of information is available about ecosystems, ecosystem services and poverty but in most studies these aspects are not linked. In government institutions, where most information is stored, it was aggregated to district or regional level. It was, therefore, hard to pinpoint the individual degraded ecosystems. In the next step of ecosystem assessment, it will be important that for the districts indicated as having stressed ecosystems, specific ecosystems be identified and studied. This will enable the government and other intervening institutions to address the right issues concerning ecosystem degradation.

### ***Acronyms and Abbreviations***

BMU	Beach Management Units
DFID	Department for International Development (UK)
DRC	Democratic Republic of Congo
EIA	Environmental Impact Assessment
GEF	Global Environment Facility
GoU	Government of Uganda
ICDP	Integrated Conservation and Development Project
IISD	International Institute for Sustainable Development
IRDI	Integrated Rural Development Initiatives
IRWR	Internal Renewable Water Resource
KUSP	Kampala Urban Sanitation Project
MEAs	Multilateral Environmental Agreements
MERECAP	Mt. Elgon Regional Ecosystem Conservation and Development Program
MEMD	Ministry of Energy and Minerals Development
MFPED	Ministry of Finance, Planning and Economic Development
MTEF	Medium term Expenditure Framework
NAADS	National Agricultural Advisory Services
NEMA	National Environment Management Authority
NFA	National Forest Authority
ODS	Ozone Depleting Substances
PA	Protected Area
PEAP	Poverty Eradication Action Plan
PES	Payment for Environmental Services
SEA	Strategic Environmental Assessment
SLA	Sustainable Livelihoods Analysis
SPGS	Sawlog Production Grant Scheme
TSU	Technical Support Unit
UBOS	Uganda Bureau of Statistics
UNCSD	United Nations Conference on Sustainable Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UWA	Uganda Wildlife Authority
WSSP	Wetland Sector Strategic Plan
WWF	World wide Fund for Nature

## 1.0 INTRODUCTION

### 1.1 Background and Context

This report presents an analysis of the status and trends of ecosystems, ecosystem services and their linkages to poverty reduction in Uganda. The context of the report is grounded in the Government of Uganda (GoU) and United Nations Environment Programme (UNEP) project entitled “*strengthening environmental policy and management capacity at the national and local levels*” implemented by the National Environment Management Authority (NEMA). The overall objective of the project is to strengthen the national capacity for integrating environment into the development strategy. In Uganda, the Poverty Eradication Action Plan (PEAP) is the overall medium term national development strategy. It is expected to be implemented through sector strategies and action plans. The long term national development framework is the Vision 2035 (still under formulation) which is a revised version of the Vision 2025 formulated during 1997/1999.

The UNEP project, under which this report was commissioned, is anchored on the Millennium declaration which highlights the global commitment to poverty eradication and sustainable development, and the Millennium Development Goals (MDGs) that, among others, establish a linkage between poverty reduction and environmental sustainability. This report was, therefore, commissioned as part of the project activities to generate information and develop tools for raising awareness about the relationship between ecosystems, ecosystem services and poverty reduction.

The preparation of this report has been inspired by the Millennium Ecosystem Assessment (MA)<sup>2</sup>, which takes stock of the conditions of ecosystems and their services around the year 2000; explores major trends in ecosystem services using indicators and attempts to identify the drivers for ecosystem change, while exploring plausible scenarios for future change and suggesting strategies and actions that can maintain and promote the capacity of ecosystems to continue providing services for human well-being.

### 1.2 Purpose of the Study

In accordance with the terms of reference (ToRs), this report highlights the status of ecosystems; points out the range of services provided by ecosystems and discuss their importance to human well-being and poverty reduction in Uganda at national and local levels. The report will serve as a tool for raising awareness among policy makers and the general public about the linkages between ecosystems, the services they provide, human well being and poverty reduction. This report is a build-up on the recent report by IISD/UNEP, and attempts to focus the analysis of ecosystems and ecosystem services at sub national levels.

### 1.3 Methodology and Approach Used

This assignment essentially relied on secondary documentation. In addition, the consultants collected primary data through interviews and discussions with selected representatives of stakeholder groups and observations in a few areas visited. Photographs depicting the interaction between ecosystems and human activities are included as is information from case studies. In summary, the methodology embraced the following:

- (i) **Literature review:** The IISD report and the NEMA/UNEP project document were the main guiding documents. In addition, several documents have been reviewed, including District State

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<sup>2</sup> This is a four-year global effort to provide decision makers with information on the consequences of ecosystem change for human well-being. The first such assessment in Africa has been implemented in Southern Africa.

of Environment Reports (DSOERs); National State of Environment reports (NSOERs); UNEP and WWF reports on ecosystems and poverty linkages; a number of research publications. The list of documents reviewed is attached.

- (ii) **Interviews and discussions:** interviews were conducted with selected key stakeholders in public institutions, NGOs and private sector actors dealing with research, development and policy issues across the main sectors related to poverty and ecosystems. The discussions reflected on the perceptions of the poverty and ecosystems and the policy interventions and the impact on poverty and ecosystem services. A list of people interviewed is attached.
- (iii) **Case study reviews:** The case studies reviewed mainly related to project interventions in areas of poverty and ecosystem improvements. Some discussions are included in the texts and some interesting ones are highlighted in textboxes.
- (iv) **Analytical tools:** Analytical and reporting tools used included tables, matrices, graphs, maps and photographs. Tables have been used to analyse and present quantitative data; graphs to explore and explain trends and variations in poverty and ecosystem dynamics; matrices to present causal relationships; and maps to present spatial information on where changes in ecosystems and ecosystem services have occurred and pinpoint where ecosystem services are threatened. For maps (particularly the changes in the Budongo forest ecosystem on land use/ cover), LandSat Images were classified using GIS software Erdas Imagine.

The approach used was a logical flow that describes ecosystems; explore the trends in the quality and quantity of services provided, and analyse the causal factors. For human well-being, a list of basic constituents of human well-being developed by UNEP (2004) has been used.

#### 1.4 Report Structure and Team

This report is structured in 6 chapters, viz:

- *Chapter 1* gives a brief background, pointing out the main thrusts of the report, and the contextual understanding of the linkages between ecosystems, ecosystem services and human well-being;
- Chapter 2 discusses Uganda's main ecosystems and ecosystem services provided; highlights factors that influence changes in the different ecosystem services; and points out the main areas where ecosystems are under threat.
- *Chapter 3* assesses the situation of poverty and human well-being in Uganda using basic poverty-environment indicators, and analyses the trends and causal factors. The rural-urban divide and spatial/regional disparities are highlighted.
- In *Chapter 4*, the linkages between ecosystems, ecosystem services and human well-being is discussed in the context of poverty and poverty reduction concerns.
- *Chapter 5* reviews the responses at policy and project level, assesses the impact on ecosystem conservation and poverty reduction.
- *Chapter 6* draws conclusions, summarises major issues and key messages from the review; and presents recommendations.
- The report also contains annexes.

The report has been prepared by a multidisciplinary team of experts, Charles Twesigye – Bakwatsa (Natural Resources Management Specialist), Dr. Eseza Kateregga (Environmental Economist), Dr. Grace Nangendo (Biodiversity Expert and Spatial Analyst) and Denis Mutabazi (Land use Expert).

## 2.0 ECOSYSTEMS AND ECOSYSTEM SERVICES IN UGANDA

This Chapter presents a review of ecosystem and ecosystem services in Uganda. Most of the information was extracted from the UNEP/IISD 2004 report.

### 2.1 The Concept of Ecosystems and Ecosystem Services

An ecosystem (short for ecological systems) is a community of organisms interacting with one another and with the chemical and physical factors making up their environment. The chemical and physical factors include sunlight, rainfall, soil nutrients, climate, salinity, etc. Ecosystems are functional units that result from the interactions of abiotic, biotic, and cultural (anthropogenic) components.

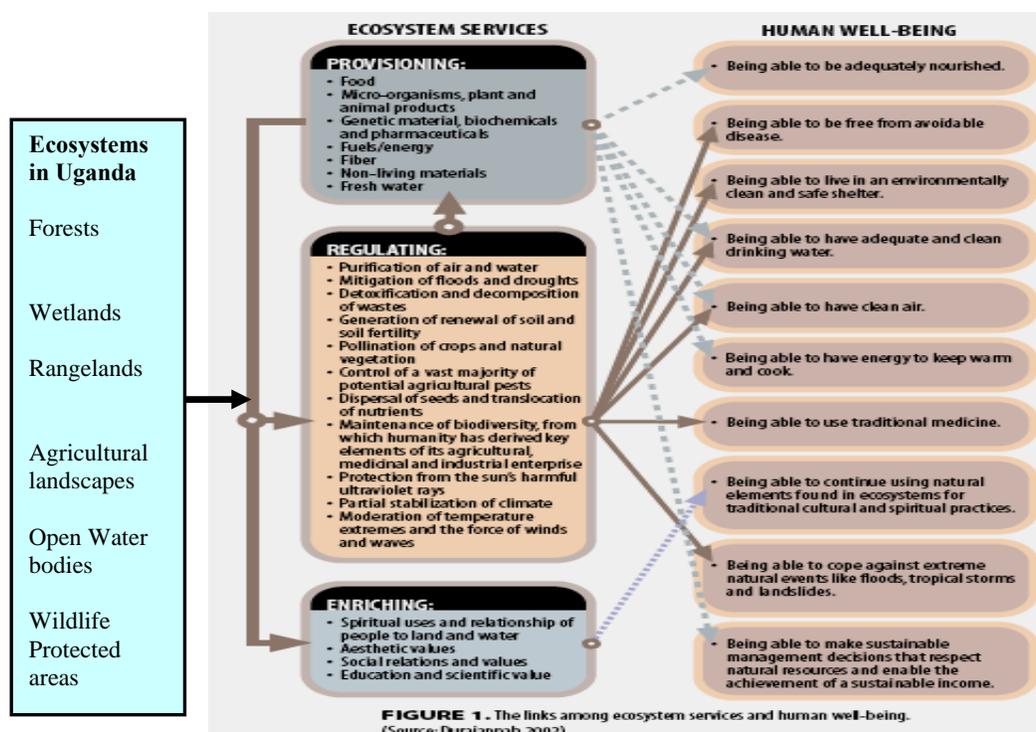
Ecosystems occur at different spatial (geographical area) and temporal (time) scales. There are small "communities" such as the living and nonliving components interacting in a pond, and larger communities, such as watersheds. At the global level, all the living and nonliving elements of the planet are interacting. Ecosystems exist wherever plants, animals, and people have an interdependent relationship within the context of their physical environment. However, small ecosystems are nested within larger ecosystems. This means that what happens at one scale affects what happens at every other scale, with varying degrees of impact. The overexploitation of ecosystems may temporarily increase material well-being and alleviate poverty, yet it may prove unsustainable, and over the long term, result in poverty. That is, to solve today's pressing problems, society is often tempted to deplete tomorrow's ecological resource base. This can jeopardize future well-being and livelihoods.

Ecosystem services – the array of benefits provided by nature – have been described by UNEP/ IISD (2004) as the lifeblood of human societies, economies and identities around the world. The range of services provided by ecosystems are categorised into 4 as follows:

- (i) *Provisioning* – direct provision i.e. the 3 “Fs” – food, fibre, fuel. These constitute direct support to livelihoods;
- (ii) *Regulating* – these include purification, detoxication, mitigation of drought, floods and other natural hazards. This is a critical category of services, even in developed countries, as there are generally no alternatives, unlike in direct provisioning;
- (iii) *Cultural* (embraces spiritual enrichment or satisfaction, aesthetic values attached to ecosystems, social amenities derived, etc. the level of valuation varies with diversity and complexity of society);
- (iv) *Supporting services* – ecosystems provide base or support services that enable provision of the services in the above 3 categories. E.g. soil formation, nutrient recycling, growth, primary production, etc. These generally tend to cover biological (and physico-chemical aspects in case of processes such as weathering, geological changes) processes that support provision of other services.

The broad range of services provided by ecosystems underscore the critical importance that ecosystems play in economic, social, cultural and political transformation. The complex relationship between ecosystems and human well-being remains unclear to many, and this limited understanding has contributed to their degradation (WWF, 2004). Recent studies (e.g. UNDP/World Bank/EC/DFID, 2002; UNEP, 2004) have developed models which help to explain the linkages. Figure 1 below presents the conceptual framework explaining the links among ecosystem services and human well-being.

Fig.1: *Links between Ecosystems, Ecosystem services and Human well-being.*



Like all other resource bases, ecosystem services can decline in quality and quantity if the utilisation and management patterns do not support their ability to regenerate themselves, and this in turn affects the quality, adequacy and diversity of services provided. The degradation of ecosystems affects human well-being by slowing down, reversing or even grounding to a halt, the services provided, over time. This explains why ecosystem degradation affects the poor most because, their ability to absorb the shocks caused by ecosystem degradation is low compared to the well-off who can have alternative options. Indeed, studies have shown that the poor people's economic dependence on natural resources makes them particularly vulnerable to environmental degradation (Duraiappa, 1996). Environment quality is a very important determinant of their health, earning capacity, secure, energy supplies and housing quality (Dasgupta, 1993).

While human life unquestionably depends on healthy ecosystems which supply life-sustaining resources and absorb wastes, current growth and consumption patterns in Uganda are placing increasing stress on ecosystems. Land degradation, biodiversity loss, deforestation and wetland destruction, are among the most visible indicators of stressed ecosystems.

The relationship between poverty and environment in Uganda is best understood in the context of people's livelihoods, especially the poor who constitute 35 percent of the population (Appleton, 2001). The activities of the rural poor have significant implications for the environment. The poor generally live off the land on which they grow crops for subsistence and sale, graze their livestock, and obtain wood for cooking, lighting and construction of houses. Since they depend on the land for most of their needs, they tend to use the land intensively, leading to degradation. As the land deteriorates, the poor become poorer (MFPED, 1999a). This leads to the well known vicious circle of poverty.

Making ecosystems work as an economic asset for the poor should be seen not as an isolated goal but part of a larger strategy for rural development. When the poor engage in good ecosystem stewardship, they create the conditions for higher productivity and greater direct environmental income for themselves. But they also safeguard ecosystem services whose benefits extend beyond their immediate surroundings. By maintaining a healthy forest cover, for example, they are helping to preserve watershed services like flood control, continuous water supply, and erosion control that landowners downstream will benefit from.

## 2.2 Brief Description of the People and the Biophysical Environment

### 2.2.1 Physical Geography and Natural Environment

Uganda is a land locked country lying between latitudes 4.2° N and 1.5° S, and longitudes 28° E and 35° W. Bordering Kenya to the East, Tanzania and Rwanda to the South, the Sudan to the North and the Democratic Republic of Congo (DRC) to the West, the country covers an estimated total area of 241,020 Sq Km, of which 15.1% is open water, 11% game reserves and national parks (protected areas) and 5.9% forest reserves.

True to the current marketing slogan, Uganda is gifted by nature. Its geographical location has endowed it with a range of geographical features which range from glacier-topped mountains, tropical rain forests and dry deciduous acacia bushlands, to vast lakes, wetlands and swamps as well as fertile agricultural landscapes. The diversity of this geography can be appreciated along both the North-South and East-West transects.

**Biodiversity:** the diverse landscapes and climate that characterize Uganda have supported a diversity of flora and fauna. In addition to the high fauna diversity, there are at least 94 recognized vegetation communities (Makumbi and Manyindo, 2000). These include closed canopy tropical high forests, montane bamboo, heather and moorland, swamps and wetlands, moist woodlands and dry bushland and thickets (FAO Forest Department, 1999).

Uganda mostly consists 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, savanna and grasslands covering 44% of the total land area, cropland/natural vegetation mosaic covering 35%, wetlands and water bodies covering 16% and, forests covering 20%. One percent (1%) of the land is barren or with sparse vegetation (World Resources Institute 2003d).

### 2.2.2 Climate, Topography and Hydrology

Much of the country has an altitude of 900-1500 m, and is on average 1200m above mean sea level (FAO. Land and Water Development Division, 2005). Uganda consists of plateau, rolling hills, flatlands and mountains which are dissected by numerous streams rivers, lakes and wetlands (Uganda National Environment Management Authority, 2001; Gowa, 2003).

Uganda has a dense drainage network, which is concentrated mainly in the South of the Nile. This includes several lakes, rivers and streams, including the River Nile, and Lake Victoria, the World's second largest freshwater body. Wetlands cover 13% 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 Development Division, 2005).

River Nile accounts for 98%- of the country's drainage. 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 1707 sq km (FAO. Land and Water Development Division, 2005).

Mean annual rainfall is approximately 1180mm; precipitation ranges from 750 mm/year in the northeast Karamojong pastoral areas to 1500 mm/year in the east along the shores of Lake Victoria, in the highlands of Mount Elgon, in the southwest Rwenzori Mountains, in the west in Masindi district and in the north in Gulu district (FAO. Land and Water Development Division, 2005).

The climate is generally tropical but mild because of the high altitude and temperature ranges i.e. between 16° and 29° C. Generally, the climate is favorable for agricultural production, making it possible to grow two crops a year under rain fed conditions (NEMA 2001).

**Economy and Land Use:** Agriculture, the source of livelihood for the majority of the population (over 80%), is the predominant land use. Uganda has 7.2 million ha or approximately 30% of the country's territory of arable land and land under permanent crops (FAO. Land & Water Development Division 2005; Gowa 2003).

This diversity and distribution pattern of vegetation, relief and other natural features has influenced the land use and socioeconomic settings in the country. There is abundant rainfall and rich, tillable land, a major determining factor in settlement of the area. At the same time, the vegetation in Uganda is extremely diverse a result of the different micro-climates of the country.

### 2.2.3 Population, Socioeconomics and Governance

**Demography and Social structure:** According to the 2002 Population and Housing Census, Uganda's population was 24.7 million and is now estimated to be about 27 million people. The spatial distribution is slightly skewed to the south and west. The Northern region has the least numbers (22% of the population) and the Central region the most (27%), followed by the Western Region (26%) and Eastern region (25%). Kalangala district, the island district in Lake Victoria, was the least populated with a total of 34,766 persons. The most densely populated areas are those around Lake Victoria.

Uganda's population is predominantly rural (about 88%), and dependant on agriculture (i.e. more than 80% of the population, according to UBOS, 2002). This implies that Uganda is the least urbanized country in the East African Community (cf. with 22% for Tanzania and 20% for Kenya).

**Political and Administrative set-up:** Decentralisation, adopted in 1991, constitutes the main governance framework. The Local Governments Act 1998 recognises districts as autonomous local authorities, exercising relative independence on planning and decision making. Municipalities and Sub-counties are also recognized as lower local governments. This arrangement has enabled transfer of resources and responsibilities to levels which are close to the population. This has, in many respects, empowered the population to actively participate in decision making regarding their well-being including natural resources management.

