



THE REPUBLIC OF UGANDA

Pilot Integrated Ecosystem Assessment of the Lake Kyoga Catchment Area





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July, 2008



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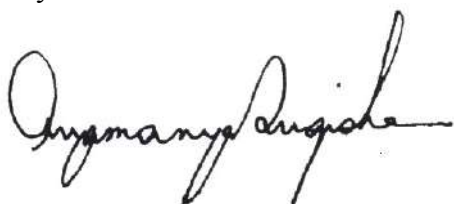
FOREWORD

This Integrated Ecosystem Assessment Pilot Study for Uganda was carried out in the Lake Kyoga catchment area as part of the Millennium Ecosystem Assessment to provide information on linkages between changes in ecosystems, ecosystem services and human well-being. The Lake Kyoga catchment is an important focal area for Uganda because of its importance in the Nile Basin and the significant differences in human welfare indicators such as health, poverty, food security among others.

The findings of this assessment show that the ecosystems in these areas have changed remarkably especially in the last twenty years. For instance, Nakasongola district lost more than 50 per cent of its forest woodland cover. The forests were cut to cater for the burgeoning need for charcoal and wood fuel in the urban areas. The report also shows that the decline in ecosystems and ecosystem services is not limited to forest and forest products alone but extends to wetlands, and other freshwater ecosystems, agro-ecosystems and grasslands. While the communities in the dryland areas have problems of inadequate rainfall, those in the Mount Elgon areas have to deal with excessive rains which are at times very heavy resulting in landslides that periodically lead to loss of crops, human life and poverty.

The major drivers of changes in ecosystems such as rapid population growth, the high demand for charcoal in urban areas, limited knowledge or extension service support and poverty are still prevalent and growing in some communities. The study shows that over the next fifty years the consequences of the deterioration in the Lake Kyoga catchment ecosystems will be extremely adverse. On the basis of four forward-looking scenarios that are drawn from the African Environment Outlook Report neither a market-driven approach, nor government action or the segregation of wealthy class as seems prevalent in Uganda, will ensure sustainable development. Instead there is a need to adopt an approach that combines the best of the different development paradigms existing in Uganda today.

There is evidence in this study to show that economic development and human well-being can be enhanced without depleting the ecosystems or the ecosystem services they provide. Indeed, by enhancing, and restoring degraded ecosystems to optimal levels and identifying substitutes to ease the pressure off key and critical ecosystems, the Kyoga catchment area can continue to provide ecosystem services for the growing populations sustainably. If the response options identified in this report are appropriately applied, the people of the Lake Kyoga catchment area can have a good quality of life within a healthy and productive ecosystem.



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EXECUTIVE SUMMARY

Linking Poverty and Environment

This Pilot Integrated Ecosystem Assessment for Uganda is an extension of the Poverty and Environment Initiative of the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP). Since the Millennium Ecosystem Assessment conducted by the United Nations (UN) between 2001 and 2003, the linkage between poverty and environment has continued to grow as a major focus of development work. For developing countries like Uganda, the dependency on natural resources is clearly evident from the country's economic balance or Gross Domestic Product (GDP) and Gross National Product (GNP). Of the 85 per cent of Uganda's population that live in rural areas, about 80 per cent of them are directly dependent on agriculture for their livelihoods. Forty per cent of the country's export revenue is from agriculture. Services and industry which contribute the rest of the export revenue are also based on natural resources.

The Uganda Participatory Poverty Assessment process identified causes of poverty as the lack of basic health services, low incomes and education, limited access to land for production, large families and lack of markets for produce. By the end of 2006, 31 per cent of Uganda's population lived below the poverty line of about US\$ 1 per day. In Uganda, the Poverty Reduction Strategy Papers (PRSPs) aims to reduce vulnerability to the root causes of poverty through economic empowerment plans and programmes. These include the Poverty Eradication Action Plan (PEAP), Plan for the Modernisation of Agriculture (PMA), Health Sector Support Programme (HSSP), '*Bona Bagaggawale*' Programme (Prosperity For All) and the Rural Development Strategy.

While some of the key programmes attempt to address the link between poverty and environment, it is evident that the linkage is inadequately covered. Some sub-sector policies and plans like those for fisheries, forestry, water and environment indicate the livelihoods link. But many other national policies fall short of doing so. The State of Environment Report for Uganda 2006/07 shows that the major environment-related indicators of poverty continue to decline against an improvement in some other indicators such as education, housing, and incomes. The distribution of these indicators is generally not described especially at a micro-level. Sometimes an overall national improvement in the balance of poverty indicators clouds adversity at lower spatial and temporal levels. As such while some communities experience an improvement in human well-being, others undergo adverse effects.

Against this background, it was decided that an integrated ecosystem assessment be conducted in one of Uganda's busiest catchment areas. Busy because many livelihoods depend on the natural resources therein. The Lake Kyoga catchment is located at the centre of Uganda. It covers at least 21 districts. It consists of a complex of lakes including Kyoga, Bisina, Kwanja and numerous wetlands in central Uganda. The main inflows for Lake Kyoga complex are the Victoria Nile and river flows from Mt Elgon on the eastern part of the catchment. The outflow is through the Kyoga Nile connecting to Lake Albert. Lake Kyoga is downstream from Lake Victoria. This catchment area is part of the larger River Nile Basin, which stretches from East Africa's Great Lakes region consisting of Burundi, Democratic Republic of Congo, Kenya, Rwanda, Tanzania, and Uganda. It flows through Sudan, with tributaries in Ethiopia, Eritrea and Somalia and connects to the Mediterranean Sea through Egypt.

The local sites for the assessment were Mazimasa sub-county in Butaleja district, Bulucheke and Bukigai sub-counties in Bududa district and Lwampanga sub-county in Nakasongola district.

Ecosystems and their Services

Four major types of ecosystems were considered during the study: forests, grasslands, agro-ecosystems, and fresh water ecosystems consisting of rivers and wetlands.

Fresh water ecosystems

The state of fresh water ecosystems in Nakasongola and Butaleja has declined for several reasons. In Mazimasa, the river has been encroached upon to create channels for irrigation. R. Manafwa suffers heavy siltation from the agricultural production that takes place along its banks. As a result, the river has several diversions downstream especially in the Mazimasa area which reduces the volume of flow and encourages further channelling of water for irrigation. The downstream functions of the river system have declined. In the past the river provided fish, clean water for domestic use and irrigation. At present, because of the excessive siltation the water has to be filtered and boiled before drinking. Fish catch has dwindled so much so that the capture of fish is now left to children. On the other hand, use of the river for irrigation has grown tremendously. More people are establishing farming villages along the river, even when the land they leave behind is still good for agriculture. Paddy rice and vegetation production has expanded over and above the growth of traditional crops such as sesame (simsim), millet, beans, maize and groundnuts.

The fresh water system in Bududa is relatively unchanged. In Nakasongola, the lake ecosystem has deteriorated because of infestation by the water hyacinth, dumping of sand bags, and poor waste management by fishing communities along the lake shore. As a result, the lake water is generally dirty and there are high incidences of malaria and diarrhoeal diseases among the lakeside communities. The El Niño rains of 1997/98 also led to flooding dislodging a number of papyrus stands. The fish catch has declined to a third over the last 15 years.

Forest ecosystems

Between 1990 and 2004, the woodlands in Nakasongola declined by over 50 per cent due to deforestation for charcoal production, resettlement of communities, expansion of pastoral lands and excessive encroachment on the Central Forest Reserves (CFRs). This exacerbated the scarcity of forest products in an already dryland area. In addition, the low biomass levels have encouraged the proliferation of termites which attack all vegetation especially during the dry season causing the scarce trees and grasslands to dwindle further.

In Bududa, the forest ecosystems are fairly intact. Over the last 15 years, there has been an improvement in the forest cover due to the activities of the National Forestry Authority (NFA) and Uganda Wildlife Authority (UWA). Concessions were given out to private companies to re-forest some of the areas as part of carbon credits trading arrangements. Although Bududa is heavily forested, the communities have limited access to forest areas/products and they have to encroach on the protected area to obtain wood fuel or timber for house construction. The forest is heavily policed by UWA and NFA rangers.

Mazimasa sub-county in Butaleja underwent heavy felling of trees in the 1990's as part of a Tororo district concession to a Chinese company. The local community was encouraged to sell their mature trees for timber production. As it turned out, nearly all the trees in the area were felled and only a few survived. Fuel wood is now hard to come by and people rely on rice husks for energy. Even wood to build local infrastructure such as bridges is not available.

Agro ecosystems

Bududa has the most productive agricultural lands of the three areas studied. This is because the ecosystems are fairly intact. Land availability on the fairly flat areas is 0.5 acres for an average family of 8 persons. However, the growing demands for land are forcing the community, especially the large scale farmers to farm the mountain slopes. These slopes are extremely vulnerable to landslides exacerbated by the heavy annual rains and the poor farming practices. Technologies such as strip cropping and terracing are not practised. In Butaleja, agro-ecosystems are shifting from the open land to the wetlands. The traditional cropping system is gradually being substituted by paddy rice and vegetable production which are more commercially orientated. Moreover because of the deforestation activities of the 1990's, the soils are generally of a poorer quality. Studies have indicated that the soils in Butaleja and Tororo districts generally require fertiliser application to increase productivity. About 60 per cent of Nakasongola is dryland. Much of it is not arable, at least not without additional modification of the land. The remaining 40 per cent is shared between CFRs, pastoral communities and crop farmers. Crop farming is concentrated in the areas neighbouring L. Kyoga. There are often conflicts between pastoralists and crop farmers over livestock that destroy crops. Production is low and the area imports food items from the neighbouring districts of Luwero and Masindi.

Grasslands

Bududa has very little grassland. Zero grazing is the preferred form of livestock production in the area, as most of the land is left for crop production to feed the big population. There are a limited number of grasslands in Butaleja. Livestock rearing is not a common livelihood. The grasslands which exist are uncared for and have deteriorated into bushes. In Nakasongola, 60 per cent of the community are pastoralists and grasslands are important for them. Over 35 per cent of the land is grassland. The harsh weather and overstocking of livestock often ensure that these grasslands are of poor quality. Between 1990 and 2004, some grassland areas deteriorated into bare lands. Increasing incidents of termites over the last 10 years has further contributed to this decline.

Drivers of Ecosystem Change

Natural or human-induced factors that directly or indirectly cause a change in an ecosystem are referred to as 'drivers'. Drivers are of two types: direct and indirect drivers. This study identified four types of indirect drivers: demographic, economic, science and technology, and cultural and religious factors. The direct drivers include climate change and climate variation, land use change, invasive species and over-exploitation of natural resources.

Direct drivers of ecosystem change

Demographic factors

According to the 2002 population census, the population density in Butaleja and Bududa is two-and-a half and 4-times respectively, higher than the national population density, while the population density in Nakasongola is just a third of the national population density. The dryland conditions in Nakasongola have ensured that there is a sparse population. In Bududa,

the fairly good climatic conditions and strong economic activity have encouraged population growth. But this has left very little arable land available per household. The impact of this is insufficient agricultural production, food insecurity, and high unemployment. For those who farm on the mountain slopes, there is the persistent exposure to landslides and excessive soil erosion as a result of the poor agricultural practices. The landslides endanger lives and livelihoods. If the population density increases further, unemployment, food insecurity and excessive soil erosion will become rampant. The largely stable ecosystem in Bududa will be converted into an over-farmed area with many unemployed people willing to take risks such as encroaching on forest reserves and farming a larger proportion of the unstable mountain slopes.

In Butaleja, the number of families dependant on agriculture moving to wetlands to practice paddy rice production is increasing. Increased channelling of the river is leading to reduced flows and siltation with adverse effects on downstream communities. Relative to the population size, the volume of river water is likely to be insufficient to support food provision. Already the communities face food shortages at household level and have to use revenues earned from rice to buy food items they do not grow. In the medium term, the excessive reliance on rice threatens food and income security. The 2005 drought considerably affected the communities that had few alternative sources of food and income. Continued population growth is likely to exacerbate these problems and lead to further vulnerability of the community.

While the population density in Nakasongola is quite low, periodic increases due to internal displacement and in-migration have often resulted into degradation of forest reserves and grasslands. Pastoralists combine with sedentary communities to further reduce the grassland and forest ecosystems through excessive stocking rates and extraction of wood for charcoal production, respectively. The district is already sensitive to annual droughts which lead to death of livestock, crop failure and migration within the district. Any significant changes in human population will increase the occurrence of these factors above.

Economic drivers

Commercial rice production in the Butaleja area started in 1976 with the Doho Rice Scheme, a government run enterprise involving the local communities. Rice is grown in the wetlands of the R. Manafwa basin. As the need for rice grew, communities seized the opportunity to start a private rice scheme adjacent to Doho in Mazimasa. As the price of rice continues to rise, more households are lured into rice production. Expanding rice production in the wetlands is likely to cause further deterioration to the freshwater ecosystem in the area and may reduce wetland functionality in the future if no alternatives emerge in the medium and long-term.

In Nakasongola, fish and livestock are the major economic activities. Livestock production is characterised by over-stocking leading to reductions in forest and grassland cover. The fisheries economy has attracted illegal practices such as dumping of sand bags and over-fishing. Also as the fishing communities grow, waste management becomes more of a challenge, reducing the quality of the water and also threatening their livelihoods.

In Bududa, a small subsistence economy exists where production and marketing of agricultural goods sustains the non-farming community. Demographic and economic indicators suggest that this balance is unlikely to remain in the near future. Unemployment

and low-value agricultural production will be unable to sustain the population. Already there are signs of increasing encroachment on the forest reserve to provide for basic needs.

Cultural and religious factors

Each of the three sites has unique cultural systems. In Bududa, circumcision of young men is an annual event. Local games such as weekly bull fights, and the attendant mating of cows with the best bulls combine to provide entertainment and herd improvement. But a number of demographic, environmental and economic factors are causing a change in some of these traditions. For instance, the requirement for every youth circumcised to have the tail of a black and white colobus monkey may eventually lead to its extinction. Circumcision itself causes health risks from using unsterilised knives on large numbers of young men. The cultural games and mating of cows is also becoming more commercially oriented reducing accessibility to quality sperm for the poorest in the community.

Science and technology factors

Technology adaptation is generally low. Agriculture is mainly rain-fed and farmers till the land with hoes and plant with their hands. There is very little irrigation except for paddy rice, and farms on the mountain slopes have no soil erosion control mechanisms. There is minimal use of external inputs for soil improvement. As a result production is low. When combined with other indirect drivers such as a high population density and low incomes, the communities are increasingly vulnerable to extreme poverty and environmental disasters. Even where some technology adoption has taken place, for instance rice production in Butaleja and zero grazing in Bududa very little diversification has taken place, which has limited the options for the rest of the community. As a result a single livelihoods option may seem good option in the beginning but as excessive pressure is exerted in the ecosystems it begins to strain and threaten the ecosystem's resilience and the sustainability of other ecosystem services.

Indirect drivers of ecosystem change

Climate change

There is evidence of climate change in the L. Kyoga catchment area. During the heavy floods caused by the 1997 El Niño phenomenon, water levels rose by 2 metres, leading to the destruction of crops and property along the water banks. In Bududa heavy annual rains exacerbate landslides and there are limited efforts to contain them using embankments or terraces.

Land use

Land use practices vary considerably across the L. Kyoga catchment. In the drier areas pastoralism is a common livelihood and a large portion of the land is composed of grasslands. In the drylands unsustainable use of the grasslands has been exacerbated by the large herd sizes. In addition, the frequent droughts negatively impact agriculture. Charcoal production has been a dominant feature in many of the wooded areas. The National Forestry Authority is engaging individual and group investors in tree production in the central forest reserves. Monocultures of pine forests have been planted in Kasagala and Katuugo central forest reserves.

The well watered lands of Mt Elgon region support agriculture. Commercial production of Arabica coffee and vegetables are the main forms of land use. Livestock is kept under zero-grazing practices so as to maximize the land use. Mt. Elgon is of national importance as

regards biodiversity. The abundance of forest and wildlife resources has brought the National Forestry Authority and the Uganda Wildlife Authority together into joint management of the resource. No where else in the Kyoga catchment does such a wealth of biodiversity exist.

The lowlands of Butaleja district are dominated by farms in the wetlands. The arable land is used for production of grain crops such as maize, sesame, and other crops such as cotton and beans. Livestock production is relatively low in these parts. Working through farmer field schools, several institutions including the International Centre for Tropical Agriculture (CIAT), Makerere University and the National Agricultural Research Organisation have been engaged in activities to improve the soil fertility. However, the efforts have only had a small response. The poor rains in the area have discouraged farmers from moving out of the wetlands.

Invasive species

The water hyacinth is still a major concern in L. Kyoga. Large sections of the lake shore are covered by the weed, which reduces the volume of fish captured. Siltation is also encouraging further growth of the hyacinth. In the cattle corridor there is an increasing proliferation of termites. The termites are attributed to the frequent drought that limits the volume of below-ground biomass. The result is that they attack all vegetation causing the drying up of crops and trees.

Over-Exploitation of Natural Resources

The most highly exploited natural resources are the forest ecosystems in Nakasongola, and the freshwater ecosystems throughout the Lake Kyoga catchment area. The growing population is leading to increased consumption of the ecosystem resources. For example, nearly all the livelihoods in Nakasongola and Butaleja districts depend on the freshwater resources. Although there are management plans for the freshwater systems in these areas, the District Natural Resources Departments do not have the capacity or tools to adequately monitor the resources. Enforcement of some of the existing laws such the National Environment Act relies on revenues generated by the local governments. These local revenues averaging about 2-5 per cent of all district expenditure are usually insufficient to support the work of the department over a year. Alternative management schemes using Beach Management Units (BMUs) have being tried in the fisheries sub-sector; however, discussions with the District Fisheries Officers of Butaleja and Nakasongola indicate these have had only minimal success. The lack of a national land use policy has also prevented districts from developing their own land use policies.

Poverty and Environment Linkages

The various dimensions of poverty in the Kyoga catchment area include landlessness, large families, inadequate access to water and sanitation, access to education, and the degradation of land and natural resources. These are all basic components for human well-being and necessities for earning a livelihood.

Eighty five per cent of the population in Nakasongola do not own the land on which they live. This widespread lack of land in Nakasongola has had a negative impact on land productivity and social welfare. Only 54 per cent of the community have access to latrines and 51 per cent have access to improved water supply. The district has lost over 50 per cent of its forest cover to charcoal production. Studies indicate that there was a net financial income loss for the households that were engaged in charcoal production. As such, not only were the households

degrading their natural resources, they were also subsidizing the energy need of the urban centres where the charcoal was sold. Nakasongola is ranked 30th in the HDI of the districts in Uganda.

Butaleja comes in at number 42 in the HDI district rankings. The only major economic activity is subsistence agriculture production with small commercial plots of paddy rice. Given the high population density, Butaleja lacks significant income generating enterprises to sustain the livelihood of the people. The soils are generally poor and in need of fertiliser. Most households do not farm their lands relying on small paddy fields to sustain them.

Bududa, as part of the former Mbale district, is ranked 11th on the HDI by district. This was due to good access to clean drinking water, good sanitation and low incidence of diseases in the area. It also has the best education indicators of the three local sites. The main livelihoods include growing food and cash crop, zero-grazing cattle. There is also considerable reliance on remittances from relatives employed outside the district.

In the medium to long-term, the poverty environment linkages for Bududa are likely to be driven by demographic factors particularly the high population density on the small productive land. Current land use practices which encourage soil erosion and risks from forest encroachment will have an adverse effect on the ecosystems. The linkages for Butaleja are likely to be driven by economic as well as demographic factors where the lack of alternatives to rice means that most of the revenue earned from rice will be used up to meet household needs and maybe insufficient to cover the needs for good human well-being. Already Butaleja is the poorest of the three locales under study. It has the least number of natural resources and its greatest resource, the agro-ecosystems are underexploited and underutilized. The safe guard resource - the fresh water and wetland of R. Manafwa - is already overexploited. This means that the future generation of Butaleja will have much fewer ecosystem and ecosystem services to derive from the environment and as such will most likely be poorer. Although the dry lands ecosystem is a major factor in the poverty of Nakasongola, human actions have played a major role in exacerbating that poverty. Overgrazing, excessive deforestation and destruction of the lake ecosystem are destroying the resilience of these ecosystems. Going forward, these poor resource use practices are likely to be the major factors that drive poverty in the area

Future scenarios

Four scenarios were chosen to visualise the future of the Lake Kyoga catchment area. The scenarios are the 'Cracking Jack', 'Global Parity', 'Survival of the Fittest', and the 'Green Paradigm' scenario. These are modelled along the lines of those used in the Africa Environment Outlook report series.

The 'Cracking Jack' scenario envisages that human well-being is best served by wealth generation through the creation of market opportunities. Investors are encouraged through the provision of economic incentives. The rationale being that wealth creation will generate opportunities for the poor to overcome their poverty. The natural resources such as oil, fisheries, forestry are the foundation on which this scenario is based. Unsustainable use of natural resources may at times occur, however this may be off set by the economic gains made. This scenario sees increased investments in the forestry, fisheries and agricultural production sub-sectors. While, these may lead to an improvement in local livelihoods, the gains are likely to be of short term in nature. So for example, if commercial tree harvesting

was encouraged in the Mt. Elgon Forest Reserve it would jeopardise the biodiversity richness of the Mt Elgon National Park with repercussions for the economy and human wellbeing.

The ‘Global Parity’ scenario is built on the premise that policy can direct development towards sustainability. This places local and international plans such as the Poverty Eradication Action Plan (PEAP) and the Millennium Development Goals (MDGs) at the centre of this development pathway. This scenario proposes that with a good macro-economic framework and support from international development partners, the country will be able to reduce the current poverty scores and at the same time meet its sustainable development goals. While policy reforms do take place, inadequate funding and poor implementation of government programmes and institutional reforms may reduce the possibilities of achieving global parity based on the MDGs. This means that even the environment and social objectives set under the MDGs may still be not achieved.

The ‘Survival of the Fittest’ scenario is a backdrop of the fortress world scenario where the class of people with access to resources and wealth fight to increase their wealth while the poor are left to fend on their own. In this extremely capitalistic scenario, safety nets such as microfinance re-distribution, education and health for the poor are only funded to the bare minimum. Resources are encouraged to flow into the industrial and commercial sectors. This scenario takes the extremes of the ‘Cracking Jack’ scenario. For example the excessive demand for energy could encourage the government to seek investments into the energy sector even at the cost of ecosystem and ecosystem services that support a large number of livelihoods. Such a development pathway eventually leads to deterioration in social, economic and moral underpinnings of society.

The best sustainable development pathway is the ‘Green Paradigm’ scenario. This development pathway includes the active engagement of all stakeholders and takes into consideration environmental, societal and economic issues. It could be seen as a combination of the three foregoing scenarios. However, in order to be successful as a development option, the scenario needs to be reinforced with adequate funding and efficient and effective implementation of the PEAP, MDG or other development programmes in the area.

The *green paradigm* proposes that the economic, environmental and social cycles are mutually interactive and can be achieved at par using sustainability indicators instead of only economic or environmental or social indicators.

For example, sustainable commercial exploitation of the Lake Kyoga fishery would need to start with the restoration of the lake’s ecosystem and enrichment of the fishery. This can only happen under a combination of scenarios like the ‘Cracking Jack’, ‘Global Parity’ and the ‘Green Paradigm’ scenario. The markets of ‘Cracking Jack’ scenario would contribute to economic growth. Any environmental and social issues would be dealt with by policies under the ‘Global Parity’ and the ‘Green Paradigm’ development pathways.

Recommendations

The recommendations from this study are listed below:

- Increase awareness, both at national and local level (especially in the Kyoga catchment area) about ecosystems and their functions, ecosystems services and changes in the ecosystems and the services they provide over time.

