THE IMPACT OF CONFLICT IN NORTHERN UGANDA ON THE ENVIRONMENT AND NATURAL RESOURCE MANAGEMENT

Internally Displaced Peoples Camp in Northern Uganda- G.Picton-Phillipps

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Abbreviations and Acronyms

CARE	Cooperative Assistance and Relief Everywhere
CBD	Convention on Biological Diversity
CFR	Central Forest Reserve
CHA	Community Hunting Area
CRS	Catholic Relief Service
CWA	Community Wildlife Area
DFO	District Forest Officer
FAO	Food and Agricultural Organisation
FD	Forest Department
FNCMP	Forestry Nature Conservation Master Plan
FR	Forest Reserve
GD	Game Department
GDP	Gross Domestic Product
GR	Game Reserve
ICCN	*Institut Congolais Pour La Conservation De La Nature*
IDPs	Internally Displaced Persons
IGCP	International Gorilla Conservation Programme
ILRI	International Livestock Research Institute
IUCN	The World Conservation Union
LEMU	Land and Equity Movement Unit
LFR	Local Forest Reserve
LRA	Lords Resistance Army
KVNP	Kidepo Valley National Park
MISR	Makerere Institute of Social Research
MUIENR	Makerere University Institute of Environment and Natural Resources
MNFP	Murchison Falls National Park
MoU	Memorandum of Understanding
MWLE	Ministry of Water, Lands and Environment
NEMA	National Environment Management Authority
NFA	National Forest Authority
NGO	Non Governmental Organisation
NP	National Park
NRA/M	National Resistance Army/Movement
OAU	Organisation of African Unity
PA	Protected Areas
SPLA	Sudanese Peoples Liberation Army
TBNRM	Transboundary Natural Resource Management
UBOS	Uganda Bureau of Statistics
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children's Education Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNP	Uganda National Parks
USAID	United States Agency for International Development
UPDCA	Uganda Peoples' Democratic Christian Army
UPDF	Uganda Peoples Defence Forces
UWA	Uganda Wildlife Authority
WFP	World Food Programme
WR	Wildlife Reserve

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EXECUTIVE SUMMARY

The conflict between the Lords Resistance Army (LRA) and the Uganda Government has been raging for nearly 20 years. Over this period many people (12,000) have lost their lives, 20,000 abducted and 1.5 million are living in Internally Displaced Peoples (IDP) Camps. Several studies have looked at the impact of the conflict on people but none have looked at its impact on the environment in northern Uganda. Some people have argued that the environment has benefited from the movement of people to IDP camps. Others have argued that the concentration of people in the camps has meant that natural resource use is no longer sustainable and as a result the environment has been degraded. Some of the protected areas in the north have had no staff or management activities taking place because of the insecurity and it has been unclear what changes have been happening within their borders as a result.

The purpose of this study was to examine the impact of the conflict in northern Uganda on the environment and natural resources management and to make recommendations for a time when peace comes to the region. Three recommendations center on the key conservation areas and where investments could be made in natural resource management. The study was conducted by analyzing Landsat Satellite Images from the 1980s around the start of the conflict and images from the early 2000s. Woody cover was mapped as a measure of environmental integrity and biodiversity. Preliminary image classification was followed by an aerial survey to 'ground truth' the satellite images and the initial classification revised using georeferenced photographic images of habitat taken from the plane. Data were compiled from the literature to assess the relative importance of protected areas for biodiversity conservation in northern Uganda and the most important were assessed for habitat changes since the mid 1980s.

The results of the literature review show that the protected areas in northern Uganda have both a national and global importance for biodiversity conservation. Although people living in the capital Kampala know little about these areas, many of the parks and reserves conserve species that are not found elsewhere in Uganda. Many reserves are on mountaintops and conserve species that are part of the Eastern Afromontane Biodiversity Hotspot (Brooks *et al.* 2004) and therefore of global significance. There is therefore an important need to consider supporting these areas when peace comes to the north. The satellite image analysis showed that woodland in districts and protected areas in the north west of Uganda has increased by about 12-23% and 20-39% respectively, particularly in Yumbe (23%), Moyo (20%), Kitgum (19%) and Pader (19%). There is a large belt of increased woody cover west and north of Kitgum where the LRA has been most active and as a result it is clear that there has been some recovery of natural habitat as a result of the conflict. In north eastern Uganda

there has been a net loss of woodland, particularly in Nakapiripiriti (36%), Lira (19%) and Moroto (16%) districts, with a similar pattern in protected areas (e.g. Matheniko WR, Bokora WR and Moroto FR). Around urban centres loss of woody cover was particularly high, although for Gulu and Kitgum this was confined to the immediate vicinity of the town and around IDP camps. Around Lira there has been widespread loss of woody cover, which may be partly a result of the conflict (people migrating south) but also due to expanding human population and conversion of natural habitat to farmland. Most Forest Reserves in Lira have lost most of their woodland or forest since 1985. Given that these reserves were established to protect watersheds there should be a more detailed assessment of the impacts of the loss of the woody cover on water supply to people.

It is important to note that changes in woody cover cannot entirely be inferred from the impacts of the conflict in the north; other factors could include the loss of elephants from most of northern Uganda in the past 40 years, changes in climate and changes in human population numbers and density. However it is clear that the movement of large numbers of people to IDP camps has allowed vegetation to recover in areas they have vacated and has led to degradation of vegetation around the camps and urban centres where they have settled.

The results presented in this report have important implications for the development of plans for northern Uganda. There has been a major loss of woody vegetation in the districts of Apace and Lira. It is probable that sources of fuel wood/charcoal and building materials are already, or will become scarce in these districts. At the same time there has been an increase in woody cover in districts to the north of these (Gulu, Pader and Kitgum). When people move back to their land there will be a period of time when they have no food in their fields while they are starting to cultivate and restart their lives and there may be an opportunity to use the regenerated woodland to supply fuel wood/charcoal to Lira and Apach and hence generate an income for the ‘returnees’ while they wait for their crops to mature. At the same time there will be a need to encourage the rehabilitation of woodlands in Lira and Apace so that they do not encourage the complete destruction of woodlands further north. Sustainable management of woodlands for fuel and building materials will be necessary in all of the districts in northern Uganda.

The proposed conservation options for the region include; 1) increased support to protected area management in form of funding to open up the boundaries, and rehabilitate infrastructure and management in the protected areas in the north; 2) increase protected area connectivity and conservation of one of the last areas of large mammals outside protected areas by creating a wildlife corridor between East Madi Wildlife Reserve and Murchison Falls National Park to allow the elephants to resume the migrations they used to show in this region. A third recommendation would

be to investigate the potential for developing transboundary peace parks between protected areas in northern Uganda and those in southern Sudan. Three potential areas exist: a. Otzi Forest Reserve and Nimule National Park, b. Agoro-Agu Forest Reserve and the Imatong Forest Reserve, and c. what we are calling the Kidepo landscape (Kidepo Valley NP, Karenga CWR, Nyangea-Napore, Rom FRs) and Kidepo Game Reserve. Peace Parks have been developed since the 1930s and aim to promote peace between nations and communities, reduce military pressure and encourage cross border collaboration in the management of natural resources between the two countries.

CHAPTER ONE

1.0 THE CONFLICT IN NORTHERN UGANDA AND ITS IMPACT ON THE ENVIRONMENT

1.1 Background

Since 1985/6 northern Uganda has experienced ongoing conflict that has disrupted the lives of most of the population in this part of the country. The conflict has been between the Government forces, the Uganda Peoples Defence Forces (UPDF) and the Lords Resistance Army (LRA). During this time, many thousands of people particularly in the districts of Gulu, Kitgum, Pader and Lira have been either killed or abducted by the LRA. As a way of protecting the local people, the government placed people in camps popularly referred to as Internally Displaced Peoples (IDP) camps. As a result, land has been abandoned and farming is only possible near the protected camps but also under a restricted radius not exceeding seven kilometres. While there have been several analyses and publications assessing the impact of this conflict on people's lives, to date there has been no analysis of the impact on the environment. Given that over 90% of people in Uganda rely on the environment for their livelihoods, and that in northern Uganda this is likely to approach 100%, it is important that this sector be assessed. It has not been clear, for instance, if the conflict has benefited the environment or been detrimental to it. Recently there has been hope for peace in the region and with that plans are being developed to improve the welfare of the people in the north. There is a need to incorporate environmental issues in the development of these plans to both mitigate any negative impacts but also to identify and address areas where conservation is nationally and globally important and where environmental restoration may be necessary.

USAID is developing plans for significant financial support to northern Uganda and approached the Wildlife Conservation Society to request its help in undertaking an assessment of the environmental changes that have occurred in northern Uganda since 1985/6 and to identify areas of conservation concern. This report gives the findings of this contract and gives recommendations where environmental issues could be targeted.

1.2 History of the war in northern Uganda

The Lord's Resistance Army (LRA), formed in 1987, is a rebel paramilitary group operating in northern Uganda, and is engaged in an armed conflict against the Uganda government. It is led by Joseph Kony, who proclaims himself a spirit medium and apparently wishes to establish a state based on his unique interpretation of the Ten Commandments of God (Ward, 2001). The insurgency has been mainly contained to the region known as Acholiland, consisting of the districts of Kitgum, Gulu, and Pader, though since 2002 violence has overflowed into other districts. The LRA has been known by a number of different names including the Lord's Army (1987-8) and the Uganda Peoples' Democratic Christian Army (UPDCA) (1988-92) before settling on the current name in 1992.