## 2.3 Status and Trends of Ecosystems and Ecosystem Services in Uganda

### 2.3.1 Status of Ecosystems and Spatial distribution

In Uganda, ecosystems are as diverse as the range of services they provide. These have tended to follow certain spatial patterns, as highlighted in the IISD report 2005.

More than half of Uganda is covered by FWS mosaics (Burgess et al., 2004), mostly because of its location in a zone of overlap between the ecological communities characteristic of the dry East African savannas and the West African rainforests (Howard, 1991). This ecoregion covers the whole area surrounding Lake Victoria being bordered by the Albertine rift montane forests to the west, Mount Elgon to the north east and stretching northwards to include the southern part of Murchison falls National Park. The area is ranked among the richest in birds, mammals and butterfly populations

(Burgess et al., 2004). There has, however, been high habitat loss and it is one of the few areas in Africa where the human population is expected to be highest by 2025 (between 200 to 1,000 individuals per km<sup>2</sup>). It is, therefore, grouped among the critically threatened areas and is of the highest conservation priority. The north and north eastern is mainly covered by rangelands and woodland areas. These are also under threat because of cattle overstocking and cutting down of the woodland trees for fuelwood and charcoal, which is on high demand in the urban areas.

### **2.3.2 State of Ecosystem Services**

The literature review identified biodiversity, food production, water supply and quality 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, within limitations of available information attempt to highlight areas in which they are declining. We start with biodiversity loss, as it unpins ecosystem functioning and hence availability of ecosystem services overall.

### **2.3.3 Biodiversity**

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

According to a classification system of terrestrial eco-regions developed by the World Wildlife Fund, there are four prominent eco-regions in Uganda:

- Northern Acacia-Commiphora bushlands and thickets (AT0711): North and northern districts in Eastern Region
- East Sudanian savanna (AT0705), mainly in the northern region
- Victoria Basin forest-savanna mosaic (AT0721), occupying much of the Central and Eastern regions;
- Albertine Rift montane forests (AT0101) in the Western region

Within these eco-regions, there are fundamental differences in the biophysical environment and its importance to and relationship with human beings.

## **2.4 Status of Biodiversity**

From the 1960s to 1990s, biodiversity richness declined steeply and 25% 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, 44 are vulnerable and 16 species are extinct. Insufficient data exists for 15 animal species and details of threatened status are lacking for 1373 species (IUCN *et al*, 2004; Gowa, 2003). Of plant species, 50 are critically endangered; in the 1990's 32 tree species already were threatened. Freshwater fish are also endangered or threatened. Nine critically

endangered freshwater cichlids are located in Lake Nawampasa, two are in Lake Nabugabo, and one is in Lake Victoria (IUCN *et al*, 2004).

Over the last two decades, a number of policy initiatives have been undertaken to conserve the country's biodiversity. To date, there are 682 forest reserves nearly 90% of which are under the management of the central government; wildlife protected areas have increased from 4 in 19, 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% of tropical forests, and 65.2% 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, Kasese, Bushenyi, and Mbarara districts (Gowa, 2003). Two main closed forest areas remain: the forests surrounding Lake Victoria in Eastern Region and those of the Western Rift Escarpment in the Western Region (FAO Forestry Department). Kabarole District in Western Region contains the most fully stocked tropical high forest, covering 999.20 sq km (FAO – Forestry).

Uganda has 150 sq km of internationally important wetlands; the two Ramsar protected areas are along the western border in Bundibugyo, Kabarole, Kasese, Bushenyi, 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 mats and fences, soundproof houses and thatch outdoor kitchens and bathrooms (National Wetlands Programme, 2004; Maclean *et al*, 2003).

#### 2.4.1 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 (NEMA, 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)<sup>3</sup>.

Another factor has been the wide array of resource management policies put in place that have contributed to the gradual loss of indigenous knowledge, particularly in agriculture, forestry, and wildlife (NEMA, 2001). Most people have left behind traditional, village-based knowledge systems as the country becomes more urban and industrialized (NEMA, 1995, Sustainable Development, 2004).

Severe biodiversity loss in Uganda has been brought about by the removal or introduction of organisms in ecosystems that disrupt biotic interactions or ecosystem processes. For instance the introduction exotic fish such as Nile Perch (*Lates niloticus*) and *Oreochromis niloticus* fish in the 1950's by the British has threatened the diversity of fish, and has been blamed for the near extinction of over 200 endemic fish species in the Lake Victoria fishery.

The water hyacinth is an aquatic plant which is believed to have been brought to East Africa as a pot plant that later found its way into the lake waters. Its rapid proliferation is directly attributed to the enrichment of the water environment by untreated industrial effluent from the expanding population around lakes. According to scientists, the weed spreads out at an alarming rate, doubling

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<sup>3</sup> 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).

its biomass every 15 days. This starves fish and plankton of oxygen and sunlight and reduces the diversity of important aquatic plants.

#### 2.4.2 Areas most affected

##### *Central Region:*

- Mukono District, the most forested district in the country, has the most degraded tropical high forest (particularly Mabira) which also has the largest number of settled communities.
- Expansion of agriculture, settlements and infrastructures around the urban areas (Wakiso, Mpigi, Mukono) have resulted in destruction of wetland and forest ecosystems, and with it, important biodiversity.

##### *Eastern Region:*

- Loss of biodiversity is high in Kapchorwa and Mbale Districts, where forest habitats are fast being replaced by savanna, farmland, and pasture;
- In more northern districts there is 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;

##### *Northern Region:*

- Notable biodiversity loss in Nebbi District
- Poaching of wildlife is particularly pronounced around Murchison falls protected area.

##### *Western Region:*

- Along the Albertine Rift, deforestation is highest around the southwestern Bugoma, Budongo, and Kagombé forests in Masindi and Hoima Districts
- Biodiversity loss from deforestation is also a problem in Bundibugyo, Bushenyi, Kabale, Kabarole, Kisoro, Mbarara, and Rukungiri Districts. In Kisoro, original wetland vegetation has been replaced by secondary vegetation;
- Poaching remains rampant around Queen Elizabeth national park, especially on the side of Bunyaruguru county, Bushenyi district. Hunting has historically been the occupation of most men in Bunyaruguru most of whom are immigrants.

#### 2.5. Food Production

Ecosystems provide the medium for growing the food on which humans and domesticated animals depend. 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.

Close to 88% of Ugandans live in rural areas and practice subsistence agriculture, primarily growing roots and tubers (61%) and cereals (30.5%), followed by pulses (4.9%) and meat (3.6%) (NEMA, 2001; World Resources Institute, 2003). Plantain bananas cover approximately 28% of cultivated area, while cereals such as maize and rice comprise 25%, roots 17%, pulses 14%, oil seeds 8%, 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. Informal, small-scale irrigation for rice, vegetable and fruit production is practiced mainly in southeast Uganda (FAO. Land and Water Development Division, 2005).

Other sources of protein are fish and livestock. Ugandans eat on average 9kg of fish products per person per year (World Resources Institute, 2003a). Livestock contributes over 8% of the GDP, but is not widely exported (FAO Livestock Information Sector Analysis and Policy Branch, 2004).

Small holder farmers own about 90% of all cattle and nearly 100% of goats, sheep and poultry and annual meat consumption in 1998 is 11 kg per person (FAO, Emergency Relief & Rehabilitation, 2004; World Resources Institute, 2003b). Pastoralists are located mainly in the northeast districts where human populations and rainfall are low. Rangelands occupy approximately 84,000 sq. km in a corridor from Moroto and Kotido in the north-east, through the flat areas of Lake Kyoga down to Masaka District and Mbarara. 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 1000 small to medium dairy farms (FAO, Emergency Relief & Rehabilitation, 2004).

The practice of urban agriculture is also increasing. In Kampala, slightly more than 50% of the land is used for agriculture and an estimated 30% of all households within 5km radius of the city centre engage in agricultural production of some sort. Farming in the city is an important means for ensuring food self-sufficiency, maintaining food security, supporting households which have ‘no other means’, as well as for commercial production (Maxwell, 1994, 2003).

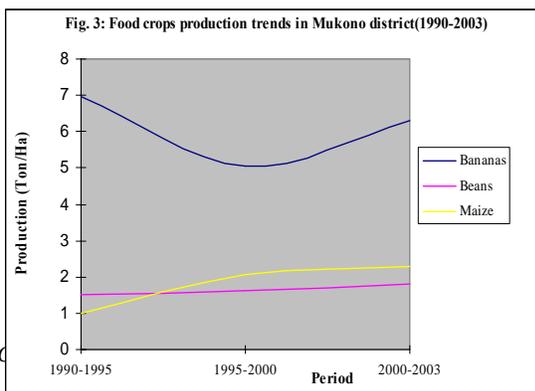
**2.5.1 Fiber and Cash Crops**

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, 2003; Portal 2003; FAO, Land and Water Development Division, 2005). Fish and fish products are also exported, employing 57,862 Ugandans and generating exports of \$30,986,000 US annually (World Resources Institute, 2003a).

**2.5.2 State of food provision service**

Even though food production has been increasing by 1.5% annually, it is not enough to meet the needs of Uganda’s population, which is growing at a rate of 3.4% per year (FAO, Land and Water Development Division, 2005). Since 1981, average cereal production increased by 88%, but per capita production grew by only 1% and during the same period, average crop yield rose only 3% (WRI – food 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% from the mean, an amount that is considerably higher than the average variability in Sub-Saharan Africa, which is 6.5% and for that of the world, which is 3.5% (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% of total cereal consumption and the government also imports at least 4,000 tons of rice/year (USAID, 2003; World Resources Institute, 2003; FAO Land and Water Development Division, 2005).

Analysis of food production in Mukono district over the last decade is presented in the graph in figure 3 below.



Data source: Mukono district state of environment report, 2004.

It will be observed that production of bananas, which is a staple food for the people, has generally declined. For maize and beans, although the figures indicate a slight increase in production, production grossly declined in terms of per capita. The

increases in production have been attributed to interventions for land improvement such as the National Agricultural Advisory Services (NAADS), but the low production suggests that the interventions are having low impact because the productive land has been stressed by the population and other pressures, raising concerns for food security and nutrition.

Between 1980 and 2000, the annual growth in meat, milk and egg production has declined along with annual per capita production, resulting in decreasing annual consumption of these products 10.1 kg/person annually (FAO. Emergency Relief & 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 5% only 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) provide both food and fiber services such as vegetables, edible fruits, mushrooms and grasses (Naluswa, 1993, FAO Forestry Department, 2004). About 80% of the population in Uganda depend on traditional plant medicines derived from at least 300 plant species (Kanabahita 2001; Naluswa, 1993). In Bushwere Parish, Mbarara district, farmers reported commonly using 120 plant species for food (20%), medicine (20%), craft (7%), grazing (4%), construction (3%), brewing (2%), commerce (2%), propping (1%), and cultural purposes (1%) (Eilu *et al.*, 2003).

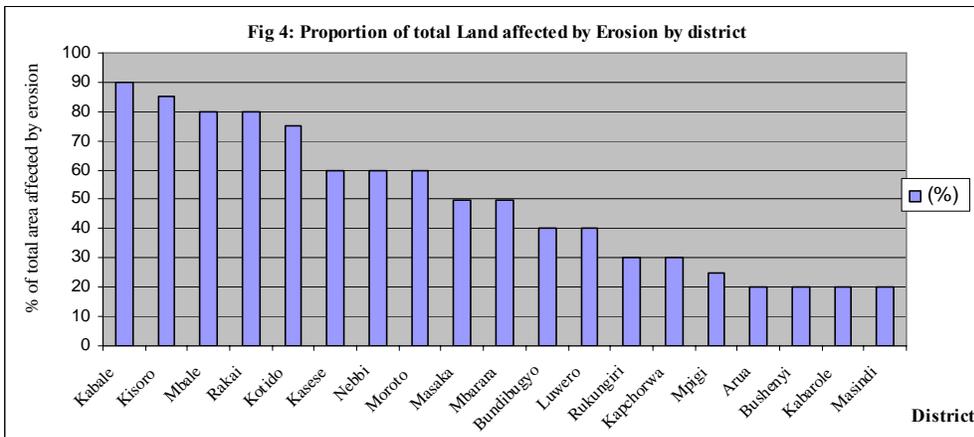
### **2.5.3 Factors influencing food provision service**

Per capita food production has declined primarily due to rapid population growth, fragmentation, over-cultivation, soil degradation, land tenure problems, and political instability (FAO, 2000; 2005; FAO GIEWS June 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, 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, 2000; NEMA, 2001). Water erosion is also severe in Mbale,<sup>4</sup> Kabale, Kabarole, Kapchorwa, Bundibugyo and Kasese districts where mountain slopes have been heavily deforested for crop production (FAO, 2000; Gowa, 2003). It is particularly evident in the highland regions which are more favorable agricultural areas and in rangelands (FAO, 2000; 2001). The graph in figure 4 below shows districts where agricultural production is stressed by erosion.

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<sup>4</sup> Note: Mbale has a combined high risk of landslides and large population (NEMA, 2001).



Data source: Annex 4.

According to FAO Land & Water Division (2000) and as shown in fig.4 above, soil erosion is most prevalent in the districts which are heavily populated districts; where there is over-tilling of land (due to small landholding and dependency on agriculture) and fragile areas as rangelands of Karamoja.

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, agrochemical input to overcome soil nutrient loss has polluted the land (NEMA, 2001). Deforestation also promotes soil erosion and is a primary cause of landslides during seasons of intense rainfall, causing damage to crops (Kitutu, 2002; NEMA, 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 (NEMA, 1995; Sustainable Development, 2004).

Drought is another problem, especially in the north and northeastern districts; 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. Persistent and prolonged drought particularly affects the people depending on rangelands, namely pastoralists. According to USAID (2000), some 90,000 pastoralists regularly migrate in search of pastures, mainly in the north and eastern parts, which has been linked to inter-clan conflicts within and cross-border raids between Uganda and Kenya pastoralists.

As a result of drought, pastoralists also tend to illegally encroach on wildlife protected areas in search of pastures and water, a situation that escalates animal disease incidences in addition to conflict. According to FAO, Emergency Relief and Rehabilitation (2004), animal diseases pose a significant problem to livestock keepers.

#### 2.5.4 Regions most affected

##### Central Region:

- Severe soil degradation in Rakai, Mubende Kiboga Luwero, Mukono
- Soil and soil fertility are stressed in Kalangala
- Drought affects livestock production in Kiboga
- 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, Kapchorwa
- Livestock tsetse fly sleeping sickness in Soroti district
- Control of agricultural pests is a problem in Bugiri, Busia, Iganga

**Northern Region**

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

**Western Region:**

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

## 2.6. Water Supply

Ecosystems play a key role in the provisioning of clean fresh water 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 1).

**Box 1**

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 ground water. 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, 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 IRWR level of 39 cu km or 1574 cu m per capita (WRI 2003; FAO, Land and Water Development Division, 2005). This is below the 5705 cu m per capita average for Sub-Saharan Africa (WRI 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).

Total water withdrawal is approximately 300 million cu m, representing only 0.4 per cent of total renewable resources (ibid). This low withdrawal rate suggests that, currently, there is little pressure on Uganda's water system in meeting demands.

### 2.6.1 State of Fresh Water Supply, Purification and Regulation Service:

The country's surface area of about 241,500 square kilometers is made up of 15 per cent open water, 3 per cent permanent wetlands and 9.4 per cent seasonal wetlands. The open surface water bodies include lakes and rivers. Groundwater exists in both the fractures and weathered aquifers. The major input into the national water resources, apart from the Nile flow from the upstream countries, is the rainfall, which ranges between 600mm to 1600mm.

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 (National Wetlands Programme, 2004).

The domestic sector uses 45% of the water followed by irrigation and livestock at 40% and industry at 15% (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 liters of water daily from wetlands (National Wetlands Programme, 2004).

Unfortunately surface water is frequently plagued by sediment and organic impurities and diarrhea is prevalent among children whose households use surface water and least prevalent in households with piped water (Taylor & Howard 1995; UBOS, 2001). Shallow groundwater also commonly exhibits levels of coliform bacteria and nitrate that exceed W.H.O. guidelines (Taylor and Howard, 1995). Water regulation is a serious concern as well. In 2000, drought affected 190,000 people (USAID, 2000). Then, in 2001 and 2002, floods affected Kabale, Kayunga (Kangulumira), Mbale, Sironko, Bundibugyo, Kapchorwa, and Bushenyi districts (DSOERs 2004 for Kabale, Kayunga, Mbale, Sironko, Bundibugyo, Kapchorwa and Bushenyi).

Wetlands provide indispensable ecosystem and regulating services, including maintenance of the water table, water filtration, flood control, groundwater recharge, and microclimate regulation (National Wetlands Programme, 2004). Although 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 (NEMA, 2001). Between 1990 and 1992, Ugandans converted 7.3% or 2,376 km<sup>2</sup> of the total original wetland area (National Wetlands Programme, 2004).

#### **2.6.2 Factors influencing water supply, regulation and purification**

Water quality is deteriorating due to domestic, industrial and agro-chemical run-off into water courses. Rapid increase in urban population and rural-urban migration has led to unplanned settlement slums, and water, sanitation, solid waste management problems (NEMA, 2001). At the same time, industrial chemical waste and municipal waste refuse significantly contaminate the water resource (FAO, Land and Water Development Division, 2000).

Water pollution from agricultural run-off is another serious concern. Ugandans annually apply 4,000 MT of fertilizer, or approximately 1kg 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 3000 kg/day to roughly 17000 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 nearly all seasonal wetland valley bottoms cultivation have been converted for rice cultivation. In some parts of the southwest large areas of wetlands have been converted for grazing pasture and cultivation (Tiega, 2001; NEMA, 2001). Wetlands also are degraded by sand-mining excavation and clay extraction for brick-making, notably in Kampala, Mukono and Wakiso districts (see plate 1).



Plate 1: Brick making in the wetland near Entebbe.

Another factor contributing to wetland degradation is their transference from common property to private ownership e.g. 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, 'juu kali' 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 (NEMA, 2001; DSOER 2004 for Mukono). Swamp forest deforestation occurs in Mukono, Mpigi, Rakai and Masaka districts and escalating soil erosion, decreasing soil fertility, and desertification are also problems (NEMA, 2001).

### 2.6.3 Region most affected:

#### Central Region

- Ground water supply is lowest in Kalangala, Kiboga, Luwero/Nakasongola, Masaka/Sembabule, Mpigi, Mubende, Mukono, Rakai districts
- Water pollution is a considerable problem in Kampala
- Intense shallow-well development where water quality is often poor in Mukono District
- Freshwater purification is stressed from wetland degradation in Kampala, Masaka, Mpigi, Mukono, Rakai

#### Eastern Region

- Wetland conversion in Iganga/ Bugiri, Jinja, Kamuli, Kapchorwa, Kumi, Mbale, Pallisa, Soroti/Katakwi, Tororo/ Busia districts where 73.8% of Uganda's converted wetland area are located
- Freshwater purification is stressed from wetland degradation in Iganga, Jinja, Pallisa,
- Water regulation is low in the Northern and Eastern districts which are affected by droughts & floods

#### Northern Region

- Region is affected by recurring droughts & floods suggesting that water regulation is poor;

#### Western Region

- Water pollution problem in Kasese District;
- Declining water levels in the River Rwizi, Mbarara district;
- Freshwater purification is stressed from wetland degradation in Kabale,

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(FAO, Land & Water Development Division, 2005;<sup>5</sup>; National Wetland Programme 1992; NEMA, 2001; Taylor and Howard 1995).