- Develop national mechanisms to counter the overexploitation and degradation of ecosystems, starting with the pilot catchment ecosystems.
- Initiate and support community organisations to assist the communities in articulating and lobbying for their rights over natural resources and as a platform for community involvement in the management of natural resources. The existing community groups are weak and not linked to the mainstream natural resources management structures at local government level.
- Develop guidelines for sustainable management and use of environment and natural resources. This will provide guidance to the natural resources departments at the local government level.
- Encourage the development of conservation enterprises and income diversification in the Kyoga catchment so as to improve livelihoods and ensuring conservation of natural resources.
- Improve education standards in the Lake Kyoga catchment and reduce inequity in education by providing opportunities for girls to go to school.
- Improve healthcare and sanitary standards within the communities throughout the region.
- Where the providers of the services (communities) and users of the services can be identified and the users are willing to pay for the ecosystem services, then payments schemes ought to be introduced.
- Strengthen the land tenure rights of communities. Previous efforts under the land fund need to be operationalised and made more realistic in line with the expectations of the landlords. In addition, the government should always carry out thorough economic and environmental impact assessments before deciding on land use changes.
- Value the natural resources in the Lake Kyoga catchment and elsewhere in the country and institute proper natural resources accounting procedures.
- Develop a comprehensive soil and water conservation plan for the entire Lake Kyoga catchment. Sustainable land use management (SLM) plans to reduce the soil erosion along R. Manafwa and on Mt Elgon, and the desertification in Nakasongola need to be developed.
- Implement measures to reduce the high population growth. These may be through population policies that may encourage population movement especially from environmentally important areas where pressure by far exceeds the available resources. Income diversification, employment and education opportunities elsewhere may be major incentives for the required population movement.

ABBREVIATIONS AND ACRONYMS

AEO	Africa Environmental Outlook
CFR	Central Forest Reserve
DDT	Dichloro-Diphenyl-Trichloroethane
GDP	Gross Domestic Product
GNP	Gross National Product
HDI	Human Development Index
HSSP	Health Sector Strategic Plan
ILM	Integrated Lake Management
MA	Millennium Ecosystem Assessment
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MDGs	Millennium Development Goals
MFPED	Ministry of Finance, Planning and Economic Development
MUIENR	Makerere University Institute of Environment and Natural Resources
MWE	Ministry of Water and Environment
NAADS	National Agricultural Advisory Services
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NGOs	Non Government Organisations
PEAP	Poverty Eradication Action Plan
SLM	Sustainable Land Management
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
UPE	Universal Primary Education
UWA	Uganda Wildlife Authority

1 INTRODUCTION

Background

Uganda's Integrated Ecosystem Assessment follows on from earlier assessments undertaken at the global level such as the Millennium Ecosystem Assessment (MA), and the regional Southern African Millennium Assessment. It is also being undertaken as part of the Poverty and Environment Initiative of the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) in collaboration with the National Environment Management Authority (NEMA). NEMA executed this study with the technical support of Makerere University Institute of Environment and Natural Resources (MUIENR).

The integrated assessment was undertaken with the aim of:

- improving the information base on the linkages between ecosystem services and human well-being with a view to informing and influencing policy formulation, planning and implementation and particularly the Poverty Eradication Action Plan (PEAP) and improving environmental decision making;
- providing policy options (scenarios) for improved human well-being and environment management;
- identifying drivers of ecosystem change which can inform the development of a monitoring and evaluation framework focusing on poverty and environment;
- providing an understanding of the winners and losers for decisions taken and opportunities for creating leverage to conserve the environment, sustain livelihoods and economic development;
- building capacity to undertake ecosystem assessments; and
- demonstrating the advantages of the millennium assessment approach with a view to mobilizing funds for a national assessment in the future.

The report is organised into seven chapters. The first provides an introduction to the study and explains the context within which the study was undertaken. The second chapter presents the methods and materials used for information collection and data analysis. The third describes the ecosystems, ecosystem services as well as any changes to these. It is followed by discussion of the drivers of ecosystem change in chapter four. Chapter five discusses poverty and well-being in relation to ecosystem services in the Kyoga catchment. Four forward-looking scenarios of ecosystem change are identified in chapter six. Response options are presented in chapter seven and chapter eight concludes the report by highlighting key recommendations.

The Millennium Assessment

Human activities are putting increasing pressure on the earth's ecosystems. Their functioning and ability to sustain future generations is in a balance. As the world's population continues to grow, the demand for ecosystem services such as food and clean water are also growing. But human activities are at the same time diminishing the capability of many ecosystems to meet these demands. For example between 1960 and 2000, the demand for ecosystem services grew significantly as world population doubled to 6 billion people and the global economy increased more than six-fold. To meet this demand, food production increased by roughly two and a half times, water use doubled, wood harvest for pulp and paper production tripled, installed hydroelectric power capacity doubled and timber production increased more than

half (Duraiappah 2004). With development, people's expectations increase, and as the population gets bigger, the pressure on earth's ecosystems also increases. This implies that protecting and improving future human well-being will require wiser and less destructive use of material assets.

The Millennium Assessment was called for in recognition of the growing burden that degraded ecosystems are placing on human well-being and economic development and the opportunity that better managed ecosystems provide for meeting the goals of poverty eradication and sustainable development. It was designed to meet the needs of decision-makers for scientific information on the links between ecosystem change and human well-being. It was organised around five core questions:

- How have ecosystems and their services changed?
- What has caused these changes?
- How have these changes affected human well-being, including the livelihood for women and men?
- How might ecosystems change in the future and what are the implications for human well-being?
- What options exist to enhance the management of ecosystems and their contribution to human well-being?

This assessment focused on the linkages between ecosystems and human well-being, with particular emphasis on 'ecosystem services'. An ecosystem is a dynamic complex of plant, animal and micro-organism communities and the nonliving environment interacting as a functional unit (MA 2005). Ecosystem services are the benefits provided by ecosystems such as: (i) *provisioning services*, for example water, food, fuel wood and other resources that directly support livelihoods; (ii) *regulating services*, including water purification, mitigation of drought, floods and other natural hazards; (iii) *cultural and aesthetic services* which embrace spiritual enrichment or satisfaction, aesthetic values attached to ecosystems, social amenities; and (iv) *supporting services* which are the base or support services that enable provision of the services in the first 3 categories. These include soil formation, nutrient recycling and primary productivity. Supporting services generally tend to cover biological processes (and physio-chemical aspects in case of processes such as weathering, geological changes) that support provision of other services (MA 2005).

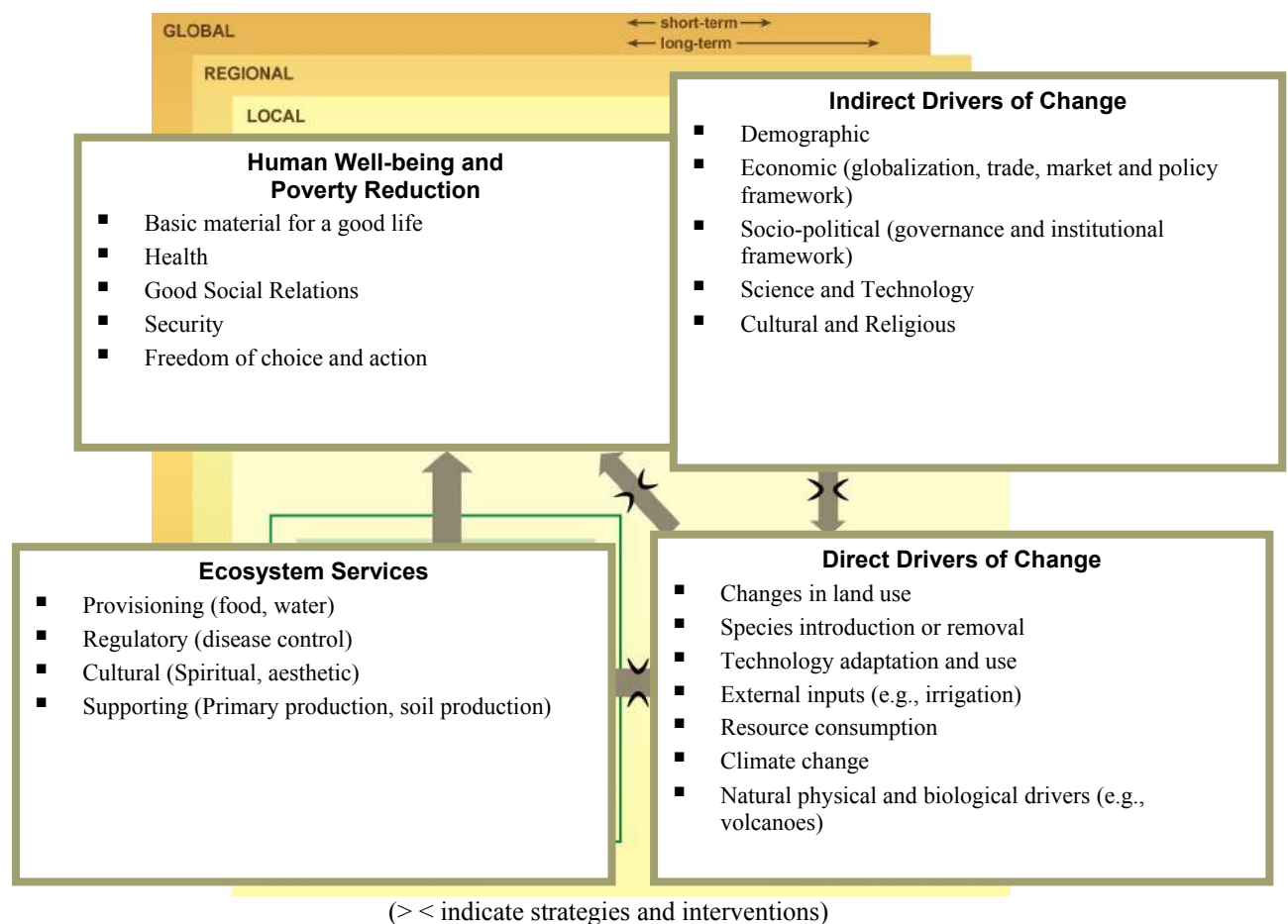
Ecosystems, Ecosystem Services and Human Well-being: The linkages

Human beings are an integral part of ecosystems and a dynamic interaction exists between them and other parts of ecosystems. The differentiated tasks that females and males of various ages undertake as they interact with different elements of the ecosystem, can contribute to changes in the ecosystem. As such, changing human conditions drive both directly and indirectly, changes in ecosystems which in turn cause changes in human well-being. Earlier research has shown that over-exploitation of ecosystems by human beings may temporarily increase material well-being and alleviate poverty, but may be unsustainable in the long run (Emerton and Elroy, 2004).

Human well-being is considered to comprise the basic material for good quality life. This includes secure and adequate livelihoods, enough food at all times, shelter, clothing and access to goods and services; health, including feeling well and having a healthy physical

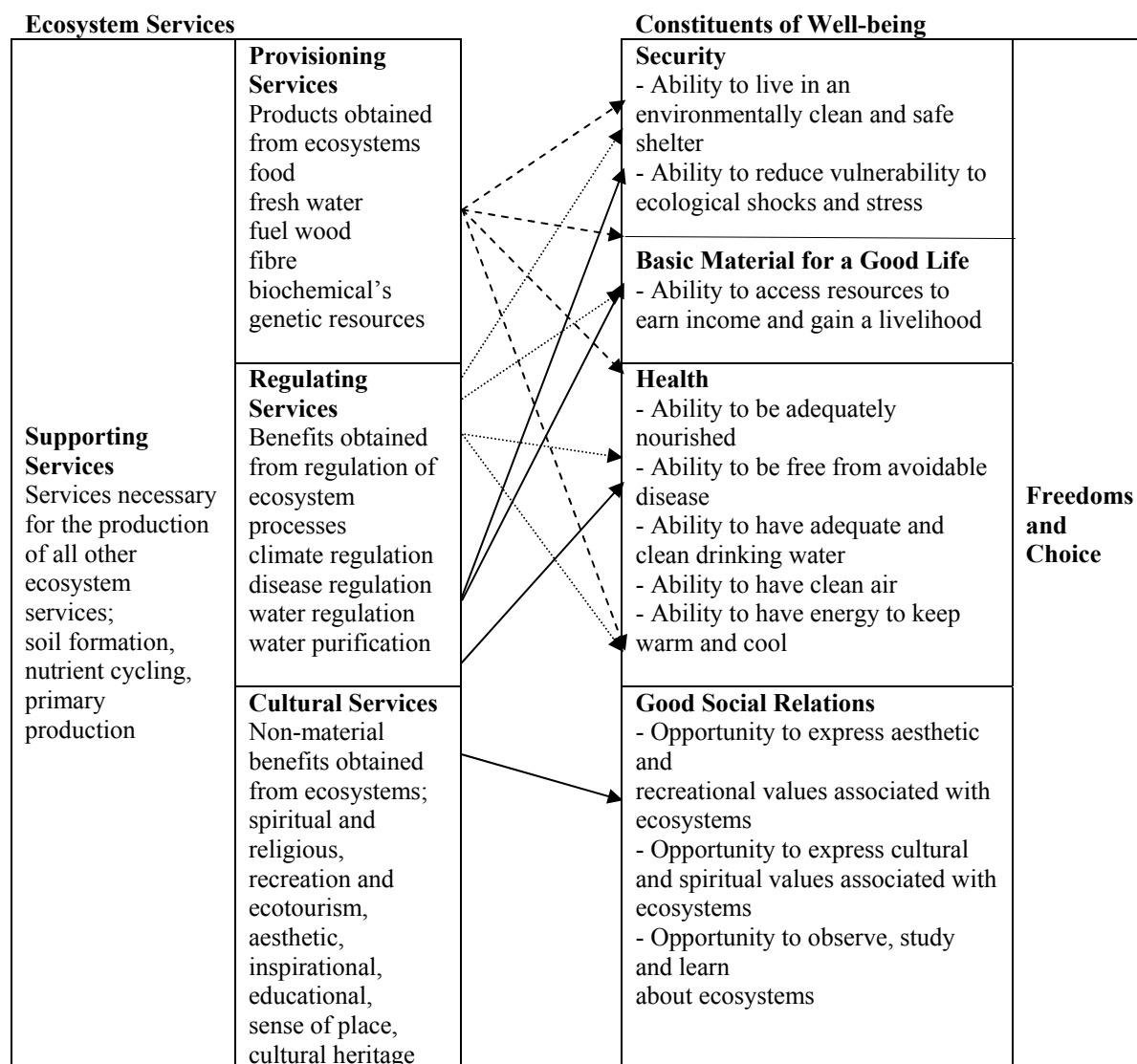
environment such as clean air and water; good social relations, including social cohesion, mutual respect, and the ability to help others as well as providing for children; security including secure access to national and other resources, personal safety, and security from natural and human made disasters; and freedom of choice and action, including the opportunity to achieve what an individual values doing and being. Ecosystem changes that have contributed substantial net gains in human well-being and economic development have been achieved at growing costs in the form of degradation of other services. Only four ecosystem services have been enhanced in the last 50 years: increases in crop, livestock and aquaculture production, and increased carbon sequestration for global climate regulation. Two services; capture fisheries and fresh water, are now well beyond levels that can sustain current, much less future, demands. Experts say that these problems will substantially diminish the benefits for future generations. Figures 1.1 and 1.2 highlight the linkages between ecosystems, ecosystem services and human well-being, and the framework for the assessment.

Figure 1.1: Millennium Ecosystem Assessment Framework



Source: MA 2005

Figure 1.2: Linkage between ecosystem services and constituents of human well-being



Source: MA 2005

State of Ecosystems in Uganda

Like other countries in the world, availability of natural resources and ecosystems in Uganda directly or indirectly affects people's livelihoods. This link will become more pronounced as the population grows. The current population is about 30 million people. With an annual growth rate of over 3 per cent, it is predicted to grow to 55 million people by 2025 (UBOS, 2006; UN, 2004). About 80 per cent of the population depends directly on the environment for their livelihoods and most of the industries are agro and natural resources based. 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 (NEMA, 2001). The degradation of ecosystems affects human well-being by slowing down, reversing or even grounding to a halt, the services provided, over time.

We take an example from the forest sector. The annual turnover of business in forestry is about Ushs 356 million, with a further estimated annual value of Ushs 112 million attributed to environmental services (MWLE, 2003). Annual deforestation rates are 9-17 per cent per year from different forest types, higher than population growth. Forest cover has shrunk from 52 to 24 per cent of the total surface area. Most of this forest loss has occurred in the rural areas, and the impacts are already being felt. Close to one million people earn their income from forestry and over 90 per cent of Ugandans depend on fuel wood as their primary source of energy. Many districts are experiencing firewood shortage increasing both the price and the distance women and children travel to collect firewood.

Meeting Development Targets: The MDGs and PEAP

Uganda's performance towards achieving the Millennium Development Goals (MDGs) shows that the country is on course for reducing extreme poverty and hunger, achieving universal primary education (UPE) and access to safe water. However, with regard to health, the reduction of child mortality and improvement of maternal health may not be achieved if the current trend continues. This is because the status of health care is determined by other factors such as the internally displaced communities in northern Uganda. Outside of health care and with better policies, institutions, and adequate funding, extreme poverty and hunger can be eradicated; universal primary education has already been achieved; gender equality is on course to be achieved; the prevalence of HIV/AIDS has been reduced to less than half from 1990 levels, malaria and other diseases can be reduced; and environmental sustainability is on course to be achieved. This is shown in table 1.1.

Table 1.1: Uganda's performance on set MDG and PEAP targets in 2005

	1990 (or closest available)	2005 (or latest available)	2007/2008 PEAP target	2013/2014 PEAP target	2015 MDG Target	Target possible at current rate?	Target possible with better policies, institutions & funding?
1. Eradicate extreme poverty & hunger	2015 target = halve 1990 \$1 a day poverty and malnutrition						
Poverty headcount ratio (%)	56	38		28**	28	Yes	Yes
Prevalence of child malnutrition (% of children under 5)	23	23			12	No	Yes
2. Achieve universal primary education	2015 target = net enrolment to 100						
Net primary enrolment ratio (% of relevant age group)	58 boys	87 boys	90 boys	100*	100	Yes	Yes
	48 girls	86 girls	89 girls				
Primary completion rate (% boys and girls)		56	69		100	Met	Yes
3. Promote gender equality							
Ratio of girls to boys in primary education (%)	83	99	100*	100*	100	Met	Yes
4. Reduce child mortality	2015 target = reduce 1990 under 5 mortality by two-thirds						
Under 5 mortality rate/1000	177	152			53	No	Uncertain
Infant mortality rate/1000 live births	98	88		68	32	No	Uncertain
Immunisation DPT3 % children	45	83		90		n/a	
5. Improve maternal health	2015 target = reduce 1990 maternal mortality by three-fourths						
Maternal mortality ratio (estimate/100,000 live births)		505	354		126	No	Uncertain
Deliveries in health centres (%)		24		50		n/a	Yes
6. Combat HIV/AIDS, malaria and other diseases	2015 target = halt and begin to reverse AIDS etc,						
Prevalence of HIV total (% of adult population)	20	6.2	5*		<20	Met	Yes
7. Ensure environmental sustainability	2015 target = integrate into government policies reverse loss of environmental resources, halve proportion of people without access to safe water & sanitation						
Forest area (% of total area)		24	27*	30*	>24		
	45	65 urban	100* urban		90	Yes	Yes
Access to safe water (% population)	55 rural	90* rural					
		65 urban	100* urban				
Access to improved sanitation (% of population)		56 rural	80* rural				
Titled land		13	17				
8. Develop a Global Partnership for Development	2015 targets = sustainable debt, make available benefits of new technology						
Debt service ratio		305	238	187		Yes	Yes

*PEAP targets more ambitious than MDGs

Source: MFPED (2005)

2 METHODS AND MATERIALS

Introduction

This Pilot Integrated Ecosystem Assessment Study was conducted in the Lake Kyoga Catchment. The assessment is a comprehensive scientific study of the ecosystem, its services, historical, current and future changes, and how this has and will impact on human well-being in the catchment and beyond.

The Lake Kyoga catchment is important to the surrounding population in different ways. The different interactions influence how the ecosystem functions and the quality of services derived from it. The use and management of the ecosystem is also determined by internal factors such as the size of the communities that rely on them and external factors such as inflows from other areas and changes in the bigger ecosystems of which the Lake Kyoga catchment is part.

The Study Area

Lake Kyoga Catchment area is part of the larger River Nile Basin, which stretches from the Great Lakes region (Burundi, Rwanda, The Democratic Republic of Congo, Tanzania, Uganda and Kenya) to North Africa. The Nile flows through Sudan, with tributaries in Ethiopia, Eritrea and Somalia and connects to the Mediterranean Sea through Egypt. The Lake Kyoga catchment includes a series of lakes; Kyoga, Bisinia and Kwania and the numerous wetlands in central Uganda. The main inflows are the Victoria Nile and river flows from Mount Elgon to the east. Lake Kyoga is downstream from Lake Victoria. It drains out through the Kyoga Nile connecting to Lake Albert.

The Lake Kyoga catchment is among the largest catchments in Uganda. It covers about 22 districts: Nakasongola, Iganga, Namutumba, Pallisa, Tororo, Butaleja, Kaliro, Kamuli, Lira, Kaberamaido, Kumi, Apac, Mbale, Manafwa, Bududa, Kayunga, Katakwi, Sironko, Luwero, Kapchorwa, Kotido and Nakapiripirit. A considerable amount of natural resources, biodiversity and the ecological condition has also influenced human development and dependence on the ecosystems therein.

At least one sub-county in each of the three focus districts (Nakasongola, Butaleja and Bududa) was selected for this assessment, each representing different ecosystems and population dynamics. These were Mazimasa sub-county in Butaleja district; Lwampanga sub-county in Nakasongola district; and Bulucheke and Bukigai sub-counties in Bududa district (Figure 2.1).

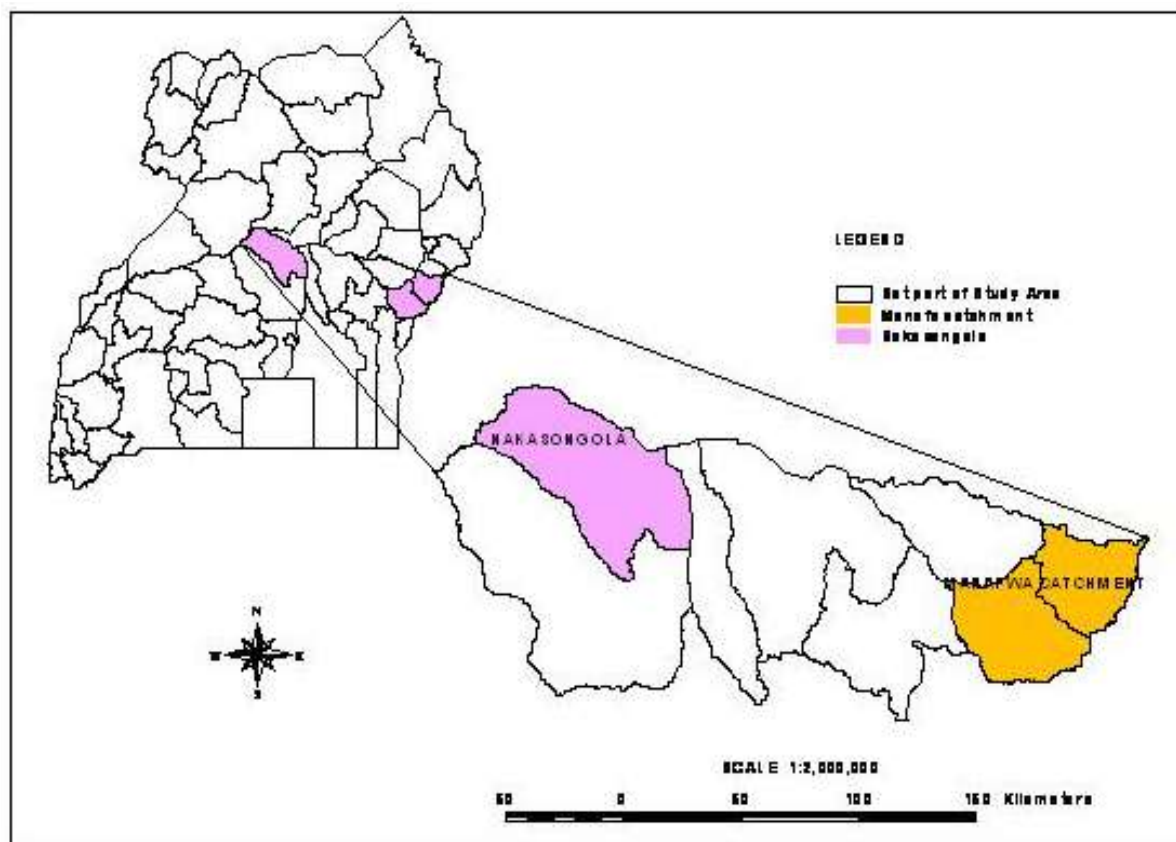
Sample selection and description of communities

Nakasongola district is found in central Uganda. It is part of the country's traditional rangelands or 'cattle corridor'. The district is largely dominated by pastoralists or cattle keepers. Cattle keepers make up at least 40 per cent of the local population and crop farmers about 60 per cent. A good fraction of the population especially those living near Lake Kyoga are fishers and a very small number carry out small businesses of selling and buying domestic goods and food. The community is split between pastoralists on one side and crop farmers

and fishers on the other. The crop farmers are located closer to the lake and some of these farmers are also fishers. Crop production has historically been poor and Nakasongola is a net importer of food.