The roots of the creation of the LRA go back to January 1986 when the then President, Tito Okello, an ethnic Acholi, was ousted by the National Resistance Army (NRA) led by a Ugandan from the west, Yoweri Museveni. The Acholi feared the loss of their traditional dominance of the national military and were also deeply concerned that the NRA would seek retribution for the brutal counter-insurgency, particularly the actions of the army in the Luwero Triangle (Doom and Vlassenroot, 1999). By August of 1986, a full-blown popular insurgency had developed in the northern region that was occupied by government forces. In January 1987 Joseph Kony made his first appearance as a spirit medium after the initial success of the Holy Spirit Movement of Alice Auma Lakwena (Gingyera-Pincywa, 1989). Throughout 1987, Kony gained military strength by absorbing small units

of this rebel group, the Uganda People's Democratic Army (UPDA) and through violent competition with other Acholi rebel groups for resources and fighters.

The June 1988 peace accord between the UPDA and the NRA, as well as the defeat the year before of the Holy Spirit Movement, left the group led by Kony as the only significant rebel force operating in Acholiland. Former commander Odong Latek of the UPDA and some of his soldiers refused to accept the accord and joined the LRA. Latek gained a lot of influence in the organization and convinced Kony to adopt more conventional guerrilla tactics. This meant that the LRA started to have more impact. In mid-1988, President Museveni created the position of "Minister of State for Pacification of Northern Uganda Resident in Gulu, later upgraded to Minister of State in the Office of the Prime Minister Resident in Northern Uganda. Betty Oyella Bigombe, an Acholi, was appointed to this portfolio and was charged with the task to convince insurgents to abandon their struggle. However, this strategy did not work well. Until 1991 the LRA continued to operate in small bands as a classic insurgency and raided the populace for the supplies, which were carried away by villagers who were abducted for short periods (Gersony, 1997). In the same year, Operation North (1991-1992) was instituted locking out all humanitarian organizations to provide room for a military operation to destroy the rebels. This was accompanied by the creation of a local militia named 'Arrow Group' to defend the local people against the LRA forces. However, this did not go well with Kony who felt betrayed by his tribesmen and he intensified the attacks, abductions and mutilation of the Acholi people.

In 2000, the Parliament of Uganda passed the Amnesty Act with subsequent creation of the Amnesty Commission to try and encourage LRA rebels to voluntarily give up the fighting. However, this strategy registered little success. In March, 2002, the Uganda Peoples Defence Forces (UPDF) launched a massive military offensive named "Operation Iron Fist" against the LRA bases in southern Sudan. However, the increased pressure against the LRA led to the spread of the war to other districts in Teso (e.g. Katakwi, Soroti, Kaberamaido), Apac and Adjumani. Later in 2003, another attempt of diplomatic initiatives failed and led to the birth of another militia the 'Rhino Group' to back up the UPDF. In the same year, the President appealed to the international community particularly the UN Security Council and International Criminal Court for action against the LRA. Peace talks in 2004 (November – December) and 2005 (January to February) by the Acholi Religious Leaders' Peace initiative and Betty Bigombe, respectively, continue to provide hope for a peaceful resolution of the conflict in Northern Uganda.

1.2.1 Causes and impacts of the conflict

The location of the conflict has primarily been in two districts, Kitgum and Gulu collectively known as Acholi-land in northern Uganda. The causes of the conflict vary with time period. First, Gingyera-Pincywa (1989) noted that the British colonial practices led to uneven economic development in Uganda, with southern Uganda becoming more prosperous than the north. As such, the socio-economic division hardened as a result of the ethnic violence that characterised Uganda's post-dependence for decades and often fell out along north/south lines. After independence, more ethnic conflicts cropped up mostly between the Langi and Acholi who inherited the colonial government and the West Nile region. With the National Resistance Movement (NRM) take over of government, the north-south divide has been exacerbated. Another factor has been the decline in economic development in the north. The average household income in Kitgum district was estimated to be US$30.5 per year in 1998 (Kitgum District Initiative Interim Committee Report, 1998) while the per capita income for the country was estimated at US$ 300 a year. The cattle population fell from 156,667 in 1986 to 7,609 in 2002 in Kitgum and 223,524 to 12,179 in Gulu districts while in the same period, the national cattle population increased from three million to six (5,749,412) million excluding exotic/crossbreed (UBOS, 2002). In addition, the Acholi lost jobs during the NRM overturn of the Obote government in 1985, coupled with killings as revenge by other ethnic groups in the army made the Acholi people more rejected and alienated from the rest of the community.

Up to 12,000 people have been killed in the 18-year conflict, with more dying from disease and malnutrition. The rebels have been accused of many atrocities in the area. It is estimated that about 20,000 children have been kidnapped by the group since 1987 for use as soldiers and sex slaves (Human Rights Watch, 2003). In the period between 2002 and May 2003, nearly 9,000 of the abuctees were children (Human Rights Watch, 2003). The total number of people in Internally Displaced People's Camps (IDP camps) in the four districts of northern Uganda namely Gulu, Kitgum, Pader and Lira has been estimated by the Ministry of Disaster Preparedness to be 1,163,797 (550,088 males and 613,709 females). Other sources estimate the number to be approximately 1.5 million people (Refugee Law Project, 2004) and 1,389,920 people (UN OCHA, EU and WFP, April 2005). However, these are crude estimates as it is not even clear if anyone knows how many Internally Displaced Persons exist in the north.

The concentration of people in IDPs has had its own toll on humanitarian assistance needed and the protected areas in the region. For example, where IDPs were placed close to the forest reserves, the demand for fuel wood, poles, water, medicinal plants, thatching grass and land for agriculture have affected the integrity of forest reserves. The Uganda Peoples Defence Forces (UPDF) and the rebel forces operating in the area put more pressure on the same resources to supply game meat, forest products and other resources. According to the Non Government Organisations (NGOs) working in the area, such as Save the Children, World Vision, CARE, Red Cross and Catholic Relief Services, it was estimated that in 2002 approximately 80% of the people live in poor makeshift dwellings. The humanitarian situation is even worse, with less than 20% of IDPs having access to safe water and 6% to medical care (UN Office for the Coordination of Humanitarian Affairs, 2004). Water remains an issue of great concern in IDP camps in all affected districts as IDPs have to queue for long hours trying to collect water from the few available boreholes (**Figure 1.1**).

While some agencies have drilled boreholes and dug shallow wells, in some cases these facilities are located in areas that are inaccessible to IDPs because of insecurity and in others they are in short supply. For example, an inter-agency humanitarian assessment of IDP camps in rural Lira conducted in March, found that very few functional boreholes were available in the camps, the protected springs were very far and the water was too muddy for human consumption. In some camps, no functional boreholes existed at all. Over 25,000 people, mostly children, trek back and forth every day from the rural areas to towns for residence and Gulu alone receives 14,000 children a day (CRS, 2004).

Figure 1.1 Women fetch water at a borehole at Labuje IDP camp, Kitgum Source: WFP September 2004

Analyses made in 1999 by UBOS and International Livestock Research Institute (ILRI) showed that very high poverty levels persisted throughout the northern region with seven out of eight districts having more than 50 percent of individuals living below the poverty line. The least poor districts were Arua and Lira. Between 1992 and 1999, the incidence of Poverty in Uganda dropped from 56 percent to 35 percent of the population. Over the last 16 years, the conflict has cost the government over 1.33 billion US dollars representing 3% of annual GDP (US$ 100 million per year) (UN OCHA, 2004). The continued difficulty in accessing productive land outside camps for cultivation and grazing remains the major limitation to household food security in the northern districts of Gulu, Kitgum, Pader and Lira. Cultivation, in most cases, has been restricted to land at the periphery of the camps due to heightened insecurity and the civilian population's fear of abduction or killings by LRA rebels

perpetuates the IDPs' dependence on food aid for basic survival. The combined effect of high population and poverty has had and will continue to have a dramatic impact on natural resources (particularly forests and parks). UBOS's population projections showed that the northern Uganda population will increase by 700,000 persons in the period 2002-2005 and the demand for natural habitat to provide goods and services will increase tremendously. During the last 18 years of conflict in the north, very little plantation establishment has been done and yet the rate of forest and parkland degradation is believed to be high around the IDP camps.

How these various impacts have affected the environment was unclear. Some people argued that the displacement of people to the IDP camps had benefited the environment because it had removed people from the countryside while others said it had been detrimental because it had concentrated people in small areas where they could not use the natural resources sustainably any longer. It was expected that woody cover would increase in areas where the Lords Resistance Army rebels were hiding out and in areas vacated by people currently living in the IDPs. We also anticipated high woodland conversion to settlement and agricultural fields in areas where IDP camps were located resulting in a decrease in woodland and forest cover. This debate was one of the reasons this study was commissioned and the work aimed to assess the validity of this general thesis.