## **2.7 Fuel Provision**

Firewood and charcoal (wood fuel) and agricultural wastes are the primary source of energy in Uganda and comprise 93% of energy consumption (Uganda Ministry of Energy and Mineral Development, 2001). Furthermore, 95% of the wood supply is used for energy consumption and it constitutes 88% of energy consumed (Uganda Ministry of Energy and Mineral Development, 2001). Woodfuel is obtained from bush land (30%), woodland (20%), agricultural land and fallow land (48%), and natural forests (2%) (Kanabahita 2001). Moreover, 86% of Uganda's total annual round wood production, amounting to 15,236,000 cu m, is for domestic fuel consumption (World Resources Institute, 2003b). Wood fuel 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 fuelwood, charcoal and black liquor<sup>6</sup> was 15,410,000 cu m (Amous 1999). Annual round wood production has steadily increased from 5,000 cu m in 1961 to 17,000cu m/year in 1998, and has since remained at this level (Gowa, 2003).

Around 2 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 also 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 production 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 tones (2.31 million tonnes) annually (HEDON Household Energy Network, 2004). Charcoal and wood are transported into the cities from rural areas. 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).

### **2.7.1 State of Fuel Provision as Ecosystem Service**

Forests and woodlands have declined from 45% coverage of land area in 1890 to just 20% in 2000. Tropical high forest, in particular, declined from 12.7% of total land area in 1900 to about 3% by 2000. Furthermore, the current estimated rate of deforestation is 0.8% per year (Uganda National Environment Management Authority, 2001)

Of total natural forestland in Uganda 30% 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). 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). A biomass study using 1995 data found that there was a negative balance of 3.8 million tons of biomass for that year alone (Ministry of Energy and Mineral Development, 2001). In part to meet growing domestic and agricultural fuelwood demand, which is accelerating at a rate 1% 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 – Forestry).

### **2.7.2 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 (NEMA, 2001). Large-

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<sup>5</sup> In contrast, in the southwest, southeast, northwest and along the eastern borders, potential yield from aquifers is steadily 3 cu m/hr (FAO, Land & Water Development Division, 2005).

<sup>6</sup>an indirect wood fuel recovered from paper manufacture (FAO Database in Amous 1999)

scale farming along the Albertine Rift has led to the greatest amount of forest loss in southwestern Uganda (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, because, unlike firewood which can be obtained from dead branches and stems in the rural countryside, charcoal making involves felling live trees (Kanabahita 2001).

Many landless people migrate from the densely populated highlands to forest areas such as around 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 districts around Lake Victoria, Masindi and Kabale, illegal pit sawing has a significant role in deforestation. In addition, in western Uganda, Kalinzu forest degradation from mechanized logging is more prominent than disturbance from agricultural conversion (Plumptre et al. 2003). The influx of refugees and internally displaced persons (IDPs) is a major contributory factor to deforestation especially around the camps (Kanabahita, 2001; District State of Environment Reports, 2004 for Apac and Kisoro).

In addition to all the factors listed above, the lack of wood substitutes<sup>7</sup> 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).

### 2.7.3 Areas most affected

As would be expected, all four ecosystem services are stressed in all four regions.

- *Central Region:* deforestation in Rakai, Masaka, Mpigi, Kampala, 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, P. & P. Drichi, 2001; Ministry of Energy & Mineral Development, 2001).

### 2.8. 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. District level information is therefore reflected for each region in the ‘Regions Affected’ sub-section.

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 wood fuel, 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. Box 2 below highlights some of the emerging views on conservation benefits.

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<sup>7</sup> 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).

**Box 2: Emerging view on conservation benefits: Extract from ASARECA’s Current Research Agenda**

Degradation of natural resources and ecosystems is continuing because there is a general perception that resource use practices that deplete the resource generate higher benefits than those that conserve. Therefore, conservation itself must be made beneficial to the immediate ecosystem managers who include farmers, their support organizations, investors, and governments. There is an opportunity for achieving this through compensation for environmental services which accrue from conservation measures, for the benefit of society. These benefits include carbon sequestration, agro- and wild biodiversity, improved water supply, flood control, soil stabilization against erosion, tourism, and mitigation of pollution, disease and pest control. However, the potential of these environmental services is not fully realized. For example, despite the fact that carbon sequestration is a widely known and recognized environmental service and countries in the ECA have a comparative advantage, markets have yet to be developed for this service. Commercialization of environmental services in the ECA sub-region is largely underdeveloped although similar markets have been developed in other regions. Current policies in the sub-region show that there is little understanding of the value of environmental services. As a result very limited valuation of these services is undertaken let alone included in national ‘accounting’, leading to under representation of costs associated with natural resource degradation or benefits resulting from conservation in economic growth figures. Another consequence is the lack of appropriate frameworks for sustainable and equitable compensation for contributions to environmental services, therefore reducing the incentive to invest in conservation. Valuation is the first step in establishing environmental services accounting systems. However, appropriate valuation techniques are largely lacking or not adapted to the circumstances that prevail in the ECA sub-region.

The emerging view seems to be that “*continued conservation of ecosystems requires that those expected to invest in the conservation should obtain direct benefits and that more knowledge and understanding of the value of environmental services is an important step towards this target*”. To achieve consensus on this view, there is need for:

- Increased understanding and knowledge about the opportunities and value of environmental services made possible by conservation measures,
- Improved valuation and thus knowledge and information on the values (costs and benefits) and distribution pattern of environmental services, and
- Adaptation of fair and equitable system for sharing the benefits and costs among those who contribute to the realization of environmental services and those who benefit.

This constitutes the core of the recent research agenda for ASARECA and it is hoped the outcomes from research will contribute to improved ecosystem-human well-being interactions.

### 3. HUMAN WELL-BEING AND POVERTY IN UGANDA: STATUS AND TRENDS

#### 3.1 Constituents of Human Well-being

In the context of ecosystems and human well-being, UNEP & IISD (2004) identify 10 determinants that are essential constituents for improving human well-being and poverty reduction (see table 1 below). These constituents discussed in the following section, provide the guiding framework for ecosystem-human well-being and poverty analysis throughout this report.

Table 1: Constituents of Human Well-being

Item	Provision from Ecosystems
1	Being able to be adequately nourished;
2	Being able to be free from avoidable disease;
3	Being able to live in an environmentally clean and safe shelter;
4	Being able to have adequate and clean drinking water;
5	Being able to have clean air;
6	Being able to have energy to keep warm and cook;
7	Being able to use traditional medicine;
8	Being able to continue using natural elements found in ecosystems for traditional cultural and spiritual practices;
9	Being able to cope with extreme natural events including floods, tropical storms and landslides; and
10	Being able to make sustainable management decisions that respect natural resources and enable the achievement of a sustainable income-stream.

Source: UNEP/IISD, 2004.

#### 3.2 Status of Ability to earn a livelihood

Poverty is primarily a rural phenomenon: 96% of the poor are found in rural areas (Robinson et al 2002). In contrast, only 16% of the urban population lives below the poverty line, but this is changing with the rapid increase in rural-urban migration (NEMA, 2001). In addition, the proportion of the population in poverty rose from 61% to 67% from 1997-2000 in the Northern Region despite the overall reduction in national poverty.

##### Region most affected:

- *Central Region*: incidence of poverty 20-25% with pockets of less than 20%
- *Eastern Region*: variable incidence of poverty ranging from areas of high incidence to areas of low incidence
- *Northern Region*: highest incidence of poverty, almost all area is over 35%
- *Western Region*: mainly less than 20% incidence of poverty with some areas having 20-25% and a pocket of high incidence around Kabale in the southwest corner of the country

### 3.3 Ecosystems and their Susceptibility to Human Pressure

In this section, we present a discussion on the susceptibility of ecosystems to pressure from human activities, and its implication on the sustainability of service provision by these systems.

Ecosystems such as forests, wetlands, soil, marine and so forth play a very important role in supporting the well being of societies. They provide food and fibre materials, fuel wood, employment and income, in addition to the provision of a vast range of ecological services. Further, where property rights clearly prevail, private holders of some of these resources have their asset base greatly enhanced.

Ecosystems vary in their natural susceptibility to over use or stress. This susceptibility depends on land use, on demographic, market, and institutional circumstances, and on the regulatory framework and control strategies adopted by different countries. Habitat fragmentation, habitat conversion, and agricultural disturbance have all been blamed for increasing the susceptibility of ecosystems to stress.

It has been shown that many of Uganda's ecosystems are under stress (IISD & UNEP, 2005). The reasons behind this stress include; deforestation, wetland destruction, poaching, the rapid population growth that has persistently led to increased demand for settlements and arable land. Thus human activities are the key forces behind the stress of ecosystem services.

Human activities can cause complex changes within the structure and function of ecosystems. Impacts include disturbances in the ecosystems that may lead to restructuring established foods webs, importing new diseases and alien species to the surroundings, and the total destruction of systems and the resulting loss of biodiversity. The level of biodiversity in an ecosystem determines its capacity to respond to external shocks, whether by the market or by environmental-induced factors. From an ecological perspective, biodiversity protects ecosystem resilience by underwriting the provision of ecosystem services over a range of environmental conditions (Perrings et al., 1992).<sup>8</sup> Loss of resilience means both an increase in the time taken to return to equilibrium following some shock and a narrowing of the range of environmental conditions over which the system can maintain the flow of ecosystem services (Holling et al., 1995). Further, if a system sufficiently flips from one state to another, production sets may be rendered non-convex (Perrings et al., 1992). This actually implies irreversibility conditions, and that the range and structure of goods and services changes drastically. This may have severe consequences for management of natural resources and for the riparian communities. Further, it may imply the non-controllability of the system itself. That is, management decisions based on observed market prices, and policy instruments geared toward control of the system may fail to achieve the desired goals, as the system dynamics would be out of conformity.

Thus, pressure from human activity may lead to situations in which ecosystems with limited resilience flip. And once systems flip, a range of ecosystem services may be completely lost, implying adverse welfare effects on riparian communities.

### 3.4 Ecosystem Services - Human Well-Being Linkages

In this section we explore the link between ecosystem services and constituents of human well-being in Uganda. Further the stress on Uganda's ecosystem services is highlighted.

Ecosystem services are the end products of nature that yield human well-being. Three necessary conditions define an ecosystem service. First, and most obvious, the service has to emerge from the natural environment. Second, a service must enhance human well-being. Third, a service is an end product of nature directly used by people. It is important to emphasize a distinction between ecosystem services and ecosystem function. Functions are the biological, chemical, and physical interactions associated with ecosystems. These functions are the things described by biology,

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<sup>8</sup> Ecosystem resilience describes the capacity of an ecosystem to cope with disturbances, such as storms, fire, pollution, and other invasions without shifting into a qualitatively different state. A resilient ecosystem has the capacity to withstand shocks and surprises and, if damaged, to rebuild itself [The Environmental Advisory Council to the Swedish Government, 2002].

atmospheric science, hydrology, and so on. Services depend on these functions but are different in that they are the aspects of the ecosystem valued by people.

The identified ecosystem services - human welfare connections for Uganda are presented in IISD (2005). The services provided by ecosystems include supporting all life, regulating natural systems, provision of food, fibre, fuel wood, medicinal materials and the provision of recreational and educational facilities.<sup>9</sup> Thus, the constituents of human well-being directly or indirectly affected by ecosystem services are nutrition, health, education and the ability to earn livelihoods. The hypothesis here is that the greater the range, quality and quantity of ecosystem services a society has access to the higher will be their well being.

High growth rates of population, however, have imparted immense pressure on forests, wetlands and marine ecosystems, among others. The IISD (2005) report indicates four ecosystem services under critical stress in Uganda. These are: maintenance of biodiversity; food and fibre provision; water supply purification and regulation; and fuel provision. This stress has resulted from a number of forces including: deforestation, wetland conversion, poaching, human encroachment, and population growth.

Some of the problems that have emerged due to stressed systems include: soil degradation, soil erosion, water quality deterioration and forest degradation. This implies lower crop yield per acre and the overall loss of soil productivity, declines in food consumption, fuel wood deficits, increased collection time of fuel wood, increases in morbidity, increased prices for food and fuel wood, among others.

The trends in area under cultivation, and the returns per hectare for the period 1980 - 2003 are shown in figures 5, 6 and 7. Figure 3 shows that area under cultivation has persistently increased since 1980. This increase in the demand for arable land is a derivative of the rapid population growth during the period. The implication for this trend on natural vegetation and forests is quite evident. It must be that forest and natural vegetation cover has persistently declined over the period.

Output per hectare for root crops steadily rises over the period. While output per acre for cereals and pulses remain more or less constant. The fact that new cultivation grounds tend to be more fertile than used ones implies that reduction in soil productivity due degradation has been offset by opening up new planting grounds. This helped to maintain soil productivity levels constant during the period. Output per hectare for plantains increased between 1980 and 1995, and then declined after 1995. There was a sharp decline in productivity of land under plantains after 2002. This event can be explained by the banana wilt disease and perhaps drought.

The fact that close to 90 percent of Uganda's population lives in rural areas where ecosystems are to a large extent the major determinant of livelihoods makes it crucial to examine effect of ecosystem services on poverty trends across regions. In the section below we examine poverty trends across regions over time.

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<sup>9</sup> The regulating services that contribute to well-being (IISD, 2004) are presented in the table A3 in the appendix.

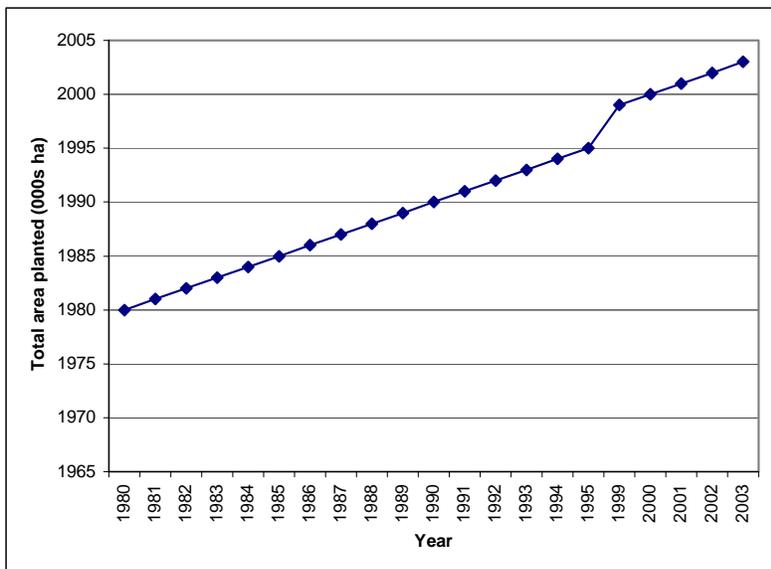


Figure 5: Planted area for Selected Food Crops 1980 - 2003  
 Source: Ministry of Finance, Planning and Economic Development (1996), (FAO 2004).

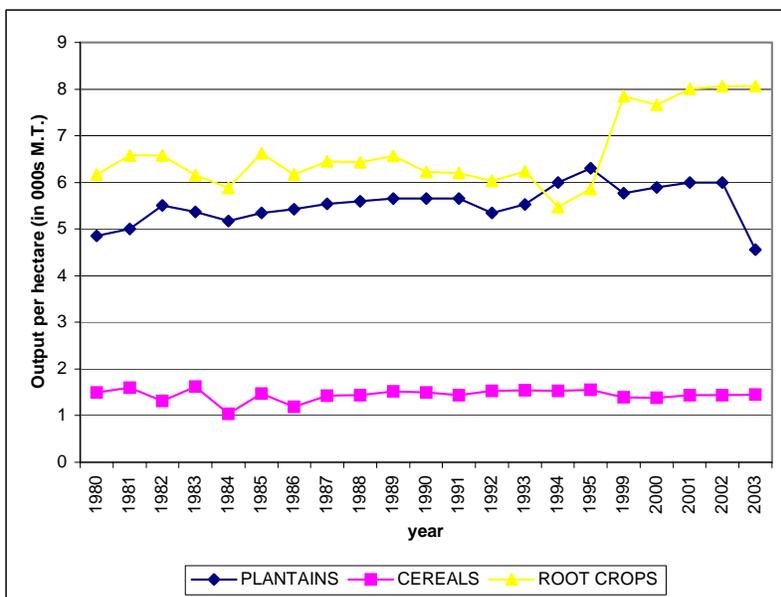


Figure 6: Production per hectare for Plantains, Cereals, Root Crops 1980 - 2003  
 Source: Ministry of Finance, Planning and Economic Development (1996), (FAO 2004).

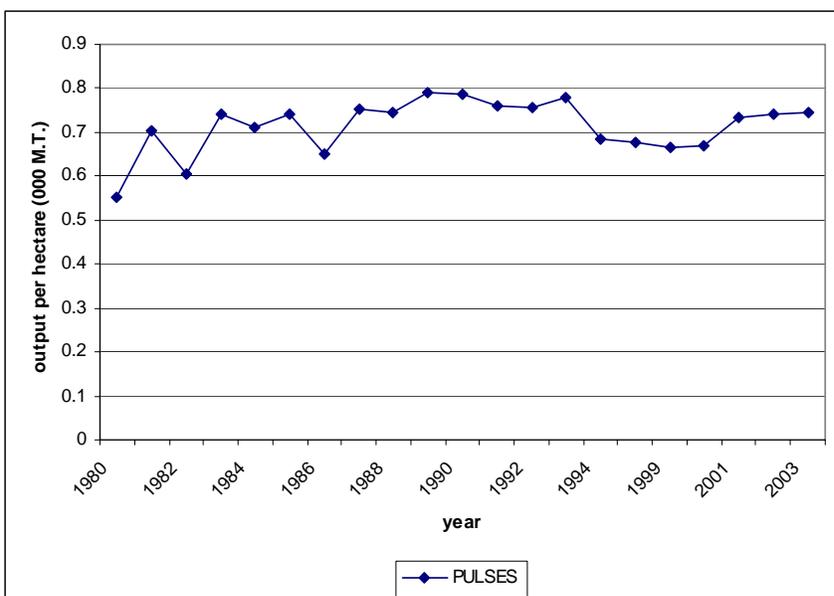


Figure 7: Production per hectare for Pulses 1980 – 2003

Source: Ministry of Finance, Planning and Economic Development (1996), (FAO 2004).

### Poverty levels and Ecosystems

In this section we first present and discuss the estimates and trends of national regional poverty levels. Then we attempt to link poverty levels to the distribution of ecosystems in the country.