Butaleja is downstream from Bududa. In both districts, the people are largely crop farmers. Coffee was historically an important cash crop in Bududa however, now it is on decline. The relatively flatter areas are over-populated and annual crops such as maize, beans and groundnuts dominate. The rains are regular exceeding 800 mm per annum and the weather is cool becoming cold at night. Additional income activities in Bududa include charcoal burning and selling of wood.

Figure 2.1: Uganda and study areas



Unlike in Bududa, the communities in Mazimasa sub-county grow commercial mono-crop rice in the wetlands along River Manafwa. In Bududa considerable biodiversity can be seen in forest and hills. But in Mazimasa sub-county the biodiversity is limited to a few agricultural crops and bushes. The mature trees have been cut down.

Figure 2.2: Nakasongola district

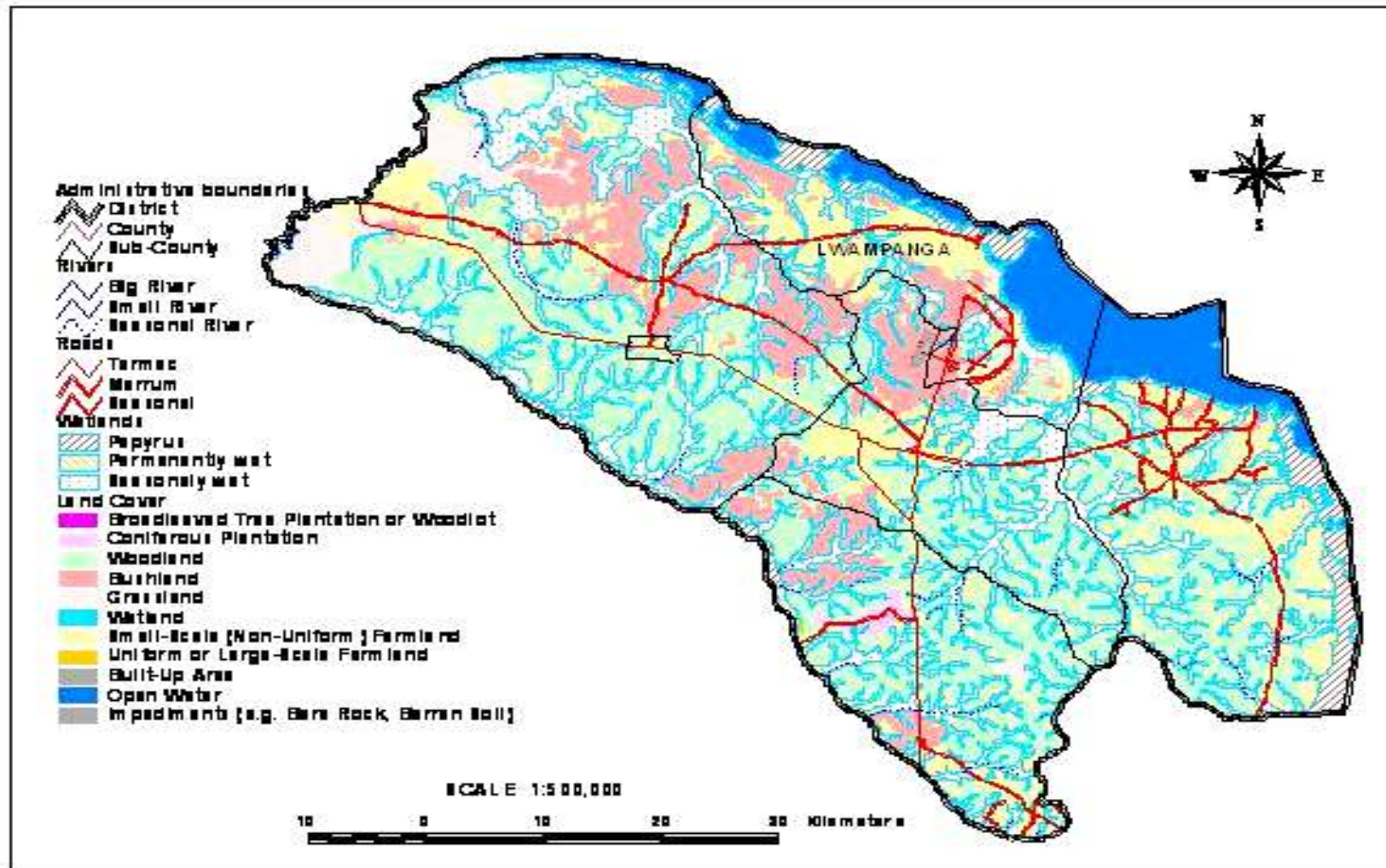
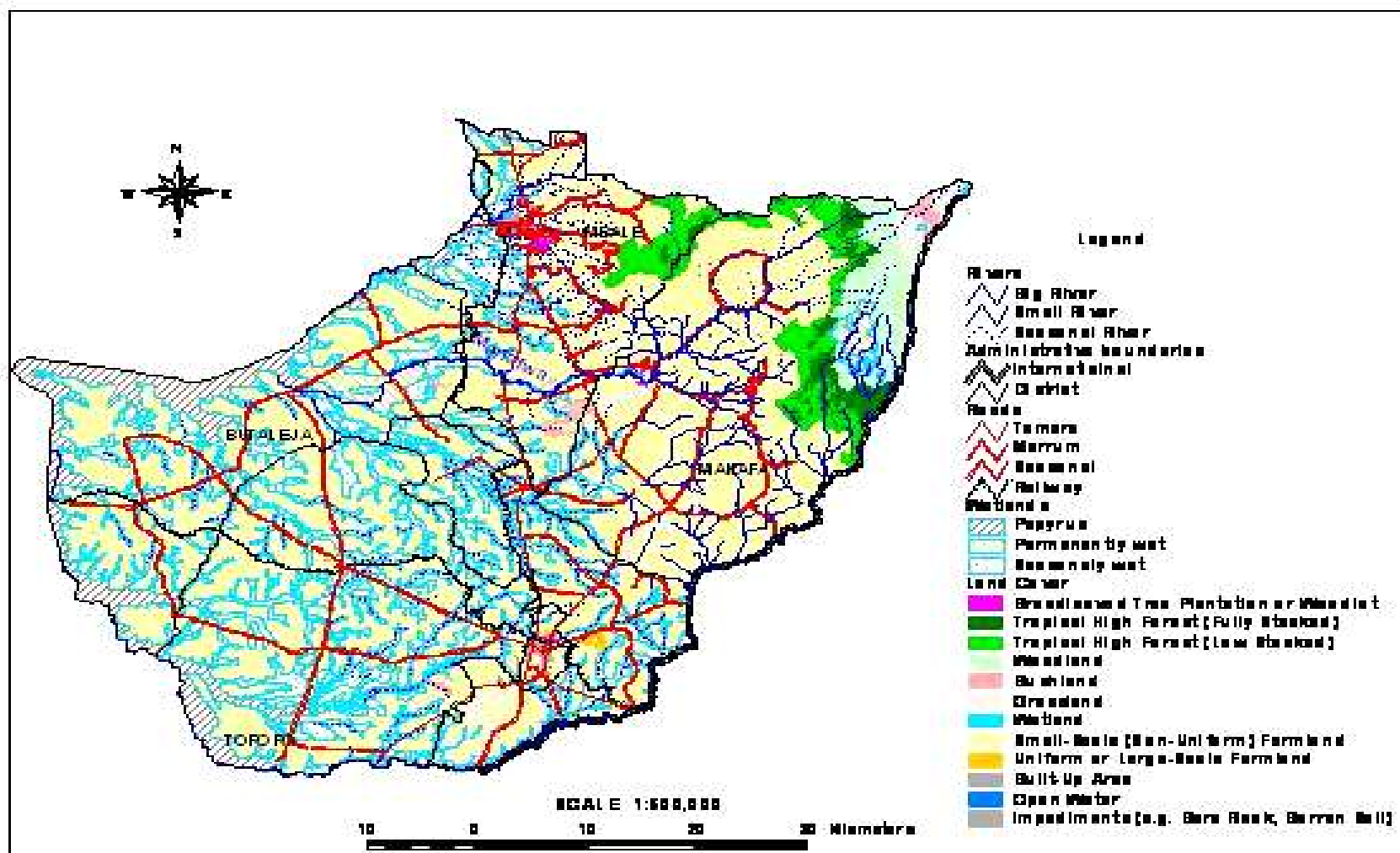


Figure 2.3: The eastern side of the Kyoga Catchment consisting of Butaleja and Bududa



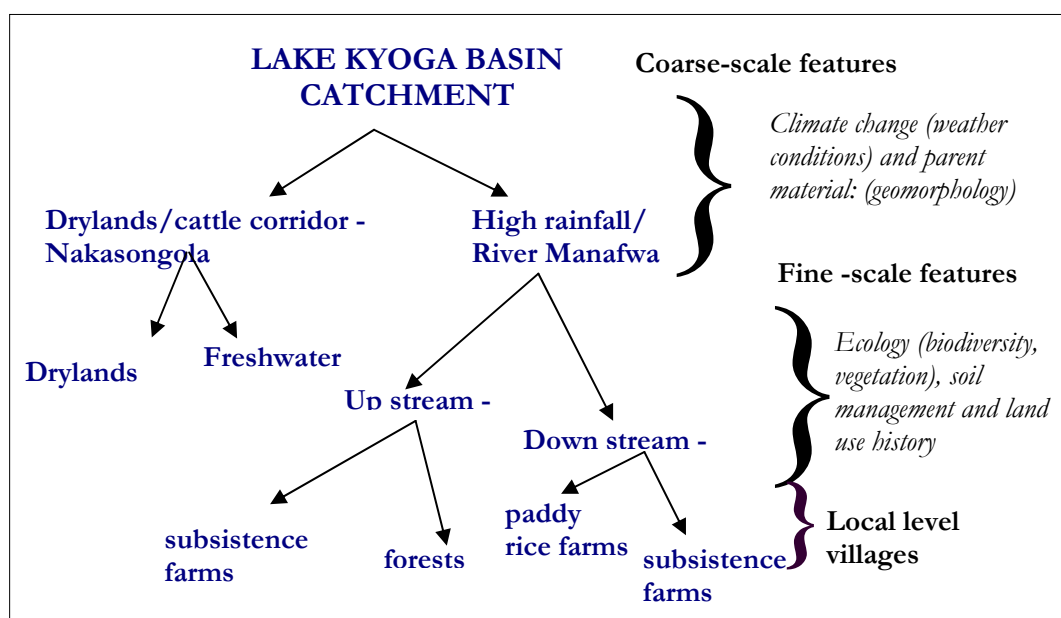
Scaling approach used for the integrated ecosystem assessment

Within the Lake Kyoga catchment there are six dominant (sub) ecosystems. These are:

- the eastern ecosystem dominated by several river flows, forests and mountains;
- the eastern downstream ecosystem dominated by streams and rice plantations;
- the plantation ecosystems dominated by commercial agriculture belonging to both small scale out-growers and the commercial plantations owned by processors and exporters;
- the fishing villages overlooking small farms and high population areas close to commercial areas;
- the drylands ecosystem on the western side of the Lake Kyoga catchment; and
- the northern side of the catchment (with Apac and Lira districts) that has a mix of drier systems, fishing villages and farming communities.

For the analysis, a multi-scale approach was adopted. The two outstanding systems in the Kyoga catchment are (a) the highly rain-fed areas with multiple streams in the Mount Elgon region; and (b) the drylands areas in the west of the catchment. In the east, the R. Manafwa system is particularly prominent. R. Manafwa flows through four districts (Bududa, Mbale, Butaleja and Manafwa). At the finer scale the spatial area of R. Manafwa was further split into the upstream area of Bududa and the downstream area of Butaleja. The finest scale assessment at the sub county and village level relied on spatial and temporal scales. The village level scale included subsistence farms and large-scale farmers and fishers. The ecosystem characteristics considered were: biodiversity and vegetation cover, soil management features, and land use.

Box 2.1: Conceptual framework for the multi-scale analysis of this assessment



Data Collection

The study relied on primary and secondary sources of data. Primary data was collected through (i) questionnaires administered during personal interviews with people at household level; (ii) focus group discussions held with communities at the village level; (iii) resource mapping techniques (combined with time-trend analysis to reflect changes over time); (iv)

discussions with local government personnel including those in charge of natural resources, environment, community development, gender and culture; (v) discussions with national natural resource management and regulatory agencies including the National Forestry Authority (NFA), Directorate for Water Development, National Environment Management Authority (NEMA) and Uganda Wild life Authority (UWA) and (vi) analysis of maps showing the ecosystems over a 20 year period in the study area.

The secondary data was obtained through a review of the literature from the Millennium Assessment, the UNEP Poverty and Environment website, NEMA-Uganda library and correspondence and data from other researchers and assessments teams nationally and internationally.

Field Visits

Visits to the study area were undertaken to delineate the study area, administer questionnaires, identify and assess the ecosystems and the ecosystem services. Through the field visits the team was able to: (i) acquaint itself with the ecosystems in the area; (ii) identify the environmental issues related to study areas including the current status of the natural resources, land uses of the area, differences in tasks undertaken by women, children and men as well as their livelihoods; (iii) make contacts with community members and leaders, district officials and other stakeholders; and (iv) assess gender attitudes of men and women, perceptions and ability to identify and participate in solving the environmental problems related to the ecosystems they interact with.

Consultations with Key Stakeholders

A number of public consultations were carried out by the team right from the inception phase to ensure that the concerns of stakeholders and interested parties were taken into consideration during the entire project. This started with attending the preparatory training workshop on Integrated Ecosystem Assessment that was held in March 2006 in Jinja. Following the reconnaissance field survey and consultations with the key stakeholders, a questionnaire for soliciting household specific data relating to the IEA study was designed and pre-tested. The exercise was intended to test the appropriateness of the questionnaire to the respondents and to find out whether the required information would be collected.

A member of the assessment team conducting a discussion in Bududa district



Analysis

The analysis was broken up into nine tasks, in which a series of methods were employed as discussed below:

a) Identification and categorisation of ecosystems and ecosystem services

Ecosystems and ecosystem services were identified using Participatory Rural Appraisal techniques, by interacting with local communities. Other methods used included, transect walks through the local sites of the assessment. Sketch mapping of local ecosystems started during the reconnaissance tour. Discussions with community members during various stopover visits enabled the assessment team identify new ecosystem-human well-being linkages.

Members of the assessment team raise cards for a women's group community in Bulucheke sub-county for ranking ecosystem services during a focus group discussion



A women's group in Bulucheke sub-county, Bududa district ranks ecosystem services in a focus group discussion



Having identified suitable assessment sites, mapping of the local ecosystems and ecosystem services was carried out through discussions with the focus group participants. At the end of each focus group discussion, community members were asked to rank the identified ecosystem services. Additional information was obtained from qualitative analysis of responses from the questionnaire using Statistical Program for Social Scientists (SPSS) software. Other ecosystems in the area were identified through discussions held with districts and sub county local government staff in Bududa, Butaleja, Manafwa and Nakasongola districts.

b) Identification of links between human societies and ecosystem services

The links between societies and ecosystem services were identified through focus group discussions held at local sites of the assessment. These discussions provided a platform for community members to express what services they derive from the ecosystem in order to meet their basic material requirements as individuals and households. The discussion was directed towards identification of provisioning, regulatory, cultural and religious services derived from the ecosystems.

The focus group discussions were divided into two: one where representation was drawn from the community and second type were for women alone. The rationale of paying

attention to such differences was to capture gender issues on household production systems, environmental management, ecosystem uses, health as well as roles, needs, social relations and conflict resolution in regard to ecosystem and their services.

c) Identification of direct and indirect drivers

Drivers were identified on the basis of the national decision making levels. These were categorised as the local levels; the sub national units such as sub-counties and districts; and the national and international level which consists of regional and the global level. At the local level, the drivers were based on the ecosystems and how the local communities used ecosystems. The direct drivers were drawn from the focus group discussions, observations made by the assessment team, and quantitative analysis of the responses obtained from the questionnaire. The assessment team reviewed literature on district profiles, district web portals, district state of environment reports, reports on natural resources and social development issues.

d) Selection of Indicators

The indicators were selected based on the criteria that they are representative, reliable and feasible (Prescott-Allen, 2001). Representative indicators are those which are able to cover the most important aspects of the ecosystems and their services. For instance, these may show the trends of change in the ecosystems and ecosystem services over time. The reliability of the indicators is used to test the accuracy of the indicators. To ensure that indicators selected were reliable, the assessment team compared the indicators used with those used in similar assessment studies (Naqvi, 2005) and literature available on the UNEP poverty-Environment Project website and MA materials (MA, 2006). The flexibility of indicators was founded on the use of the integrated ecosystem assessment questionnaire. Additional assessment was based on previous studies conducted on climate change in Uganda and available databases at the Meteorology Department and the National Biodiversity Databank at MUIENR.

e) Assessment of conditions and trends of ecosystem and their services

The conditions and trends of ecosystems and ecosystem services were described based on the quantitative assessment of results from the focus group discussions. These were augmented with information from talks with the natural resources managers at the sub-county and district level. In addition, analysis of maps from National Forestry Authority, district and national state of environment reports showed the trends of ecosystem in Lake Kyoga catchments. Further trend analysis was based on reported history by farmers and literature review.

f) Assessment of impact on human well-being

Human well-being was assessed using health-based sanitation and income-based indicators. Other indicators considered were: food security, access to land for production, access to ecosystems to derive ecosystem services, access to clean water, access to cultural/ religious sites and social relations. The trends of these indicators were then compared with the change both

Women focus group discussion in Nakasongola



in the ecosystem and human populations based on the actual stated changes by the respondents, based on the questionnaires and focus group discussions. Analysis of trends was carried out by reviewing the historical information provided by community members, quantitative analysis of responses provided in the questionnaire and review of the literature. In addition, the trends of economic goods and services from the Lake Kyoga catchments recorded in national statistics were compared with the reported national indicators of human well-being in the lake catchments.

g) Development of scenarios

Having identified the indicators of ecosystem and ecosystem services, their changes and the impact on human well-being, scenario analysis was carried out based on four story lines. These are 'Global Parity' scenario, 'Cracking Jack' scenario, 'Survival of the Fittest' scenario and the 'Green Paradigm' scenario.

h) Analysis of response options

Each of the four scenarios is a development pathway that would lead to certain outcomes and actions. Some of the actions proposed are beneficial and others are detrimental. The benefits may accrue to the economy, environment or ecosystems and ecosystem services, or may reduce human well-being. However, each of the scenarios proposes alternative actions that may need to be compared. The analysis was carried out by trading off the options available in each of the scenarios and coming up with a cost-effective path that considers the aspirations of the local people who participated in the assessment, local government (sub-county and district) development plans, national development plans, Uganda's obligations both for economic development and natural resource management and the millennium development goals. Some response options require local-village, regional-district and sub-county, national or global action. These actions include: programmes, new policies, revising policies, improvement in regulations and resource management. The response options also looked at local, regional and national level dialogue needed to manage ecosystems in a more cost-effective way.

i) Analysis of Uncertainty

Uncertainty was analyzed using the Strengths-Weaknesses-Opportunities-Threats (SWOT) framework. It addressed the stakeholders, health assessment techniques, gender and socio-economic issues. Some of the analysis was based on the premise that a number of the response options may not be achievable. Based on this the response options may then be ranked on the basis of certainty/uncertainty and support justification provided.

3 ECOSYSTEMS AND ECOSYSTEM SERVICES

Introduction

The four major ecosystems in the Lake Kyoga catchment area include freshwater systems (consisting of the Lake Kyoga complex, several permanent and seasonal rivers and wetlands); forests; grasslands; and agro-ecosystems. Although the dryland ecosystem, a major feature of Uganda's cattle corridor, is also identified within the catchment, it is only represented by a small component of the study area. Therefore for this study the drylands ecosystems will be described within the discussions of the four major ecosystems.

Also discussed will be the range of ecosystem services that are derived from these ecosystems. These range from the traditional provisioning and cultural or aesthetic services to the more complex regulating and supporting services. Most of these services are moderated by the cultural context in which the natural resources are used and managed.

Freshwater systems and ecosystem services

State of freshwater ecosystems

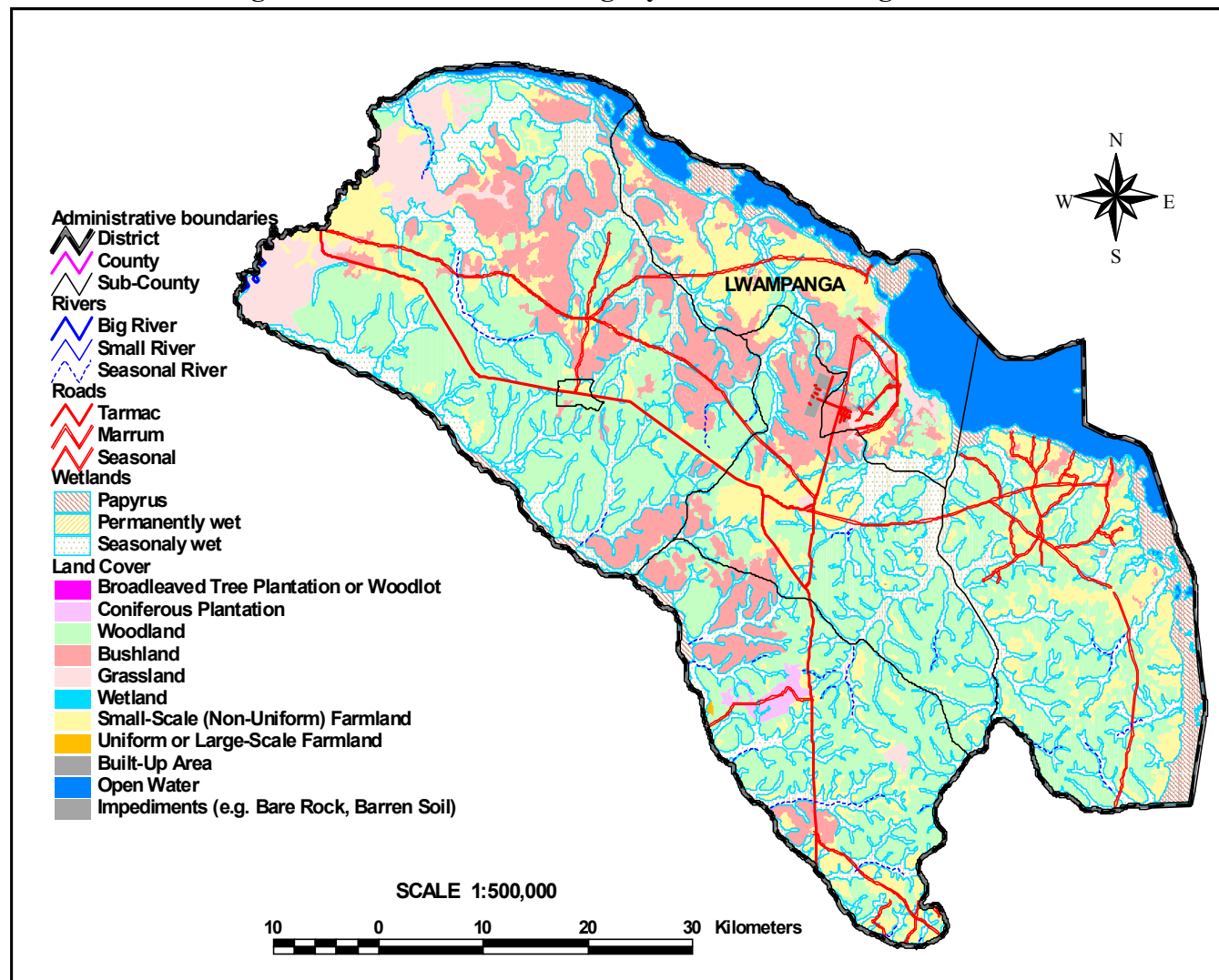
In Nakasongola the freshwater systems drain from the forest reserves and seasonal river channels into Lake Kyoga. Three seasonal rivers: Kasakwa, Muganwa and Wabayi flow from Wajala-Wabisi and Kyalubanga forest. On the northern and north-eastern borders of Nakasongola flow Rivers Kafu, Sezibwa and Lugogo, respectively. None of these water bodies traverses the middle of the district but rather straddle its borders with Masindi and Kayunga districts.