1.3. Objectives of this Assessment

The objectives of this study were to:

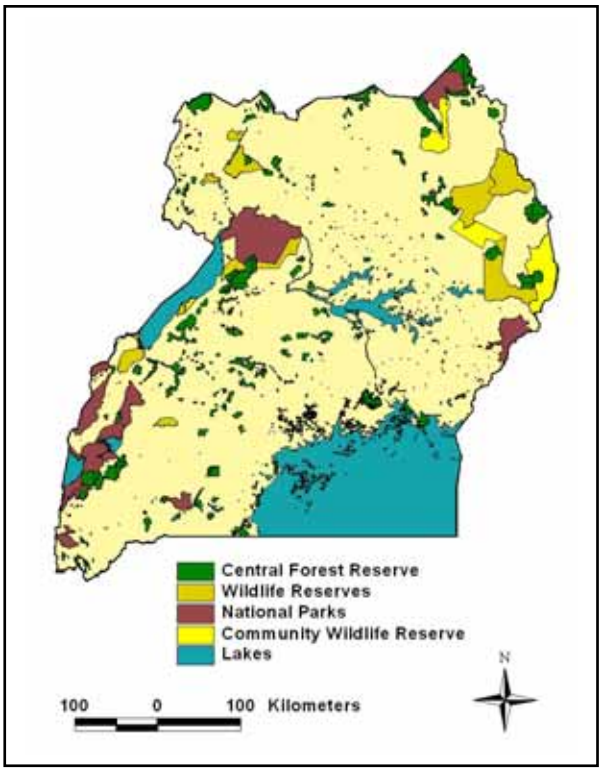
1. compile information from the literature about the conservation values of areas in northern Uganda;
2. assess the impact of conflict on protected areas and vegetation change outside protected areas in northern Uganda focusing mainly on Gulu, Kitgum, and Pader districts;
3. identify key protected areas and possible corridors of high conservation value that could be established in northern Uganda; and
4. assess potential sites for natural resource management and conservation options in the region.

The report is structured in four main chapters: **Chapter one** provides a general background to the study, detailing the history and sources of the conflict in northern Uganda, and the objectives of the study. It gives a brief account of the socioeconomic situation of the people in northern Uganda. In **Chapter two**, the existing information on the biodiversity conservation values of northern Uganda are compiled and summarised. Information held by the Lands and Survey Department of the Ministry of Water, Lands and Environment (MWLE), the Biomass and Biodiversity Reports of the National Forestry Authority (NFA), Makerere University Institute of Environment and Natural Resources (MUIENR), Uganda Wildlife Authority (UWA), International Food Policy Research Institute (IFPRI) and the New Sudan Wildlife Society Reports have been used. **Chapter three** considers Forest/woodland cover inside and outside protected areas in northern Uganda in more detail and assesses the impact of the conflict on forest cover using LANDSAT Image analysis and aerial photographic interpretation. As such, we were able to show where woody biomass has increased or decreased but also attempted to detail the types of vegetation existing in the area. **Chapter four** pulls together this information to give recommendations for conservation and natural resource management in northern Uganda. It also presents some potential areas that might be created as Peace Parks with Sudan. **Chapter five** discusses the natural resource management and conservation options for northern Uganda, the conclusions drawn from the study and summarises the recommendations that need to be taken per site.

CHAPTER TWO

2.0 BIODIVERSITY SURVEYS IN NORTHERN UGANDA

This chapter presents the results of a synthesis of biodiversity surveys and assessments that have been made in and around protected areas in northern Uganda. Effectively three main surveys have been carried out in the recent past (1990s and early 2000s): 1. a survey of large mammals in national parks, wildlife reserves, controlled hunting areas and community wildlife reserves that was used to reassess the protected areas managed by UWA in 1999; 2. an assessment of the larger forest reserves for biodiversity conservation by the Forest Department in the early 1990s; and 3. an assessment of the biodiversity of Karamoja by Makerere University Institute for Environment and Natural Resources in 1996. In addition to these the vegetation types in Uganda were mapped in the 1950s and early 60s (Langdale-Brown *et al.*, 1964) and this provides a useful template, which can be used to assess biodiversity across the country.



UWA currently manages ten National Parks, 10 wildlife reserves and five community wildlife reserves where regulated community use (by local people in parishes adjacent to protected areas) is allowed. The protected areas under UWA management cover 10.5% of Uganda's land surface (UWA, 2002). The National Forest Authority (NFA - formerly the Uganda Forest Department) was managing 712 Forest reserves before 2002, which were reduced to 506 following an assessment of the conservation and timber values of Uganda's forests (National Forest Plan: MWLE 2002). The Central Forest Reserves cover about 7.6% of Uganda's land surface (out of an estimated 24% of national forest cover) (**Figure 2.1**).

Figure 2.1 The protected area system of Uganda

2.1 Historical background to the existing protected areas in Uganda

2.1.1. National parks and Wildlife Reserves

Before 1972, Uganda's Protected Area System was considered as one of the best state enterprises in the region. National Parks and Game Reserves were then managed by the Uganda National Parks (UNP) and the Game Department respectively. At the time, these Protected Areas held large herds of game; Murchison Falls National Park, for example had 12,389 elephants (Buechner and Dawkins, 1961). There were also large populations of large mammals outside protected areas although these were declining by the early 1970s and being isolated to the protected areas. Unfortunately after 1972, effective operations of UNP and the Game Department were made impossible by the breakdown in law and order in Uganda. By 1991, Murchison's vast herds of elephant had been reduced to 308 (Olivier, 1992). The 1990s saw an increase in the number of national parks from three to 10 and the

merger of the UNP and the Game Department to form the Uganda Wildlife Authority, which is now responsible for wildlife management both inside and outside protected areas.

In the 1920s and 30s, wildlife reports described Uganda as a country of vast and diverse wildlife resources. The primary role of Uganda's wildlife agency, the Game Department, was to protect people from wildlife (Game Department, 1935) because many large mammals roamed outside the Game Reserves that had been established. However, by the 1950s, it became apparent that the increasing human population was posing more of a threat to wildlife, than vice versa. Traditional hunting, which in former times had little impact on wildlife and which the Game Department tried unsuccessfully to control through a permit system, was now significantly impacting wildlife populations (Game Department 1955). The cultivation of formerly wild areas was also leading to loss of habitat.

In the 1950s and 1960s, the response of the Game Department and the newly created Uganda National Parks (UNP) to the challenges of wildlife conservation was to create and expand a network of national parks and game reserves to protect wildlife and its habitats in key areas. Sport hunting, a primary source of revenue to the Game Department was more carefully controlled. Important wildlife areas outside the Protected Areas were designated 'Controlled Hunting Areas' (CHAs), in which sport hunting could only be carried out with a special licence, and against set quotas. Two national parks, Murchison Falls and Kidepo and several Game Reserves including East and West Madi, Ajai, Matheniko, Aswa-Lolim and the Boor corridor were created in northern Uganda.

2.1.2. Elephant populations and migrations

During the 1960s, UNP made great efforts to develop its three national parks, Queen Elizabeth, Murchison Falls and Kidepo Valley. Murchison Falls National Park became the most popular wildlife destination for tourists in East Africa, attracting some 60,000 visitors annually (Game Department). Outside the parks and reserves, however, the available land for wildlife was decreasing rapidly and large mammals were retreating into the protected areas or being exterminated outside. Murchison Falls NP in particular was greatly affected by this influx. By the mid-1960s the park's elephant population had increased from 8,000 to 14,000 and the huge herds destroyed woodlands throughout the Park, creating extensive tracts of grassland (Laws *et al*, 1975).

In the 1970s the regulations established for the protection of the wildlife in the national parks and reserves were ignored. Idi Amin's leadership encouraged people to hunt in the parks and the high levels of poaching led to the rapid decrease in animal populations. Corridors of elephant movement between Murchison Falls and southern Sudan and Kidepo Valley National Park became fragmented and migrations ceased (**Figure 2.2**). Between 1980-1983, aerial surveys were conducted (Eltringham and Malpas 1980, 1983; Douglas Hamilton *et al* 1980) which indicated a drastic decline in wildlife and elephants in particular throughout the Protected Areas. It has been noted that elephants play a critical role in forest regeneration through seed dispersal and soil fertility maintenance through dung deposition and are known to structure savanna woodland and forest communities extensively by their activities (Buechner and Dawkins, 1961; Douglas-Hamilton, 1972).

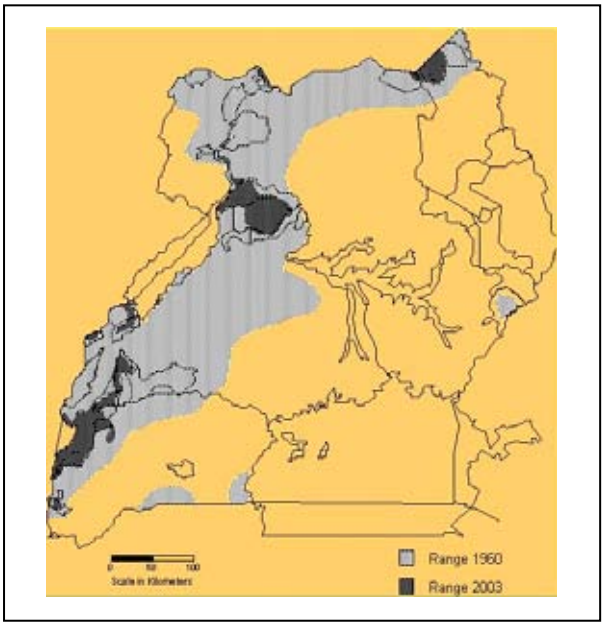


Figure 2.2. Elephant corridor that existed before the 1970s and the isolated populations that currently exist in the protected areas. Source Lamprey *et al.* 2003.