#### Poverty Estimates and Trends

Poverty is measured against an absolute poverty line that reflects the monetary cost of meeting certain basic requirements of life. This includes both food and non-food requirements<sup>10</sup>.

Data on the incidence of poverty across regions for the period 1992 – 2003 is presented in Table 2, and the regional trends in poverty over time are shown in Figure 8. The inventories of poverty in 1992 and 1999 are presented in Appendices 1 and 2.

The figures in Table 2 show that the percentage of people living below the poverty line is higher in rural areas in all regions. On the average, poverty levels persistently decreased between 1992 and 2000 in the central, eastern and western regions. In the northern region, poverty levels dropped slightly between 1994 and 1998, and increased thereafter.

<sup>10</sup> In terms of food, the poverty line is USD 0.33 per day, while the non-food requirement line is placed at USD 0.47 per day. The former is used to quantify the hardcore poor, while the latter is the absolute poverty line [Bahigwa & Muramira, 2001].

Table 2: Incidence of Poverty in Uganda 1992 - 2003

YEAR	1992/93	1993/94	1994/95	1995/96	1997/98	1999/00	200/03
REGION							
CENTRAL	44.7	35.6	30.3	30.1	27.7	20.1	22.3
Rural	52.9	43.4	35.9	37.1	34.3	25.6	27.6
Urban	21.2	14.2	14.6	14.5	11.5	7.0	7.8
EASTERN	59.5	58.0	64.9	57.5	54.3	37.3	46.0
Rural	61.2	60.2	66.8	59.4	56.4	39.2	48.3
Urban	42.6	30.5	41.5	31.8	24.8	17.4	17.9
NORTHERN	71.4	69.2	63.5	68.0	58.8	64.8	63.7
Rural	72.7	70.9	65.1	70.3	60.7	66.7	65.0
Urban	49.7	46.2	39.8	39.6	32.6	30.6	38.9
WESTERN	52.5	56.0	50.4	46.7	42.0	28.0	32.9
Rural	53.6	57.4	51.6	48.3	43.2	29.4	34.3
Urban	34.4	24.9	25.4	16.2	19.9	5.6	18.6

Source: Appleton (1999), UNHS 2002/03

As compared to other regions, the northern region has the highest record of poverty. It is worthwhile to note that recorded poverty levels increase in the central, eastern and western regions after 2000.

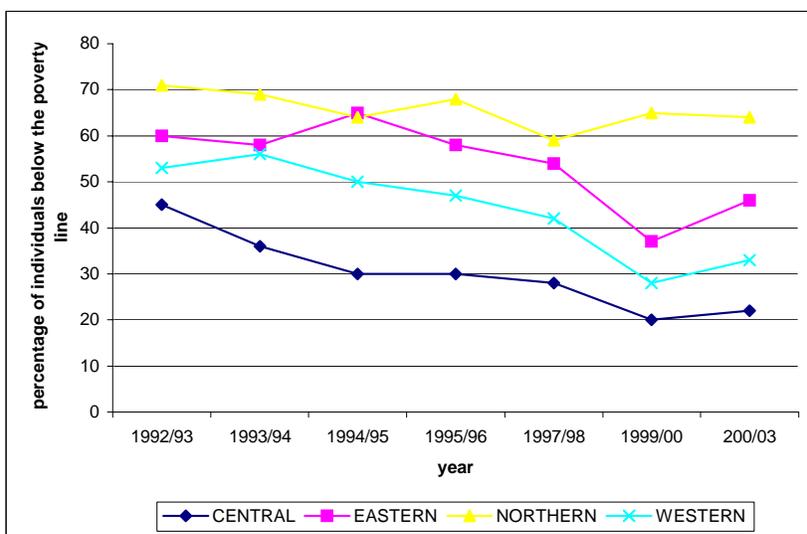


Figure 8: Trends In Poverty Across Regions 1992 – 2003

The reduction in poverty between 1997 and 2000 is attributed to the PEAP implementation. The increase in poverty after 2000 is perhaps a result of the macroeconomic environment. But other factors may be at play. One of the notable features during this period is that GDP growth imparted

significant stress on the natural resource base. This resulted in high levels of resource degradation (MFPED, 2003). GDP growth rates are shown in the Table 3. The key identified problems emerging from this over use of nature's resources are: loss of agricultural productivity; loss of forest cover particularly outside protected areas; water pollution (eutrophication) due to excessive release of residuals; declining resource stocks due to over harvesting and encroachment on wildlife and wetlands. Poor households heavily rely on nature's resources for food, employment, fuel wood, and so forth. Increasing resource degradation implies declining availability and quality of resource to the poor, particularly those in rural areas. This reduces their access to productive assets. This may explain the increase in poverty levels in 2003.

Table 3: GDP, GDP Per Capita and Growth rates (1987 –2004)

Year	GDP (Million US\$)	GDP/Per capita	GDP Growth rate (%)	GDP Per Capita Growth rate
1987-88	3786258	247468	7.3	4.4
1988-89	4020985	255447	6.2	3.2
1989-90	4241117	261878	5.5	2.5
1990-91	4473376	268510	5.5	2.2
1991-92	4639669	269343	3.7	0.3
1992-93	5010004	281156	8.0	4.4
1993-94	5279982	286442	5.4	1.9
1994-95	5807790	304585	10.0	6.3
1995-96	6292700	319029	8.3	4.7
1996-97	6597080	323323	4.8	1.3
1997-98	6888596	326369	4.4	0.9
1998-99	7393862	338643	7.3	3.8
1999-00	7828950	346632	5.9	2.4
2000-01	8274376	354155	5.7	2.2
2001-02	8772644	362986	6.0	2.5
2002-03	9199814	367951	4.9	1.4
2003-04	9836219	380305	5.8	2.2

Source: Uganda Bureau of Statistics

Note: GDP and GDP per capita at factor cost in constant 1997/98 prices.

In Tables 4 and 5 below, we present the estimates of some of the key poverty indicators.

Table 4: Nutrition indicators 1990 – 2003

Indicator	1990 - 1992	2000 - 2002	1995 - 2003
Prevalence of under-nourishment (% of population)	24.0	9.0	
Prevalence of Child Malnutrition (% of children under 5)			
Underweight			22.9
Stunting			39.1
Prevalence of Overweight (% of children under 5)			2.6
Low birth weight babies (% of births)			12

Source: World Development Report, various issues, African Development Indicators various issues.

Table 5: Poverty Indicators 1980 – 2003

Indicator	Year					
	1980	1985	1990	1995	1999-00	2003
Per capita GNI (US\$)		200	320	230	270	510
Life expectancy at birth in years	48	48	47		42	43
Estimated HIV sero prevalence in % of adult population		18.5		8-10		
Infant mortality (per 1000 live births)	116	116	104	91	80	81
Children under 5 mortality per 1000 births		180	165	164	154	140
Immunization measles % of children under 12 months	22	17		74	30	
Immunization D P T % of children under 12 months	9	14	77		46	
Total fertility live births per woman	7.2	7.2	7		6.9	
Unmet need for family planning (% of reproductive age women)				29	36	
Population with access to improved water sources (%)						
Total			44		50	
Rural			40		46	52.0
Urban			80		72	
Population with access to sanitation facilities (%)						
Total			84		76	
Rural			82		72	39.0
Urban			96		96	
Total health expenditures (% of GDP)					5.9	7.4
Public health expenditure (% of GDP)			2.3		1.9	
Gross enrolment ratio (%)						
Primary level		73.2	68.7	74.3	133.9	140.7
Secondary level		10.0	12.5	12.0	16.6	19.7
Tertiary level		0.8	1.2	1.7	2.9	3.2
Adult literacy rate % (age 15 +)		50.9	56.1	61.8	67	68.9
Total spending on education as % of GDP		5.1	1.5	2.5	2.5	

Source: World Development Report (2003, 2004 & 2005); African Development Indicators (2003).

An examination of these estimates shows that infant mortality records persistently declined between 1980 and 2003. Life expectancy also declined over the period. Nutrition indicators show that the proportion of children under age 5 stunted due to malnutrition was still high in 2003.

**Box 3: Some Indicators of Ecosystem Importance to Human well-being in Uganda**

In Uganda, more than 80% of the population are directly dependant on ecosystems for the services enumerated above as shown by the following indicators, among others:

- agriculture is almost entirely rain-fed (very little irrigation);
- there is very limited use of external inputs and soil fertility levels are largely dependant on the capability of nutrient regeneration and recycling by natural processes;
- more than 90% of the population depend on wood fuel for domestic energy including in urban areas;
- emerging economic sectors such as tourism, crafts and art largely depend on the natural attractions (especially wildlife) and biodiversity.

### 3.5 Poverty Levels and the Distribution of Ecosystem Services

In this section we explore the correlations between the distribution of land cover/use, on primary health, education, water, agricultural extension services, local government expenditures and the district wide poverty levels. Data on land cover and use were obtained from the National Biomass Report of 2003. Data on local government expenditures were obtained from the Uganda Bureau of Statistics (UBOS).

The results from the correlation analysis are presented in Table 6. Poverty levels are negatively correlated with hardwood plantations, softwood plantations, and both normal and degraded tropical high forests, wetlands, commercial farms and water bodies. This seems to suggest that districts, which have large coverage of these ecosystems, had relatively lower levels of poverty in 2000. Thus, whether the forest was degraded or not its correlation with poverty levels was negative. This result is not so peculiar since for some of the rural communities access to forest land is the only means of provision of arable land. Further, forest and wetland products (for example fuel wood, medicinal plants, and water) are accessed at little or no cost. This helps to boost household production and consumption, and hence reduce poverty levels.

**Table 6: Correlation Coefficients of Poverty and Land cover/use**

Variable Land cover/use	Poverty level The % of individuals living below the poverty line
Hardwood plantations	-0.17705
Softwood plantations	-0.02418
Tropical High forests (normal)	-0.13574
Tropical High forests (degraded)	-0.28745
Woodlands	0.40028
Bushlands	0.39865
Grasslands	0.38069
Wetlands	-0.11846
Subsistence farmlands	0.19277
Commercial farms	-0.03459
Built up areas	-0.21874
Water	-0.06717
Local Government Expenditure	-0.15163

\* All coefficients were significant at 5%.

The correlation coefficients between poverty levels and bushlands, grasslands and subsistence farmlands were found to be positive. Our interpretation for this finding is that districts for which a

greater proportion farm production was for subsistence had higher levels of poverty. Degradation of land under both subsistence farming and grasslands (grazing lands specifically) may be the key explanation behind this positive association between poverty and subsistence farming and grasslands. The correlation coefficient between poverty levels and the amount of local government expenditure on primary health, education, water and agricultural extension services was also found to be negative. This suggests that districts will bigger allocations of funds for these items also had lower poverty levels.

### 3.6 The Poverty Implications of Controlled Access to Ecosystems

Controlling access to wildlife, forest and wetland ecosystems has been implemented in a number of areas in the country. The main goals of controlled access were to reduce the rate at which these resources are being depleted or degraded and to ensure long term sustainability of the resources. As means of compensating the villages on the fringes of these resources, mutually beneficial concessions and management policies that promote re-investing or plough-back of part of the revenue to local communities were strongly suggested.

A survey was conducted on villages fringing Mabira forest in order to examine the effect of controlled access on poverty. The villages surveyed included Buwoola, Bulyasi and Najjembe. The following were the observations from the field study:

- Household living in these villages were very much aware of the adverse welfare effects of losing forest cover.
- Household were very much aware of the local and global advantages of conserving forests.
- The benefits of controlled access by the National Forest Authority were mainly in form of social infrastructure (building of classroom blocks, etc).
- Between 70 – 80 % of household male heads were unemployed as a result of controlled access.
- Generally from discussions with a number of respondents, household income levels drastically went down as a result of controlled access.
- Local communities were of the view that instead of providing more classroom blocks, their share of revenue collected should be used to help them start minor income generating projects.
- Fuel wood collection rations were small compared to household demand. Households engage in poaching as a means clearing the fuel wood deficit.
- Some households had resorted to growing and trading *miraa* as a means of survival.

Although the new restrictions imposed on the forest resources by NFA could have improved the ecological status of the forest ecosystem, it resulted in increased unemployment, especially among the forest dependant communities. The policy of controlled access, therefore, needs to be reviewed in order for it to incorporate poverty eradication.

## 4.0 ECOSYSTEMS SERVICES AND HUMAN WELL-BEING IN UGANDA: THE LINKAGE

To explain the complex linkages between poverty and ecosystem services, selected poverty – environment indicators are used:

### 4.1 Food security and Incomes

This relates to ability to be adequately and qualitatively nourished . 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 in nourishment terms 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 agricultural productivity. Uganda may face a severe food nourishment problem if it does not increase its agricultural productivity and also start producing more protein based foods. The high population growth rate implies an increasing demand for food which cannot be met under present conditions. One of the primary factors causing loss in soil fertility is soil erosion caused by high rates of water run-off. This is most probably caused by the rapid rate of deforestation.

Another factor of concern is the loss of wetlands which are primary reservoirs of aquatic biodiversity. The decrease in wetlands caused by encroaching agriculture and industrialization may have dire consequences on the presently abundant fish resources in the country. This will not only cause a big loss in income but also diminish a potential source of protein.

Although water 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. At the same time, wetlands, which not only serve as water reservoirs but also as natural water filtration plants, are being lost at a fast rate. The decrease in wetlands coupled with an increase in pollutants in the country's water systems has caused increasing concerns over water quality.

### 4.2 Fuel wood

Although quantitative information on the impact of declining fuel sources on human well-being, particularly the poor was not accessed, available literature indicates that many of the coping measures have serious consequences on basic elements of well-being. The most cited impacts are:

- *some households have coped with the fuel wood scarcity* by reducing the number of meals per day and the frequency of cooking<sup>11</sup>. This has impacted on their ability to be adequately nourished;
- *low compliance to basic environmental health practices* e.g. reduced boiling of drinking water, which increases possibility of water borne diseases;
- *increasing cost* (in form of distance and time) to collect fuel wood, which translates into opportunity cost for schooling children, and lost time for other economic activities for women. In urban areas where poor households depend on the market, increased cost of fuel wood impacts on the proportion of household income spent on energy
- *indoor pollution* has also been reported to be on the increase, as a result of using poor quality of fuel wood. This is one of the leading causes of respiratory tract infections. Some NGOs,

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<sup>11</sup> These are findings from the Uganda Participatory Poverty Assessment Project (UPPAP) survey 1999/2000. UBOS/MFPED 2000.

notably Integrated Rural Development Initiatives (IRDI) are currently exploring mechanisms for monitoring indoor pollution and its effects on health and well-being.

Table 7: Ecosystem services stressed & Constituents of Human well-being threatened / Region

Region	Stressed ecosystem services	Threatened constituents of Human well-being
Central Region	<i>Biodiversity loss</i> : mainly deforestation <i>Food provision</i> : soil degradation, drought & control of pests. <i>Water supply, regulation &amp; purification</i> : wetland degradation, low groundwater supply <i>Fuel (energy)</i> : deforestation & wood deficit districts.	- Almost 50% of children stunted & severely stunted - Prevalence of diarrhea - Wood deficit in many regions - Incidence of poverty mainly 20-25% range
Eastern Region	<i>Biodiversity loss</i> : habitat fragmentation & land degradation <i>Food provision</i> : soil degradation, tsetse fly & control of pests <i>Water supply, regulation &amp; purification</i> : wetland degradation, droughts & floods <i>Fuel (energy)</i> : deforestation & some wood deficit districts.	- Generally food insecure - Prevalence of diarrhea - Wood deficit in a few regions - Low – high areas poverty across districts
Northern Region	<i>Biodiversity loss</i> : land degradation, overgrazing & poaching <i>Food provision</i> : soil degradation, drought <i>Water supply, regulation &amp; purification</i> : recurring droughts & floods <i>Fuel (energy)</i> : large number of displaced persons.	- Generally food insecure, most underweight children - Drought, least access to water; diarrhea - Wood fuel shortage in two districts - Highest incidence of poverty
Western Region	<i>Biodiversity loss</i> : habitat fragmentation, deforestation, hunting & poaching <i>Food provision</i> : land and soil degradation & control of pests <i>Water supply, regulation &amp; purification</i> : wetland degradation, water pollution <i>Fuel (energy)</i> : wood deficit in many districts	- High incidence of child stunting - Incidence of river blindness, drought, prevalence of diarrhea - Wood deficit in many districts - Lower incidence of poverty with higher pockets

### 4.3 Impact of Ecosystem degradation on Human Well-being and Poverty

To assess the impact of ecosystem degradation on human well-being, a number of case studies in selected districts where critical ecosystems are under threat have been reviewed and the underlying causes and effects explored. Box 4 below presents the case study of Bala, Apac district, while Box 5 outlines the main factors underlying the degradation of the Lake Victoria ecosystems. In section 4.3.1, the impact of commercial agriculture and out-grower approaches, are illustrated using a case study of expanding sugarcane growing around Budongo Forest Reserve.

**Box 4: How Deforestation and Conflict have affected the livelihoods of forest dependant communities in Bala Sub-county, Apac district.**

Kulu Obia Forest Reserve, stretching some 210 Ha was gazetted as a central forest reserve in late 1950s, partly for its rich biodiversity, although *terminalia sp* is the dominant species. Kulu Obia forest reserve was a very important source of livelihoods for the Olola Dyang community over the years. The forest reserve indeed sustained commercial charcoal production and in the wake of declining rangelands, livestock grazing. The forest, however, suffered severe damages and lost a large part of its estate during the long periods of civil strife that destroyed the governance structures. After the 1979 war, hundreds of households invaded the forest with some establishing permanent settlements and intensifying agricultural activities. But the climax of deforestation was in 2000 when hundreds of internally displaced persons from various areas (from the Lords Resistance Army War) were settled in the forest reserve. To date, all that exists in the forest reserve are settlements and agricultural activities, with hardly any tree standing in the entire reserve.

The impacts of these illegal activities have been visibly disastrous:

- Charcoal and firewood selling which used to be a source of income for many people has ceased, rendering them jobless;
- Women and children trek long distances in search of firewood, often in isolated areas, exposing them to the risks of abduction by LRA rebels. The opportunity cost is missing school and economic activities;
- Conflicts over land within the forest reserve have escalated – especially with diminishing size of cultivable plots, and as the forest soils quickly lose their productivity having been exposed to continuous cultivation. This results in the need for shifting agriculture.
- livestock grazing has been severely constrained by over-cultivation, hence reduced productivity.
- And, as the trees and vegetation in the forest reserve and the surrounding community got depleted, drought has become more persistent.

A combination of these complex factors account for the increasing poverty in the Olola Dyang community and in the entire Bala sub-county. Moreover, there are concerns that lack of alternative options will only serve to escalate the already severe poverty situation. Two options could help resuscitate the ecosystem and the well-being of communities. The first is securing the forest boundaries and rehabilitating the forest and the second is empowering communities to explore alternative livelihood options. But for this to happen, it will require more than the money. There must be political will to resettle people out of the forest reserve.