All these fresh water bodies receive their recharge from seasonal rains. Annual rainfall in the district ranges from 800-1000 mm (NDC, 2004). Ground water resources are the second source of fresh water in the district. The ground water resource lies in the Bunyoro aquifer system, which has a depth zone of 110-135m. The water level in the aquifer systems ranges from 8-15m deep, with a yield of 2-10 m³ per hour. However no spring resource has ever been identified as another source of water.

The wetland areas in Nakasongola are located in the areas near Lake Kyoga and the thin belts around seasonal rivers such as Kasakwa, Muganwa and Wabayi in Lwampanga sub-county (Figure 3.1). The wetlands that are supplied by the seasonal rivers often dry up in the dry season. The clay in the swamp dries and cracks up and cannot support any vegetation in the dry season.

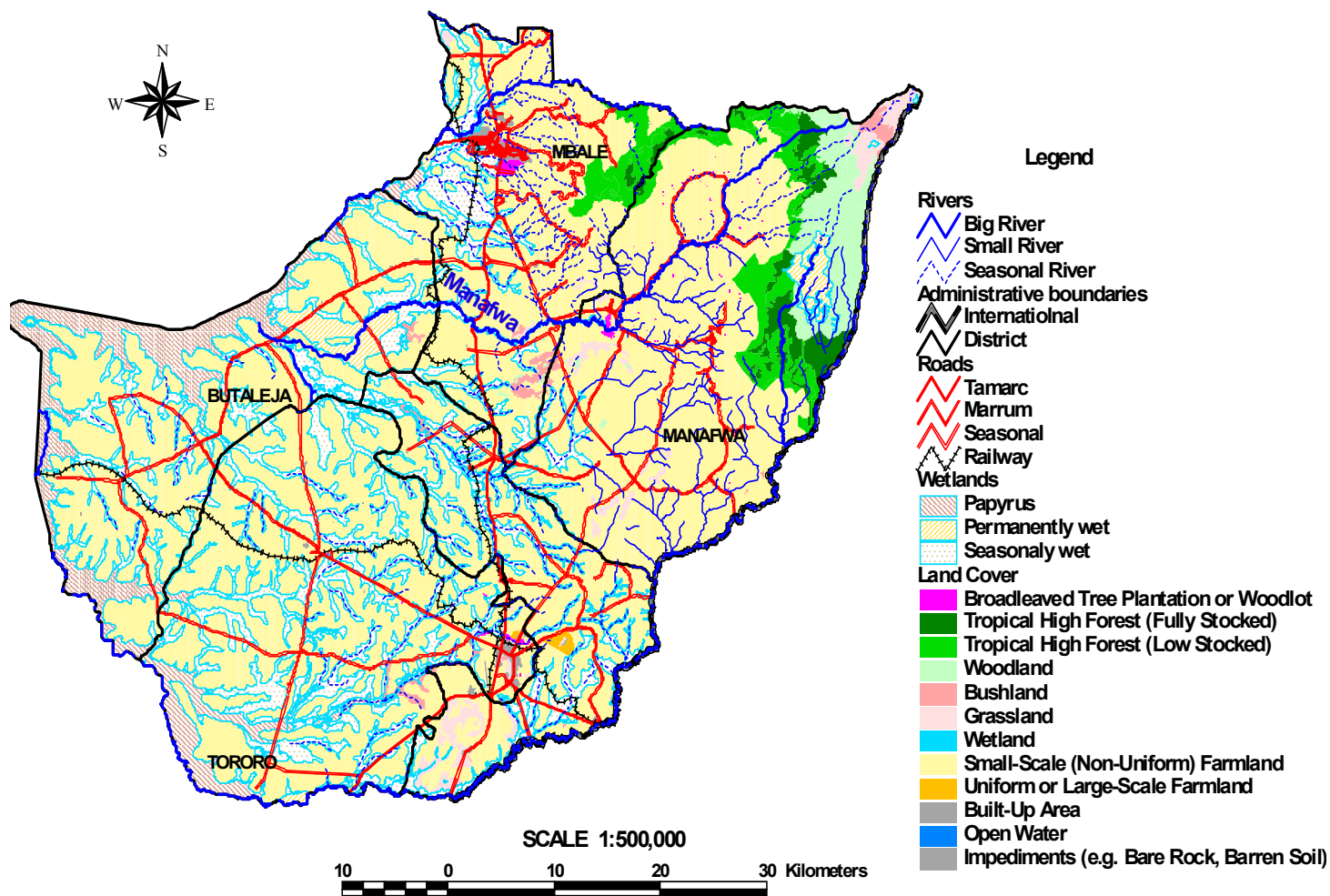
For both Bududa and Butaleja districts, the main source of water is the River Manafwa. It starts out as small streams from several points on Mount Elgon. These later join up in Bulucheke sub-county to form R. Manafwa. The river then flows downstream through Manafwa district to Mbale district and finally into Lake Kyoga.

Figure 3.1: Freshwater drainage systems in Nakasongola district



Source: NARO/KARI 2007

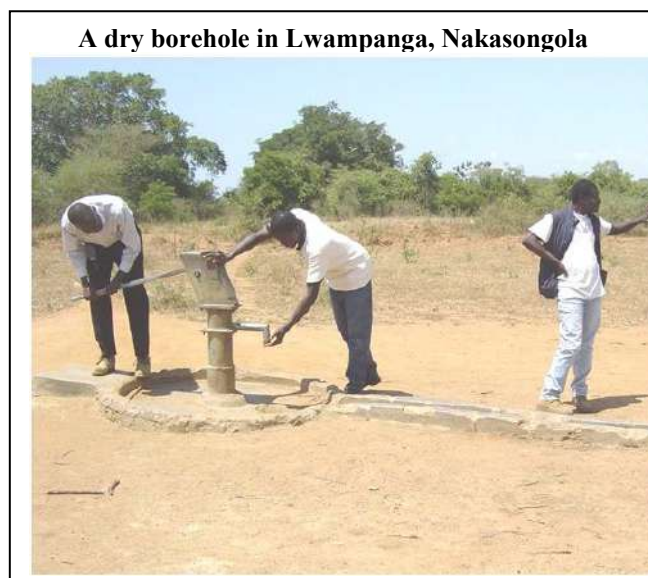
Figure 3.2: Surface and ground water systems in Bududa and Butaleja districts



Source: NARO/KARI 2007

Freshwater ecosystem services in Nakasongola

The main services provided by the freshwater ecosystems in Nakasongola are water for domestic and livestock use, and fish. During the rainy season the seasonal rivers in Lwampanga sub-county – Kasakwa, Muganwa, and Wabayi – are filled to the basin. However, by the middle of the dry season, the rivers are completely dry. Groundwater is obtained from boreholes that were constructed by the Directorate of Water Development of the Ministry of Water and Environment. However not all of these are still functional. For instance in villages such as Nakalekire, Lwampanga, and Kabasombwa, the boreholes have been out of service for the last two years. Even where functional, the water from the boreholes is inadequate even for drinking and cooking purposes alone.



Given the seasonality of the rivers and the limited access to ground water, Lake Kyoga is of great importance as a source of water for households and livestock. For domestic use, both women and men get into their fishing canoes and paddle a few hundred metres from the shore, where they collect water that is deemed to be relatively cleaner than that at the shore. Women and children are frequently seen carrying jericans of water on bicycles. Each jerrican can hold 20 litres of water. Some enterprising members of the community fetch water which they then sell to others in the local town at Ushs 50-100 per jerrican.

Livestock are watered at the lake. It has been reported that some conflicts are beginning to develop where army veterans are fencing off land thus denying herdsmen access routes to water their cows. In Lwampanga sub-county and throughout Nakasongola there is no tradition of irrigation.

Lake Kyoga is also important as a source of livelihoods for the fishers who live in the fishing villages around the lake. Fishing is the main source of livelihoods in Lwampanga (Table 3.1). The next most important sources of livelihoods is crop production – for subsistence and the market – supporting one-quarter and one-tenth of the population respectively. Other sources of livelihoods are livestock production, businesses, self created artisan jobs, public sector jobs and jobs with development organisations.

Table 3.1: Main sources of livelihood in Lwampanga sub-county

Main source of livelihoods	Percentage
Fishing	32.7
Home gardens crop farming	25.5
Subsistence crop farming enterprises	10.9
Livestock production	14.5
Local businesses	7.3
Artisan jobs (carpentry)	3.6
External job	5.5

Freshwater ecosystem services in Bududa and Butaleja

In Bududa and Butaleja, R. Manafwa is the major source of provisioning services related to water. These include sand, fish and water for domestic and agricultural use. For instance, water from R. Manafwa is purified and supplied to the districts of Mbale and Tororo town. At

A girl waiting for help to offload four plastic jericans of water in Nakasongola district



several locations along the river, the water is used to irrigate crops. R. Manafwa is also a major source of livelihood support. But unlike in Nakasongola, the communities along R. Manafwa have other ecosystems and services to rely on, for instance rangelands, grasslands and wetlands. In Butaleja, wetlands are among the most important resources; while in Bududa the rangelands and grasslands are of secondary significance because of the importance of land for agriculture to support the growing population.

Silt carried by the river settles along the river banks as sand dunes. While this sand is a major source of income for the youths in the two districts, it is also a source of pollution. As R. Manafwa emerges from the mountains in Bududa district, it carries a clean stream of water. In fact in Bulucheke and Bukigai sub-counties in Bududa, the river water is often drunk without boiling. Soils, from the open farms along the river bank, eventually enter the river system causing the water to be turbid and brown in colour. The farming activity continues downstream up to Butaleja. So in addition to boiling, the downstream communities have to sieve and decant the water before drinking. Many have thus resorted to using water from springs and wells. Overall, in Bududa no significant changes in the ecosystem of R. Manafwa were reported.

The importance of R. Manafwa as a source of fish for the riverine communities has been decreasing over time. Today very little mudfish is harvested compared to what was caught in the past. This might be due to over-fishing as the population increased or to the heavy silting of the water downstream. Only 23 per cent of the respondents in Bududa and 5 per cent in Butaleja expressed an interest in fishing.

Youth selling and loading sand extracted from River Manafwa on a truck



Wetlands ecosystem services and changes in Bududa and Butaleja districts

The wetlands in Mazimasa sub-county have been entirely converted for rice production. In Bududa, wetlands are of particular importance in Bukigai and Bulucheke sub-counties. While wetlands provide water, papyrus for making mats, and fish for consumption, the major wetlands are those closely associated with cultural ecosystem services. Several wetlands in Bulucheke serve as cultural sites where circumcision and other traditional events take place. On the whole, the wetlands in Bududa have largely been unchanged. However in a few cases,

communities use part of the wetlands to grow vegetables. The scale of production is relatively small even though these vegetables are for commercial purposes. There is slight degradation of the wetland ecosystem but in most cases fertilizers are not used. However, further downstream starting in Manafwa district the wetlands have been converted for rice production as in Butaleja. In fact, at several locations diversion channels have been dug to provide irrigation water.

Changes in the freshwater ecosystem services

The main changes to the fresh water systems have seen a decline in quality and the impacts of floods. The most recent floods occurred in 1997 as a result of heavy rains caused by the El Niño climate event. Studies indicate that Lake Kyoga levels rose by 2 metres (ILM, 2005), leading to the destruction of crops and property along the lakeshore. The El Niño rains uprooted papyrus from the shores of the lake causing the papyrus to float on the lake. The floating papyrus sumps blocked the exit of the lake into the Kyoga Nile, leading to a further rise in the water level and a decrease in the water flow along the Nile. By the time the water levels receded, the area of the papyrus at the lakeshore had reduced and the papyrus plants dried.

Communities have also observed a decline in the quality of the water in the lake. As the number of people increased, more waste from human activities and from livestock has been discharged into the lake. Given that L. Kyoga has a clay base, there is a high retention of the waste especially along the shoreline areas. This increase in wastes (and associated plant nutrients – nitrogen and phosphorous) has led to eutrophication and increased proliferation of the water hyacinth. Table 3.2 quantifies some of the changes described above.

Impacts on human well-being

Changes in the size of the wetland, water quality and amount of water in L. Kyoga have had considerable effects on human well-being. The occurrence of waterborne diseases, especially diarrhoea, is said to be increasing (but this increase has so far not been documented elsewhere). Three quarters of the households surveyed are reported to have suffered from diarrhoeal attacks, in the last three months, as a result of drinking water contaminated with

human and animal waste. The worst affected areas include: Lwampanga, Nakalekire and Kasombwa in Lwampanga sub-county. The situation is made worse by the fact that several households do not boil water before drinking it.



Fish catch is said to have declined to less than half the catches before 1997/98. This has been attributed to an increase in fishing effort to supplement incomes. The reduction in fish catch leads to a reduction in incomes and fish for household consumption. Possible reasons for the decline in the quantity of fish in the lake include loss of breeding

grounds, fish migration and an increase in fishing effort. Fish breed in sheltered areas to avoid predators. The reduction of the area covered with papyrus vegetation has reduced the

amount of available fish breeding grounds. Secondly, the fish are said to migrate to the Apac across from Nakasongola district. This migration causes a short fall in the quantity of fish harvested and fishermen have to camp in Apac to catch more fish.

Table 3.2: Changes in freshwater ecosystem services of Lake Kyoga

Observed changes in freshwater ecosystems services	Percent
Reduction in flood control (more frequent flooding)	41.81
Reduction of wetland and wetland use	20.00
Water quality	9.00
Expansion of agricultural production into wetlands	9.00
Reduction in water level	20.00

Forest ecosystems and ecosystems services

State of forest ecosystems and ecosystem services

Forest ecosystems range from the undisturbed forests in the east to extremely degraded forest reserves in the western part of the L. Kyoga catchment. As one moves away from L. Kyoga, the seasonal rivers disappear and the volume of the forested area expands.

In Nakasongola, this may be linked to the level of human activity in the different areas. Lwampanga is the sub-county with the highest number of households in Nakasongola. Katuugo and Kasagala central forest reserves are larger than Wabisi-Wajala and Kyalubunga (Table 3.3). Yet, it is in the larger forest reserves where the forest trees have been better maintained. The forest ecosystem in Lwampanga is composed of dry woodlands.

Table 3.3: Central Forest reserve characteristics in Nakasongola district

Central Forest Reserve	Area (ha)	Description	Sub-county	Population
Kasagala	10,828	Savanna woodland, classified as <i>Combretum</i> , <i>Terminalia</i> ; <i>Londetia</i> woodland (N), with <i>Sorghastrum</i> grassland.(N)	Kakooge	20,447
			Wabinyonyi	13,618
Katuugo	3,318	Plantation forest About 1600 ha of pine (<i>P. oocarpa</i> and <i>P. caribean</i> (N) many are mature and under harvest. About 1200 ha of woodland savanna for example <i>Termanalia</i> , <i>Combretum</i> , <i>Albizia</i> , <i>Tedeanobilis</i> approximately 100 ha of swamp.	Kakooge	20,447
Kyalubunga	4,393	Savanna/grassland areas common trees <i>Terminalia</i> spp, <i>Albizia</i> , <i>Tedea nobilis</i> , and <i>Acacia</i> spp	Lwabiyata	10,686
			Wabinyonyi	13,618
			Nabiswera	14,413
Wabisi-Wagale	4,453	Thuchets, dry <i>Combretum</i> savanna and <i>Acacia imperata</i> grassland.	Lwampanga	21,440

Source: NDC (2004)

Although the western side of Nakasongola still has savannah woodland and grasslands, these have been degraded considerably. Lwampanga is the most adversely affected area. The forests in Lwampanga have declined because of factors such as over grazing, settlements for internally displaced people (IDPs), and poor resilience of the vegetation. As a result, most of the forest vegetation in Lwampanga sub-county is unable to regenerate quickly. This is not helped by the fact that the whole area lies in the drylands belt of the district.

Much of Butaleja does not contain any significant forest ecosystem. For instance, in Mazimasa sub-county thick bushes were noted, but no forest areas were observed. A few fruit trees such as mangos and avocados were seen. The decline in tree cover was caused by commercial harvesting of trees carried out in early 2000-2001. At that time, Butaleja was part of Tororo district. Under this concession, the local community were encouraged to sell their mature trees for timber production. Most of the trees in the area were felled and only a few trees survived.

Figure 3.3 Forest ecosystems in Bududa and Butaleja districts:

Source: NARO/KARI 2007

Between 1990 and 2004, there was a major transformation in the forest ecosystems in Nakasongola. Broad-leaved trees, which were already a very small component of the forest cover (1.4 ha) disappeared completely and the woodlands declined by about 56 per cent (Figures 3.4 and 3.5). However, the area under coniferous forests increased by over 13 per cent. Coniferous forests have grown because of the re-forestation efforts of the National Forest Authority and private concessionaires in the Central Forest Reserves. At least two forest reserves Katuugo and Wabisi-Wabayi have already been given out for plantation purposes, but only the former so far has a plantation.

largely replacing the ecosystems that existed before such as woodlands, grasslands and wetlands. This is shown in table 3.4.

Table 3.4: Changes in land cover in Nakasongola district, 1990-2004

Types of land cover	Totals 1990 (hectares)	Totals 2004 (hectares)	Percentage change
Broad leaved woodlots	1.40	0.00	--
Coniferous Plantation	1 706.90	2 332.50	13.41
Woodland	127 051.90	59 697.30	-56.41
Bush	48 865.50	151 448.80	33.87
Grassland	78 091.70	40 182.10	-47.17
Wetland	15 805.60	15 273.20	-1.74
Small scale farmland	54 729.30	51 717.70	-2.91
Commercial farmland	66.90	179.00	31.31
Built up area	793.20	828.6	2.14
Open water	23 884.10	25 734.50	3.59
Impediments	0.80	3 603.60	49.99

Source: NFA (2007)

Changes in the forest ecosystem services and impacts on human well-being

In Lwampanga sub-county, dry woodland and shrubs dominate the forest ecosystem. These shrubs serve as the main source of wood fuel (either as firewood or charcoal) for households and businesses. The sale of firewood is also an income earner. For instance, in Nakalekire village, women collect firewood which they then sell to residents of the local town who are otherwise too busy to collect the firewood themselves. These include operators of eating places and shopkeepers. The women then use the money to buy domestic items like salt and food. The demand for wood fuel has led to a decline in the availability of wood fuel. Eighty-six per cent of people say that the availability of wood fuel has decreased. The decline in forest resources is affecting the livelihoods of some of the people. For instance, charcoal burning was a major source of livelihood in Nakasongola until the number of trees reduced (NDC 2004).

Contributing to the pressures on forests is the fact that the use of energy alternatives is very limited. Ninety-one per cent of households indicated that they used only wood fuel. Over the last one year only 7 per cent had used paraffin for domestic cooking. And even those who have used paraffin before may not still be using it today. Other fuels like diesel fuel are used for commercial purposes. For instance in Nakalekire village diesel is used to provide energy for a community commercial television telecasting live football matches.

Many forests in Nakasongola are also under heavy attack from termites especially during the drought. Efforts by the National Forestry Authority (NFA) to plant trees in some areas, though generally successful still suffers considerably from termite attack.

Table 3.5: Types of fuel used for cooking in the household over the last one-year

Fuel source type	Percentage (per cent)
Firewood	67.2
Charcoal	25.5
Paraffin	7.3

In Bududa, the restrictions imposed by UWA have limited the number of ecosystem services the nearby communities derive from the park and adjacent forest reserves. In the mid-1990s, a Collaborative Forestry Management scheme was introduced to help increase access to the forest by the community while ensuring the conservation objectives were adhered to. This scheme was only partially successful and the communities still feel immensely restricted from dealing in timber, firewood or charcoal.

Unlike the forests in Bududa, those in Butaleja have declined and continue to decline. The major contributor to the decline of trees in Butaleja was caused by the commercial harvesting of timber over the 2000-2001 period. This has also affected energy security in the district that today cooking fuel in Butaleja is obtained from rice and maize husks. Further, the existing trees cannot even be used to support infrastructure development. For instance, the young trees used to build bridges break all the time and the community are forced to wade across streams. Other reported impacts associated with the disappearance of forests include an increase in the local temperature and a decline in soil fertility. What is upsetting for the community is that the trees were sold under pressure from political leaders of the former Tororo district. Local council leaders enforced a tender order hence the communities had to sell most of the trees that had timber value.