The vegetation of Budongo Forest appears to have been contiguous at one time with Rabongo Forest in Murchison Falls National Park (Buechner and Dawkins, 1961) and to the forests in north western Uganda (Brasnett, 1951). The occurrence of similar tree species such as *Holoptelia grandis* in Bula Forest on the Ora River and Zoka Forest in the West Nile districts (Brasnett, 1951) is clear evidence that Budongo Forest was contiguous with these relict forests that still exist today. Such forests were being maintained and species composition was probably regulated by the presence of elephants which are now lost. Studies have shown that human impacts (e.g. shifting cultivation, forest resource extraction, game hunting), fire, elephants and increasing aridity are some of the factors that influenced the forest distribution (Buechner and Dawkins, 1961; Laws *et al.*, 1975; Lamprey *et al.*, 2003).

During the National Resistance Movement regime in the 1990s, support by the international community and Uganda Government to the protected areas increased, seven forest reserves were made national parks. In 1995/96, an aerial survey was conducted of the wildlife estates including National Parks, Wildlife Reserves and Controlled Hunting Areas (CHA) to determine the status of wildlife protected areas prior to the creation of the new Wildlife Authority (Lamprey and Michelmore, 1996). It revealed that many protected areas were massively encroached and that wildlife populations had been reduced critically to low levels (Lamprey and Michelmore, 1996) and several key wildlife species had become extinct. Elephants had been completely isolated to the large protected areas (**Figure 2.2.** e.g. Murchison Falls and Kidepo) although some small populations still occur in forested areas as well (e.g. Zoka FR and Nyangea-Napore FR). Oryx had been entirely extirpated from their range in Karamoja, Derby's eland from West Nile and both the black and the white rhino from their ranges in the north. Over the entire country, savannah wildlife had been reduced by 90% since the 1960s (Lamprey and Michelmore, 1996). Following this assessment most Controlled Hunting Areas were degazetted or gazetted as Wildlife Reserves (**Figure 2.3**).

2.1.3. Forest Reserves

The creation of Forest Reserves started in 1904 during which the Survey Department began surveying and demarcating the 9,000 sq miles (603,724,320 ha) of private and official estates recognised by the Uganda Agreement. This was affected after signing the Uganda (Buganda) Agreement between Sir Harry Johnston and the Regents and Chiefs of the Kingdom of Buganda. This agreement mandated 1500 sq miles (100,620,723 ha) of forests in the kingdom to be controlled by the Uganda Administration (Brasnett, 1951). The creation of the existing Forest estate started in 1946 after investigation of the usefulness of economic and protective forestry. In the north, Central Forest reserves (CFRs) and Local Forest Reserves (LFRs) covered (95,440,768 ha) 1422.78 sq miles (35.5% of the National total area) and 213.82 sq miles (14,343,148 ha i.e. 18.3%) respectively (**Figure 2.3**). These were gazetted mainly to protect water catchments and provide fuel wood (Brasnett, 1951). A total of 1366 hectares of soft wood plantations were created (1356 ha in West Nile and 10 ha in Acholi) during the 1950s and 60s. Attempts were made to manage forests sustainably for timber and fuel wood/charcoal in the 1950s and 60s and at the time the Forest Department was highly regarded in tropical forestry (Brasnett, 1951; Webster and Osmaston, 2003).

Management of the forest estate suffered in the 1970s and 80s but with support from the European Union, World Bank and NORAD it was revived in the 1990s. Boundaries were demarcated and some control of illegal pitsawing occurred. However, corrupt politicians and District leaders continued to support illegal timber harvesting and many Forest Department staff became involved as well. In the 1990s an assessment of all the large forest reserves (those larger than 50 km^2) was made by the Forest Department to identify which areas of the forest estate could be set aside for conservation purposes, 20% as strict nature reserves and 30% as buffer areas in which no timber harvesting would take place (FNCMP 2002). The creation of the NFA in 2004 has led to changes in management and a push to regain control of forests that have been encroached or heavily harvested. However, the emphasis on revenue generation for the Authority has meant that less attention is being placed upon conservation of the forest estate as it had been in the 1990s.

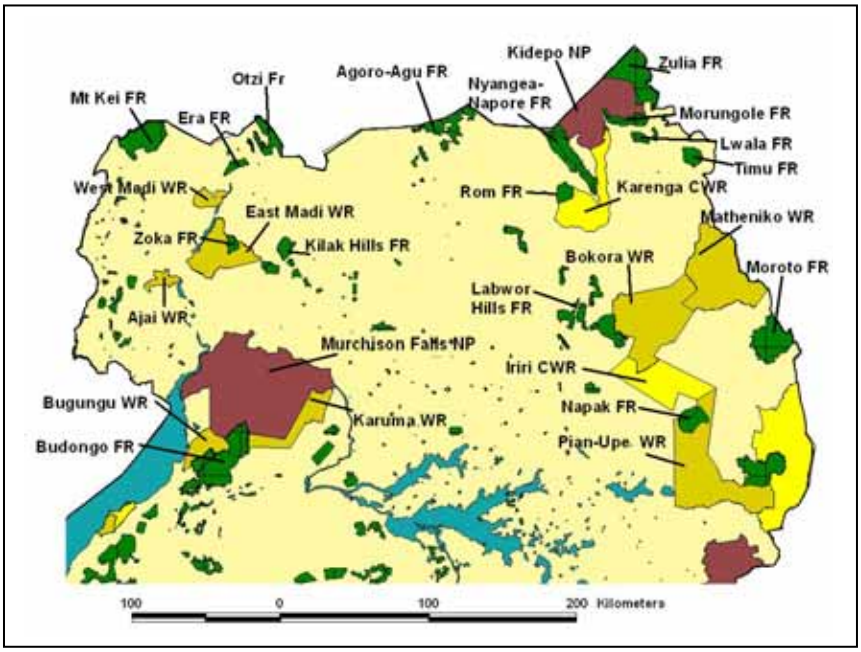


Figure 2.3 The larger protected areas in northern Uganda

2.2 Vegetation mapping in Uganda

Vegetation in Uganda has been classified in various ways (White, 1983; Green *et al*., 1996; Pratt and Gwynne, 1997; Olson and Dinerstein, 1998: at global scale) of which the most important for assessment of conservation value are those of Langdale-Brown *et al* (1964) and the National Biomass Study (1996). Langdale-Brown *et al* (1964) mapped the vegetation of the whole country at a scale of 1:500,000, using aerial photography from the mid-1950s as a basis but with considerable work on the ground. Twenty-two major plant communities were identified for the whole country with sub categories. The following studies by the Uganda Wildlife Authority (2000), Forest Department (FNCMP, 2002), and Makerere University Institute of Environment and Natural Resources (MUIENR - Pomeroy and Tushabe, 1996; Arinaitwe *et al*., 2000) used the Langdale-Brown *et al* (1964) classification system in their studies to characterise Uganda's protected areas (forests and parks). These analyses show that most plant communities are protected in at least one protected area. Vegetation in northern Uganda is very different to that in the rest of the country and the management of the protected areas in this part of the country is important for the conservation of national and international biodiversity (**Table 2.1**).

From Langdale-Brown *et al*. (1964)'s study, it was reported that the rainfall gradient in northern Uganda increased from northeast to the northwest with a concentration to the northwest of Gulu town. As such, the vegetation type across northern Uganda varies along this gradient. This rainfall gradient affects productivity and as a result, cultivation in eastern Uganda is not practised much while in the northwest soils tend to be more fertile and land is cultivated to a greater extent.

The National Biomass Study used SPOT and LANDSAT satellite imagery obtained for 1989 and 1995 supported by aerial photographs and extensive fieldwork between 1993 and 1995. They mapped woody biomass rather than the species composition to estimate the quantity of potential fuel wood and timber available. Only five types of natural vegetation namely forest, woodland, bushland/grassland, cultivation and wetland were recognised. This mapping was used by the Forest Department when planning their biodiversity assessments across the country (Davenport & Howard 1996).

An assessment by Makerere University Institute of Environment and Natural Resources identified those plant Communities of Langdale Brown *et al.* (1964) that are well protected within the existing protected area system and those that need further protection. **Table 2.2** lists the various communities in northern Uganda that have reasonable protection or require further action to conserve a reasonable extent of habitat.

Table 2.1 The main vegetation classes represented in the protected areas of northern Uganda.