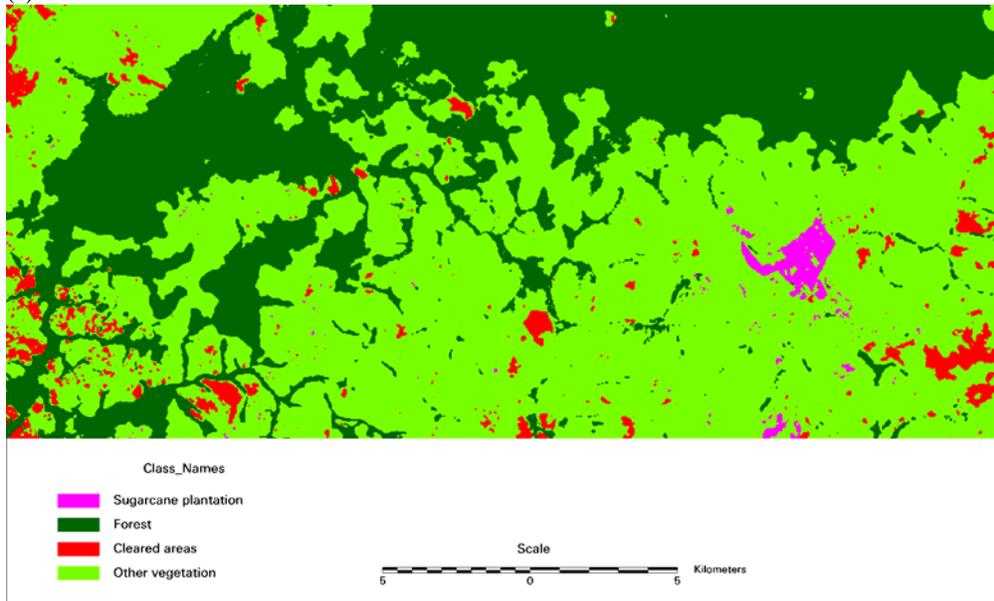
**Box 5: Main Causes of Resource Degradation of the Lake Victoria Ecosystem**

Recent studies have acknowledged the visible decline in resource productivity of the Lake Victoria ecosystem resources. It is argued that the main causes of resource degradation are related to the following issues:

- *Nutrient enrichment and eutrophication*: nutrient enrichment especially with phosphorous and nitrogen have resulted from increasing eutrophication. These are mainly caused by poor farming around the riparian areas, deforestation and dumping of untreated waste and industrial effluents.
- *Unsustainable utilization of wetland resources*: conversion of wetlands into agricultural areas; and infrastructure (in urban areas) as well as inappropriate harvesting of wetland resources have destroyed the wetland capacity to act as buffers for floods; clean up of waste; and to conserve and store water. In addition, the rich biodiversity of wetlands as well as critical habitats for fish have been destroyed.
- *Excessive and destructive fishing pressure*: use of inappropriate fishing techniques & tools, uncontrolled number of fishers, and lack of adequate scientific information on the fish stocks and the general resource potential, are the main problems compounded by inadequate sensitization among fisher communities; poverty; lack of ownership and ineffective regulatory framework.
- *Introduction of alien species*: the main species that were introduced to the Lake Victoria are the Nile perch (*Lates niloticus*) and the Nile tilapia (*Preochromis niloticus*). While these species were deliberately introduced, and have had a high commercial value and boosted the economic returns from fishing, their predatory behavior has left over 200 species of aquatic fauna, mostly endemic ones, at the verge of extinction. The result has been devastating environmental calamities. For instance, according to Twong'o & Sikoyo (2003), the decimation of haplochromines, exacerbated the accumulation of phytobiomass whose decay caused anoxia and accumulation of toxic gases that enhanced eutrophication. And, through competitive displacement, the Nile perch virtually eliminated the major native fish predators viz, *B. docmac*, *C. gariepinus*, *B. altianalis*, *P. aethiopicus* from Lake Victoria, thereby creating the three species fishery in the Lake Victoria.
- *The water hyacinth (Eichornia Crassipes)* has disrupted fishing activities, hydroelectric power generation and transport and has caused water pollution through change of colour. In general, the water hyacinth created suitable environment for invasive weeds; enhanced introduction of disease pathogens and vectors, exposing lake shore communities to biharzia, skin diseases, dysentery and other water borne diseases.
- *Weak community participation* – sustainable management of Lake Victoria ecosystem resources continues to be undermined by weak participation of the principal resource managers and beneficiaries – local communities. There is, thus low sense of ownership, inadequate knowledge and awareness on ecosystem resources management and appreciation of the need for integrated ecosystem management.

4.3.1 Impact of the Sugar-cane induced land use change on the Budongo forest on the ecosystem services and human well-being.

(a)



(b)

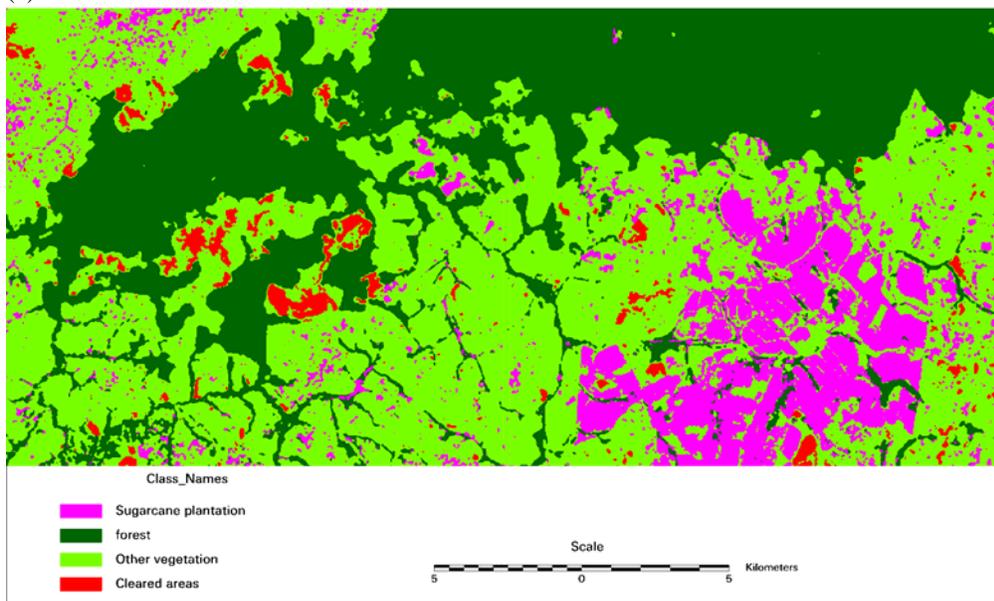


Figure 8: Vegetation cover changes at the southern end of Budongo forest between 1985 and 2002.

Comparing the 1985 vegetation cover to that of 2002, two major differences can be observed. First, the areas covered by sugarcane increased by more than 10 (ten) times. Whereas in 1985 the sugarcane was mainly located in one place, in 2002, in addition to the enormous expansion of the patch that existed in 1985, there are many smaller patches that now occur in the whole area below the forest reserve. Most of this expansion was attributed to out growers, who were attracted by the comparatively high financial returns. Second, the riparian forests, especially below the Siba block (the block on the left side of the map), have been cleared.

With the expansion of the sugarcane plantations, much of the land originally used for subsistence agriculture by the local people was taken up. This has, in turn, encouraged the people to encroach on the riparian forests. A study carried out by Klunne and Mugisha (2001) also reported increased distances traveled to find fuel wood. Some families had even been forced to reduce on the number of meals they had each day due to lack of adequate fuel wood.

The large sugarcane plantations and the Kinyara sugar factory in turn attracted workers from other areas. Interviews with some key informants indicated that there has been unprecedented growth of commercial centers as a result of sugarcane growing, partly due to the influx of unskilled labour to work as cane cutters. With more people, higher pressure was exerted on the available natural resources e.g. fuelwood, craft materials and poles. It has also been reported that the clearing of the riparian forests has caused a lot of siltation into the rivers and streams, a situation that has exacerbated access to clean water. In this regard, there are reports that the Nyabyeya forestry college is having difficulties with its water pump due to increasing siltation of the water sources.

Another aspect worth noting is that the boundary of the main forest has hardly changed. The changes in the forest itself, according to field observations and other classifications (not included in this report), are mainly in reduction of tree cover. A lot of pit sawing, both legal and illegal, has resulted in reduced tree cover. Nearby sources of non-timber forest products have also been degraded and surrounding communities have to go deep into the forest to get useful materials such as firewood, craft materials and medicine that they used to obtain in the areas surrounding the forest and at the forest edges.

These observations, when evaluated against the 10 determinants of human well-being (UNEP & IISD, 2004), it is evident that the land cover/land use changes have had a negative impact on the human well being.

#### **4.4 Rangelands degradation: Threat to the Social capital and Economic base for pastoral communities.**

Rangelands are critical ecosystems supporting the livelihoods of many people through livestock production. Most of the cattle currently in Uganda, are based on rangelands largely in the cattle corridor extending through the districts of Ntungamo, Rakai, Mbarara, Sembabule, Mubende, Luweero, Kiboga, Nakasongola, Masindi, Apac, and the Teso and Karamoja regions. These rangelands have, however, been subjected to severe degradation due to overstocking, resulting in shortage of pastures and water. While the most stressed resources were in the Karamoja region, which suffered from persistent drought yet it receives the lowest rainfall, the situation is getting worse in the districts of Nakasongola, Masindi, Kiboga and Mubende, where extensive areas of savannah woodlands have been cleared of tree cover to produce charcoal, in response to the expanding urban market especially in Kampala (NEMA, 2001, District Environment Reports 2004 for Nakasongola, Masindi, Kiboga and Mubende).

##### **4.4.1 Cultural beliefs and long held traditional values have had both positive and negative influences on the ecosystem-human well-being relationship.**

- *large herds of livestock are kept for social prestige and as capital* to meet social demands such as marriage and traditional ceremonies. Largely because of this, many pastoral communities

are reluctant to reduce stocks to meet the carrying capacity of rangelands; and to transform from too many low productivity breeds to few high productivity breeds being promoted by Government and other interventions. In the Karamoja region, the need to boost the numbers of herds has been at the heart of cattle rustling, which is the main cause of conflict.

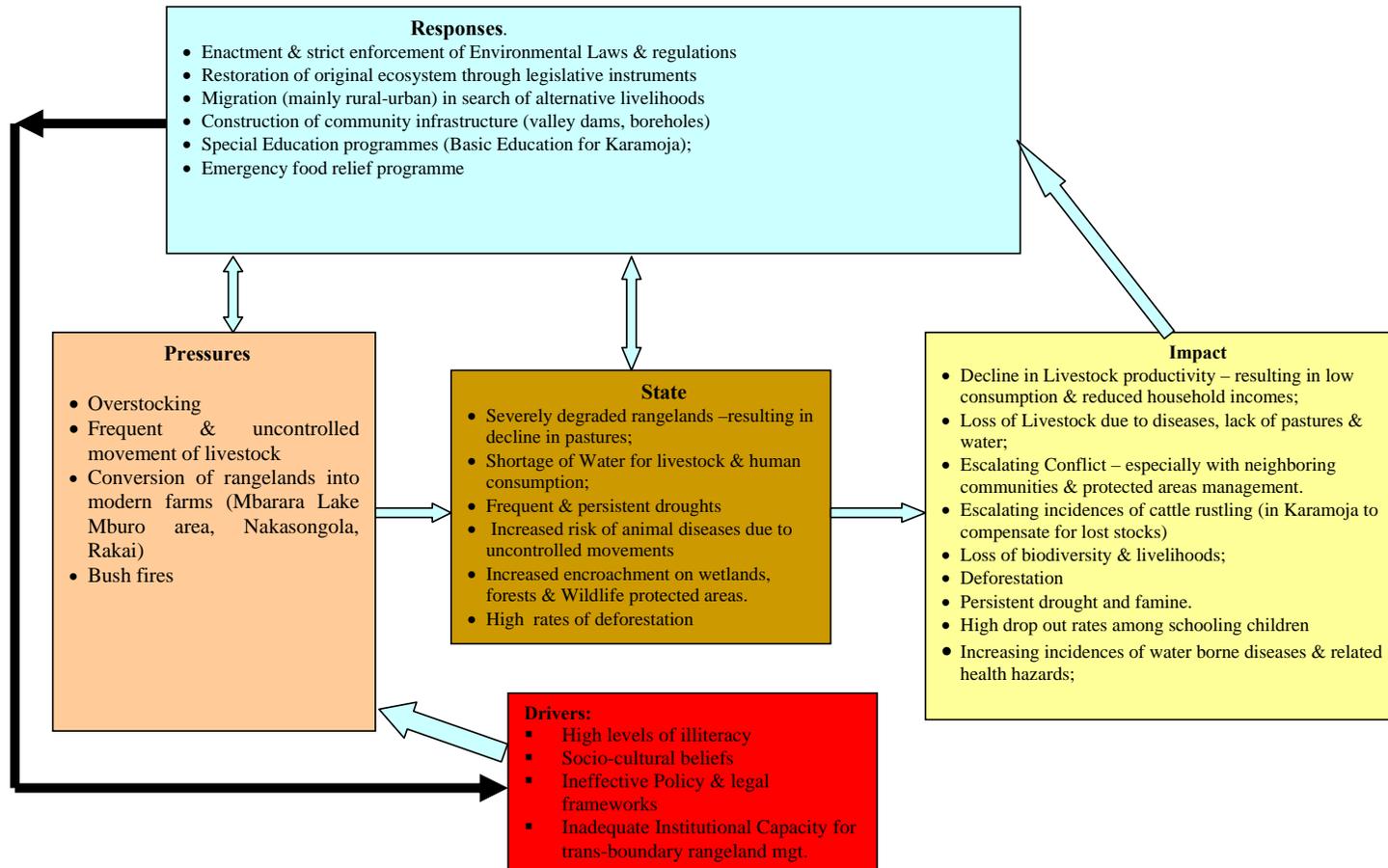
- *inappropriate resource tenure and management of rangelands* – pastoralists traditionally move around in search of pastures and water. The belief in common property resource management, provided few incentives for pastoralists to invest in sustainable rangelands management. Recent interventions to improve property rights and tenure have been met with stiff resistance because they were perceived as intended to restrict livestock producers to particular areas irrespective of their productivity status.
- *Kabanda village, Ngoma Sub-county in Ntungamo district* was categorised as a low consumption area by the UPPAP study (MFPED/UBOS, 2000) because all the households in the village depended on milk and had a low consumption of solid foods. This was attributed to a combination of culture related factors: low production of food crops; declining production of milk which implies less milk for home consumption and for sale to buy food stuffs. Kabanda village residents cut down trees arguing that tree cover reduces grazing land, a situation that has contributed to increasing drought in the area.

***4.4.2 The impacts of these practices/ attitudes on rangeland ecosystems and ecosystem services are increasingly enormous and stressful:***

- Pastoral communities are among those with the lowest safe water and sanitation coverage and low rates of school attendance, among others.
- Decline in productivity and nutritional levels. Reduction in milk production implies reduced incomes and because most traditional livestock producers (pastoral communities) do not grow food, a reduction in milk production further escalates the nourishment problems

The graphical presentation of the causal link between ecosystem services and human well-being among rangeland dependant communities is presented in Figure 9 below.

**Figure 9: Rangelands degradation and Human well-being – Cause-Effect Analysis**



#### 4.5 Summary of constituents of well-being under threat

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 reported in this report. Our preliminary review identified the following critical constituents (Table 9), which appear to be under serious threat among many social groups within Uganda.

Table 9. Summary of Constituents of Human Well-being Threatened

Region	Constituents of Human well-being threatened
Central	Adequately nourished: almost 50% of children stunted & severely stunted Adequate & clean water: prevalence of diarrhea Energy: wood deficit in many regions Ability earn a livelihood: incidence of poverty mainly 20-25% range
Eastern	Adequately nourished: generally food insecure Adequate & clean water: prevalence of diarrhea Energy: wood deficit in a few regions Ability earn a livelihood: variable incidence of poverty across districts – high to low
Northern	Adequately nourished: generally food insecure, most underweight children Adequate & clean water: drought, least accessibility to water; prevalence of diarrhea Energy: wood fuel shortage in two districts Ability earn a livelihood: highest incidence of poverty
Western	Adequately nourished: high incidence of child stunting Adequate & 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.

Source: IISD, 2005.

Uganda has had limited success in improving the four main constituents of well-being linked with ecosystem services. 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.

## 5.0 KEY RESPONSES AND THEIR IMPACTS ON POVERTY REDUCTION AND ECOSYSTEMS SUSTAINABILITY

In this section, responses to shocks and changes in ecosystems are analysed at 2 levels, viz:

- *the intervention response* - through policy reforms and/ or project interventions, to ameliorate the productivity of ecosystems and/ or improve the well-being of the poor;
- *community level* – to identify and assess the adaptive responses (coping strategies) used by the ecosystem dependant population in the wake of declining or changing supply of ecosystem services.

### 5.1 Policy and Regulatory Reforms

Analysis of sectoral policies and legal frameworks indicate a trend of positive reforms over the last 10-15 years, geared towards improving ecosystems conservation and encouraging collaboration and partnership with stakeholders. However, integration of poverty reduction and well-being issues into ecosystems management appears to be very recent, yet with limited impact. The most important policy reforms and regulatory reforms which have implications on poverty and ecosystem services are in the sectors of forestry, fisheries, rangelands, agriculture, wildlife and water, summarised in the following texts.

- **The forestry policy 2001** particularly emphasizes the promotion of private investment in forestry activities. The Sawlog Production Grant Scheme (SPGS) funded by the EU has invested enormous amount of funds and technical resources to facilitate commercial wood plantation development on private and public forest reserve lands. To date, the SPGS which is scheduled to end in December 2006, has facilitated establishment of some 2,700 ha of timber plantations, and it is targeted to reach 5,000 ha, in more than 20 districts in the country. It should be recalled that besides timber production, these plantation forests will provide other ecosystem services. This incentive-based scheme has received good attention including planting on private land. Indeed, some 38% of the area planted so far is private land. In the context of poverty-ecosystem linkages, this commercial tree planting scheme promises, as indeed any other plantation forestry activity, to generate interesting results. For instance, more than 2,200 jobs have been created (including about 300 full time) by SPGS clients alone working on the 2,700 ha planted, which has provided opportunity for increased direct income for poor households. Wood production (timber, firewood) has also been boosted; and the establishment of forest plantations has also generated opportunity for environmental services (notably carbon sequestration).
- **The national fisheries policy 2003** provides for decentralization and co-management of the fisheries resources with the local stakeholders including the poor. As a mechanism to involve local ecosystem managers – the fisher communities, beach management units (BMUs)<sup>12</sup> have been established, and legal power has been delegated to these units to plan and manage the fisheries resources. BMU approach seems to be yielding results in fostering sustainable fisheries management for a number of reasons: the BMU committees are democratically elected by all local stakeholders; representation of the poor and women is guaranteed; they have a clear mandate, a situation that facilitates collaboration

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<sup>12</sup> BMUs are organized entities. All people engaged in fisheries-related activities at an officially gazetted or designated fish landing site organize themselves to form a BMU for purposes of fisheries management. To ensure fairness and all-inclusiveness, a set of criteria has been formulated and legal provisions enacted to guide the formation and operation of BMUs.

with local authorities; and a national network of BMUs has been established, creating avenues for local capacity building and exchange of information. But most importantly, for poverty reduction, BMUs involve the exploited poor fishing crew (locally referred to as *barias*) in the decision making process, and provides avenues for improving their livelihoods.