Grassland ecosystems and ecosystems services

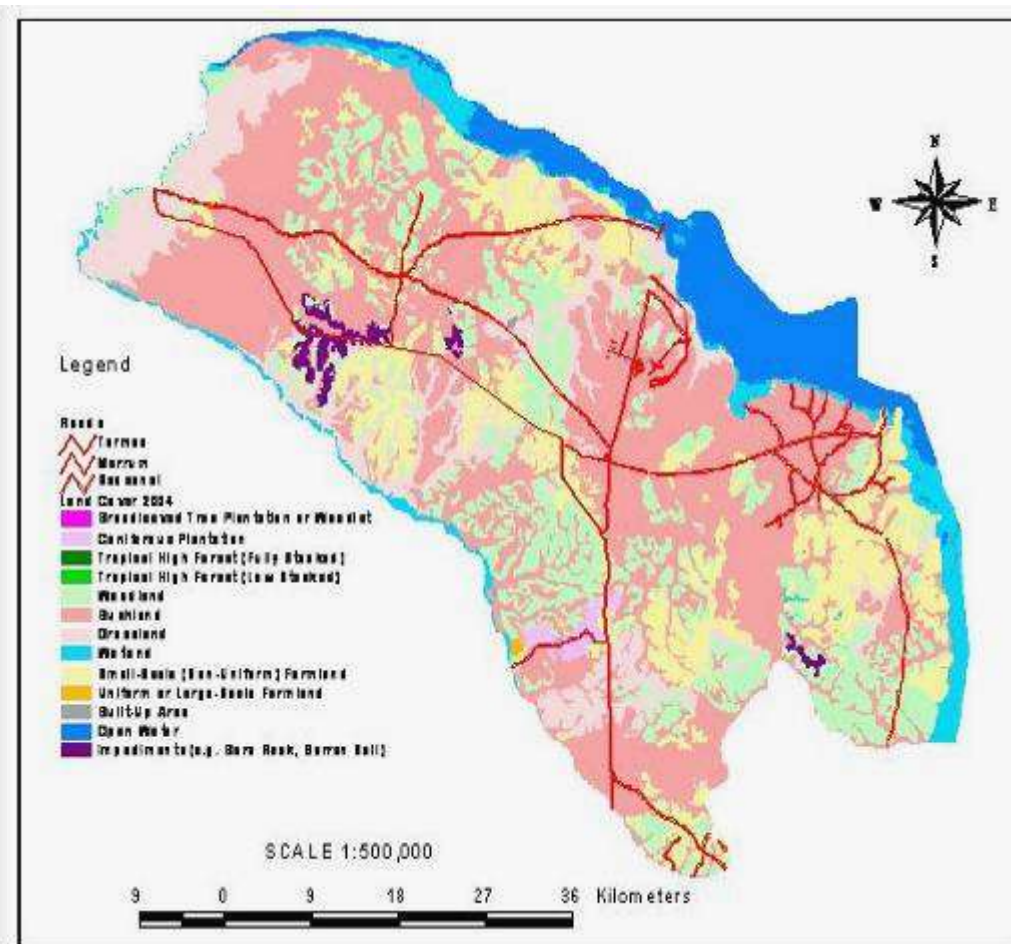
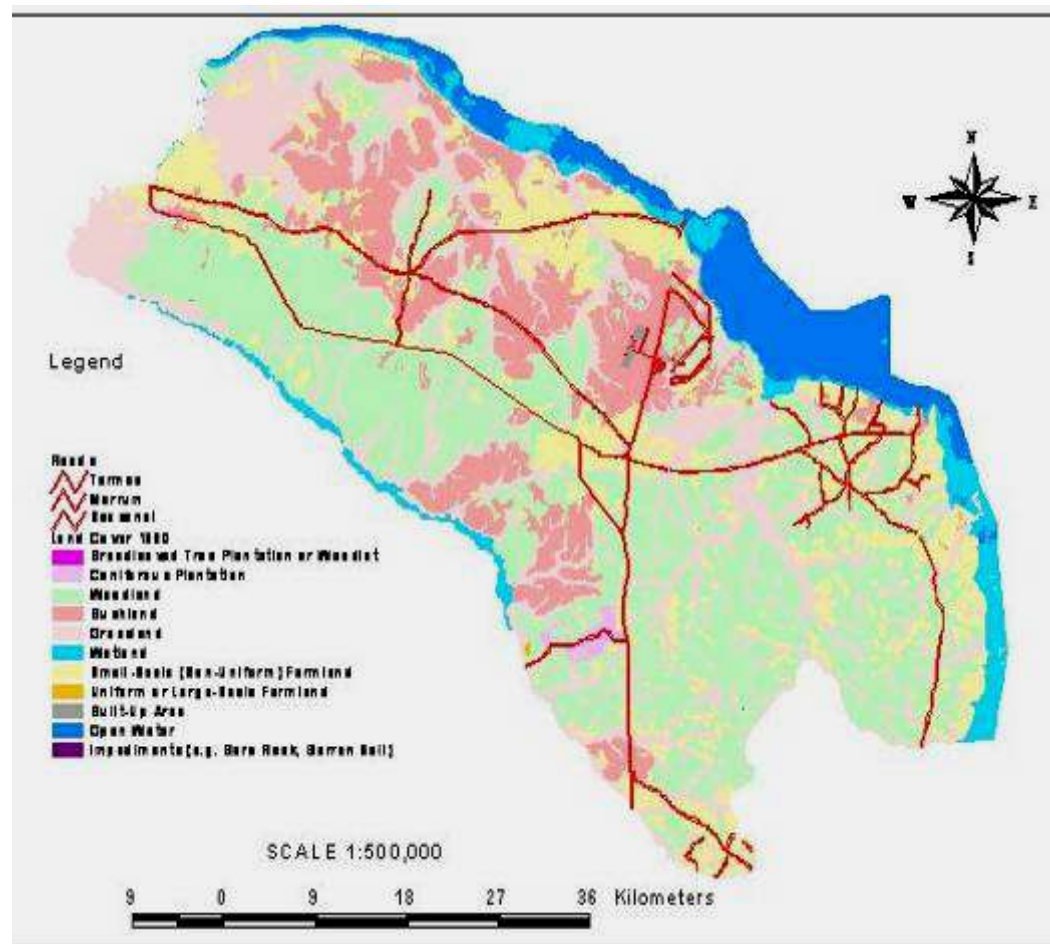
In Nakasongola, grassland ecosystems just like forest ecosystems are found in the dryland belt. Grasslands provide provisioning services of pasture for livestock which in turn provide food and milk for the pastoralists. The grasslands are also used by farmers to grow crops, especially in the areas where the former arable lands have been so degraded there is just bare ground left. Grasslands contain shrubs, which provide fuel wood and browse for livestock. They also regulate soils and reduce on the extent of degradation that occurs from the elements, by providing a cover against heavy rains and winds that could lead to excessive soil erosion.

Pastoralists frequently stray into areas that are largely inhabited by crop farmers and fishers. The movement of pastoralists into crop farming areas has been on the increase since 2001. The reasons for the increase are the erratic rains, and the reduction of grasslands in the traditional rangeland areas. This has increased the level of conflict between the pastoralists and crop farmers, with the farmers complaining that the animals eat and trample their crops. Farmers believe that such actions are deliberately carried out as the drought intensifies to discourage them from using certain pieces of land, which the pastoralists later convert into grazing areas. However, the conflict could also have emerged because when the crop farmers migrated to other areas the pastoralists used the abandoned lands to graze their cattle. Now that the crop farmers have returned, having also been joined by communities emigrating from other areas into the district, the conflicts over grasslands have intensified.

Grasslands and rangelands cover a very small portion of land in both Bududa and Butaleja districts. The communities keep very small numbers of livestock. The preferred form of livestock production is the intensive zero grazing because of the small pieces of land per person. In Butaleja the goats and cattle are taken to grasslands because these are found next to crop fields. In both Bududa and Butaleja, grasslands declined as population increased and more land was taken up for agricultural production.

Figure 3.4: Land cover of Nakasongola district 1990

Figure 3.5: land cover of Nakasongola District 2004



Source: NFA 2007

Agro-ecosystems and ecosystem services

Typically, the agro-ecosystems in Lwampanga sub-county are the lands along the thin papyrus belt along the lakeshore. These have expanded to gradually eat up the papyrus belt along the lake. Some areas within the drylands are shaded by trees, have nearby sources of water and serve as agricultural lands. In the more semi-arid areas, many of the crops fail. The crops grown include: cassava, maize, beans and ground nuts. Crop production in Nakasongola is largely constrained by crop diseases, inadequate water availability and continuous drought and low soil fertility. In Bududa and Butaleja crop diseases and the lack of markets were the major agricultural production concerns and water concerns were in third place (Table 3.6).

Table 3.6: Constraints to crop production by percentage

Constraint	Percentage by District		
	Nakasongola	Bududa	Butaleja
Crop diseases	67.3	37.7	20.0
Lack of markets	9.1	33.3	36.4
Low soil fertility	34.5	8.4	4.0
Low labour	5.5	8.4	7.1
Lack of water	45.5	12.5	10.6

The agro ecosystem provides food for consumption, but only on a limited scale. Low food productivity has always been a characteristic of Nakasongola, especially in the drylands areas. Erratic rainfall, shrinking vegetation cover and termites are some of the challenges. Frequent droughts have been reported since 2002 and this has led to declining food harvests. As a result much of the food (maize, rice, and beans) consumed in Lwampanga is bought from neighbouring districts including Luwero and Kampala. The erratic rainfall and shrinking vegetation cover has encouraged the growth of termites which need vegetation to feed on. The termites eat the maize and other standing crops in the field and even attack trees. The termite problem has existed for at least 10 years.

During the 1960s and 1970s, the low food productivity of the area forced several people to leave and move to Lango (Apac and Lira districts) and central regions (Kayunga and Luwero districts). At the beginning of the 1980s these people were asked to leave the areas they had moved to. This resulted in them returning to Nakasongola. The population has continued growing as more migrants return in addition to people from other areas that migrate to Nakasongola. Because many of the new migrants are crop farmers, they chose to grow crops on already vegetated areas.

Bududa and Butaleja are agricultural areas. In Bududa the major crops grown include coffee, which is also Uganda's major cash crop, bananas, vegetables such as tomatoes, cabbages, egg plants and fruits particularly passion fruits. The other crops grown in Mazimasa sub-county are bananas, beans, ground nuts and maize. On a relatively smaller scale, millet, sorghum and cassava are also grown. Coffee is grown on the slopes of Mt. Elgon and in the relatively flatter areas of Bukigai and Bulucheke. Over time, however,

coffee plants were removed and replaced with bananas and annual crops such as beans, groundnuts and maize. This is because, as the population in Bududa increased, the land was increasingly fragmented. Coffee is a plant that calls for economies of scale for maximum gain. Being a perennial crop, it cannot be sustainably grown on the small plots and neither is it able to offer a short-term source of income to the farmers. Nevertheless, coffee is still the principal cash crop, but it is largely grown by the farmers who live along the mountain ranges. Passion fruit is grown on the mountain ranges.

In Butaleja the major crop is rice. It is grown in the wetlands that have been converted into agro ecosystems. The soils in Butaleja have low soil fertility, which affects crop productivity. Prior to 1994, the land in Mazimasa sub-county was largely used for agricultural production. Rice has always contributed a significant, although smaller, part of the local economy. Indeed even before the Doho rice scheme was started in 1976, the local communities already grew some rice. With the launch of the Doho rice scheme, under an agreement between the Chinese and Ugandan governments, nearly all the land in the Doho area in Mazimasa sub-county was allocated to paddy rice production. Only a small section of the wetlands outside the rice scheme was left and this has since been converted into a private rice scheme.

The agro-ecosystems in Bududa and Butaleja are a source of provisioning ecosystem services of food and fuel (rice and maize husks). In addition the agro ecosystems support zero-grazed livestock. The livestock are fed on remains from the crop plantations and cut grass. In Butaleja, the agro ecosystems support community livelihoods through commercial rice production. With the decline of crop production in Mazimasa, it is increasingly becoming the major food crop.

4 DRIVERS OF ECOSYSTEM CHANGE

Introduction

Natural or human-induced factors that directly or indirectly cause a change in an ecosystem are referred to as ‘drivers’. A *direct driver* unequivocally influences ecosystem processes. An *indirect driver* operates more diffusely, by altering one or more direct drivers (MA, 2005).

Indirect drivers of ecosystem change

The indirect drivers of change that are discussed in this assessment are population change (including growth and migration), change in economic activity, cultural and religious factors and science and technology. Collectively these factors influence the level of production and consumption of ecosystem services and the sustainability of that production.

Effect of demographic factors on the Lake Kyoga catchment

Population growth leads to increased consumption of ecosystem services. People in different locations interact with their environment with differing pressures on ecosystems and uses of ecosystem services. This is evident across the different parts of the Lake Kyoga catchment.

The population density of Bududa is 534 people per km². This is over four times the national average of 124 people per km² (UBOS, 2004). Although lower than the national average, the population of Bududa is growing faster at the present time than at any other time in the last decade. In Butaleja, the population density is also higher than the national average, but the population growth rate has declined over the last 10 years. Nakasongola has the lowest population density and growth rate of the three districts. This is shown in table 4.1.

Table 4.1: Population statistics of Bududa and Butaleja districts

Demographic statistics	Period	Nakasongola	Butaleja	Bududa	National average
Population		125 297.0	160 927.0	124 368.0	24 748 977.0
Population growth rate (%)	1980-1991	2.8	3.0	2.7	2.5
	1991-2002	2.0	2.7	3.1	3.3
Population density (p/km ²)	1991	31.0	242.0	406.0	85.0
	2002	41.0	330.0	534.0	124.0

* Statistics for Butaleja and Bududa were extracted from Tororo and Mbale respectively

Source: UBOS 2004

High population density has implications on the amount of arable land available per household. For instance in Bududa, many households have only 0.5 acres of land on which to grow crops and support their livelihoods. The small plots of land are the result

of land fragmentation as adult members of the household split and share the land they inherit from their parents. Gradually, community members who wish to farm extensively or acquire more land shift to the mountain ranges where land is less likely to be contested in the short term.

In Butaleja, there seems to be a lot of idle land - some with poor crops and some lying unutilised. The wetland has encouraged the communities to grow rice, because they are fertile and have a lot of water. Indeed a large fraction of the wetland has been converted for rice production and parts of the river are being diverted to provide irrigation for more land. The rate of conversion of the wetlands for agricultural production has increased markedly as rice production has grown to dominate the livelihoods in the area. This has also largely been brought on by an ever increasing population in the area.

Demographic pressures in Nakasongola have been felt in the lake fishery and the forestry ecosystems. The influx of IDPs into Wabisi-Wajala forest reserve led to an accelerated destruction of the reserve. Similarly, over-fishing to supply growing demand has resulted into a reduction in fish catch.

Economic drivers and their effect on the Lake Kyoga catchment

The desire for economic growth and livelihoods also impacts on the way the ecosystems are used. It must be noted that the extent of any negative impacts depend on the efficiency of the technologies used in the economic or livelihood endeavour.

Paddy rice is by far the most important economic activity in Mazimasa sub-county. The community has concentrated much of their effort on rice production in the wetlands, virtually abandoning other land use alternatives. Commercial rice production started in 1976, when the government of Uganda with support from the Chinese government set up the Doho Rice Scheme in Butaleja (just next to the assessment site in Mazimasa sub-county). By 1994 on realising its income potential, the local communities also set up a private rice scheme. Many local rice farmers transferred the experience gained from the Doho scheme into private rice enterprises.

Farming in the wetlands in Mazimasa has expanded due to the periodic flooding of R. Manafwa caused by among other reasons the El Niño rains of 1997. The community have also dug irrigation channels to provide water during the dry season. Many farmers have been attracted by the good farm gate prices they fetch from the rice, which range between Ushs 700-1000 per kg, higher than crops such as beans or maize which fetch between Ushs 150-400 per kg. On average, every rice farmer has between 0.5-2 acres of paddy rice crop size of a private wetland area farm popularly referred to as Ahmada's farm (named after the a local landlord with the largest claim on the wetland). Because most of the farmers have moved into the wetland, there is little additional production elsewhere. In addition to its importance as an income earner, rice is now the most important food crop in the area, relegating other crops such as millet, sorghum and maize.

The major crops grown in Bududa district are Arabica coffee, bananas, beans, groundnuts and vegetables such as cabbages, onions, tomatoes and fruits such as passion fruits.

Coffee has always been an important crop in Bududa because of the strong history of coffee co-operatives especially Bugisu Cooperative Union. The Mt. Elgon region has conditions favourable for Arabica coffee growing in high altitude areas. As indicated earlier, population pressure and reducing land availability forced coffee farmers to shift to the mountain slopes to keep growing the crop. However, they soon realised that the soils on the mountain side were also suitable for other crops such as vegetables and fruits. As a result, most commercial agricultural production in Bududa district now takes place on the mountain ranges. The gently sloping areas near homesteads are instead used for growing domestic crops and zero grazing.

In Lwampanga sub-county fishing, agricultural production and livestock are the major sources of income. Lwampanga is the leading fish landing site in Nakasongola and one of the most important landing sites on Lake Kyoga (NDC, 2004). Most of the fish is sold fresh to fish processors and a smaller fraction is processed using techniques as smoking, drying, frying and salting. The processed fish is then sold to, traders, who transport the fish to parts of northern Uganda (Gulu and Lira districts), and out of the country to Southern Sudan and the Democratic Republic of Congo. Most of the people engaged in buying and selling of fish come from outside the sub-county.

As the population in Lwampanga sub-county grew, the number of fishers also increased. Additionally, following the El Niño rains of 1997/98, several changes were reported in the lake ecosystem. The flooding reduced the area covered with papyrus vegetation and thus led to the loss of fish breeding grounds. This resulted in reduced fish catch. The fishers' response was to increase their efforts. They also ingeniously decided to create their own breeding grounds by anchoring floating papyrus using plastic sacks full of sand (NDC 2004). The polyethylene sacks eventually sink into the lake and cause the lake to be partly filled with plastic bags. At times they become a trap leading to fish deaths before they become commercially useful (that is before they breed or are captured).

A little subsistence farming complements fishing as a source of livelihood. But on the whole, Nakasongola is a net importer of food especially maize flour, beans, and cassava flour. Petty trade of household items also sustains a few livelihoods in the community.

Livestock production is the main source of livelihoods for the pastoralists who occupy about 60 per cent of the land in Nakasongola. However, the increasing incidents of pastoralists straying into the farming areas, especially during the drought, are sparking off conflict with the sedentary communities of farmers and fishers.

Cultural and religious drivers of ecosystem change

Of the three study areas, the communities in Bududa seem to have a more advanced culture than the communities in the other districts. Among the Bagisu in the Mount Elgon region (Bududa, Manafwa, Mbale and Sironko districts) a 2-3 month period,

The boys to be circumcised (without shirts) marching with friends and relatives as they go to be smeared with clay



running from July to September, is characterised by initiation of young men into adulthood through circumcision. The circumcision events are carried out during the day and follow weeks of celebration, beating of drums and running until the party reaches a meeting point, which is often a cultural site. An elder cuts the foreskin of the young man's penis and this signifies entry into manhood. Every youth circumcised is required to have the tail of a Black and White Colobus monkey which he waves around during the celebration. A number of these monkeys are trapped and killed during this period and the number increases as the population grows. Cultural celebrations are also threatened by changes in the area's ecosystem use patterns. For instance, as they prepare for circumcision, the young men smear clay extracted from the wetlands, all over their bodies. However, as more wetlands are converted for agriculture, there are only a few sites left for extracting clay.

The cultural site in Bulucheke, Bududa where the circumcision is carried out is also a salt lick for cattle and the arena for bull fighting. The site overlooks one of the streams that flow downwards to form R. Manafwa. Every Saturday a bull fight is organised. Different groups bring bulls which have been trained to fight and, the spectators pay a fee to watch the fights. This fee is divided amongst the owners of the bulls and the organisers of the event. The owner of the winning bull takes the larger share of the collection, and the owner of the losing bull gets a small consolation. A little money is left over to ensure continued organisation of the event. While the bull fights are going on, people whose cows are on heat can have them mate with the strongest bulls free of charge.

The strong culture in Bududa has created community institutions in charge of circumcision and bull fighting, which is good for community cohesion. Indeed, the offer for free mating of bulls allows every member of the community an equal chance of improving the quality of their cattle by choosing to breed only with those bulls that have strong characteristics and other productive attributes (high milk or meat production). On the other hand, the circumcision ceremonies threaten the survival of the Colobus monkey. Indeed it has been reported that the population of these monkeys has shifted firmly to the Kenyan side of Mt. Elgon to escape capture during the circumcision periods.

Cultural institutions in Nakasongola are also quite strong. The Baruli form the majority of people who live in Nakasongola. They are an annexed group belonging to the Buganda Kingdom of central Uganda headed by a king (the Kabaka). The Baganda are organised along a clan system, each with its own totem. The totems are animals such as lions and antelopes. There are 55 clans. The clan system was in the past aimed at protecting animals. It is taboo to kill or eat the totem of one's clan. It is also unacceptable for one to marry from his/her own clan. In Nakasongola, there is also a local witchdoctor who is believed to have spiritual powers to guard L. Kyoga. Although there are questions on how much influence the witchdoctor actually has.

Science and technology drivers of ecosystem change

In all the three districts, agriculture is not technologically advanced. It is largely rain-fed and subject to the vagaries of climate change and climate variability. Subsistence farming methods using a hand hoe and manual labour are dominant. Ox-ploughing could be used,

but the small plots of land and gradient of the highland areas makes this a limited possibility. The use of fertilizer is also limited – mainly occurring in Mazimasa sub-county with the paddy rice. However, for the most part no external inputs are used.

In Nakasongola, the plots of land cultivated are extremely small yet so much land goes to waste and is being overtaken by bare ground as drylands expand. There are opportunities for these areas to be put to better use with the adoption of the appropriate technology for dryland areas. For instance the northern part of Kamuli district, which shares part of Lake Kyoga and is located in the lake catchment, has historically grown citrus and passion fruit. Similar climates elsewhere in the country produce pineapple on a large scale. These enterprises are absent in the locales studied. For the communities in Lwampanga sub-county production is constrained by the distance (40 km) to the main urban centre in the district (Nakasongola Town Council) from where inputs could be procured.

The government has continued to support the diffusion of improved coffee lines in Bududa. The Uganda Coffee Development Authority (UCDA) distributes new coffee plantlets that are then planted by the farmers. Although organic coffee production dominates, there have been reports of fertiliser use, especially under donor supported programs.

Research shows that the Butaleja area in the former Tororo district suffers from very low soil fertility and improvements are needed (Pali *et al.*, 2005). This could be one of the factors contributing to the limited agricultural activity in the upland areas of Mazimasa sub-county. The rice grown in Mazimasa is of an improved type that was bred in Doho Rice Scheme. The farmers regularly buy seeds and use fertilizer to maintain the high yields. The commonly used fertilisers are super phosphates and urea. It is likely that these fertilisers might have a long-term effect on Lake Kyoga, in terms of nutrient enrichment, especially since the filtration and retention properties of the wetland are reduced, as more of the wetlands are converted for agriculture.

There are several options that call for action in Mazimasa. With the higher yields from the improved rice seed, it follows that the farmers could be encouraged to use less of the wetland for rice production. By using less of the wetland for agriculture, the community would benefit from the other provisioning or regulating wetland ecosystem services. Secondly, there is a lot of underutilised land in the sub-county. As rice seed technology improves, varieties of upland rice could also be an alternative to farming in the wetlands. Current expansion of upland rice farming has been constrained by the decline in fertility, associated with the over-harvesting of trees in the area.

Direct drivers of ecosystem change

The direct drivers of change discussed in this assessment are climate change, land use change, invasive species and over-exploitation of natural resources.

Climate change drivers of ecosystem change

Climate change is already having an impact at the local level in Uganda. The main impacts are envisaged to exacerbate the constraints on livelihoods activities leading to a decline in water rights, insecurity, rising unemployment and the spread of HIV/AIDS.

By virtue of Uganda's location along the equator, the country experiences two rainy seasons annually. Mean annual rainfall ranges between 750-2000 mm (Orindi and Eriksen, 2005). The majority of farmers practice rain-fed agriculture, which is sensitive to fluctuations in weather conditions. Food security arising from occurrence of drought and floods may worsen with climate change. Increased temperature, declining and unreliable rainfall may lead to crop failure, scarcity of water resources for human consumption and watering livestock. This may result in increased conflicts among different groups over water particularly in drought prone areas. Fodder for livestock may also become scarce with drier conditions. Other areas may experience enhanced crop potential with increased rainfall, although any increase in rainfall intensity and flooding may destroy both crops and property. The heavy rainfall expected in the medium and high altitude areas may accelerate soil erosion and land degradation and also cause damage to communication infrastructure. Table 4.2 shows some of the climate-related disasters that Uganda has experienced.

Soil erosion is already an emerging issue in Bududa. Frequent landslides are reported but there are limited efforts to contain the problem using embankments and terraces. These interventions are more common in western Uganda where plantation agriculture is quite prominent. It has been argued that the only reason that the terraces were adapted was strong enforcement by the then colonial government (Zaake *et al.*, 1997). Smallholders working individually have no institutional backing or resources to embark on large infrastructure developments as these. Where farmers have to rely on incomes from the coffee crop, in a densely populated area like Bududa, they spend more time looking for alternate livelihoods to augment their earnings (such as growing fruits or providing manual labour for others) than setting up long term structures such as terraces to protect themselves from landslides.