Langdale-Brown Vegetation	Montane/ medium altitude forests				Forest/savannah mosaic, woodlands and thickets					*Butyrospermum*, *Combretum* and *Acacia* savannas						Dry thickets		Grasslands and wetlands			
Categories	A	B	C	D	F	G	H	J	K	L	M	N	P	Q	R	S	T	V	W	X	Y
NATIONAL PARKS																					
Murchison Falls NP																					
Kidepo Valley NP																					
WILDLIFE RESERVES																					
Pian-Upe WR																					
Bugungu WR																					
Karuma WR																					
Matheniko WR																					
Bokora WR																					
Ajai WR																					
East Madi WR																					
West Madi WR																					
FOREST RESERVES																					
Kadam FR																					
Napak FR																					
Zulia FR																					
Timu FR																					
Moroto FR																					
Rom FR																					
Morungole FR																					
Mt. Kei FR																					
Otzi FR																					
Nyangea-Napore FR																					

KEY: Bordered box: protected area is especially important for conserving the class, or a subtype of the class. Dark shading: more than 100 km^2 of the class represented in the protected area, Pale shading: 50-100 km^2 of the class represented. Source: Lamprey *et al* (1999)

Table 2.2 Plant communities with no block of habitat greater than100 sq.km inside NPs, WRs and FRs and less than 200 km^2 protected in total in Uganda. Only those communities for northern Uganda are listed here.

Code	Plant Community	Area in Uganda (sq.km)	Area in NPs, WRs and FRs (sq.km)	Location
G2	Riparian woodland	574	51	Matheniko, South Karamoja
G3	Lowland Bamboo	302	16	Small part of Kitgum District, Lipan
H4	*Albizia-Combretum*	778	0	Lake Kwania shore, Lira
J2	*Acacia-Albizia-Chloris-Panicum*	1,847	43	Parts of Apac, Lira, Kitgum
L1	*Butyrospermum-Daniellia-Hyparrhenia*	934	16	Koboko, Arua
L2	*Butyrospermum-Hyparrhenia rufa*	2,787	35	Otzi Forest, parts of Gulu, Lira, Soroti, Pallisa Districts
N6	*Combretum-Acacia-Lasiurus*	705	46	Part of Kitgum District
N7	*Combretum-Acacia-Heteropogon*	342	93	Murchison Falls NP
N9	*Combretum-Acacia-Commiphora*	307	125	Matheniko WR
N10	*Boswellia-Fagara-Heeria*	72	72	Zulia FR
N12	*Acacia-Heeria-Terminalia*	587	87	Pian-Upe WR
Q1	Moist *Hyparrhenia*	1,492	175	Murchison Falls NP, Mukono, Masaka
Q4	*Themeda-Chloris*	2,031	66	Escarpments Toro-Semliki. WR, Kaiso-Tonya
R2	*Lannea-Acacia*	343	161	Kidepo Valley NP
T6	*Lannea-Acacia-Balanites*	1,064	142	Kidepo Valley NP, parts of North and South Karamoja CHAs
T1	*Acacia mellifera*	410	142	Kidepo Valley NP
T2	*Acacia-Commiphora-Lannea*	21	0	North Karamoja CHA
T4	*Acacia reficiens-Commiphora*	418	163	Matheniko WR
T5	*Commiphora-Euphorbia-Lannea*	120	8	Parts of Moroto District
T8	*Acacia mellifera*	93	0	Matheniko WR
V4	*Acacia nubica*	72	0	Small part of Moroto District
W2	*Sorghastrum grassland*	2,574	22	Grasslands central Uganda (e.g. Kafu R.); Malabigambo FR
W3	*Brachiaria-Hyparrhenia grassland*	182	35	Parts of Aswa River, Lira District
W5	*Combretum-Acacia-Hyparrhenia savanna*	1,618	47	Wetlands, Kiboga, Nakasongola; Achwa R. Kitgum, Lira
W6	*Combretum-Acacia-Hyparrhenia savanna*	1,469	2	West Madi CHA, wetlands in Soroti
Z3	*Hyparrhenia-Pteridium*	3,324	114	Cultivated areas in Bushenyi and Nebbi Districts
Z4	*Eragrostis-Chloris-Hyparrhenia*	2,014	97	West Madi CHA, Ajai WR, parts of Nebbi District

The communities in boxes are those which should be given more protection. Those communities not boxed are those where no further conservation action is required, either because they are sufficiently well represented in the protected area system (or as well as can be hoped), or because they have been so radically altered by human activities that conservation measures would be pointless.
Source: Davenport and Howard, 1996; Pomeroy and Tushabe, 1996; Lamprey *et al.*, 2003

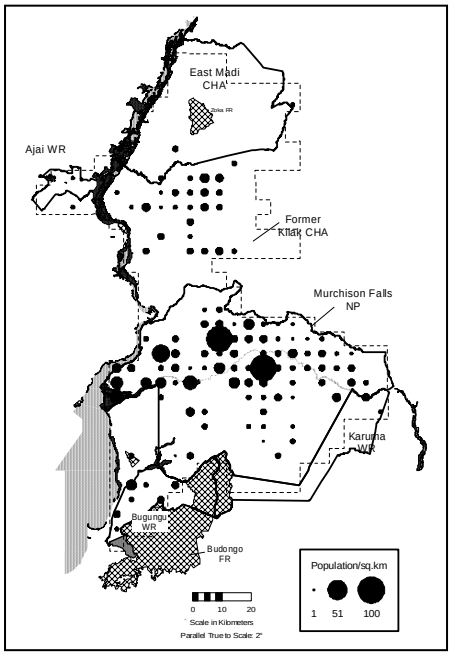
2.3. Uganda Wildlife Authority Large Mammal Surveys

Most biological inventories in Uganda have been carried out in national parks and forest reserves because of the interest in these areas. In the parks, comprehensive species lists of plants, mammals and birds have been compiled by the Makerere University Institute of Environment and Natural Resources (MUIENR) and other research groups to determine the distribution of endangered species for Uganda. In the recent past, UWA has been assessing its protected areas as part of the merger between National Parks and Game Department (Lamprey and Michelmore, 1996; Lamprey *et al.*, 1999; Rwetsiba *et al.*, 2002; Lamprey *et al.*, 2003). These assessments surveyed large mammals from the air with some on-the-ground fieldwork and looked at encroachment of the parks and wildlife reserves. The results were used to develop the Protected Areas Plan for Uganda, where heavily encroached portions of parks and reserves were degazetted to provide for protection of only biologically and economically viable areas. The results of the surveys show that Murchison Falls and Kidepo Valley National Park are two key areas for large mammal conservation in northern Uganda. Several of the wildlife reserves are also critical for certain species in Uganda, particularly East Madi, Bokora and Matheniko. Most large mammals have been exterminated outside these protected areas (Lamprey, *et al.*, 2003).

Kidepo Valley NP has very important wildlife populations with species found nowhere else in Uganda, particularly cheetah and wild dog. The park is secure although some species such as zebra and eland have declined and the cause is attributed to lion predation (Lamprey *et al.*, 2003). The eastern edge of Karamoja still supports Uganda's last population of lesser kudu whose population was estimated to be 400 in 1995. A small group of Bright's gazelle, a race of Grant's gazelle, which was

found in Matheniko and Bokora in the early 1990s, no longer exist (Lamprey *et al.*, 1999). Rothschild's giraffe and Lelwel hartebeest can only be found in Kidepo and Murchison Falls National Parks. The population of Greater Kudu in Kidepo Valley numbers about 10 while the Roan Antelope have dwindled to about 15 individuals in Pian Upe WR. Ostrich can only be found in small numbers in Bokora Corridor WR and Pian-Upe WR.

Murchison Falls is important because it is Uganda's largest protected area and historically supported large numbers of elephants and other large mammals. It contains an important area of Borassus Palm savanna, which is only found in one other protected area in Uganda (East Madi WR). It currently supports most of Uganda's Rothschild giraffe, Nile crocodile, lion as well as Jackson's hartebeest populations. Denham's bustard and Shoebill storks are also found there in good numbers.



The Wildlife Reserves are less rich in species (although this may be partly explained by fewer surveys in these areas) but do serve to increase the areas adjacent to the national parks. East Madi WR in particular, to the north of Murchison Falls NP is part of the elephant corridor to Sudan and still contains reasonable numbers of large mammals (Lamprey *et al.* 1999) as does the former Aswa-Lolim and Kilak Controlled Hunting Areas which were degazetted in 1972 to make way for ranches. These were not developed greatly and wildlife still occurs in this region between Murchison Falls and East Madi (**Figure 2.4**). Details about the parks and wildlife reserves are given in **Annex 1**.

Figure 2.4 Map of large mammal concentrations in the Murchison Falls-East Madi region showing reasonable numbers in the former Kilak CHA (also includes Aswa Lolim CHA). Source: Lamprey, *et al.* (2003).

2.4 Forest Department Biodiversity Surveys

Between 1993-1995 the Forest Department carried out surveys of all forest reserves larger than 50 km^2. The surveys looked at five taxa; small mammals (rodents and shrews), birds, butterflies, moths (hawk and silk moths) and trees. Sixty-five forest reserves were surveyed leading to the production of a 33 volume series of biodiversity reports (Davenport and Howard, 1996). The data were used to rationalise a planned program to create 50% of Uganda's forest estate as protected for nature conservation because of the remarkable biodiversity found in this country. Of this 50%, 20% was reserved as core protection zones (nature reserves) and 30% as buffer/research zones where minimal harvesting of poles, fuel wood and non-timber forest products can take place. The biodiversity data and zoning plans were compiled into a conservation master plan for the Forest Department (FNCMP 2002).