- **National policy and law on sustainable environmental management:** to operationalise the National Environment policy, a number of legislative instruments have been enacted particularly since 2000. These include regulations on Environment Impact Assessment (EIA), Standards for Discharge of Effluent into Water or on land; regulations on waste management; management of hilly and mountainous areas; regulations on wetlands, river banks and lakeshore management; minimum standards for management of soil quality; and management of Ozone Depleting Substances and Products (ODSs), among others. All these legal instruments are initiatives to protect the environment and enhance certain basic services derived from ecosystems. Many of these, however, remain largely un-effective mainly due to institutional capacity weaknesses and lack of political will. For instance, degradation of river banks continues to cause siltation of the rivers especially river Nile which is a trans-boundary environmental resort; and so is the cultivation of steep hills and mountainous areas and wetlands, which have been encroached as a result of dwindling arable land in the wake of unprecedented population growth and acute land degradation.

**The Water Policy (1995)**, addresses among others, formation of water committees, LGs partnering with user groups in operating, maintaining and managing water systems, LGs (S/Cs) providing water and sanitation services, and protection of natural resources assistance of extension staff. There is a very low level of domestic water supply in the country, with only 40% and 75% coverage for rural and urban areas respectively.

**The Wetlands policy (1995) and the Wetlands Sector Strategic Plan (WSSP)** recognize the central position of wetlands as providers of essential goods and services (food, incomes, water, aesthetic beauty) to local populations. In accordance with the RAMSAR convention, the GoU has adopted the wise use approach. By the nature of the wide public goods and services, wetlands have stakeholder interests. In this respect, the National Environment Act and the Land Act 1998 entrusted all wetlands into the hands of the state to ensure their protection and wise use. These efforts notwithstanding, wetlands continue to face immense pressure from expanding populations and dwindling productive land. Indeed, field observations show unsustainable exploitation of wetlands, and almost only those found within protected areas like National parks are adequately protected. But these constitute a small proportion of the total wetlands' coverage. The other factor that perhaps explains the increasing destruction is the tendency to under-value wetlands. Currently, even the tangible goods and services such as crafts, food, fuelwood, eco-tourism and medicinal plants that are derived from or supported by wetlands do not seem to be well reflected in the national income accounts. Subsequently, attention and public investments to conserve and enhance the services derived from wetlands, are still low.

**The Uganda Wildlife management policy, 1995 and the Wildlife Act 2000:** constitute radical departure from previous policies, as they recognize the user rights of the local communities. Uganda's wildlife is found in both protected areas and outside protected areas. There are 10 National Parks, 12 Wildlife reserves, 14 controlled Hunting areas and 4 wildlife sanctuaries. The management of wildlife in both protected areas and unprotected areas is vested in Uganda Wildlife Authority (UWA). The threats to wildlife management are poaching and impact of settlements and encroachment. However, the tourism sector has continued to grow, with an annual average growth rate of 10% per annum since 1995.

**Solid waste management** in urban areas is appalling, resulting in careless and indiscriminate open-waste-space-dumping, which has created unsanitary conditions on streets and alleys in urban centers.

They have also resulted into pollution of both surface and ground water through the leakages and impairing the permeability of soil as well blockage of drainage systems. This is due to the weak institutional capacity of urban authorities and lack of appropriate incentives to promote cost-effective waste management mechanisms.

**Promotion of private sector investment:** the policy reforms in most of the natural resource sectors (forestry, fisheries, water, land use, wildlife) reflect changing paradigm in natural resources management towards greater stakeholder participation. Of particular implication to enhancing ecosystem services are the recent developments in forest plantation development, forest based ecosystem development, fisheries management and water services delivery.

**Regional Integration:** Uganda is at the centre of some of the most important trans-boundary ecosystems, viz: the Nile basin whose interests transcend the 10 member countries of Burundi, Rwanda, DRC, Tanzania, Kenya, the Sudan, Egypt, Ethiopia, Somalia and Eritrea; and the Lake Victoria basin.

## 5.2 Ecosystem Conservation and Poverty Reduction Initiatives

In the wake of increasing ecosystem degradation and massive loss of biodiversity, a number of policy and programme intervention initiatives have been put in place, as a means to conserve the remaining proportion of nature and to ensure that such resources provide optimal and sustainable benefits to the communities. The most noticeable ones are the stringent legislation and regulatory framework in the sectors of forestry, wildlife and water. In the Wildlife sector, the gazettelement of wildlife zones as protected areas reduced community access to resources they were traditionally entitled to but created opportunities for sustainable, more economically viable and socially acceptable way of resource conservation, if equity is to be respected. Below (Box 6), we cite an example of an ECOTRUST project where the poor have been targeted to benefit from PES initiative.

**Box 6: Tradeoffs in Payments for Environmental Services (PES) – Lessons from Ecotrust Initiative in Ruhinda County, Bushenyi District.**

ECOTRUST is a pioneer in the carbon offsets initiatives in Uganda implementing a pilot project among rural poor communities. The areas selected were mainly adjacent to national parks and other protected areas. The Pilot carbon trade project is being implemented in Bunyaruguru and Ruhinda counties, Bushenyi district. These areas were selected because of the complex natural resource problems that have exacerbated poverty among the farming communities. These areas are also border with the Queen Elizabeth conservation area, and have suffered wrath of problem animals which raid their crops. Ruhinda's hills are virtually bare and the need for innovative approaches to restore the tree cover and meet the people's fuelwood and other tree products needs was high. Hence, in addition to addressing conservation and climate change objectives, the project prioritizes poverty issues.

The carbon trade project promotes tree planting activities in three different tree land use patterns namely woodlots, agro forestry and boundary planting, while also promoting income generating activities such as bee keeping and Silvi-pastoralism. Emphasis has been placed on indigenous native tree species as a way of restoring on-farm tree diversity and building a strong supply of quality tree products to the farmers for their own use and for the market.

Payments are made according to the number of trees planted and the payments are expected to go on for the next ten years. It is assumed that by then the trees will have grown enough so that the farmers would rather wait for better incomes when the trees are mature than harvest them prematurely. TETRA PAK, a European buyer has expressed commitment to purchasing over 7000tc annually. Although initially slow, the response from farmers gradually picked up and has been overwhelming. Some 112 farmers had by beginning of 2005 benefited from this trade.

Considering the fact that the project is still in its infancy, however, having run for only three years, the benefits to the local participants are still limited. But with the seed money provided by the project, the local people have been able to purchase seedlings, land and household items and meet schooling needs for their children.

### **5.3 Impact of Response Actions on Ecosystem Services and Poverty**

As demonstrated in the previous sections, various policy and project interventions have generated remarkable impacts on enhancing ecosystem productivity and poverty reduction. But, a review of selected case studies reveals that some of the interventions are associated with negative impacts, particularly on critical constituents of the poor's well-being and the continued health of ecosystems.

### 5.3.1 Community perspective of Ecosystem Services in the face of Declining Resource Availability

The findings of a study (Nabanoga, 2005), which compares dependency on forest resources for 2 villages around Mabira forest, are summarized in box 7 below.

#### Box 7: Dependency on Forest Ecosystems: Comparative Study of 2 villages

One of the villages (Sanga) is completely enclosed by the forest and rather distant from markets and another (Kisamula-Malube) is located on a forest fringe and more proximate to markets. Kisamula-Malube village surrounds Buttobuvuma forest and is very close to the main road whereas Sanga is an enclave in Mabira forest and is far from the main road.

Products collected from the forested landscape include poles, fuelwood, wood for charcoal making, medicinal plants, fruits and wild food plants, craft materials, timber and fodder. Trees also provide shade and act as boundary markers, as well as sites for beehives. The law allows all people to harvest non-timber forest products from the forest reserve in 'reasonable quantities' for domestic use only, but does not define those reasonable quantities. Any harvesting in forest reserves for commercial use is illegal. The respondents from Kisamula-Malube and Sanga both mentioned and identified 51 and 55 plant species, respectively, that are harvested from various niches within the forested landscape and identified their various uses (Nabanoga 2005).

Most people depend on medicinal plants collected from their landscapes to treat ailments such as stomach-ache, helminthic infections, fever and malaria, wounds, pregnancy-related ailments, and sexual and spiritual related ailments that cannot be diagnosed by doctors within the formal medical systems.

The average reported annual income of the households in Sanga was below both rural and national average incomes (Table 9). That of Kisamula-Malube appears high because of the few individuals whose earnings were reported to be more than 2 million shillings. Removing these individuals resulted in an average income that was almost the same as that of Sanga. Forty four percent of the sampled households earn less than UG.Shs.300, 000 (approx. USD 154) per year.

Table 9: Household annual income (n=80)

Community	Annual household income					
	Lowest		Highest		Average	
	UG.Shs	USD	UG.Shs	USD	UG.Shs	USD
Kisamula-Malube	40.000	21	14.400.000	7.385	1.074.422	551
Sanga	12.000	06	1.200.000	615	320.000	164
National rural					350.000H	180
National total					500.000H	259

H =UBOS -2000

The major livelihood activities include farming (mainly food crops), petty trade, wage labour and gathering materials for handcrafts. Fuelwood collection and beer brewing were only mentioned by residents of Kisamula-Malube while pitsawing and traditional herbalism were only mentioned in Sanga. A comparison of livelihood activities between villages showed a highly significant difference between farming and petty trade in the two villages. There were more petty traders and farmers in Sanga than in Kisamula-Malube. The petty trade in Sanga was mainly within the village.

While the respondents from Kisamula-Malube regarded fuelwood sales as a major livelihood activity, those in Sanga, with less market access, did not mention it as one of the most important activities. Sanga residents have ready access to sufficient fuelwood by virtue of their being surrounded by the forest. Whereas beer brewing was the main income generating activity for the men of Kisamula-Malube, pitsawing was the main income generating activity for the men of Sanga.

Some 84% of the poor households were involved in farming as compared to 53% of the richer households. Although all wealth categories were involved in craft materials collection, the average wealth households were most involved.

Access to the forest resources does not reflect such a strict boundary between the village lands and the forest reserves. Villagers only recognize and respect the boundary of the forest reserve as far as the expansion of agricultural fields is concerned. With regard to collecting forest or tree-based products, villagers do not recognize a boundary between the forest reserve and the village. In many cases the people collect the forest products needed for their livelihoods from the forest reserve, whether it is illegal or not. This does not mean that the villagers do not recognize boundaries for the collection of the different forest products. Rather, the villagers' perceptions of the forest and forest boundaries do not conform to official boundaries. Thus, there are multiple boundaries depending on forested landscape, resource availability and needs.

From this report it is evident that people from both villages are dependant on forest resources for their livelihood. *Stopping them from using the forest is equivalent to denying them survival. There is therefore a need to develop a system where they can use the forest in a sustainable way while conserving the ecosystems there in. Other than prohibiting them from accessing resources from the forest, means of working with them in conserving the forest need to be sought.*

As indicated in the box 7 above this study came to the same conclusion as the recent survey on the impact of controlled access (section 3.6), that while restrictive policies in natural resource conservation may appear to restore the productivity of the resource, they are not sustainable, unless the welfare of the dependant communities are considered and adequately addressed.

#### 5.4 Changing paradigm in Wildlife Management

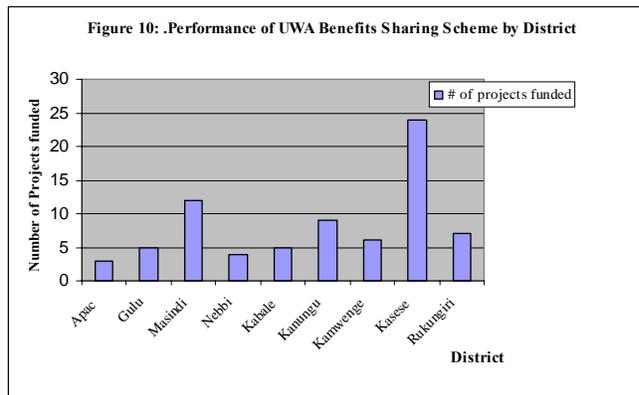
Although protected areas have long been hailed as an important strategy that has assisted to conserve threatened species and maintain pristine ecosystems; as well as boost local and national economies through millions of dollars from tourism and employment, it is being challenged by social advocacy groups on account of undermining the poor people’s livelihoods (Wilkie et al, 2006).

The analysis of UWA’s approaches reveals positive and negative results in two fascinating innovations:

##### **Wildlife Benefit Sharing Scheme- Have the Poor’s Access to Services been Enhanced?**

Since 2000, UWA has been implementing a benefits sharing scheme, in which communities around protected areas (usually all parishes neighboring the PA), receive 20% of all entry fee collections, as provided for in the Uganda Wildlife Act 2000. By the end of June 2005, more than USHs 800 million had been disbursed and close to USH 900 million was on account awaiting disbursement. It should be noted, however, that the scheme has only been implemented in 3 protected areas which have sufficiently good collections, i.e. Murchison falls (4 districts), Bwindi Impenetrable national park (2 districts) and Queen Elizabeth protected area (3 districts). This is largely attributed to large numbers of beneficiaries, a situation that requires sufficient amount to be collected before disbursement is effected.

The graph in Figure 10 below shows the districts where communities around PAs have benefited from the benefits sharing scheme. As shown in the graph, Kasese, Rukungiri, Kanungu and Masindi benefited most, and this is attributed to the number of parishes with proximity to the PA in addition to the level of revenue generation.



Benefit sharing aims at overcoming inequities in wildlife benefit distribution and involves permitting limited wildlife resource utilization, creating employment opportunities for local people, and generating income (Sikoyo 2001). However, the analysis in Table 10 below indicates that very few of the projects directly addressed the livelihood concerns of the beneficiary communities. As shown in Table 10, most of the projects funded were social

services (more than 62% on education and health facilities) which are regarded as normal services to which all citizens are entitled. It is also observed that some projects included public administration (e.g. construction of sub-county offices), which has very remote relationship with poverty at household levels. A possible explanation is that the level of beneficiary participation in decisions regarding the projects to be funded is low. Hence there is need for better targeting of direct livelihood concerns (food, incomes/employment, energy, etc), if the scheme is to be effective.

Table: 10: Projects funded by the UWA Benefits Sharing Scheme (2000 – 2005)

Projects District	Schools	Health Facility	Safe Water	Income Generation	Tree planting & land rehab.	Roads & infrastructures.	Problem Animal control	Others	Total
Apac	3	0	0	0	0	0	0	0	3
Gulu	0	0	0	2	1	0	0	2	5
Masindi	9	3	0	0	0	0	0	0	12
Nebbi	4	0	0	0	0	0	0	0	4
Kabale	5	0	0	0	0	0	0	0	5
Kanungu	4	1	0	1	0	2	0	1	9
Kamwenge	0	3	1	1	0	1	0	0	6
Kasese	9	6	0	1	4	0	1	3	24
Rukungiri	0	0	0	0	1	0	5	1	7
<b>Total</b>	<b>34</b>	<b>13</b>	<b>1</b>	<b>5</b>	<b>6</b>	<b>3</b>	<b>6</b>	<b>7</b>	<b>75</b>

Source: UWA records. December 2005.

### 5.5 Concerns for Agricultural Commercialization

There are concerns that agricultural modernisation is being promoted without sufficient safeguards to environmental sustainability, which could result in a backlash.

**Forestry** – public-private partnerships – no community forestry; serious trade offs without due calculation of cost-benefits in Conversion of natural high value forests e.g. in Kalangala; and the Peri-urban plantation in Namanve – public participation in critical decision processes remains low.

- There are some initiatives especially under the National Agricultural Advisory Services (NAADS) to promote aquaculture, but these are still in infancy, to avail fish protein to many and to alleviate the demand for fish – given the high export value of the capture fish industry. Moreover, as shown in plate 2 below, some of the fish farming are being undertaken without sufficient environmental safeguards.
- Despite the efforts of especially NGOs in promoting agro-forestry and tree planting, wide adoption remains to be seen. Initiatives such as afforestation are particularly complicated, given the difficult trade offs farmers have to make in the wake of land scarcity and lack of information on the economic benefits of tree crops.
- Need for transboundary mechanisms to manage complex ecosystems whose coverage and/ or importance transcend national boundaries.

Plate 2: A fish pond under construction in a wetland in Wakiso district. Despite the protected status of the wetland (in a central forest reserve), such activities are going on unhindered.



## **5.6 Impact of Project Interventions on Ecosystem Services and Poverty - A case of South western Uganda**

In South Western Uganda, soil erosion and degradation remain major productivity challenges to the livelihoods of the high density communities. The majority of ECOTRUST supported projects in the districts of Bushenyi, Masindi, Kabale, Kisoro, Kanungu, Ntungamo and Rukungiri are involved in soil and water conservation.

Studies estimate that 10% of formally arable land in the region has become totally degraded so that it is now permanently out of production and the area of abandoned land is increasing by approximately 3% per year. Only 25% of farm households in the South West highlands practice soil and water conservation technologies. This deterioration of the natural resource base has increased rural poverty, malnutrition and made it difficult to meet basic human needs. The same degradation puts pressure on farmers to encroach adjacent national parks, forest reserves and wetlands. Other land management problems include increased cultivation of fragile steep slopes, overgrazing, bush burning and landslides. The land tenure system associated with the customary type of land holding has also contributed to the major problem of land degradation.

For example, the rainy season used to be a source of misery for every household on the slopes of Igomanda watershed. Water from the hilltop would wash away soil, crops, houses and threaten lives. Recurrent food shortages, lack of water for drinking and domestic use and lack of livelihood options increased the vulnerability of the community.

ECOTRUST supported Africare to implement activities in the districts of Kabale, Ntungamo, Kisoro, Kanungu and Rukungiri aimed at reversing the alarming degradation trend and to provide sustainable natural resource management options that would increase productivity as well as reduce pressure on the threatened rich biodiversity in the protected areas of the Albertine rift. The activities were:

- Dissemination of improved technologies for controlling erosion and increasing soil fertility including crop rotation and terrace construction and maintenance.
- Promotion of economically viable agro-forestry techniques.
- Promotion of fuel-efficient stoves' use, backyard composting, rainwater harvesting and zero grazing.
- Roadside planting and slope stabilisation in conjunction with the roads component.