For the Ugandan drylands of Nakasongola rainfall ranges between 500-1000 mm. Rainfall is intensive often the result of convection storms, with very high intensity and extreme spatial and temporal rainfall variability (Rockstrom, 2000). Frequent and severe droughts in Nakasongola have in the past led to famine, food insecurity and social conflicts over pasture and water for livestock (Kisamba-Mugerwa, 2003).

Globally, mean temperatures are expected to increase by 1.4-5.8⁰C over the next 100 years (Orindi and Eriksen, 2005). Uganda's contribution to global warming is quite low in terms of emissions from the use of fossil fuels. Nearly 90 per cent of the national energy demand is derived from biomass. This excessive dependence on biomass has contributed to land degradation and led to a decrease in forest and vegetation cover (Kayanja and Byarugaba, 2001).

El Niño 1997 and effects on Lake Kyoga

The El Niño and La Nina phenomena are the principal causes of the most severe climate-related disasters in Uganda. During a La Nina year, chances of drought conditions and possibly famine are increased during the period of November to April/May of the following year. This is especially so in the eastern parts of the country (UN Water/MWLE, 2005). In an El Niño year the chances of intense flood level rains are increased during the period of October to December over most parts of the country. The intense flood level rains are reflected in increased incidence of intense lighting, thunderstorms, hail storms and wind storms/gust winds. The wide spread flooding often leads to destruction of life and property and outbreaks of water borne disease such as cholera and dysentery

Table 4.2: Climate-related disasters in Uganda

Year	Disaster	Impacts
1961/1962	El Niño rains	▪ Extensive floods experienced in many parts of the country ▪ Destruction of roads, bridges, houses, crops, property ▪ Drastic rise in the water levels of Lake Victoria (2.5 m) submerging all major infrastructure along the lakeshore
1993/94	Drought and famine	▪ Over 1.8 million people were affected due to lack of food, water and inadequate pasture for livestock
1997/98	El Niño rains	▪ Landslides killed 53 people and over 2 000 people were displaced especially in the Mount Elgon region. ▪ Roads, bridges, houses, crops and property worth over US \$ 20 million were destroyed
1999	Drought and famine	▪ Over 3.5 million people in 28 districts were affected by lack of food and a large number of livestock suffered from inadequate pasture and water

Source: MFPED (2004)

For the most part, when the region is not experiencing El Niño and La Nina effects, precipitation and evaporation are almost in balance in a yearly scale in the Lake Kyoga region. Average yearly precipitation around the lake is 1 284 mm while average evaporation is 1 500 mm. Precipitation contributes about 10 per cent of the water coming into the lake, another 10 per cent comes from smaller water systems to the east such as Rivers Mpologoma and Manafwa while most of the water comes from Lake Victoria.

After the El Niño rains of 1997/98 the level of L. Kyoga rose and dislodged the papyrus bed, floating suddes and water hyacinth mats. The weeds accumulated and blocked the outlet of the lake. Within one year, the water level had risen to over two metres. The area flooded altogether was about 580 km². The floods displaced populations, destroyed infrastructure, caused disease and some deaths, and paralysed the socio-economic activities of the region. To date, the outlet of the lake is still partly blocked by the papyrus and hyacinth (ILM 2004). In Nakasongola, the revenue lost by people displaced by the floods was estimated at 13 per cent of their annual revenue. In addition, three roads, 1 390 houses, 300 ha of crops and 7 000 ha of farmland were flooded and destroyed. A total of 5 493 people were displaced (NDC 2004).

Land use change

More than half of the land in Nakasongola is under *mailo* system of land tenure. *Mailo* tenure was created by the British colonial government, in the then Buganda kingdom

(central Uganda) to distinguish the land over which the colonial government had control (Crown land) from the land held by the King (Kabaka) of Buganda (*mailo*). Much of the *mailo* land in Nakasongola is owned by several absentee land lords, who were awarded land by the Kabaka. Indeed, in Lwampanga sub-county, close to half of the residents live under a customary tenure system. More than one-third of the people use rented land or have no definite understanding of the circumstances under which they occupy the land on which they are. Only 12 per cent of the population has a secure long-term tenure which is leasehold, *mailo* or freehold, which are largely inherited.

There are three types of land tenure in Bududa district: customary, freehold and leasehold. Customary ownership is predominant although freehold is on the increase in the rural areas. The urban areas are basically leasehold. The average farm holding is estimated to be 0.5 acre with a few owing up to five acres and above. Ownership of land in Butaleja falls under the same categories as Bududa with customary also being predominant. Land is held by the clan under trust. The clan members may occupy portions of it based on family lineage or through inheritance. Normally, the sale of land to non-members without the consent of the clan is discouraged. Public land is basically leasehold tenure.

It is estimated that about 48 per cent of Uganda's arable land is not yet under cultivation (World Bank 2006). Seventy five per cent of the country is relatively fertile and receives sufficient rainfall to support rain-fed agriculture, cropping and pasture. Around 30 per cent of the arable land is currently under cultivation (Zaake *et al.*, 1997). Agricultural zones have a high population concentration. However for land that is cultivated there are signs of soil degradation as evidenced by declining yields. A switch to production of crops that demand fewer nutrients has not kept up with the country's population growth despite an expansion of the area under cultivation. Arable land per capita is expected to decline to 0.6 from 1.1 persons per hectare between 1991 and 2015 (NEMA, 2001).

Land use change has been brought about by diseases and pests, pursuit of markets, declining soil fertility, water shortage and labour requirements among others. In Lwampanga sub-county, the farmers were influenced to use land on the basis of proximity to the lake, which is largely a wetland. The same was noted in Mazimasa sub-county. The prevalence of pests and diseases was a major concern for those involved in crop and livestock production (Table 4.3). The high relative humidity and temperatures in Lwampanga sub-county encourages proliferation of pests and diseases. Indeed, much of the cassava crop was infected with the cassava mosaic virus, Soil fertility was less of a concern in Nakasongola than in Bududa district largely because there is more land per person available in the former.

Butaleja district has sandy soil which is highly susceptible to leaching. The soils comprise sandy clays and loam with low organic carbon and low soil fertility (Pali *et al.* 2005). Crops grown in Butaleja are finger millet, rice, maize, cassava, groundnuts, sweet potatoes, sorghum, beans, soya beans, cow peas, simsim, bananas, sunflower, cotton and vegetables. In Butaleja the main cash crops are paddy rice and vegetables. Paddy rice which started off in a limited area has rapidly expanded. It would seem that the paddy

rice has expanded rapidly in part because the upland areas suffer from high rates of soil fertility loss. The soil fertility loss seems to be a consequence of soil texture, which allows high levels of leaching and because of the non-cultural practices such as crop rotations and use of manure to increase the soil water retention in the area.

Table 4.3: Reported percentage occurrence of crop and livestock production problems

	Nakasongola	Bududa	Butaleja
Crop production			
Pests	72.7	61.8	83.3
Diseases	67.3	91.2	73.3
Markets	9.1	35.3	31.0
Soil fertility (low)	36.3	52.9	41.4
Lack of water	47.3	14.7	44.8
Shortage of labour	5.5	11.8	23.3
Livestock production			
Pests	45.5	55.9	43.3
Diseases	49.1	61.8	53.3
Markets	7.3	8.8	13.3
Lack of feeds	67.3	17.6	20.6
Lack of water	32.7	11.8	23.3
Labour shortage	1.8	11.8	13.3

Invasive Species

Lake Kyoga is infested with the water hyacinth, which was introduced into the area in the mid-1990s. It is believed that the water hyacinth came into Uganda as an ornamental plant and this aided its dispersal. It has since spread from L. Victoria throughout the Nile basin.

The water hyacinth continues to proliferate in the areas where there is eutrophication caused by human and animal wastes and this is affecting the balance of the lake ecosystem. This is particularly concentrated at the edges of the lake which is the common breeding grounds of the fish. The thick covering of the water hyacinth prevents the penetration of light and air to the lower layers thus depriving the aquatic biodiversity of the essentials for survival. If left unabated, the water hyacinth has the potential to cover the whole lake system. So far, control measures have included dredging the weed out of the water. The Egyptian government provides most of the funding for this.

Water hyacinth in a papyrus wetland at the shore of Lake Kyoga A young fisherman in his canoe with the day's catch



Overexploitation of natural resources

In all three locations the fisheries have dwindled. In Butaleja and Bududa, fishing is not considered a significant income earner largely because R. Manafwa is used for other activities such as water for irrigation in the wetlands and domestic consumption, and sand

A boy with his fish catch from Butaleja wetland along River Manafwa



mining. There are a few fish (mud fish) captured from the river and these are usually left for children to catch. In Nakasongola, the system is on the verge of overexploitation because environmental changes have reduced the productivity of the system. The increasing population of fishermen and the use of poor fishing practices have also added to the pressures.

To address this challenge, Beach Management Units (BMUs) were introduced on an experimental basis between 2000 and 2004 by the Integrated Lake Management Project funded by DFID. They were tried out under the Lake George Basin Integrated Management

Organisation in western Uganda and subsequently with Lake Kyoga Integrated Management Organisation. The success of these two initiatives convinced the government to include BMUs as mainstream management structures for fisheries in Uganda, and they are duly recognized in the National Fisheries Policy (2004).

The concept of the BMUs allows local communities, to participate in the decision making on how the fisheries are managed. At the lake basin level integrated management organizations were created that allow the districts with a transboundary resource to partner with the local fishing communities, represented by the BMUs, in the management of fisheries (UNEP/NEMA 2006). The arrangement of the integrated lake management system – the BMUs and the district is such that BMUs retain 25 per cent of the revenue they collect and 75 per cent is remitted to the administrative officer (Chief) of the sub-county where the landing site is located. This money forms part of the districts local revenue. The Chief remits the money to the district and the incomes are then redistributed by percentage 65 per cent for the district and 35 per cent for the sub-county.

In Butaleja and to a smaller extent in Bududa, there is great danger of the wetlands being degraded and losing their natural resilience to provide ecosystem services. For instance there is increasing conversion of the wetlands in Mazimasa sub-county and at several locations along River Manafwa into rice schemes.

Rampant deforestation has reduced the size of community forests in Nakasongola, and in part led to a rise in termite attacks. The reduction in vegetation cover leaves the land bare and increases the risk of soil erosion. In Bududa, soil erosion occurs because the mountain slopes are farmed without the concomitant use of soil erosion control mechanisms. The growing population, high population density and poor farming methods are reducing the productive ability of the land and before long the system will also experience pressure of over exploitation.

5 POVERTY AND ENVIRONMENT LINKAGES

Causes of Poverty in Uganda

Two participatory poverty assessments in Uganda in 1998/99 and 2002 found that the most frequently cited causes of poverty were disease, limited access to land or land shortage, large families, and lack of markets for produce. Other causes of poverty that emerged strongly in the second participatory poverty assessment were high and unfair taxes and market dues and the death of important members of the household particularly the income earners. Women in particular considered the lack of control over productive resources such as land, livestock and the crops produced by their labour as a major root cause of poverty (MFPED, 2002). This is shown in table 5.1.

The participants of the second participatory poverty assessment also noted that poor farming methods lead to land degradation, soil fertility loss and declining yields. Large families were cited as the key cause of such poverty (MFPED, 2002). For instance, large families are more likely to fragment their land into smaller plots to satisfy their needs. The other demographic pressures and land shortage concerns were: over cultivation of small plots, environmentally destructive income-generating strategies like charcoal burning and over fishing in Nakasongola (especially by the youth), population migration, land renting (which limits the level of investment into land improvement) and use of fragile areas.

Causes of Poverty in Nakasongola, Bududa and Butaleja

The causes of poverty seem to be much the same whether at national or at local level. In all three locales of the ecosystem assessment, various social and economic activities have been noted as having links with poverty.

Land degradation through over-exploitation and improper management is evident throughout the study area. About 60 per cent of Nakasongola lies in the drylands, a lot of land has become bare ground with the intensity of degradation being highest in the last fifteen years (NFA, 2007). In-migration of several communities has led to settlements in the central forest reserves (NDC, 2004) and the only lands available for agriculture production in some areas are fragile wetland ecosystems along Lake Kyoga. As these fragile belts reduce and the central forest reserves get degraded, the opportunity for maintaining or sustaining livelihoods decreases. This is likely to exacerbate poverty.

Environmentally destructive income-generating activities are also an issue. For instance Nakasongola has for long been a major source of fuel wood and charcoal for urban centres in Uganda including Kampala and nearby districts like Luwero district. In the 1990's the revenue from charcoal production was so high such that by the time Nakasongola became a district charcoal levies were said to contribute close to 60 per cent of the district revenue (NDC, 2004). Over half of the wooded lands in Nakasongola disappeared between 1990 and 2004, all broad leaved areas varnished and grassland areas also halved (NFA, 2007).

This is a worrying trend. Over 90 per cent of all energy used in Uganda is obtained from biomass (UNDP, 2005; NEMA, 2005). Energy efficiency in Uganda has not improved and there has been no reasonable reduction in biomass consumption even with the

A lady in Nakalekire village, Lwampanga sub-county (Nakasongola district) loads fire wood on a bicycle for the market. The jericans are for water



introduction of fuel efficient stoves in the country (MEMD, 2006). In fact fuel wood shortages are becoming more common. For instance, the shortage of wood fuel has meant that communities in Mazimasa sub-county use rice husks for cooking and domestic heating. These shortages are also being felt in the alternative economy where young people are denied the opportunity of an income from trees through timber for the construction industry or wood for brick making. Box 5.1 discusses the link between

charcoal burning and poverty.

The use of fragile ecosystems such as wetlands, hilly and mountainous areas is also a challenge. Butaleja, just like Nakasongola is characterised by the continued use of fragile wetland ecosystems for paddy rice production. In Butaleja, however, some of the arable lands are not utilised because of low soil fertility. Instead the whole community in Mazimasa sub-county has concentrated on the wetlands, which are likely to provide less and less with time. Abandoning production in alternative areas may prove critical in the long term as these could have served as safety nets in case of any eventuality.

Bududa suffers considerable soil erosion linked to the steep slopes and cultivation on them. In 2001, NEMA, reported that this region of Mt. Elgon had 85 per cent of total area exposed to soil erosion (NEMA 2001). For Bududa, the high population density renders some young people idle as they have no work to do and therefore vulnerable to poverty.

Measures of human well-being

Human well-being can be measured using two different indices: Human Development Index (HDI) and Human Poverty Index (HPI). HDI is a measure of human development based on three components – health education and income. Four indicators measure progress in each of these components: life expectancy at birth, adult literacy, average number of years of education and real per capita GDP. HPI, on the other hand, measures deprivation using the same three components.

On the basis of the HDI ranking by district carried out in 2004, Nakasongola was in 30th position out of a list of 56 districts. Tororo the mother district for Butaleja was in 42nd position, while Mbale, from which Bududa was carved, was in 11th position. This is

shown in table 5.1. From a regional perspective, Nakasongola had the lowest HDI ranking in central Uganda, the most developed region of the country. Considering the districts in eastern Uganda, Mbale had the highest HDI ranking, while Tororo was fourth from bottom.

District demarcations have since changed with creation of new districts like Bududa and Butaleja. It is therefore likely that the HDI ranking of these new districts may change. Bududa, being largely a rural district is likely to have an HDI that is lower than that of Mbale in 2004. However, the ranking of Bududa is likely to be higher than that of either Nakasongola or Butaleja because of the greater abundance of provisioning (food, water and fuel wood) and regulating (forests cleaning the air, lower disease incidence e.g. malaria, and a cool breeze) ecosystem services. HDI ranking for Butaleja is likely to be much closer but lower than that of Nakasongola district, since the latter has had a longer time to grow and receive development support.

Box 5.1: Charcoal burning and its effect on human poverty

Estimates by the Forest Department (MWLE, 2001) found that charcoal makers earn very little. An individual could physically produce a maximum of 60 bags in one month. This gave them receipts of between Ushs 2 000 - 4 500 per bag, a gross return of Ushs 120 000-270 000 per month. In addition they paid the landowner, Forest Department and Local Government Ushs 50 000, Ushs 17 500-27 000 and Ushs 500 per bag per month, respectively. This leaves the producer with between Ushs 15 000 - 165 000 per month. Those who avoided fees kept larger part of their income. Some producers make as little as 15 bags in a four months period grossing Ushs 30 000 - 67 500 per month. After deductions it is likely that many operate at a loss (MWLE 2001). Yet, these charcoal burners continued cutting trees for charcoal to supply the urban markets. As a result, their well-being declined because they invested more than they ever got out of the charcoal business and the forest degradation has ensured that there are very few trees left even for charcoal production in many of the forest reserves, particularly Wabisi-Wajala Central forest reserve in Nakasongola district.

Nakasongola had the highest HPI, followed by Tororo and Mbale districts (UNDP, 2005). The Government of Uganda has made poverty reduction its overarching development goal. The PEAP recognises that social and economic changes on livelihood strategies could cause increased pressures on the environment and vice versa. It also recognises that the poor are the greatest victims and to some extent agents of environmental degradation. The PEAP targets thus hope to achieve poverty reduction by addressing some of the factors seen as causing poverty. These are discussed in the sections that follow.

Table 5.1: Human Development Index Ranking by district, 2004

District	Human Development Index		Human Poverty Index	
	Position	HDI	Position	HPI
Mbale	11 th	0.514	48 th	28.9
Nakasongola	30 th	0.469	21 st	37.1
Tororo	42 nd	0.434	27 th	35.3

Source: UNDP (2005)

Human Well-Being in the Study Area

Landlessness

Recent studies conducted by the Ministry of Finance Planning and Economic Development (MFPED) have supported the realisation that the poor increasingly have limited access to land. Yet land is often the only productive source of livelihood that the poor have (MFPED 2006). Eighty five per cent of the people in Nakasongola do not own the land on which they live (MWLE, 2005). The reason for landlessness is due to the large number of absentee landlords. This widespread lack of access to adequate land has had negative impacts on production potential and social welfare (MFPED 2006). In Bududa, most people have only 0.5 acres of land on which to grow their crops, manage a zero grazing unit and also build a home. In Butaleja land would ideally be available, but under a customary tenure arrangement.

The greatest danger for Bududa is emerging from the very high population density. Whereas Bududa has the highest level of productivity per unit area, of the three districts, the high population rate and very low access to land indicates that the poor are likely turn to natural forests and rivers to ensure that they sustain their livelihoods and make up for their growing needs. This will turn a relatively sustainable community with a sufficient resource base into an unsustainable one. Population pressures may once again lead to encroachment in the protected areas and practices such as deforestation for agriculture, charcoal burning and timber harvesting are likely to become prominent. This may lead to widespread loss of forests as was the case in Nakasongola. Such degradation of the Mt. Elgon forest (catchment degradation) would for instance reduce the water volume flow in R. Manafwa, increase soil erosion and seriously dampen the livelihoods of people living along the river in future.

In Butaleja, demographic pressures are manifested in the aggressiveness for expanding the wetlands for rice cultivation. This is likely to continue as the population grows. Young men and women grow up seeking to grow more rice as a means of overcoming their poverty. While a higher population in Butaleja could provide the opportunity for some to diversify into agriculture for landscapes, this has not been well managed over the years. It is thus likely that the pressure on the wetlands will still intensify with time.

Access to water and sanitation

Water and sanitation are key constituents for human well-being. One of the MDG and PEAP targets are to reduce the proportion of people without adequate access to water and sanitation. About 71 per cent of the people in Nakasongola have access to improved water supply, but only 42 per cent are functional. A survey carried out by the Directorate of Water Development (DWD, 2005) in Nakasongola found that only 50 per cent of the valley tanks constructed by government were operational, 37.5 per cent were dry and 12.5 per cent of the borehole pumps had broken down. Although all the water facilities had water use committees, the concept of preventive maintenance was absent. For instance, only 15 per cent of the water use committees collected money for maintenance (DWD 2006). The costs of repair were also quite high, ranging from U.Shs 20,000 to over U.Shs 200,000. These are the highest per capita costs in the country. So even where

resources can be pooled, the communities have to pay a higher cost than communities in other parts of the country.

Compared to Nakasongola, water coverage in Bududa is quite low. This could be related to the presence of R. Manafwa and natural springs and wells. Much of the water for domestic use in Bududa is collected from springs and from R. Manafwa and a number of people even drink the water without boiling it. In Nakasongola, the main source of water is L. Kyoga. In many cases the water has to be sieved and boiled before drinking and it is often associated with diarrhoeal disease. For this reason, the residents of Lwampanga town willingly pay for water drawn further into the lake by boat owners because it is thought to be cleaner than that from the lake shore. By the time R. Manafwa gets to Butaleja it is carrying a lot of sediment and pollutants from human activities like domestic wastes. As a result the communities of Mazimasa sub-county often have to sieve and boil the river water if they are to use it for domestic purposes and for drinking.

Access to sanitation, especially in the rural areas, is generally inadequate. Table 5.2 shows that access to latrines in Nakasongola is less than half that in Butaleja and almost three times less than in Bududa. During the field surveys it was found that even the well-built homes of local politicians and school teachers in Nakasongola lacked adequate sanitation facilities such as latrines. In 2001/02, latrine coverage in Nakasongola stood at 49.5 per cent (DWD, 2006) increasing to 54 per cent in 2002/03 (NDC, 2004) and 66 per cent by 2004/5 (UBOS, 2006). Box 5.2 discusses how this improvement has been achieved.

At the lower levels, the situation is quite dire. In Lwampanga sub-county, the waste management situation is compounded by lack of latrines. The communities indiscriminately dispose of considerable amounts of waste in the surrounding environment including L. Kyoga. Waste not deliberately dumped into the lake is washed to the lakeside during the heavy rains. As a result the quality of water along the shores of the lake is poor and the danger of contracting water-borne diseases is high, especially for those who cannot afford to collect water far from the lakeshore. All the participants of the focus group discussions complained of at least one attack of diarrhoeal disease in their household in the last three months.

Table 5.2: Access to water and sanitation

Administrative area	Access to improved water source (%)	Access to improved sanitation (latrine) (%)
Nakasongola	71.3	66
Bududa	57.9	85
Butaleja	46.6	69
National	60.8	57

Source: UBOS 2006

Given the weak and unreliable sanitation situation, communities are likely to spend a considerable portion of their disposable income treating environmentally-related diseases such as diarrhoea, malaria and HIV/AIDS. In Nakasongola, for instance, the stagnation of water at the lakeshores due to parked canoes and resident water hyacinth creates breeding grounds for female anopheles mosquitoes that carry malaria parasites. In addition, the promiscuous behaviour of fishermen leaves them vulnerable to contracting and transmitting HIV/AIDS (UNEP/NEMA, 2006).

Box 5.2: Addressing the sanitation issue in Nakasongola

Lack of sanitation facilities has been attributed to the unwillingness to pay and a widespread lack of awareness of the link between improved sanitation, hygiene and livestock health (UN-Water/MWLE, 2006). The improvement in Nakasongola was achieved through: creating increased awareness of latrine construction and usage; enforcement of a public health act and other bylaws; home improvement campaign; and incentives such as rewarding exemplary households. The district also embarked on construction of sanitary facilities in public places, poor performing areas and areas with unstable soil textures such as close to the lake (NDC, 2004).

These diseases have social and economic consequences extending far beyond just health. They undermine people's productive capacities, perpetuate poverty, exacerbate social problems and overwhelm health services. Indeed the health sector is already overstretched. For example, Nakasongola district has 4 884 people per health unit (NDC, 2004). Further, in Lwampanga sub-county 5 633 households are served by one clinical officer, one registered mid-wife, one enrolled mid-wife and one health assistant one nursing assistant.

From the above discussion, it is evident that people in Nakasongola are less well off than their counterparts in either Bududa or Butaleja. The main environmental concerns that link to the poverty situation in Nakasongola (based on sub-county environmental action plans) in order of importance were: deforestation, vermin, termites, inadequate safe water, bush burning, drought, crop pest and diseases, mosquitoes and as a result, malaria, lack of environmental awareness, poor fishing methods, poor waste disposal and management, overgrazing and HIV/AIDS (NDC, 2004).