In northern Uganda, fifteen forest reserves were surveyed namely Mount Kei FR (formerly the Mount Kei White Rhino Sanctuary), Agoru-Agu, Lokung, Otzi, Era, Labwor Hills, Nyangea-Napore, Rom, Ogili, Moroto, Kadam, Napak, Morungole, Timu and Lwala Forest reserves. A summary of each biodiversity inventory report for the forest reserves is described in **Annex 1**. The majority of the forests surveyed, support at least one species found in no other protected area in Uganda. The most biodiverse forest reserves are located in western and southwestern Uganda particularly in the Albertine Rift region (e.g. Bwindi Impenetrable NP, Kasyoha-Kitomi FR, Rwenzori Mountains NP and Budongo FR) and in the east of the country (Mt Elgon, Kadam and Moroto FRs). In the north and east, Moroto Forest reserve is ranked forth while Otzi, Kadam and Nyangea-Napore are ranked 10^{th}, 11^{th} and 20^{th} respectively. Zulia forest reserve located at the extreme north east of Karamoja, which is the largest forest reserve in the north, was not surveyed due to inaccessibility and insecurity in the

area. **Table 2.3** provides a summary of the biodiversity recorded in each forest based on the five biological taxa and indicates their order of biodiversity importance. **Figure 2.5** maps the overall biodiversity scores into three categories of importance.

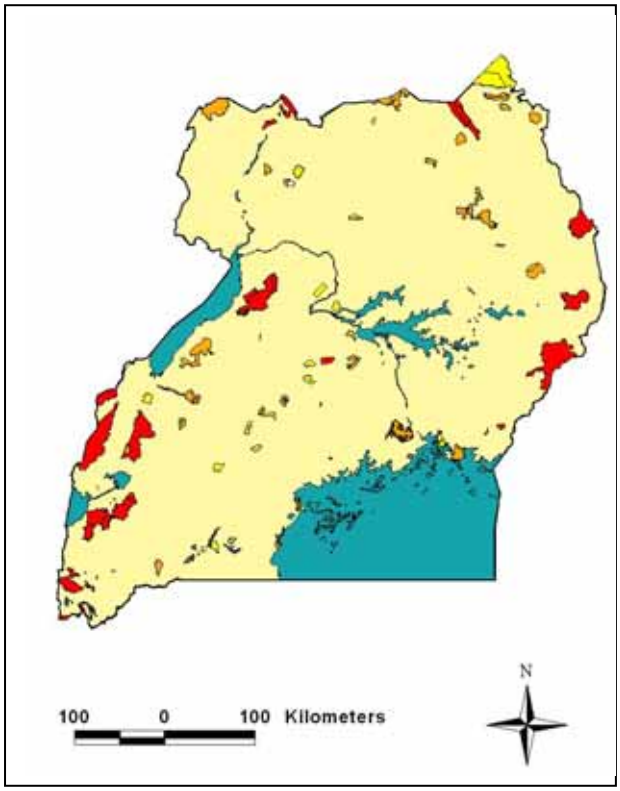


Figure 2.5.Relative rankings of the 65 Forest Reserves surveyed by the Forest Department for biodiversity. Red-highest rank; Orange medium rank; Yellow –lowest ranking.

The northern forests were surveyed for very few days (as few as 10-15) during these surveys because of insecurity and LRA activity. As a result it is possible that these forests might prove to be more important with further work.

Table 2.3 Biodiversity score based on the ranking of forests using data from five taxa on total species richness, endemic species and species unique in Uganda to those forests.

		Trees and shrubs			Birds			Mammals			Butterflies			Moths		
Forest	Biodiversity importance (score, max 20)	Sp known	AM/ SM	Sp unique to forest	Sp known	AM/ SM	Sp unique to forest	Sp known	AM/SM	Sp unique to forest	Spp known	AM/ SM	Sp unique to forest	Sp known	AM/ SM	Sp unique to forest
Moroto	14.7	203	1	3	220	7	**13**	22	2	**3**	106	7	**9**	45	4	**8**
Otzi	14.1	261	2	7	168	0	0	21	0	0	94	1	3	44	0	0
Nyangea-Napore	13.4	261	3	4	154	0	0	25	0	0	129	1	*4*	39	0	0
Era	13.4	145	1	3	113	0	0	15	0	**1**	56	0	0	39	0	1
Morungole	13.2	191	2	*8*	96	0	0	12	0	0	77	1	2	16	0	0
Mt.Kei	13.2	229	0	3	175	2	4	22	0	**1**	126	1	*7*	54	0	*2*
Ogili	13.1	115	0	1	50	0	0	2	0	0	42	0	0		0	0
Agoro-Agu	12.8	254	4	*7*	76	0	0	11	0	0	66	0	0		0	0
Labwor hills	12.8	239	2	4	139	0	1	15	0	0	109	0	3	43	0	0
Zoka	12.2		0	3		0	0		0	0		0	0		0	0
Rom	12.2	212	1	3	64	0	0	15	0	0	109	0	0	7	0	0
Timu	12.1	166	5	*6*	68	0	0	12	0	0	77	2	*5*	10	0	0
Lwala	12.1	111	0	0	33	0	0	5	0	0	17	1	1	3	0	0
Aswa River	11		0	2		0	0		0	0		0	0		0	0
Lokung	10.6	85	1	1	54	0	0	13	0	0	51	0	0	4	0	0

Sp known – Species known from the forest, Zoka and Aswa River forests were not surveyed by FD because of insecurity. Where data from the literature exist these were used to fill in some numbers.

Note: Figures in bold denote totals exceeding 1% of species known from protected area system, in italics denote totals representing 0.5-1% species known from protected area system. AM/SM - denotes afromontane or Somali-Masai endemics

Source: Davenport and Howard, 1996. Biodiversity Reports No.1-33, Forest Department, Forestry Conservation Master Plan, 2002.

2.4.1 Current Status of forests in northern Uganda

The NFA faces management challenges such as forest degradation due to human influence and deforestation. Out of 1.7 million ha of Central Forest Reserves (CFRs) in the country, 58,000ha (5%) have been degraded or depleted (NBS, 2003). In northern Uganda, 1,053 ha out of 1,456 ha (72.3%) local forest reserves have been deforested. The major threats to the forests in northern Uganda include encroachment (i.e. settlement and cultivation), game hunting, illegal harvesting of forest products and fires (**Annex 1**). Woody cover loss in some areas has been accelerated by the insecurity in northern Uganda and southern Sudan that has led to the settlement of people in camps located in or near forest reserves. Most forest reserves in Karamoja suffer mainly from grazing and hunting while in Moyo, illegal activities continue to occur unchecked due to poor access.

Zoka Forest Reserve is relatively insecure due to the presence of LRA rebels. It is a core biodiversity forest, which also serves as a water catchment. Otzi Forest reserve offers protection to the water catchment. It has suffered severe human impacts particularly cultivation and grazing by both the internally displaced people from Pakele Camp and army officers are rumoured to be involved in timber harvesting. The local community is reported to harvest bamboo for house roofing because of its resistance to termites. Ayipe and Era Forest Reserves have been heavily cultivated and grazing of cattle and goats also occurs. African Blackwood (*Dalbergia melanoxylon*), which occurs in a few of the forests in northern Uganda (e.g. Otzi, Agoru-agu), has been heavily harvested. Apart from those forest reserves where no information is available, the rest experience similar threats (NFA Zonal Field Reports, 2005). Worth noting is the forest reserves in Lira district, where most of the central forest reserves have been converted into urban centres (**Annex 1**). The NFA has already recruited field officers in charge of the northern region. As such, reserve boundary opening, afforestation and eviction of illegal forest encroachers is on-going.

2.5. Makerere University Institute of Environment and Natural Resources Surveys

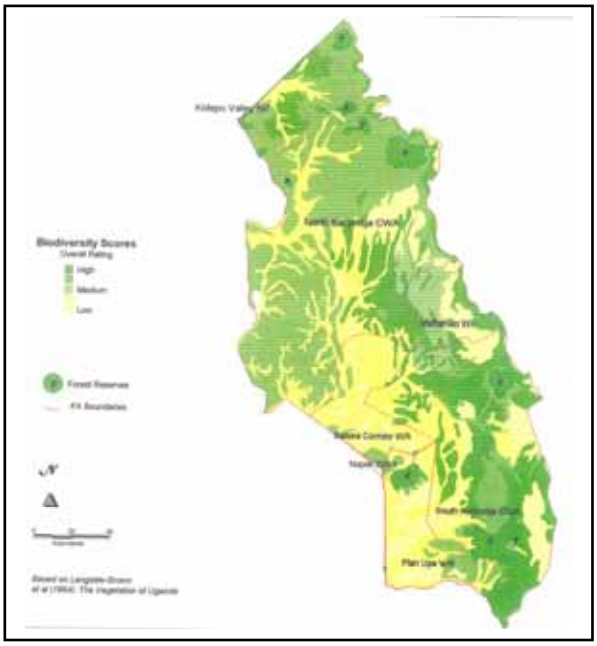
The Makerere University Institute of Environment and Natural Resources (MUIENR) has undertaken a number of biodiversity surveys in Uganda either individually or in collaboration with other institutions. In the mid 1990s MUIENR (Pomeroy and Tushabe, 1996) conducted a survey of the biodiversity of Karamoja based on Langdale-Brown Vegetation types. They focused on five biological taxa namely plants, butterflies, reptiles, birds and mammals. Sites within the different vegetation types were surveyed for the five taxa and extrapolations made to the rest of the vegetation type.