Over 56,448 people have adopted and utilize skills and technologies that have enhanced the health and livelihood of both people and biodiversity. Over 1,143 hectares of land and 620 metric tones of wood have been conserved. Over 3,000 households are earning incomes from increased productivity arising out of the improved land management practices.

**Table 11: Summary of Responses and Impacts on the Ecosystem-Human well-being balance.**

<b>Ecosystems under stress</b>	<b>Main pressures &amp; areas most affected.</b>	<b>Key Policy and project responses</b>	<b>Impact on Ecosystem sustainability &amp; Well-being of the poor</b>	<b>Emerging Challenges</b>
<b>Agricultural lands:</b>	Soil erosion mainly in densely and hilly populated areas of Kabale, Kisoro, Kasese, Bundibugyo, Mbarara, Ntungamo, Mbale, Sironko & Kapchorwa	Soil and water conservation technologies	- Adoption and utilization of skills and technologies - Enhanced health and livelihood of people - Improved conservation of ecosystems, especially the soil resource	Near absence of a vibrant and sustainable agricultural extension system; low commercialization of agriculture resulting in low access to agricultural credit
<b>Forestry:</b>	Fuelwood, timber & non-timber products e.g. poles are increasingly becoming scarce. Areas most affected include Mukono, Mpigi, Dry forests of Karamoja	- The new forestry policy 2001 that resulted in SPGS and gender integration. - The EU/ Forest Management and Conservation Project assisted developing forest management plans & building capacity for collaborative forest management	Sensitization of forest communities around Budongo and Mabira resulted in reduced encroachment - forest dependant communities have been denied access to forest products & services, resulting in unemployment and illegal entry into the forests.	- Access to forest products remains a critical issue for areas where alternatives have not been provided or are not attractive. -Strict policing of resources has to be maintained.
<b>Wetlands</b>	Water sources have been polluted and/ or destroyed. The mitigating & purifying functions of wetlands are declining. In rural areas, wetland foods & materials. The most districts affected are Kabale, Wakiso, Masaka, Mayuge, Mukono, Jinja. In Kampala and surrounding districts, expanding urbanization that has escalated the demand for high quality clay bricks, cheap land for housing & industrial set-up.	- Wetlands policy & law recognized the multiple uses of wetland ecosystems; put in place management structures at all levels, a situation that has strengthened law enforcement; - IUCN, BTC and other donor supported interventions have intensified awareness about wetland conservation.	- Several wetland ecosystems have been conserved.	- Need for economic valuation of wetlands; -Inter-sectoral coordination still difficult.
<b>Rangelands</b>	- Overstocking and drought in Nakasongola, Sembabule. In Mbarara & Luweero & Karamoja, - In Apac, settlement and expanding	- Building of water dams - Creation of modern fenced farms	- Replacement of grasslands and shrubs with acacia	- Land tenure - Addressing cultural beliefs e.g. value of large herds - Decline in productivity and nutritional levels - Low safe water and

Ecosystems under stress	Main pressures & areas most affected.	Key Policy and project responses	Impact on Ecosystem sustainability & Well-being of the poor	Emerging Challenges
	agricultural land has resulted in resource degradation.			poor sanitation conditions
<b>Water bodies:</b>	Key stresses are lake shore & river banks and watershed degradation. These are prominent on Lake Victoria & River Nile. - Also of concern are water quality, quantity & aquatic biodiversity decline. - Water hyacinth infestation	- National fisheries policy 2003 which resulted in formation of BMUs - Water policy 1995	- Improvement of protection of the rights of the poor - Improvement in coverage of domestic water supply	- Excessive dumping of industrial effluent - Decline in fauna diversity - Increase of water born diseases among fisher communities

## 6.0 CONCLUSIONS AND RECOMMENDED ACTIONS FOR SUSTAINABLE MANAGEMENT OF ECOSYSTEMS

### 6.1 Summary of Observations and Conclusions

The analysis of the ecosystems, ecosystem services and poverty in Uganda, suggests that ecosystems are critical to both human well-being and economic development, at individual, household, community and national level. A number of deductions are made:

***1. Dependency on ecosystem services in light of declining ecosystem services:*** ecosystem services constitute a direct life-blood of the majority of the population. The trend is more direct dependency on ecosystems among rural and peri-urban populations and indirect dependency among a small proportion of the urban populations. In rural areas, for instance, agricultural production continue to rely on rain and therefore climatic conditions; and the soil productivity is generally maintained naturally with few farmers using external inputs. While this would have been expected to trigger change in the ecosystem-human well-being relationship, the dependency on ecosystems is still high, and this largely accounts for the pressures on the ecosystem sustainability.

***All critical ecosystems*** (forests, wetlands, fisheries; agricultural/ arable lands and rangelands) *are severely stressed in all districts*, albeit with some variations. The most affected ecosystems are where population density is high. Poverty incidences are high; where ecosystems are naturally fragile, around urban areas; and where there has been conflict.

***Appropriate Policy and institutional frameworks for sustainable management of ecosystems are emerging*** – over the last 10 years or so, there have been efforts to put in place robust policies and regulatory frameworks for managing ecosystems, although the impacts to date can be described as modest. Weak inter-sectoral coordination, inadequate institutional and human resource capacities and political interference appear to undermine any efforts for sustainable management of ecosystem resources. Structures for natural resource governance at local levels are still very weak. Even though decentralization has taken implementation and resources to lower levels, very little resources trickle down to communities, perhaps except for a few direct interventions.

***Innovations in management and governance of ecosystem resources e.g. economic instruments have emerged but the overall impact on the well-being of the ecosystem dependant poor communities remains arguably low.*** It is clear from literature that two fundamentally divergent opinions exist i.e. those who argue that regulatory frameworks have improved conservation of ecosystems and in effect the welfare of the communities, and those who argue that the local poor communities have not benefited from the gains in conservation and have instead suffered decline in access to essential ecosystem services to which they were historically entitled. Weaknesses in institutional capacity for pro-policy analysis and implementation have arguably contributed to this. This policy and legislative failure is manifested in continued clashes between conservation and communities (e.g. Queen Elizabeth National Park/ Bunyaruguru-Bushenyi communities; Lake Mburo National Park/ and surrounding pastoral communities) The more practical approaches that promise to impact positively on ecosystem conservation and poverty, are the Wildlife benefits sharing scheme and wildlife user rights implemented by UWA; and the emerging payments for environmental services initiatives – mainly that implemented by Ecotrust.

## 6.2 Emerging Issues

In the context of the national long-term development framework (Vision 2020, PEAP,) and the Millennium Development Goals (MDGs), a number of issues of concern have emerged:

### 6.2.1 Economic Sustainability - Industrialization and Commercialization

The industrialization and economic transformation policies pursued by the GoU are undoubtedly well intentioned – to create employment and improve livelihoods of the population, but since most development projects are natural resource based, there is need to bring to the fore, the issue of environmental sustainability. Unfortunately, however, this seems not to be the case. Moreover, much of the environmental damage created by such economic activities is suffered by the poor who are often the least beneficiaries of such projects, The increase in fish processing in response to the demand for fish exports, has contributed immensely to the economy, but has also had devastating effect on the fisheries resources – significant depletion of fish stocks in lake Victoria and other lakes has been associated with the increased number of fish processing plants and subsequently more fishers; and the severe shortage of otherwise cheap fish protein is associated with fish processing and export. Indeed, the “eating of fish bones by the poor” locally referred to as *mugongowazi*, is a widespread complaint for communities around the lake resources and has been in fact a political campaign tool in the 2006 elections.

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### 6.2.2 Water Resources Availability and access:

More than 90% of water in Uganda is drained by the Nile (NEMA, 2003). Although water is perceived to be abundantly available, many of the communities around the main water bodies have no access to safe water. In Adjumani for instance, the main source of safe water is underground (boreholes,) but the areas along the river Nile are the least covered by safe water source due to geotechnical reasons, and rely on dirty and polluted water of the Nile. In the context of production, utilization of water for production (through irrigation) is very low. The other main concern is declining quality and quantity of water due to siltation of rivers (through destruction of river banks) and drying up of feeder streams. Another issue that needs to be addressed is resource monitoring and accounting. Despite the capacity development efforts in the water sector, no information exists on how much water is used for what activity and by who, hence it is difficult to monitor access and availability of water resources to the poor, and to enforce resource accountability measures. This is an issue of concern considering the transboundary interests involved.

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The other concern with regard to access is the intra-district spatial variability, which is not reflected in the access indicators usually used<sup>13</sup>. In Kisoro district, for instance, although statistics reflect a modest increase in safe water coverage from 27% in 1991 to 43.9% by 2004, many parishes are still under 27% (are still at the 1991 level). This is because, a big part of the district (Nyakabande, Murora, parts of Chahi, Nyakinama and Mutanda) have no water sources at all, yet they are hilly. These areas call for specific innovations (e.g. rain water harvesting) to address the problem.

### 6.2.3 Rights and Equity

Recent reforms in some sectors promise to address issues of well-being of the poor such as security of resource and decision making. This issue is largely ignored. The Uganda Land Act (1997) guarantees the rights of the tenants and landless farmers who are squatters, and the Government has put in place measures (a Fund) to compensate landlords. It is hoped that this security of tenure will translate into optimal and sustainable use of land resources to improve livelihoods of the poor. In the forest sector, however, there are concerns that controlled access to these resources has reduced

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<sup>13</sup> MWLE uses aggregate population served and the number of water sources to derive the performance indicator for the sector (% of people with access to safe water). This, however, does not take into consideration the areas within districts that are under- or not served and where large sections of the population have to travel long distances)

livelihood options for some poor communities and exacerbated unemployment. This is especially reported in Mukono district around Mabira forest and South Busoga forest reserves.

Another concern in this regard relates to the need to explicitly address poverty as a conservation strategy. Kisoro district is arguably the richest in terms of biodiversity, but is among the least in terms of the human well-being constituents (e.g. safe water coverage is under 44% and there is food insecurity). There is a tendency for communities around protected areas to be among the poorest – e.g. Murora subcounty which neighbours Echuya forest, has no safe water. This study agrees with Wilkie et al (2006) who voice concerns about the role of protected areas management in poverty eradication, and calls for longitudinal studies to track changes in human welfare indicators over time for people around protected areas. This information will assist to refocus policy reforms towards more pro-poor ecosystem conservation approaches.

#### **6.2.4 Drought and Desertification**

The massive clearing of drought resistant indigenous shrubs and tree cover to meet charcoal demands and fuel wood demands (especially in Nakasongola, Apac, Masindi, Luweero, Kiboga, Kayunga) and conversion of rangelands into modern farms in the rangelands of Mbarara, Rakai, Masaka and Sembabule, has escalated drought conditions and desert-like conditions. This situation is severely impacting on the ability of the poor people especially in these zones, to be adequately nourished; access incomes; and other aspects of well-being. And, the uncontrolled destruction of wetlands and destruction of watersheds are further exacerbating drought by reducing the ecological capacity of the wetland ecosystems to naturally moderate the microclimate. While the efforts of the Government (Wetland Inspection Division) are commendable, they are unlikely to be effective without clearly addressing the livelihood needs of the poor communities.

As the most immediately vulnerable ecosystems to the looming desertification are the rangelands, the most critical issue of concern is how to control overstocking, and to promote sustainable practices. It must be appreciated that the current initiatives in expanding access to water for livestock is unlikely to control livestock movements if no rains will fall to fill the dams and if there are no pastures. It should also be noted that management of carrying capacity, common property management concerns, etc are of prime importance. In case of Mburo, the attempts to remove indigenous drought resistant vegetation cover have resulted in threats of desertification.

#### **6.2.5 Green Accounting – monitoring natural capital utilization**

Although significant progress has been made in reflecting on the state of environmental resources through the regular preparation of national and district state of environment reports, there is still no mechanism to take stock of what has changed. The regular stocktaking will not only assist us see the balance sheet but also trace where and how the poor are benefiting from the utilization of the natural capital. This review can then be used to inform policy and project design. The Government/development partners/ stakeholder joint sector reviews presently organized regularly do not seem to address the issue of resource accounting. For instance, waste discharge permits and pollution levies were introduced in the water sector but a review of the Joint Water & Sanitation sector documents did not reveal any statement on how the performance of such levies in restoring the water quality or compensating the poor people who suffer the effects of water pollution. Nonetheless, these institutional initiatives could be used as important starting forums to kick-start the debate. The other critical issue is the need to develop appropriate tools and instruments and develop capacity to apply them. Instruments such as strategic environmental assessment (SEA) and environmental audits need to be considered.

In addition to taking stock of our natural capital, there is need to establish thresholds at which interventions should be taken. For example, evaluate the contribution of forest cover reduction to GDP increase and determine when and how much should be ploughed back. There would also be need to establish the maximum forest resource to be harvested and how much area under forest cover should be cleared within a year.

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### 6.2.6 Knowledge management:

Although a lot of information exists or has been generated on various components of ecosystem services and human well-being, policy formulation, analysis and implementation processes are yet to be grounded in reality. Evidence based decision making for complex issues like ecosystems management should benefit from not only information generated locally but also take advantage of the opportunities created by increasing global networks. The information generated has yet to move from the libraries of research institutions and ministry boardrooms to inform the debate on conservation and well-being, as well as trigger positive reforms in policy and project interventions. Quite clearly, the current developments in politics, economics and social transformation present worrying situations

– There is more emphasis on economic growth and only lip service is paid to ecosystem sustainability  
- The challenge for technocrats and scientists in this regard is to translate the many disjointed information pieces into questions and answers for how the economic growth advocated by politicians will be increased and sustained through better ecosystems management.

For instance, despite the widely acknowledged fact that the Lake Victoria ecosystem has been widely studied over the last four decades or so, and the fact that disastrous impacts of ecosystem degradation are already being felt, questions still remain among top decision makers who continue to push for greater economic investments, often at the expense of ecological sustainability. Moreover, many such investments lack the long term measures for cushioning the poor communities that depend on such ecosystems. Thus, *focus needs to shift from mere knowledge generation to managing knowledge in an impact-driven way.*

An important aspect of knowledge management is the need to recognize and integrate indigenous knowledge in ecosystems management. Knowledge of ecosystem services is central to valuation of ecosystems and hence their sustainable management. The most critical ecosystem services that are affected by degree of knowledge is medicine and cultural attachment. Poor people, especially those around forests, wetlands, etc, hold a wealth of knowledge, which is threatened by inability to pass it on. Recent initiatives in documenting ecosystem resources<sup>14</sup>, importance and critical habitats constitute a positive step but scope and dissemination of such information remains low.

**6.2.7 Holistic approach to water resources management is yet to evolve** – although considerable investments have been made in the water and sanitation sector, the focus of public investments has been on increasing access to safe water and building operation & maintenance (O&M) capacities – with little consideration of watershed protection, which is the main threat to sustainable productivity of water sources.

### 6.2.8 Trans-boundary natural resources management/ governance:

Uganda is centrally positioned in terms of regional ecosystem networks, often serving as a source, sink/ outlet or central distribution centre for ecosystem dynamics. Ecosystems with trans-boundary elements where there is increasing level of conflict related to declining ecosystem services include:

- a. **River Nile basin resources** – More than 95% of Uganda’s water resources lie within trans-boundary watersheds of River Nile<sup>15</sup>.
- b. **Lake Victoria** supports aquatic and terrestrial biodiversity on which the livelihoods and economies of millions of riparian communities across the East African region and other

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<sup>14</sup> One example is the “*Useful Trees & Shrubs for Uganda*” published in 1995 with the assistance of Swedish International Development Authority (SIDA).

<sup>15</sup> MWLE, October 2005. Review and Sector Performance Assessment Report. Fifth Joint Government of Uganda/ Development Partners’ Sector Review of the Water and Sanitation Sector in Uganda.

basin countries of Burundi and Rwanda are based. It is also a water reservoir from which the Nile River's main flow originates to the Sudan and Egypt. But the utilization of its resources at different levels remains largely unquantified; degradation and changes in quality not sufficiently monitored; and potentials for optimal utilization to improve the well-being of riparian communities not yet explored at micro-levels.

- c. **Forest and Wildlife ecosystems** –one of these ecosystems is the Mt Elgon forest ecosystem that covers part of eastern Uganda and western Kenya highlands. It supports the well-being of millions of people on either side, which include the Bamasaba/ gishu/Luhya, Kupsabiny, Itesot, Basamya – Bagwe and others. It's also a critical watershed for the Lake Victoria. The diversity of direct and indirect services provided by this ecosystem perhaps, more than any other factor, accounts for the high population density in this zone. Despite the recent interventions such as the Integrated Conservation and Development projects (ICDP) implemented in the 1990s, and policy initiatives to gazette a big proportion as a protected area, human pressures especially on the Ugandan side continue to escalate. It is hoped that the new Trans-boundary Ecosystem management approach, through the Mt Elgon Regional Ecosystem Conservation and Development Programme (MERECP) will address these concerns. Other transboundary forest ecosystems include the Bwindi and Mgahinga protected areas; the Rwenzori ranges; and the Sango bay forests in Rakai shared with Tanzania.
  
- d. **Management of rangelands** – Pressures on rangelands has often manifested in conflicts especially in the southern districts of Rakai and Mbarara (with Tanzania's Karagwe region); and more prominently in the North eastern region of Karamoja with the Turkana of Kenya, the concerns in this regard, involve livestock and human diseases as well as other human well-being aspects such as declining incomes, nourishment and education.

Uncoordinated management of transboundary resources has been reported to be a serious problem. For instance, Wakhungu and Sikoyo (2003) reported that it was responsible for over-harvesting and degradation of forest resources in the Minziro-Sango Bay Swamp forests in Southern Uganda. The forest which is shared with Tanzania provides forest resources such as timber (especially *P. Usambensis* species) and non timber forest products used for making baskets and other crafts.

While there is increasing recognition of the need to address trans-boundary issues and a number of regional interventions are underway, response actions remain at much higher levels while little is done at the local levels where active interactions between ecosystems and human well-being occur, except perhaps the recent MERECP which seeks to develop an ecosystem-wide intervention.

### 6.3 Challenge encountered

**Most available information is aggregated to district or regional level.** Information at ecosystem level was missing in most reports that we accessed. This hindered us from pinpointing specific ecosystems that are threatened. There is, therefore, need to generate ecosystem specific information in the areas where interventions are to be implemented.

## 6.4 Recommendations for Improved Ecosystems Productivity and Sustainability

### 6.4.1 General Recommendations

Reforming the *ecosystem management paradigms to promote equitable, productive and sustainable* utilisation of ecosystem resources. This is needed to enhance the services to the poor—particularly in the management of wetlands; rangelands; natural forests and water resources. As Brockington *et al*, 2006 indicate, analysis of community conservation schemes has to consider both the distribution of benefits to people as well as the local people's impact on nature and biodiversity.

### 6.4.2 Policy level Strategies/ actions

*Improving the understanding of ecosystem-human well-being linkages*: there is need to generate relevant information; and to put in place an appropriate strategy for information management. There are indications that a lot of information exists about ecosystems, poverty and well-being but in most studies, these aspects are considered independently. There is, therefore, need to centralize this information and translate it into workable policy strategies.