Sources of income and livelihood

In Nakasongola fish, crop farming and livestock production are the major sources of livelihood (Table 5.3). In Butaleja nearly all the income is derived from paddy rice production. However, some vegetables and pulses are grown on small scale. Local businesses mostly related to food also thrive in Mazimasa sub-county in Butaleja. Coffee and zero-grazing cattle enterprises, vegetable and fruit production and remittances from relatives working in other areas are the major forms of livelihood sustainability in Bududa. Many men who can no longer harvest timber, firewood and burning charcoal from the nearby protected areas opted to look for employment elsewhere. Several men are employed as skilled labour in transport business and others are casual labourers in the neighbouring Mbale district and beyond.

Table 5.3: Sources of income by percentage in Nakasongola, Bududa and Butaleja

Sources of income	Nakasongola	Bududa	Butaleja
Subsistence farming	25.5	48.5	76.7
Fishing	32.7	3.0	--
Commercial farming	10.9	21.2	13.3
Livestock	14.5	3.0	--
Trade	7.3	9.1	3.3
Public office	5.5	6.1	--
skill service	1.8	3.0	--
Carpentry	1.8	6.1	3.3

In Lwampanga sub-county, the community acknowledged that charcoal burning takes place. However, they also noted that the charcoal business is usually carried out by people from outside Lwampanga, whose numbers have reduced as the number of trees suitable for making good quality charcoal decreased. In Butaleja, the community relies on rice husks for cooking and heating, but in Bududa there is plenty of firewood for cooking. Despite the availability of wood fuel in Bududa, the community is restricted from burning charcoal by the Uganda Wildlife Authority and the National Forestry Authority for fear that they will encroach on the forest reserve and the national park. The livelihood of people in the studied areas varied but seemed to be related to the available natural resources (Table 5.4). From focus group discussions, fishing from Lake Kyoga was ranked highest in Nakasongola, whereas rice growing (depending on water carried by River Manafwa) was ranked highest in Butaleja. Good weather, fertile soils and reliable rainfall could be the reason as to why coffee growing is ranked highest in Bududa.

Table 5.4: Ranking of sources of livelihood in Nakasongola, Bududa and Butaleja

Rank	Main source of livelihood		
	Nakasongola	Butaleja	Bududa
1	Fishing	Paddy rice	Coffee Milk from zero grazing cattle
2	Crop farming (cassava, beans, maize)	Vegetables (tomatoes, cabbages) and pulses (beans)	Vegetables (tomatoes cabbages) and fruits (passion fruits)
3	Livestock keeping/pastoralism	Local businesses	Remittances from relatives employed outside district
4	Local businesses		Local businesses
5	Artisans		Woodlots (timber and wood for fuel)
6	Remittances from relatives employed outside district		Livestock

Access to Education

Generally, communities and individuals that have a higher access to education have a greater ability to extricate themselves from a state of poverty or low human well-being (MA, 2005). Access to education is one of the indicators of poverty in Uganda (UNDP, 2005). Of all three districts, primary education is lowest in Nakasongola, but it has the highest number of adults with secondary education (see table 5.5). Several factors affect the effectiveness of primary education in Nakasongola:

- serious shortage of physical facilities including buildings, furniture and instructional material,

- long droughts and famine that make teachers and pupils unable to concentrate due to hunger,
- late payment of school fees on account of economic hardships.
- preference to pay fees for boys rather than for girls,
- the majority of the teachers are untrained; and
- long distances that children have to walk to reach the nearest school.

Young girls collecting water for domestic purposes from River Manafwa in Bududa. In many cases, instead of going to school, girls stay home to help with domestic chores.



The high secondary school education may be as a result of second generation returnees who left Nakasongola on account of the 1969/71 drought. Many of the returnees are from other areas of central Uganda where education standards are higher. There is a small increase between primary and secondary education attainment in Bududa. This is associated with migration to urban centres like Mbale where the education levels are higher. However the numbers attaining secondary education in Butaleja declines markedly after primary school.

In Bududa and Butaleja boys are three-times more likely to be taken to school than girls. This could be an indication of early marriages for the girls and the additional domestic household duties allocated to girls as opposed to boys. In addition, in Bududa it is customary for boys who have matured to manhood to get a wife. They may then continue with school while the wife stays at home and looks after the home. In Nakasongola pastoral duties and early involvement in fishing are the major impediments to boys schooling. For instance, young men in their teens in Lwampanga sub-county are expected to have a wife as long as they have a source of income which is usually from fishing or livestock. Girls are required to marry and start a family.

Table 5.5: Education levels and school attendance by percentage

Education status of household head	Nakasongola	Bududa	Butaleja
Primary	20.0	32.4	40.0
Secondary	50.9	41.2	13.3
Post secondary	14.5	14.7	16.7
None	14.5	11.8	6.7
Education of children			
Number of male children in school	15.2	54.7	46.3
Number of female children in school	16.5	12.6	13.9
Number of male children not in school	32.7	20.2	17.3
Number of female children not in school	35.5	12.5	22.6

Poverty, ecosystem change and human well-being

Nakasongola

Vital to the livelihoods of the majority of the population are the agricultural lands, water and forest resources. At present, about 85 per cent of the district's population is employed by the agriculture sector but Nakasongola is experiencing some of the worst forms of soil degradation. This has led to the collapse of the soil structure. Soil and water conservation practices, which rely on planting trees and grass, have not been successful principally due to high termite activity. Throughout the district, termites have destroyed crops and rangelands leaving large distinct areas of bald ground (NDC, 2004). Further, over-grazing, loss of forests and low education are combining to exacerbate poverty in Nakasongola.

The savannah woodlands areas in Nakasongola and other districts such as Masindi, Kiboga and Mubende have been extensively cleared of tree cover to produce charcoal. Aside from charcoal, the predominant occupation in these dryland areas is livestock keeping. Sixty per cent of the land area in Nakasongola is used for livestock keeping. Although the human population is sparse in these areas, the cultural attitudes of people, coupled with survival coping considerations, have resulted in overstocking. Thus, carrying capacities of drylands are frequently exceeded leading to over-grazing and erosion. The intensive trampling of grazing lands by cattle, particularly at watering places causes the disappearance of vegetation, soil compaction and loss of structure. Gully erosion is also common (NEMA, 2001).

Nakasongola has about 49 per cent of its land set aside in protected areas and other central government controlled lands like Luwero industries. These are facing several environmental threats, and the government's policy of industrialisation has further contributed to deforestation. For instance the degazettement of Wabisi-Wajala forest reserve (8 744 ha) in Lwampanga sub-county for industrial purposes has further reduced the forest areas in the district (NEMA, 2001).

All these factors, and low education levels have combined to exacerbate the poverty situation in Nakasongola. By 2004, Nakasongola had the lowest level of education in central region. It is also the poorest district in central Uganda (Concern, 2006). By 1992, about 65 per cent of the people in the district were poor and in 1999 about 53 per cent of the population (6 222 people) were poor (ILRI and UBOS, 2004). Nakasongola still has the lowest Human Poverty Index in Central Uganda (UNDP, 2005)

Bududa and Butaleja

Deforestation, poor farming methods, rural-urban migration and landslides are some of the effects of poverty in Bududa. Despite considerable policing efforts by the Uganda Wildlife Authority park officials and the NFA, young men still extract trees from the forest reserves for charcoal production. Many are also leaving for urban centres such as Mbale and Kampala in search of better opportunities. Those who stay, farm the steep slopes. However due to limited resources and know-how they usually plough the slopes

in an unsustainable way leading to soil erosion. This is evident in the amount of silt in R. Manafwa from the boundaries of Bududa and Butaleja. In Bududa homesteads built on the mountain slopes suffer from regular landslides that displace the population, destroy crops and often lead to loss of lives (NEMA, 2000; NEMA 2005; MWLE, 2005).

In Butaleja poverty is driving more people into the swamps as they try to compete and to survive just as their colleagues who have been in the paddy rice production business longer. The incomes from the rice are largely used to buy additional food items as there is little production elsewhere. However, the satisfaction of being paid and holding money drives still more people into paddy rice production. Meanwhile the landscapes are left to suffer soil erosion as much of the surface cover was removed. The agro-ecosystems and the vegetative cover that protected the uplands from soil erosion are no longer managed. When the community eventually realises the importance of utilising the uplands, the cost of improving the land to be sufficiently productive will be higher than it is at present and that may serve to further disenfranchise and impoverish those who are already poor.

Soil erosion leads to turbid water in the River Manafwa. This is near the water abstraction point of water treatment works of National Water and Sewerage Corporation in Mbale



6 SCENARIO ANALYSIS

Introduction

The foregoing chapters have discussed the state of the ecosystems in the study area, the services provided and any impacts on human well-being. They have demonstrated that the L. Kyoga ecosystems are under pressure from people and other natural phenomena. In an attempt to ensure a sustainable environment for the country's present and future needs the Government of Uganda has developed and signed up to and is implementing policies and plans to try and address some of these issues. These have included the PEAP and MDGs. Now the government is formulating a new 5-year National Development Plan (NDP). To do so requires insight both into the present and into the future. Since the future is generally unknown, there is need to use mechanisms which facilitate an understanding of the future. One such methodology is the use of scenarios.

Scenarios for sustainable development have been in use in various parts of Africa for some time now. These have focussed at various spatial scales. The scenarios in this chapter follow the pattern described in the Africa Environment Outlook report series. Four scenarios are described in the AEO and these provide the foundation for the scenarios used in this assessment. Box 6.1 gives a brief description of a scenario and table 6.1 highlights the relationship between the scenarios used in the two reports and a brief description of their assumptions.

Box 6.1: What is a scenario?

A scenario is a story told in words and numbers concerning the manner in which future events could unfold, and offering lessons on how to direct the flow of events towards sustainable pathways. They offer a means of examining the forces shaping the world, the uncertainties that lie ahead and the implications for the tomorrow of today's actions

Source: UNEP (2002)

Table 6.1: Linkages between the AEO and IEA scenarios

AEO Scenario	IEA Scenario	Brief description
Market Forces	Cracking Jack	The markets and desire for economic growth influence development decision-making
Policy Reform	Global Parity	Policy reforms steer development towards environmental and poverty reduction goals
Fortress World	Survival of the Fittest	Increasing socio-economic problems and environmental degradation contribute to inequality and fuels widespread conflict
Great Transitions	Green Paradigm	The principles of sustainable development form the cornerstone of this scenario

Source: Adapted from UNEP (2002), IGAD (2007)

Description of the scenarios

The *Cracking Jack* Scenario

This scenario was defined in terms of the prevailing economic growth paradigms based on the experience of models developed mostly in Europe and America. The premise being that the development models pursued by the developed countries are appropriate for Africa as well. In the market forces scenario the invisible hand of market mechanisms control the allocation and distribution of resources and the benefits of growth, respectively. It is akin to the ‘wealth generation movement’ in Uganda. It blames the poor economic and welfare situation on the lack of or slow industrial growth. Therefore, the belief is that where there is an opportunity to industrialise, that is alternate Foreign Direct Investment (FDI), or to utilise natural resources to industrial levels it should be taken. This scenario proposes that human well-being is best served through wealth creation, meeting all available market opportunities and pursuing investors by offering them sufficient incentives to invest into the country’s natural resources. ‘*Cracking Jack*’ is a marketing jargon for a strategy offers a breakthrough.

The Policy Reform Scenario

The government and civil society eventually realise that there are negative impacts to development that is solely driven by markets. While economic growth is good, it does not always cater for the well-being of the majority. To address the growing disparity, government encourages a certain amount of private-sector led growth, while taking up the mantle for those areas or sectors which do not particularly appeal to private sector. This is to ensure that a more uniform growth or ‘*Global Parity*’ situation can be achieved. Some examples of such policy initiatives include the ‘*Bonna Baggaggawale*’ initiative and the MDG targets.

The *Survival of the Fittest* Scenario

The ‘Survival of the Fittest’ scenario is based on the struggle for power between two basic groups – the elites and the masses. The elite have access to resources of economic growth and monopolise them for their own development. The masses have few resources and are left at the mercy of the elites. For many private sector-led initiatives supported by government in Uganda, there seems to be insufficient concern for the needs of the masses. The private investors are likely to grow into an elite group with the means to invest and increase their incomes. While at the lower end of the economy the masses suffer from unemployment, under employment, poor pay, poor access to resources and massive poverty. Already the highest 20 per cent of wealth category in Uganda control over 52.5 per cent of the nation’s wealth and the means to generate wealth (World Bank, 2007). As the country moves forward it seems that the pursuit of a sustainable livelihood is increasingly becoming a fight for the survival of the fittest.

The Green Paradigm Scenario

The *Green Paradigm* approach seeks to adapt the good aspects of the other scenario to strengthen the three pillars of sustainable development – environment, society and economy. It involves a new set of strategies that differ ideologically from the current strategies; and that approach development at the conceptual, methodological, institutional, operational and financial levels. For a country like Uganda, which is largely natural resources based, it is logical for the government to adopt a scenario that is greener than the current development outlook. For Uganda's ecosystems to continue providing commercially exploitable and profitable services there has to be a deliberate effort to invest in ensuring that the ecosystems are of a high enough quality to provide the required services and that the users consciously use these resources in a sustainable way.

Indicators and Driver Assumptions

The indicators discussed in this section provide the basis on which the assumptions for the scenarios are based.

Population statistics

By 2050, Uganda will be the thirteenth most populated country in the world with a population of 127 million people more than quadrupling from 27.4 million people at the beginning of 2007 (UN, 2004). For the study area the population densities will increase by a factor of 4.6 to 2 475 persons per km², 1 530 persons per km² and 190 persons per km² in Bududa, Butaleja and Nakasongola respectively (Table 3.1). The national average population density will be 575 persons per km². High population density is not a bad thing per se, but requires careful management for maximum opportunities. Other places in the world have high population densities. For instance, Monaco in France has a population density of 16 205 persons per km² (World Atlas, 2006), while Macau in China has a population density of 18 428 persons per km² (Wikipedia, 2008c).

Food demand, supply and deficit

In Uganda, the number of undernourished people (children and adults) increased from 4.2 to 4.6 million between 1990/92 and 2001/03, while the prevalence of under nourishment declined from 24 to 19 per cent (FAO 2005). This took place against a backdrop of strong per capita GDP growth, at an average annual rate of 3.8 per cent, and a modest average growth rate of 1 per cent in per capita agricultural GDP. Average dietary energy consumption also increased from 2 270 to 2 380 kcal per person per day. The Uganda food balance sheet shown in Table 6.2 revealed that food outlook at the national level was apparently satisfactory for 2006. But there are food-deficit areas in several northern and north-eastern districts due to production problems ensuing from civil insecurity, displacements and cattle rustling. Substantial numbers of people face serious food shortages and are in need of food assistance. Table 6.3 provides data that guided the quantitative expressions of the scenarios. These are used in the scenario narratives that follow.

Table 6.2: Uganda Food balance sheet 2006

	Cereals	Pulses	Roots and Tubers	Matooke (plantain)
Availability	2657	767	8050	9391
Stock drawn	0	0	0	0
Production	2657	767	8050	9391
Utilisation	2,584	767	8050	9391
Food	2,051	711	5744	4404
Animal feed and other uses	261	0	2126	4987
Seed	39	56	180	0
Export	233	0	0	0
Import requirement	73	0	0	0
Commercial import	73	0	0	0

Source: FAO 2006

Table 6.3: Quantitative expression of the drivers

Indicators/Drivers	Baseline (2007)	Global Parity	Cracking Jack	Green Paradigm	Survival of the Fittest
A. Food security scenarios					
GDP growth rate (%)		10.5	>10.5	6-7	3.8
Projection period	2007	2050			
<i>Annual grain crop production</i>		3.6%	<i>Mixed picture</i>	3.6%	<i>(1% per annum)</i>
Nakasongola	11 800	54 860	12 200 ^a	54 860	18 627
Bududa	11 730	545 000	12 088	545 000	18 505
Butaleja	15 160	70 466	113 800	70 466	23 926
National ('000 tonnes)	2 657 000	12 004.4	8 531 200	12 004.4	4 075 900
<i>Annual grain crop food gap</i>	2007	<i>Annual grain crop food gap 2050</i>			
Nakasongola	0	0	-42 660	0	-36 233
Bududa	0	0	-42 412	0	-35 995
Butaleja	0	0	+43 334	0	-46 540
National (tonnes)	0	0	-3 473.2	0	-7 928 500
B. Environmental health /poverty indicators					
<i>Access to improved water source</i>	2007(%)	<i>Access to improved water source 2050 (%)</i>			
Nakasongola	71.3	100.0	71.3	100.0	15.5
Bududa	57.9	100.0	57.9	100.0	12.6
Butaleja	(46.6	100.0	46.6	100.0	10.0
National	60.8	100.0	60.8	100.0	13.2
<i>Access to improved sanitation</i>	2007(%)	<i>Access to improved sanitation (latrine) 2050 (%)</i>			
Nakasongola	30	77.0	30.0	100.0	6.5
Bududa	85	77.0	85.0	100.0	18.5
Butaleja	69	77.0	69.0	100.0	15.0
National	57	77.0	57.0	100.0	12.4

^a grains food crop production increasing at 0.7 per cent as cash crop 4.8 per cent. The national average may be 2.75 per cent.

Source: Adapted from FAO 2006, UBOS 2006, UN 2004, MFPED 2006 and IMF 2006

Envisaged changes under the four scenarios

Uganda's development and subsequent changes in ecosystems and ecosystem services are driven by the economic orientation of the country. Under the *Global Parity* scenario, Uganda will be able to reduce the proportion of the people whose income is less than US\$ 1 a day, from 31 per cent in 2007 to 19 per cent in 2015. This is based on the long-term target set during the PEAP (1997) which was co-opted as a target for the MDG. The policy of reducing poverty by half will be followed and government will aim to reduce poverty levels to 9.5 per cent by 2050. The *Global Parity* scenario proposes to achieve this reduction by allowing all school children to have access to Universal Primary Education; reducing under-five mortality rate from 150.8 (1995) to 75.4 (2015) and to 37.7 (2050) (UBOS 2006); by halving the proportion of the population without access to water from 36.65, 57, and 45.3 per cent in 2005 in Nakasongola, Butaleja and Bududa to 8.3, 28.5, and 22.7 per cent in 2015 and then further to 9.2, 14.3, and 11.4 per cent in 2050 respectively. These economic growth objectives will be achieved through increased access to export markets and support from international development partners.

On the other hand the *Cracking Jack* scenario is shaped by Uganda's recent oil discoveries. The economic value of the oil is unknown but in oil and private-sector led economy Uganda can finally achieve its long-term development goals. During the coffee boom of 1997/99, Uganda achieved annual GDP increases of 9.7 and 8.2 per cent as the fiscal growth. If Uganda becomes an oil producing nation, the GDP could once again reach the heights of an increase of 9.7 per cent, equivalent to a per capita GDP growth of 6.1 per cent (UBOS, 2005), starting in 2009 to 2050. In 2009 Uganda's oil production comes online and Uganda starts exporting oil. In addition, support will be given to the manufacturing sector. The manufacturing sector is currently dependent on food processing (40 per cent) with little additional processing (UBOS, 2006). One of the biggest impediments to the manufacturing sector is the unclear property rights laws.

The *Green Paradigm* approach envisages that economic growth will exploit the areas where Uganda has comparative advantage – fertile land (including the drylands), forests, biodiversity and water. A sustainable economy will be developed as follows:

- in Nakasongola enterprises such as fruit orchards, aquaculture, carbon sequestration in forests, ecotourism, vegetable and horticulture production, floriculture and reduced scale pastoralism, pasture and hay production, oil seed and seed cake production, and crops for bio-fuel will replace the existing enterprises. The area covered by pastoralists will be scaled back from 60 to at least 20 per cent, and watering points for livestock will be increased. The fishers will be persuaded to adopt aquaculture. Crop farmers will be encouraged to practice mulching, agro forestry, fruit tree and tree enterprises. Immigrants will not be allowed access to the community forest reserves; instead they will be annexed onto existing regular communities.
- in Butaleja, agro-forestry enterprises will be established in areas where the forests were cut. Farming in wetlands will be scaled back by at least half. This includes both the land area and number of farmers. Alternative enterprises, such as upland rice (instead of paddy rice), fruit enterprises (mangoes and pineapple) and aquaculture production will be encouraged.

- in Bududa, resettlement of some people from Bulucheke and Bukigai sub-countries to other less densely populated areas within the region will be encouraged. However, recognising that this requires major transformation, industrial activity within the region will be enhanced especially in the urban centres such as Mbale and Manafwa. Non-farm labour will be created by increasing the local processing and manufacturing in the area, and alternative enterprises in which local communities participate such as tourism and eco-tourism. Currently, a lot of manufacturing takes place in the capital city in Kampala, meaning that produce is transported in relatively raw form from production centres such as Bududa. This produce includes coffee, passion fruit, cabbage, onions, and tomatoes. This scenario will also seek to maximise the tourism potential within the Mt. Elgon region. Sustainable farming methods including organic farming and contour building on the hill slopes will replace the current cultivation systems.

In the *Survival for the Fittest* scenario, the communities will survive on their own without government intervention. In Nakasongola for instance, immigrants have settled in the CFRs because they found them empty. Pastoralists use the same CFRs for grazing especially in the dry season, while crop farmers consider them safe from drought, and thus suitable for cultivation. If access to the CFRs is restricted, these people will lose their livelihoods. The lakeshore is another area of competing interests. It is believed that a group of individuals allocated themselves an area in the wetland that buffers the lake for crop production, and they rent the land to other people in the area who grow some crops especially during the droughts. Several community members are opposed to having one group of people as the owners of the converted wetland. Pastoralists compound competition for the wetland area which they use during droughts. These competing interests may evolve into a major conflict, especially as the population grows on a diminishing resource: the wetland. Customary land owners are also under threat. Absentee landlords who own the land under the mailo land tenure system have not yet been compensated by government. They therefore still have a right to this land, especially those that are still unoccupied or communally used.

In Butaleja the struggle for survival is over the wetlands converted for rice production. By 2007, observations suggested that as much as 20 per cent of R. Manafwa had been converted for paddy rice production. By 2050, when the population will have quadrupled, 80 per cent of the river will be diverted and only 20 per cent of the river will flow to its final destination. By 2065, the entire river will have been diverted. It is expected that 15 per cent will be diverted every ten years until all the water from the river ends up in the wetland. The communities will then be forced to move upstream. When that dries up they will move further up. The ecosystem will be rapidly transformed as the major water systems continue drying leading to a decrease in vegetation cover.

The Environmental Outlook

Effect of the scenarios on the environment

The *Cracking Jack* scenario will encourage increased production for markets. In Nakasongola there will be increased livestock production, in Butaleja rice production,

and increased farming on the hills of Bududa. There will also be increased exploitation of the Lake Kyoga fishery. The increased effort on is likely to lead to over-exploitation of the fishery resources. The maximum sustainable yield of the lake is not known and already the fishery is on the decline. Excessive over-harvesting of the Kyoga fishery, if uninterrupted until 2050, will threaten the resilience of the fishery. A similar situation will result under the *Survival of the Fittest* scenario. However, commercial interests are likely to be limited since the lake is not the major national fishery.

Under the *Green Paradigm* scenario, the fresh water systems in Nakasongola, Bududa, and Butaleja will be managed using ecosystem approaches to derive a sustainable amount of provisioning, regulatory and cultural services. For instance through improved management, the capture fisheries of L. Kyoga will be improved and fishing on R. Manafwa will be revived. The *Green Paradigm* approach also proposes restoration of the Lake Kyoga papyrus cover and a reduction of the siltation on R. Manafwa. To achieve this, no cultivation will be allowed within 20 m from the river system. The silt will be regularly dredged thus improving the fresh water systems. These interventions will all require considerable effort and expenditure.