MUIENR's biodiversity survey of Karamoja recorded a total of more than 1200 species (**Table 2.4**). Between 7 and 28 % of Uganda's total numbers of different taxa can be found in Karamoja.

Table 2.4 Numbers of species recorded in Karamoja compared with Uganda's total species richness.

	Species recorded	Uganda's total	Percentage of Uganda's total
Flowering plants	735	4500	16
Butterflies[1]	120	1000	12
Amphibians	5	75	7
Reptiles	26	191	14
Birds	241	1008	24
Mammals (Small)	39	225	17
Large	32	116	28
Total	1219		

Note: One record of one species in one site was the standard basic item. 1 Excluding the small Hesperidae
Source: Pomeroy and Tushabe, 1996. Biodiversity of Karamoja unpublished report.



A composite map of biodiversity was produced (**Figure 2.6**). This shows that areas around Kidepo Valley NP and Moroto FR are the most biodiverse parts of Karamoja.

There is good evidence that the vegetation of Karamoja has been undergoing changes for a long time. Langdale-Brown *et al* (1964) gave an interesting account of some of the factors, which have been responsible for the changes to the plains vegetation, but overgrazing by cattle and goats is a primary factor.

Figure 2.6 Biodiversity of Karamoja by MUIENR (source-Pomeroy *et al.* 1996).

2.6. Key sites for biodiversity conservation in Northern Uganda and biodiversity hotspots

Synthesizing the information presented above it is clear that northern Uganda, though not fully exploited for biodiversity conservation in the past 20 years, has areas of clear conservation importance at both a national and international level. The vegetation of northern Uganda is very different to the centre, south-east and east where most conservation activities currently are funded and these vegetation types contain animal species that are not found elsewhere in Uganda. While the region is not as rich in rare and endemic species as the Albertine Rift ecoregion in western Uganda it does contain a good number of species of conservation concern. Uganda's only cheetah and wild dog populations occur in Kidepo Valley NP and several large mammals (e.g. elephants, giraffe, lions) are confined to both Kidepo and Murchison Falls NPs that are found in not more than five protected areas in Uganda. Many of the Forest Reserves contain plants and animal species that are known to occur only in those forests (**Table 2.5**) in Uganda and also harbour several species endemic to afromontane habitat or the Somali-Masai biome.

Eastern Afromontane habitat in Africa has recently been identified as a Biodiversity Hotspot and of global conservation importance as a result. Many of the isolated mountains in northern Uganda and southern Sudan contain forest with endemic species to the Eastern Afromontane hotspot (Brooks *et al.* 2004). Most have been poorly surveyed as well and may well contain more species of conservation concern than we currently know. Global Biodiversity Hotspots are areas that have high biodiversity value (over 1500 species of endemic plants) combined with high threats to their continued existence (at least 70% of their area must have been lost). Only 34 sites have been classified as hotspots in the World and several funding agencies have used these to help prioritise their support to biodiversity conservation in the world (Mittermeier *et al.* 2005).

Key protected areas that have been identified from these three studies are listed in **Table 2.5** with some of their conservation values. Of these Kidepo Valley and all of the forest reserves apart from Zoka FR have mountains and form part of the Eastern Afromontane hotspot. It should be noted that among the parks and wildlife reserves, Murchison Falls National Park ranks highly followed by Kidepo Valley NP in biodiversity value. Among the forest reserves in Uganda, Moroto ranks forth in

biodiversity value in the whole of Uganda. Zulia FR, which is the largest forest reserve in northern Uganda, has not been surveyed due to insecurity in the area. It is important to note that northern Uganda with such high biodiversity, suffers from conflict related threats resulting in species loss inside and outside protected areas.

Table 2.5 Biodiversity of conservation value in the protected areas of northern Uganda. It should be noted that the scoring criteria for Parks and Wildlife Reserves is different from that of the Forest Reserves.

Protected Area	Biodiversity Value	Species of Conservation value
Parks		
Kidepo Valley NP	**4**	Cheetah, Wild Dog, Lion, Elephant, Zebra, Ostrich, Greater Kudu, Bright's Gazelle
Murchison Falls NP	**6**	Lion, Elephant, Hippo, Crocodile, Hartebeest, shoebill
East Madi WR	**4**	Kob, Elephant, chimpanzees, Hartebeest
Matheniko WR	**4**	Bright's gazelle, Ostrich
Bokora WR	**4**	Bright's gazelle, Ostrich
Forest Reserves		
Moroto FR	14.7	3 trees, 9 butterflies, 13 birds,3 mammals, 8 moths
Otzi FR	14.1	Chimpanzees, elephants, 7 trees, 3 butterflies
Era FR	13.4	3 trees, 1 mammal, 1 moth & endemic cycads
Nyangea-Napore FR	13.4	Elephants, 4 trees + very species rich, 4 butterflies,
Morungole FR	13.2	8 trees, 2 butterflies
Mt Kei FR	13.2	7 butterflies, 3 trees, 4 birds,1 mammal, 2 moths
Agoro-Agu FR	12.8	7 trees, endemic subspecies of bird
Rom FR	12.2	3 trees
Labwor Hills FRs	12.8	4 trees, 3 butterflies, 1 bird
Zoka FR	12.2	Elephant, chimpanzees, tree and shrub species
Zulia FR		No information available due to insecurity

For parks and wildlife reserves, the scores are: **6-** International significance, IUCN listings, **4-** Conservation of landscapes, ecosystems and species of national importance. The maximum score for Parks and Wildlife Reserves is **7-** International Significance - World Heritage, Man and the Biosphere Reserve, Ramsar Site.
Scores of forest reserves were based on species of biological importance and the maximum is 20.
Source: adapted and modified from UWA Protected Area System Plan for Uganda, 1999; Lamprey *et al.*, 1999; Forestry Nature Conservation Master Plan, 1999.

Several of these areas are connected and form larger landscapes. For instance Kidepo Valley NP, Nyangea-Napore FR, Morungole FR, Karenga CWR and Rom FR all form a single landscape of connected protected areas in Uganda. Murchison Falls NP, Karuma WR, Bugungu WR and Budongo FR all form one landscape also. This landscape could be connected again to East Madi WR and Zoka FR to conserve the old corridor that allowed elephants to migrate between Murchison Falls and East Madi. Efforts by UWA in the late 1990s to create this corridor did not succeed because of the conflicts between the Gulu and Nebbi district local government over administration boundaries and problems of land ownership (land in the north is mostly communal). Most of the land owners are absentee landlords. The timing of the negotiations was bad given the conflict in the north, the leadership and local people were more willing to listen to security issues than to conservation issues. However, it was the desire of UWA that the old Kilak and Aswa-Lolim CHAs would be protected as a wildlife corridor and managed in a manner compatible with wildlife conservation regulations. At present there is little management of this area because of insecurity and absentee landlords, which would be a goal worth pursuing further. This issue of conservation of larger landscapes is assessed further in **Chapter Four**.

CHAPTER THREE

3.0 WOODY COVER CHANGES INSIDE AND OUTSIDE PROTECTED AREAS IN NORTHERN UGANDA

The assessment of change in woody cover was conducted from February to May 2005 in northern Uganda focusing on the districts of Gulu, Kitgum, Pader, Lira, Adjumani, Yumbe, Moyo and the northern part of the Karamoja region. Given the level of insecurity in the region and timeframe, this study was limited to an assessment of the woody cover changes inside and outside protected areas using two analyses. These were, a) a satellite image analysis covering the region in question, and b) an aerial reconnaissance survey to assess the accuracy of the satellite image classification and to 'ground-truth' the classification.

3.1 Remote Sensing and GIS analysis

Two sets of Landsat imagery were used to determine the extent of woody cover change in Northern Uganda. One set, the Landsat 5 Thematic Mapper (TM) data was taken from the mid 1980's and the second set, Landsat 7 Enhanced Thematic Mapper Plus (ETM+) was taken from the early 2000's. Some of these images were acquired free from the Global Land Cover Facility (http://glcf.umiacs.und.edu/index.shtml) and some purchased from the United States Geological Survey (USGS). The images were carefully selected according to the date of acquisition (around September) and for their relatively cloud-free characteristics. The acquisition time coincided with the peak rainfall during the wet season facilitating the identification of woody vegetation. Each image set, consisted of five images of an area approximately 900 x 900 km, together covering the whole of Northern Uganda from the northern end of Lake Albert to about 100 km into Southern Sudan. Landsat images used for analysis were identified based on the three principal parameters (Burrough and McDonnell, 1998) namely the Path, Row and Date of acquisition (**Annex 2**).

In order to ensure accuracy in forest change measurements, both the 1980 Landsat,TM and 2000 Landsat ETM+ imagery were geo-referenced and orthorectified to a standard form of 0.5 pixels RMS error (Wilkie and Finn, 1996; Lilles and *et al.*, 2004). The images were mixed to form a mosaic without histogram matching to ensure the spectral integrity of the imagery remained before classification was undertaken. Also to ensure consistence, neighbouring re-sampling was made during geo-referencing. An unsupervised classification was performed on the Landsat 7 ETM+ 2000's imagery, whereby the major distinctions in land-cover type were identified according to the spectral properties of the imagery (**Figure 3.1**). Although it is difficult to identify with any accuracy the different land cover types from such a product, it was possible to use such a classification to guide the stratification of the aerial survey to ground-truth the images. Using the unsupervised classification along with several Geographical Information System (GIS) layers (National Park and Wildlife Reserve and International Boundaries), three flight paths were identified and mapped (**Figure 3.2**). In determining the flight paths, the following criteria were considered; (i) to cover as much heterogeneous land cover as possible while collecting training samples for a final image classification; (ii) to cover as many protected areas as possible, (iii) to cover areas of potential landscape management value as identified from the literature review (**Chapter 2**) and (iv) to visit areas of strong vegetation disjunction/change on the unsupervised classification.