- *Strengthen the institutional framework for sectoral coordination* – the complex nature of ecosystem-human well-being linkages requires inter-disciplinary approaches and strategies. To achieve this, political will at the highest level, which could involve institutional restructuring, is required.

- *Strengthen local community based institutions for promotion of sustainable management of ecosystem resources* – Due to lack of proper governance at community level, the local community's share of revenue from protected areas is placed at the district offices. In the process of transferring it to the communities, much of it is lost in administration. Decisions made at the district level of how the money should be used are also not well informed since, as observed in this study, they have summarised information e.g. of which ecosystems are stressed. If institutions at local community level were equipped to directly receive, plan for and utilise these resources, much more would be done with the generated revenue.

*There is need to generate consensus on how to improve the conditions of the poor communities in/ around protected areas and other critical ecosystems* i.e. to inform appropriate policy reforms as well design intervention projects. In this regard, detailed and focussed studies are needed to generate scientific evidence on whether the well-being of the poor communities in/ around protected areas has been improved, by tracking changes over time based on locally relevant poverty-ecosystem-welfare indicators.

A participatory way of agreeing on how to use the conservation area generated revenue is needed. This will enable the planners to place funds where they are most needed. In case is the building of schools and health centres for migratory communities who would later abandon them.

*Strengthen the framework for sectoral coordination* – to promote integrated and holistic policy/ programme design and implementation.

*Evidence based policy formulation and programme/ project design* – will assist to better targeting of the poor in enhancing ecosystem services. An example of good practice in this regard is the Kampala Urban Sanitation Project (KUSP), in which beneficiary communities/ areas were selected on the basis of six basic criteria which are all poverty-environment indicators, viz: cholera attack rates; sanitation coverage; water coverage; population density; housing and poverty indices.

*Need to prevent rapid conversion of forest land and other natural vegetation* - From the correlation analysis between poverty and land cover/use, districts with larger endowments of forests, wetlands, water sources, etc seemed to have lower numbers of people below the poverty line. This suggests that ecosystems distributions are significant determinants of poverty levels. There is, therefore, need to improve on the methods used in agricultural production, in order to reduce the rapid conversion of forest land and other natural vegetation into arable land. The PMA is desirable effort towards this end.

#### **6.4.3 Interventions at micro-level**

Identified/ suggested appropriate interventions that can both improve ecosystems and human well-being;

(i) *Small scale Irrigation* – there are indications that prolonged droughts will continue to recur if the current trends in climatic conditions continue. To enhance the productive utilisation of land in arid and semi arid areas which are mostly affected, there is need to establish small scale irrigation schemes, with smallholder farmers organised and empowered to manage the schemes sustainably. The districts of Pallisa, Bugiri, Soroti, Nakasongola, and Apac should be targeted, partly because this is where high potential for irrigation exists. This would boost production of cereals e.g. rice and maize as well as vegetables to enhance food security and increase household income.

(ii) *Explore options of block farming e.g. where several families would agree to consolidate land and harness the economies of scale in production and marketing.* This would enable communities to access technical support and resources for mechanisation. These options will, however, require policy support and a governance framework that is willing to implement the agreed upon options.

(iii) *Creating non-agricultural employment opportunities* – the most serious cause of deforestation and other ecosystem degradation is conversion of areas into agricultural land e.g. in Kabale, Mbale, Sironko, Kasese and Kisoro.

(iv) *Micro-projects in new and renewable energy* – areas around forests and areas where energy demand far exceeds the supply. The districts that should be prioritised are Kabale, Mukono, Mbale, Wakiso, Mayuge and Iganga. In these areas, rural energy interventions are likely to have visible impact on reducing the pressure on forests; improve the health of women (effects of indoor pollution); and increase free time for women and children to engage in productive work. Monitoring the performance of such projects will, however, require baseline data on the indicators.

(i) *Design and implement integrated watershed management projects* focusing on resuscitating critical watersheds especially in highlands, lake Basins, river line and montane forest ecosystems. The most critical areas are the Mt Elgon (Mbale, Sironko, Kapchorwa); South Western Highlands of Kabale, Kisoro, Kasese and Bundibugyo; riparian areas around Lake Victoria, especially where Lake Basin forests are threatened like Jinja, Mukono, South Busoga, Mpigi, Wakiso, Luwero, Rakai and Masaka. The integrated approach to watershed management will ensure that interventions in agro-forestry, soil and water conservation, afforestation, agricultural modernisation, etc, will address all aspects of livelihoods i.e. satisfy demand for food production, energy, incomes; achieve sustainable ecosystem conservation and empower local communities – who are the principal ecosystem managers. Microprojects under the UNEP/ NEMA project should be implemented around Mabira forest; South Busoga areas of Mayuge and Iganga.

- (ii) *Micro projects in sustainable water resources management* – this should cover access to safe water and water conservation e.g. rain water harvesting technologies. Rain water harvesting technologies should be promoted in areas of steep terrain to conserve water but also as a control measure for soil erosion caused by rain runoff (Kisoro and Mbale districts). Kisoro district is of particular concern because of low safe water coverage (43.9%) and very low functionality of safe water facilities<sup>16</sup>.
- (iii) *Promotion of value addition and domestication of locally valued plant resources whose habitats are threatened and/ or whose regeneration capacity has declined.* To conserve useful but threatened species, there is need to inventory species of critical importance to human well-being, including medicinal and cultural values, analyse the pressures they face, and devise options for conserving them. Part of the strategy could be promoting their domestication (i.e. cultivation outside protected areas) and promote value addition in terms of good practices in harvesting. The suitable sites are around Mabira and Budongo forests, as well as Mt Elgon and Sango bay forests and in Mpigi.

**“We do not realize the value of Water until the well is dry”, Benjamin Franklin**

**“ To eradicate poverty and protect our ecosystems and biodiversity, we must use the opportunities nature gives us today in a way that does not reduce our benefits from nature tomorrow” ,Børge Brende, Minister of Environment, Norway & Chair of the 12<sup>th</sup> Session of the UNCSD.**

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<sup>16</sup> According to the Kisoro DSOER, 2004, only 1 out of 13 boreholes in the district (7.7%) was functional due to problems of operation and maintenance.

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## Appendices

### Appendix 1: Poverty Levels by District 1992

Region District	Head count index: Percent individuals below poverty line	Poverty Gap as percent of poverty line	Gini Coefficient Inequality Measure	Total number of individuals in 1992	Estimated number of poor individuals in 1992
<i>Central reg.</i>					
<b>Kalangala</b>					
Rural	31.46	8.66	0,32	14,207	4,469
Urban	44	12	0.32	1,322	759
<b>Kampala</b>					
Urban	15	3	0.38	711,737	105,892
<b>Luweero</b>					
Rural	55.92	18.33	0,30	403,898	225,840
Urban	47	13	0.30	29,256	13,709
<b>Masaka</b>					
Rural	51.74	16.04	0.29	749,541	387,824
Urban	32	9	0.33	73,986	23,882
<b>Mpigi</b>					
Rural	51.49	17.35	0.34	754,594	388,560
Urban	19	5	0.33	132,351	24,996
<b>Mubende</b>					
Rural	64.16	23.52	0.32	450,140	288793
Urban	40	11	0.30	30,006	11,938
<b>Mukono</b>					
Rural	48.67	15.43	0.31	705,090	343,148
Urban	25	6	0.29	96,176	23,839
<b>Rakai</b>					
Rural	59.91	20.00	0.28	363,111	217,537
Urban	18	4	0.34	13,959	2,461
<i>Eastern reg.</i>					
<b>Iganga</b>					
Rural	63.92	23.13	0.30	882,613	564,210
Urban	24	7	0.38	41924	9,964
<b>Jinja</b>					
Rural	38.84	11.90	0.33	203,322	78,974
Urban	31	10	0.35	76249	23,600
<b>Kamuli</b>					
Rural	70.16	27.35	0.31	461,476	323,750
Urban	34	12	0.40	6,944	2,340
<b>Kapchorwa</b>					
Rural	54.31	17.68	0.31	108,932	59,166
Urban	48	16	0.35	4,306	2,046
<b>Kumi</b>					
Rural	82.29	36.81	0.30	210,527	173,244
Urban	47	18	0.44	11,133	5,248
<b>Mbale</b>					
Rural	55.91	18.80	0.31	640,986	358,390
Urban	47	19	0.41	56,408	26,277
<b>Pallisa</b>					
Rural	62.58	22.33	0.30	347,196	217,270

Region District	Head count index: Percent individuals below poverty line	Poverty Gap as percent of poverty line	Gini Coefficient Inequality Measure	Total number of individuals in 1992	Estimated number of poor individuals in 1992
Urban	50	18	0.37	2,743	1,373
<b>Soroti</b>					
Rural	77.70	33.62	0.32	356,408	276,945
Urban	43	14	0.38	44,180	18,785
<b>Tororo</b>					
Rural	62.29	22.61	0.31	480,915	299,547
Urban	45	16	0.38	60,894	27,195
<i>Northern re</i>					
<b>Apac</b>					
Rural	67.92	24.56	0.30	440,757	299,358
Urban	60	20	0.32	5,540	3,308
<b>Arua</b>					
Rural	63.19	18.86	0.25	599,995	379,145
Urban	59	22	0.36	24,193	14,216
<b>Gulu</b>					
Rural	75.54	32.58	0.34	289,151	218,431
Urban	41	13	0.35	35,061	14,287
Kitgum					
Rural	91.47	47.53	0.30	328,926	300,854
Urban	63	22	0.33	15,089	9,481
<b>Kotido</b>					
Rural	91.16	46.23	0.29	153,315	139,754
Urban	66	26	0.38	8,702	5,753
<b>Lira</b>					
Rural	68.92	25.66	0.31	465,042	320,501
Urban	40	13	0.38	25,700	10,235
<b>Moroto</b>					
Rural	86.71	42.95	0.34	153,244	132,883
Urban	46	16	0.41	11,567	5,311
<b>Moyo</b>					
Rural	70.09	24.54	0.28	158,927	111,393
Urban	61	23	0.37	10,549	6,403
<b>Nebbi</b>					
Rural	83.60	36.50	0.29	286,543	239,563
Urban	44	14	0.35	22,535	9,856
<i>Western reg.</i>					
<b>Bundibugyo</b>					
Rural	55.04	22.42	0.35	101,405	59,869
Urban	37	12	0.40	8,771	3,207
<b>Bushenyi</b>					
Rural	48.96	15.46	0.30	709,940	347,593
Urban	34	9	0.30	13,502	4,658
<b>Hoima</b>					
Rural	55.76	22.60	0.38	187,024	104,278
Urban	31	10	0.32	4,173	1,277
<b>Kabale</b>					
Rural	57.59	21.32	0.34	381,102	219,468
Urban	34	10	0.38	27,449	9,278
<b>Kabarole</b>					
Rural	56.10	20.32	0.34	691,705	388,014
Urban	42	13	0.34	32,500	13,650

Region District	Head count index: Percent individuals below poverty line	Poverty Gap as percent of poverty line	Gini Coefficient Inequality Measure	Total number of individuals in 1992	Estimated number of poor individuals in 1992
<b>Kasese</b>					
Rural	52.90	20.44	0.38	293,047	155,011
Urban	21	6	0.35	38,709	8,424
<b>Kibaale</b>					
Rural	65.64	29.20	0.40	208,893	137,114
Urban	40	11	0.31	2,215	885
<b>Kisoro</b>					
Rural	70.53	27.38	0.30	174,947	123,393
Urban	58	21	0.34	6,919	3,997
<b>Masindi</b>					
Rural	66.22	28.63	0.37	220,130	145,769
Urban	33	10	0.34	8,431	2,749
<b>Mbarara</b>					
Rural	46.59	14.38	0.30	862,019	401,621
Urban	24	6	0.32	41,593	9,871
<b>Rukungiri</b>					
Rural	67.40	26.17	0.32	368,754	248,531
Urban	41	12	0.31	12,145	5,007

Source: The Uganda Bureau of Statistics, 2005

**Appendix 2: Rural Poverty Levels by District 1999**

<b>Region District</b>	<b>Head count index: Percent individuals below poverty</b>	<b>Poverty Gap as percent of poverty line</b>	<b>Total number of individuals in 2000</b>
Central Region:			
Kalangala	35	12.5	34,766
Kampala	<20		1,189,142
Luwero	25	<10	478,595
Masaka	25	<10	770,662
Mpigi	<20	<10	407,790
Mubende	35	<10	689,530
Mukono	35	12.5	795,393
Rakai	25	<10	470,365
Eastern Region:			
Busia			225,008
Iganga	25	<10	708,690
Jinja	25	<10	387,573
Kamuli	35	<10	707,332
Kapchorwa	35	<10	190,391
Kumi	55	17.5	389,665
Mbale	35	<10	718,240
Pallisa	35	<10	520,578
Soroti	45	12.5	369,789
Tororo	35		536,888
Northern Region:			
Apac	75	22.5	683,993
Arua	65	22.5	833,928
Gulu	35	12.5	475,260
Kitgum	>80	37.5	282,375
Kotido	>80	>40	591,889
Lira	55	17.5	741,240
Moroto	75	37.5	189,940
Moyo	75	37.5	194,778
Nebbi	65	22.5	435,360
Western Region:			
Bundibugyo	55	22.5	209,978
Bushenyi	35	<10	731,392
Hoima	35	12.5	343,618
Kabale	45	17.5	458,318
Kabarole	35	<10	356,914
Kasese	65	32.5	523,033
Kibaale	25	<10	405,882
Kisoro	<20	<10	220,312
Masindi	55	22.5	459,490
Mbarara	<20	<10	1,088,356
Rukungiri	<20	<10	275,162

Source: The Uganda Bureau of Statistics, 2002 & 2005

**Appendix 3: Estimates of the Proportion of Land Area Affected by Soil Erosion in Selected Districts**

	District	Total Land Area (ha)	Estimated Area Affected by Soil Erosions		Population Density (Pple/sq.km)	Main Causes of Soil Erosion
			(Ha)	(%)		
1.	Kabale	165,300	148,770	90	250	Slopes, population pressure, deforestation, poor farming, vulnerable soil
2.	Kisoro	66,200	56,270	85	279	Slopes, population pressure, deforestation, poor farming, vulnerable soil
3.	Mbale	250,400	200,320	80	282	Slopes, population pressure, deforestation, poor farming, vulnerable soil
4.	Rakai	388,900	311,120	80	98	Vulnerable soils, poor farming, overgrazing
5.	Kotido	1,320,800	990,600	75	14	Overgrazing, bush burning, vulnerable soils
6.	Kasese	272,400	163,440	60	126	Slopes, vulnerable soils population pressure, overgrazing, poor farming
7.	Nebbi	278,100	166,860	60	114	Slopes, vulnerable soils, deforestation, population pressure
8.	Moroto	1,411,300	846,780	60	12	Overgrazing, bush burning, vulnerable soils
9.	Masaka	551,800	275,900	50	151	Slopes, population pressure, vulnerable soils, poor farming
10.	Mbarara	1,058,700	529,350	50	88	Deforestation, bush burning, overgrazing, poor farming, vulnerable soils
11.	Bundibugyo	209,700	83,880	40	55	Slopes, population pressure, deforestation, poor farming, vulnerable soils
12.	Luwero	853,900	341,560	40	53	Overgrazing, bush burning, vulnerable soils
13.	Rukungiri	258,400	77,520	30	150	Slopes, population pressure, deforestation, vulnerable soils
14.	Kapchorwa	173,800	52,140	30	67	Slopes, deforestation, poor farming
15.	Mpigi	448,600	112,150	25	204	Overgrazing, bush burning, vulnerable soils
16.	Arua	759,500	151,900	20	82	Slopes, vulnerable soils, population pressure, overgrazing, poor farming
17.	Bushenyi	490,600	981,200	20	149	Slopes, vulnerable soils, deforestation, population pressure, overgrazing
18.	Kabarole	810,900	162,180	20	91	Overgrazing, vulnerable soils, poor farming, deforestation
19.	Masindi (Rift Valley)	845,200	169,090	20	33	Vulnerable soils, bush burning, vulnerable soils

Source: NEMA (2001)

#### Appendix 4: List of Persons Met

	<b>Names</b>	<b>Title</b>	<b>Institution/ Organisation</b>
1	Dr. Edward Rugumayo	Energy for Rural Transformation Project	Ministry of Energy & Minerals
2	Sendaula Yasin K	Area Based Agricultural Modernisation Proj.	Ministry of Local Government
3	Eng. Karuma Kagyina	Asst. Commissioner/ Rural Roads	Ministry of Works, Housing & Communication
4	G. Turyahikayo	Executive Director	Rural Electrification Agency
5	Kaggwa Ronald	Environmental Economist	NEMA
6	Muramira Terry Augene	Director, Planning & Policy	NEMA
6	Byamukama Biryahwaho	Programme Officer	Eco-Trust
7	Akankwasa Damian	Director, Planning,	Uganda Wildlife Authority
8	Tumwesigye Charles	Coordinator, Community Conservation	Uganda Wildlife Authority
9	Rwetsiba Aggrey	Coordinator, Research & Monitoring	Uganda Wildlife Authority
10	Bikangaga	Senior Economist/ Planning	Ministry of Lands, Water & Env't
11	Frank Kansiime	Director,	MUIENR/ Makerere University
12	Ben Mungereza	Principal Statistician	UBOS
13	Edgar Mugisha	Technical Officer	Uganda Cleaner Production Centre
14	Constantine Bitwayiki	Research, Innovation, M&E	National Planning Authority
15	Hategekimana Sylver		UMEME
16	Allan Amumpe	Saw Log Production Grant Scheme	National Forestry Authority
17	Paul Jacovelli	Chief Technical Advisor, SPGS	“
18	Israeil Kikangi	Commercial Plantations	“
19	Robert Muwawu	Agricultural Coordinator	Straight Talk Foundation Limited
20	Dr. Reddy M.R.	General Manager/ Agriculture	Sugar Corporation of Uganda Ltd
21	Godfrey Ndaula	Asst. Commissioner/ Renewable Energy	MEMD
22	Bo Sandgren	Technical Advisor	KCC/ Ecological Sanitation Project
23	F.X Ddamulira	Project Manager/ ECOSAN	KCC/ Ecological Sanitation Project
24	Ruth Muguta	Community Development/ ECOSAN	“
25	Eng. S. Bomukama	Director of Water Development	DWD/MWLE
26	David L. Hafashimana	Forest Inspection Division	MWLE
27	Baguma	Programme Officer	Nile Basin Initiative
28	Timothy Twongo	Retired Principal Fisheries Research Officer	Retired/ FIRRI
29	Prof. Julius Zaake	Professor/ Soils & Land Management	Makerere University
30	Gakwaya Helen	Deputy Executive Director	Integrated Rural Dev't Initiatives
31	Sarah Nassuna	Programme Officer	Integrated Rural Dev't Initiatives
31	Walugembe		Uganda Forestry Association