The MDG-friendly *Global Parity* scenario will also encourage conservation of the freshwater ecosystem. Also enhanced economic activity is not likely to be encouraged. This may affect those in Bududa and Butaleja who depend on sand mining in the river as a significant income activity. This scenario will also see better farming practices to ensure environmental sustainability. Terraces will be built on the foot hills in Bududa and livestock stocking rates regulated in Nakasongola.

The *Green Paradigm* would take this further, using the regions comparative advantage by exploiting the potential for organic farming. For example, Gumutindo, a coffee cooperative in the Mt. Elgon region is already encouraging farmers to grow organic Arabica coffee. For the marginal soils as in Bududa, large scale coffee production is not possible because land is in limited supply. However, the farmers can have high productivity with organic cotton, because the volcanic soils are naturally fertile. The fertility can also be improved by growing legumes, composting and use of animal manure. The *Green Paradigm* scenario in Nakasongola would aim to keep livestock at manageable numbers and to reduce the overall area used by pastoralists from 60 per cent of the district to at least one-third. At 20 per cent of the district area, the pastoralists would together with other stakeholders (extension -services and crop farmers) increase the vegetation cover of the land through planting of drought tolerant vegetation. Collective water sources like valley dams would be put in place. Bush burning would be stopped altogether. The use of forage and alternative feeds to grass such as hay, silage and legumes would be encouraged. Maintaining a pastoral livelihood is a fundamental right of the community and would not be substituted. But, alternate livelihoods among pastoral communities would be encouraged through adult education and increased access to education for the pastoralist children.

Effect of environmental changes on poverty

Changes in the *Global Parity* scenarios are aimed at halving poverty by 2015 and a further halving the 2015 poverty rate before 2050. In 2003, Uganda's poverty was estimated at 38 per cent; by 2015 it should reduce to 19 per cent and to 9.5 per cent by 2050.

In the *Cracking Jack* scenario, poverty would be expected to decline for the majority of people who are able to secure jobs in the oil industry, manufacturing, and commercial agriculture. Astute farmers will also take advantage of the growth of the agro-processing industry. However, small-holder farmers may not be able to adjust to the higher requirement for fertilizers and pesticides, and may thus be out competed. As the soil resources become more degraded, farmers may not be able to afford the external inputs required to maintain productivity demands. This may increase poverty for the smallholder farmers. In addition the property rights or land tenure structure may not allow for smallholders as more land is ceded to commercial production.

The *Green Paradigm* is expected to reduce poverty by fostering equity for small holder farmers on natural resources. Additionally, it will focus on increasing the productivity of natural resources through restoration of degraded systems. Alternate environmentally friendly enterprises will be developed to counter environmental degradation. For example carbon sequestration, agro-forestry, woodlots for wood fuel, organic agriculture, and oil seed. While the incomes of commercial and conventional producers may decline as alternative enterprises arise, it has been proposed that exclusive use of organic matter and organic fertilizers may not be sufficient. Instead, both fertilizers and organic matter may be used, sustainably, and be mutually beneficial.

The *Survival of the Fittest* scenario is likely to make poverty most severe in future. The poorer communities, with limited knowledge and skills, poor tenure rights, limited access to fisheries and other natural resources, and who use rudimentary technology will be further marginalised. The populations are likely to continue growing and this will increase the incidence of poverty.

The Social Outlook

The *Global Parity* scenario is targeted at improving the lot of the poor. The major interventions include health care improvement and social alleviation programmes such as education. Improvement in health will be carried out, in part, through improving ecosystem health. For instance the prevalence of malaria and waterborne diseases reduced by decongesting populated wetlands, reducing the pollution and stagnant water around the shorelines of L. Kyoga and R. Manafwa. However, because the *Global Parity* scenario targets poverty reduction, it may ignore certain environmental aspects that affect the integrity of the ecosystems. For instance, if DDT was used to control anopheles mosquitoes that transmit malaria, it may end up in water systems and bio-accumulate in living organisms. Fish that bio-accumulate may not be fit for human consumption. This will also be counter productive to people's livelihoods. In fact, more people will be affected by the chemical contamination of the water system far beyond the target area, of

the malaria control. The economic effects will also reduce government's ability to pay for the malaria control and the communities' livelihoods will enter a downward spiral since not only water systems will be affected but the land as well. On the other hand the eradication of malaria would improve the health of the people and their well-being.

The *Cracking Jack scenario* will undoubtedly, improve the life style of the people employed in the oil and commercial agriculture industry. The quality of services offered to the major industry sectors will grow. However, for small farmers in Nakasongola, Bududa and Butaleja the *Cracking Jack* scenario may have limited to large effect. The impacts will depend on the importance attached to key natural resources in the catchment such as L. Kyoga and R. Manafwa. Two industries emerge as important for the scenario, fisheries on the Kyoga and crop production - paddy rice in Butaleja and coffee on the Mt. Elgon ranges. Fisheries on the Kyoga will be boosted with commercial interests for capture fisheries and caged farming and the converted wetlands for rice will be boosted further. The coffee farmers on the mountain ranges will be encouraged to commercialize their production activities.

The *Cracking Jack scenario* will benefit only those stakeholders who are the target for government, such as the agricultural zoning programmes. In Nakasongola, government priority is beef cattle under a traditional system; in Bududa it is coffee; and in Butaleja rice, fruits and vegetables. It is likely that a large proportion of farmers will lose out and only the innovative ones will benefit.

The *Green Paradigm* will empower the poor and marginalised groups such as women. There will be equity as regards access to natural resources. The scenario may improve the overall well-being of the people. There will be reduced disease incidence, better nutrition and longevity of life. This will be achieved by guaranteeing high quality food, clean air and clean water.

Social indicators under the *Survival of the Fittest Scenario* are likely to start a downward spiral. The current scarcity of natural resources, if shared out among commercial interests will further isolate the poor from livelihood supporting resources. Ecosystems will no longer be able to provide provisioning and regulatory services.

Impacts on Human Well-being: Losers and Winners

As River Manafwa flows through Bududa, Manafwa, Mbale and Butaleja districts, it picks up a lot of sediment from the agricultural activities. The sedimentation has three major impacts: the water downstream is not clean enough for human consumption, and yet upstream it can be drunk without boiling. Water related diseases such as diarrhoea have also been reported. Diarrhoeal diseases occurrence is estimated at 5.8 per cent.

Activities in the Manafwa catchment area have impacts further a field though these may be immediately evident. Cultivation of rice in Mazimasa sub-county is likely to shift upstream as more and more people join the trade. This will mean a reduction in the volume of the Manafwa and ultimately in the re-charge of the Kyoga. R Manafwa is just

one of many small rivers that are being converted in Manafwa and Mbale districts for rice production. From this study, over the last 30 years, about one-quarter R. Manafwa has been converted since the start of the first rice scheme. Over the next forty three years with the population quadrupling 75 per cent of the river systems could be converted and when the population increased by five times, there is a possibility that the entire river system may be diverted. This is likely to occur under, *the Survival of the Fittest* and the, *Cracking Jack* scenarios.

Complete conversion of the Manafwa and similar systems is likely to result in a loss of 20 per cent of the water that flows into L. Kyoga. The Manafwa system contributes a very small percentage to the entire basin (since over 70 per cent of the lakes recharge comes from Lake Victoria and a further 10 per cent from rainfall). However, considering that the livelihoods of the people downstream of the Nile, in northern Sudan and Egypt, depend on the Nile as their only source of water the impact of diverting the Manafwa and other smaller river systems may have international implications.

Discovery and exploitation of oil under the *Cracking Jack* scenario alone is unlikely to reverse the changes envisaged in the *Survival of the Fittest* scenario. The *Global Parity* scenario while setting goals does not demonstrate where the resources will come from. Moreover, even if the *Cracking Jack* scenario took on the targets set under the *Global Parity* scenario, the orientation of the development goals will always strengthen one objective: enlarging the resource rich *Cracking Jack* scenario and weakening the *Global Parity* scenario. Government's focus has always been a private sector led growth and developing the oil industry presents an important opportunity to focus government resources, especially since the *Global Parity* scenario does not suggest an economy on its own. Instead, resources for the *Global Parity* are likely to come from development partners. The *Green Paradigm* attempts to provide a solution that can co-exist with both *Global Parity* objectives and *Cracking Jack* objectives. Under the *Green Paradigm* a conservation economy is suggested. This will take advantage of Uganda's food production potential, and conservation enterprises such as tourism, organic agriculture, aquaculture, sustainable agriculture and bio-trade. These can be run alongside other mineral rich resource discoveries. There will be incentives for the communities to sustainably plan the management of their resources and increase the productivity of the resources. These will include using substitutes and modern technologies that ensure that the ecosystems are able to provide sufficient ecosystems services for the growing communities.

7 RESPONSE OPTIONS AND RECOMMENDATIONS

Response options

Land and land use

Landlessness and land use are major concerns that limit productivity for the communities in Uganda. The major issues of concerns within the Kyoga catchment area are security of tenure in Nakasongola, the threat from farming of steep slopes in Bududa and inappropriate use of the wetlands in the lowlands of Butaleja.

The Land Act 1998 empowered governments to create a land fund that would enable landless people such as those in Nakasongola to buy land from absentee land-lords. At the local government level some of these efforts enable the district acquire land on private ranches, with the squatters on the ranch as the first beneficiaries (District Land Officer – pers comm). However, money to pay off absentee landlords has not been forthcoming. This has held back the process. The government ought to revisit the fund for landless people.

In several areas of Nakasongola and Butaleja opportunities exist to utilise the large expanse of land that are not already in use. For instance, there are prospects in reforesting the large tracts of Central Forest Reserves that have been cut down in Nakasongola. Currently many projects have gone for extractive plantation forestry such as planting of pines. However, multi-purpose trees that capture opportunities for bio-fuel energy production, carbon credits, fruit tree production, and generation of organic matter may not only restore the forest ecosystems, but lead to growth of a new economy in the area.

In Butaleja, the Wetlands Act and the National Environment Act should be able to regulate the activities that take place in the wetland. Enhancing the powers of the local environmental officers and training agricultural extension officers so that they are in position to supervise and monitor use of the wetlands would facilitate enforcement. The rate of expansion of the wetlands and digging of water channels can be controlled through local by-laws, especially if the local community is adequately trained on the dangers that lie in the unsustainable use of the wetlands. Other land use strategies for Butaleja should include use of fertilisers and organic matter to restore the fertility of the arable lands. Agro-forestry and upland rice production are viable alternatives to paddy rice. However, these ought to be contained in the districts land policy, land use plans and by-laws.

In places like Bududa improved soil and land management might come from development of local by-laws aimed at regulating utilisation of steep slopes if soil erosion is to be reduced. Similarly, incentives such as increased access should be given to farmers who use appropriate soil and water management practices on the mountain slopes.

All three districts should be supported to develop district land policy's and land use plans. In these plans it should be clear which areas will be used for agricultural production, livestock production, settlements, fishing and fish farming, among others. The land use policy should encourage reforestation in Nakasongola and Butaleja. In addition, local by-laws for enforcing the aims of the land policy should be put in place.

Climate change

Climate change concerns are a growing problem in Uganda. A National Action Plan for Climate Adaptation was developed in 2007 and some national level climate change projects (funded by donors such as the Austrian Government (EA *et.al.*, 2007). However, where the risk is great such as in the cattle corridor in Nakasongola or in Butaleja where farmers seem to be abandoning arable lands, adaptation may need greater attention. Climate change adaptation action plans should move from national focus to local or district level focus. For instance, a district level Climate Change Adaptation Strategy could include measures to harness utilisation of fuel efficient technology, encourage local community participation in carbon trading, production of bio-fuel plants or trees, agro-forestry, and restoration of the wetlands along Lake Kyoga belt. For the Kyoga catchment two types of responses exist – those involving private or the public sector. Investments from the private sector could be encouraged through concessions to forest reserves or extremely degraded ecosystems outside protected areas, including the Lake Kyoga fishing landing sites. On the other hand, public sector intervention will be required where a lot of people derive livelihoods, even in the degraded ecosystems.

The meteorology department, which is based in Kampala, is poorly linked to most districts. Many districts including Nakasongola, Bududa and Butaleja do not get accurate weather forecasts (District Forestry Officer Nakasongola; Agricultural Officer Butaleja; Environment and Wetlands officers Manafwa district - personal communication). Deliberate efforts need to be made to set up local weather data collection and monitoring centres in each district. In addition, the accuracy of the information provided should be improved. The provision of weather timelines would allow local extension officers to mobilise production. For instance, in the case of Nakasongola, and to a lesser extent Butaleja, mobilising production may involve irrigation. In water stressed areas, there may be efforts to develop appropriate tree and plant technology alongside irrigation.

Invasive species

The only known invasive species in the study area are the water hyacinth and termites. The termites are not invasive per se, but they have had a devastating effect that has led to the disappearance of vegetation in Nakasongola. The long-term solution to the termite problem lies in increased vegetation cover and soil organic matter. This can be addressed through an appropriate district land policy, plans and by-laws.

The Water hyacinth, in Eastern Africa, is being fought with a natural enemy of the weed - a beetle that was first bred in South America. Other options such as the use chemicals and

dredging were not approved or were stopped because of fears about the environmental consequences and the cost, respectively.

Demography

The demographic future Uganda faces is a large one. The population growth rate of 3.2 per cent alternates between being the highest and second highest in the world (UN, 2004). Bududa has already reaching bursting point and Butaleja also has a fairly high population density. Although the population density in Nakasongola is low, the area has suffered from regular in-migration from either pastoral groups or people from northern Uganda fleeing the armed rebellion of the Lord's Resistance Army.

There is an urgent need to reduce both the national and regional population growth rates. These efforts should include educational and awareness programmes that take into consideration the cultural concerns of the people.

Economic Responses

Bududa already attracts international trade at three sources: Coffee is purchased by international trading companies on such terms as organic, fair trade and conventionally-produced coffee (Masiga and Ruhweza, 2007). Coffee outputs could very easily be increased through extension campaigns on improved agronomic practices and encouraging more farmers to participate. The market for good quality coffee, especially Mt. Elgon Arabica coffee is huge. The opportunities to earn premiums on organic, fair trade or sustainable coffee certifications may also spur greater participation. Fair trade and organic farming are described in box 7.1.

The second source is from carbon trading. Until recently, Mt Elgon was a beneficiary of the Forest Absorption Carbon Emissions (FACE) foundation project where carbon credits were sold by UWA. Third, UWA earns tourism revenues from the national park, and considerable biodiversity ecosystem services are enjoyed by tourists and other visitors to the park.

Apart from the obvious benefits such as clean water and cool weather which ensures low disease incidence, the benefits from the national park are still not clear to the community. It might be necessary to allow for limited resource extraction arrangements so that the communities can benefit more from having the protected areas in their locality.

Economic responses for Nakasongola and Butaleja could emerge from incentives for sustainable land use practices and soil and water conservation. A package of payments for ecosystem services for watershed services, carbon credits, and biodiversity conservation could be developed in the process.

Box 7.1 Fair trade and organic farming

Fair trade is an organized social movement and market-based approach to alleviating global poverty and promoting sustainability. The movement advocates the payment of a fair price as well as social and environmental standards in areas related to the production of a wide variety of goods. It focuses in particular on exports from developing countries to developed countries (Wikipedia, 2008b).

Organic farming is a form of agriculture that excludes the use of synthetic fertilizers and pesticides, plant growth regulators, livestock feed additives, and genetically modified organisms. As far as possible, organic farmers rely on crop rotation, green manure, compost, biological pest control, and mechanical cultivation to maintain soil productivity and control pests. Organic agriculture can be considered a subset of sustainable agriculture, the difference being that organic implies certification in accordance with legal standards (Wikipedia, 2008c)

Social–Political Responses

Concerns over land use have traditionally been overcome through national and local level legislation. When the Land Act of 1998 was passed it strengthened the rights of customary land owners. However, the *Mailo* land owners and other stronger tenure forms have ensured that a lot of people especially in Nakasongola are using land as occupants. The Land Act created a Land Fund that was meant to empower poor people to buy land from their landlords. However, this has not been operationalised. In addition, the lack of a national land use policy has prevented many districts from developing comprehensive land use plans of their own. Meanwhile soil erosion continues to be the number one form of soil and land degradation (UNDP, 2005). Where a clear cut need for by-laws exists, especially regarding degradation of natural resources, support should be extended to technical staff in time to ensure conservation of vital ecosystems.

Scientific and Technology Adoption and Use

Uganda is not technologically advanced. Agriculture is still largely rain fed and subject to the vagaries of climate change and climate variability and characterised by minimal inputs. For instance, average fertiliser use as low as 1 kg/annum (NEMA, 2005). There is evidence that the use of fertilisers may improve yields markedly. However, there is equally significant evidence that improved management of soils would also lead to increased yields (Bolwig and Gibbon, 2007; Tumushabe *et. al.*, 2007). The key therefore is to find the perfect combination of soil improvement practices and fertilizer use as farmers should not have to rely too much on resources they cannot sustain beyond aid programmes. There have been indigenous technologies developed such as ox-ploughing, organic/sustainable farming practices, improved (non-GM) seed and other technologies that could prove useful. With introduction of the National Agricultural Advisory Services

(NAADS), agricultural extension was completely privatised. As a result there is limited follow up or extension supervision such as farmer visits.

Future support programmes that need to maintain a regular technical backup may choose long-term relationships such as social entrepreneurship, which run for an extended period on contractual basis. When the communities have been completely weaned then the entrepreneur can allow the community to run the enterprise on its own.

In the last ten years several technologies have been experimented with in Nakasongola. These range from improved fuel efficient stoves to re-afforestation and fish farming. Historically, technology adoption in Nakasongola district has been low (MWLE, 2002). Yet, technology options have to be tried out. Some limited success has been seen in the introduction of cassava cuttings that are resistant to cassava mosaic disease and proper fishing nets on Lake Kyoga. Above average success has also been achieved in Central Forest Reserves where trees were planted by private concessionaires. However, there are some areas where the concessionaires have not yet taken up their offers and thus there is no investment on the ground.

Cultural and Religious Responses

Culture is an important factor in the response of communities to technologies. Adaptation to technologies varies by geographical region. For instance grain crops and other annuals have been strongly adapted in the northern and eastern parts of Uganda, especially under the cotton farming systems, where Butaleja district is found. Perennial production systems are more prevalent under the coffee farming systems of Uganda where Nakasongola and Bududa district lie. In recent times, however, many communities are gravitating towards having at least one perennial crop for their income security. In Nakasongola introduction of cassava has proved popular. Annual crops such as upland rice, groundnuts, and beans together with agro-forestry enterprises could prove popular in Butaleja. The communities are still keen to participate in the charcoal trade. There could thus be potential for increased participation in tree planting programmes and sustainable methods of producing charcoal and firewood. In Bududa where the farming system is fairly mature, there may be need to consider utilisation of land in neighbouring districts such as Sironko, and the Busoga region where land is still in surplus.

Recommendations

1. There is a general need for awareness raising nationally and in the local communities especially those in the Lake Kyoga catchment about ecosystems and their functions, ecosystems services and changes in the ecosystems and the services they provide over time. The awareness training should be targeted at national policy makers, local government and community leaders, and the communities themselves.
2. There is an urgent need to develop national, starting with pilot catchment ecosystems, mechanisms to counter the overexploitation, degradation of ecosystems. The

mechanisms will involve developing mitigation, and restoration and/or regeneration strategies for the current threats observed for the ecosystems in for instance:

- there is need for restoration and regeneration of shore ecosystem on, including developing actions for improving the water quality and the vegetation along the shoreline of Lake Kyoga;
 - there is a need for both research and adaptation and introduction of mechanisms to counter the heavy attack of termites in Nakasongola district;
 - there is a need for a strategy for conservation and restoration of wetlands that have been degraded along the River Manafwa. The strategy can borrow ideas from the current wetlands policy;
 - there is need for a strategy to reduce the current and future potential conflict over resource use in Nakasongola between pastoral communities and the crop farmers;
3. Community organisations should be initiated and supported to assist the communities in articulating and lobbying for their rights over natural resources and as a platform for community involvement in the management of natural resources. The community groups found were weak and were not linked to the mainstream natural resources management structures at local government level.
 4. One of the underlying causes for the degradation in some areas is that the environment and natural resources management laws are not being enforced. This is because there are no guidelines available to natural resources officers on the one hand and also because local laws (bylaws and ordinances) are so difficult to push through because of political leanings, corruption and nepotism, and the lack of funding geared towards encouraging community action to sustainably use environment and natural resources;
 5. Conservation enterprises and income diversification in the Kyoga catchment would go a long way in improving livelihoods and also ensuring that conservation of natural resources occurs. The following conservation enterprises are likely to lead to the achievement of synergies both at national and local community economic development and lead to conservation and improvement of the local ecosystems and their services:
 - Integrated agro-forestry enterprises targeting fruit and fodder trees, which also tap on the potential for trade in carbon sequestration;
 - In Bududa organic agriculture boost for production of coffee and exploration of organic cotton production in Butaleja;
 - In Nakasongola and Butaleja districts, especially in the former, there is potential for production of sustainable certified charcoal and wood fuel from trees purposely planted for fuel and managed in leased private estates or by communities of well managed pieces of land;
 - Government should explore the solar energy potential of Nakasongola district;
 - Nakasongola and Butaleja and to a limited extent Bududa district have potential for sustainable fisheries on Lake Kyoga and fish farming both in Nakasongola and along the River Manafwa;

- There is already a lot of sand mining in Bududa, Manafwa, Mbale and Butaleja. This can help in the restoration activities for River Manafwa. The sand mining can also be used as revenue for the natural sources departments in the districts;
 - Upland rice production in Butaleja district as an alternative to the paddy rice production;
6. The low education standards in the Lake Kyoga catchment are a major cause of poverty in the area. The situation is exacerbated by the inequity, which reduces the education opportunities for girls. There is a need to create additional awareness of the purpose for education in these communities in relation to ecosystems and poverty reduction. There may also be a need for ordinances to put a stop to early marriages and employment for children, which prevents them from going to school.
 7. The healthcare standards within the communities are low. In Nakasongola where the worst cases are found the water access provided by government has not been well managed or even serviced. In addition, the sanitary standards are extremely low evidenced by low latrine coverage and waste management. This would be overcome with awareness programmes and development of local legislation to penalise household heads that endanger the livelihoods of others. In some cases the government may have to take the responsibility of establishing sufficient sanitation facilities.
 8. For many natural resources where the providers of the services (communities) and users of the services can be identified and are willing to pay, payments for environmental services schemes may be introduced. For instance payment schemes can be introduced for watershed services of the River Manafwa system in collaboration with the National Water and Sewerage Corporation and the Directorate for Water Development in the Ministry of Water and Environment. Certified charcoal and wood fuel could carry a charge, production of bio fuels, sustainably produced fish and timber products.
 9. The land tenure rights of communities, especially in Nakasongola district, need to be strengthened. Previous efforts under the land fund need to be operationalised and made more realistic in line with the expectations of the landlords. In addition, the government should always carry out thorough economic and environmental impact assessments before deciding on land use changes.
 10. Natural resources in the Lake Kyoga catchments and elsewhere in the country need to be valued and the natural resources accounting procedures implemented. This will provide information and comprehensive criteria for government, civil society and private sector on the management required to ensure that there is sustainable utilisation of natural resources in the country. The country needs to ensure that the welfare of future generations is not lost at the expense of the behaviour of the present generation.

11. There is need for a comprehensive soil and water conservation plan throughout the entire Lake Kyoga catchment. Sustainable land use management (SLM) plans need to be developed to reduce the soil erosion along the River Manafwa and on Mt Elgon, and to reduce the desertification in Nakasongola district.
12. Nationally there is a need to reduce the very high population growth well in excess of 3 per cent per annum. In addition, there may be a need to encourage population movement especially in Bududa where the pressure by far exceeds the available resources and yet there are very important natural resources to protect. Income diversification, and employment and education opportunities elsewhere may be major incentives for the population movement required.

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