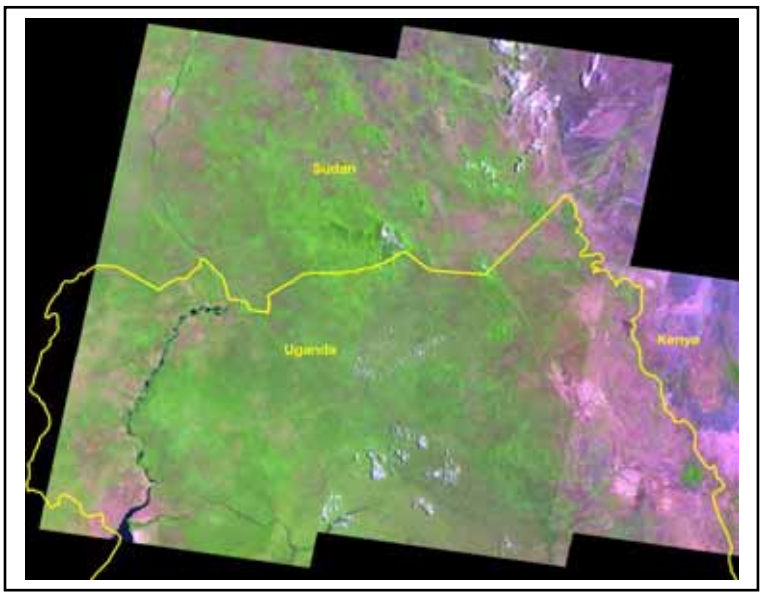


Figure 3.1 Landsat 7 ETM+ Image False colour (5,4,3) Mosaic for Northern Uganda (2002).

3.1.1 Aerial survey

The flights were carried out over a period of 5 days, flying out of Bugungu Airstrip in Murchison Falls National Park (flying at a height ranging from 400-600 m above the ground) covering approximately 2,000 km. The aeroplane used was a four-seater Cessna 182, equipped with a camera port in the undercarriage into which a Nikon D-70 Digital SLR camera was slotted and connected to a laptop with shutter control software to facilitate camera operation. The planned flight paths were uploaded to the plane's GPS unit to ensure the pilot followed them as closely as possible (**Figure 3.2**). During the flights, information about the vegetation cover was recorded approximately every two minutes and a photograph was taken for later laboratory analysis to standardise the field observations. Geographical Positioning System (GPS) points were also recorded in synchronisation with photographs and field observations taken resulting in a total of 650 aerial photo survey samples.

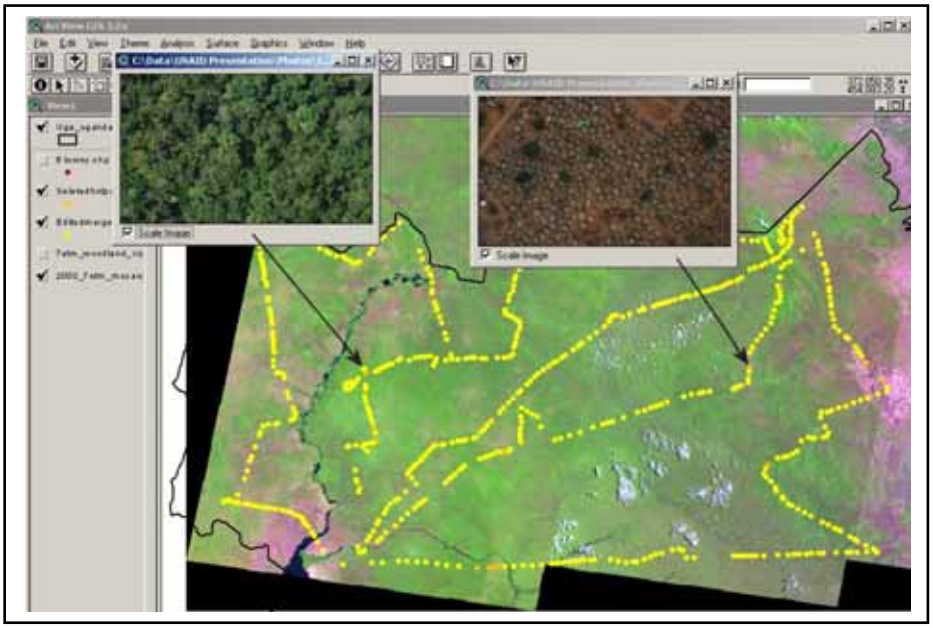


Figure 3.2 Flight routes taken for the northern Uganda Aerial survey showing two example photos from the collection taken every 2 minutes.

For purposes of woody cover change identification, three land-cover types were identified from the images: 1.Grassland & 1-25% Woody Cover; 2. 25-100% Woody Cover and 3. Other (meaning human settlement, cultivated land, bare earth and rock etc.). A further class, "Cloud and Cloud Shadow" was also extracted as a means of eliminating the effects of clouds in the classification results. Woody cover maps were developed for both periods of satellite imagery, 1985 and 2002 (**Figure 3.3 and 3.4**). The reason why Grassland and 1 – 25% woody cover were put in the same class was because understorey grass in sparsely wooded areas has a high reflectance, which results in very little ability to separate these classes using spectral characteristics. This meant that overestimation of the woody cover in either 1985 or 2002 might easily occur and to avoid this, the classes were combined. This study therefore, presents a conservative estimate of woody cover change during the measurement period. It should be noted that all the geographical coverage features of the maps were projected in a common coordinate – Universal Transverse Mercator (UTM) Zone 36N, WGS 84 and produced in the Madagascar, East and Southern Africa Remote Sensing and GIS Centre of the Wildlife Conservation Society.

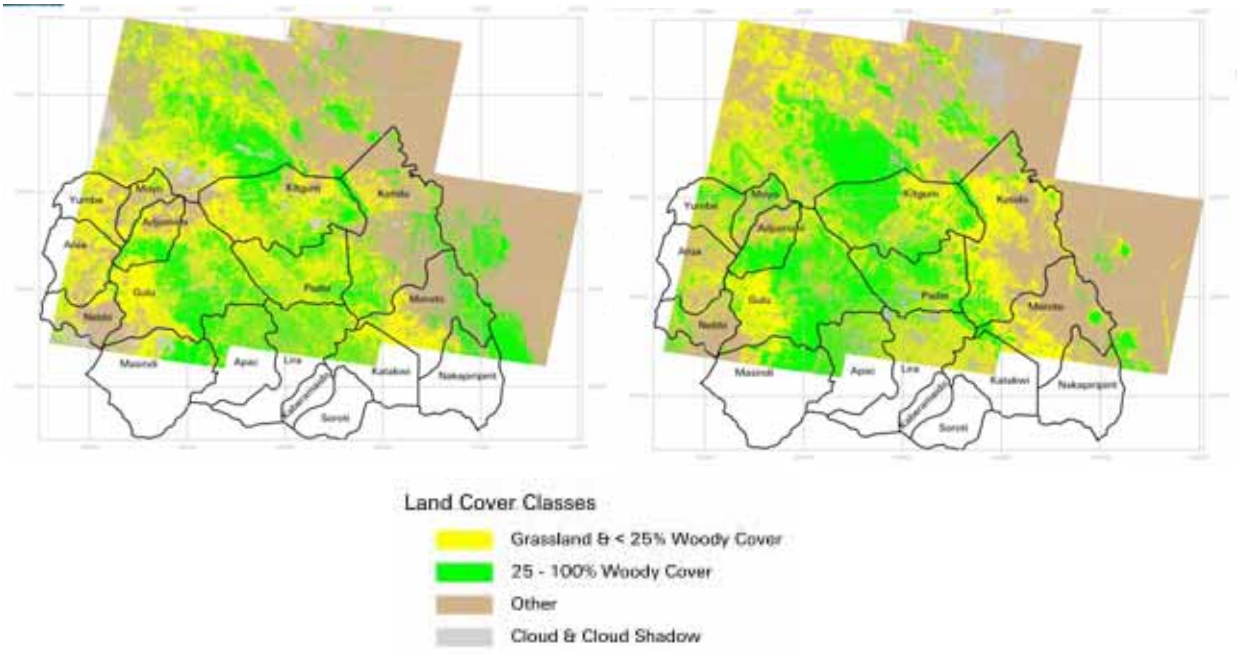


Figure 3.3 Woody cover in Northern Uganda in 1985.

Figure 3.4 Woody cover in Northern Uganda in 2002.

3.1.2 Laboratory Analysis of satellite imagery

Post flight processing involved ensuring accurate geo-coding of both the field observations and the photographs to the GPS points and later evaluating the results in conjunction with the unsupervised classification product. In order to use the field observations to classify different dates of satellite imagery, it was necessary to take into consideration the time difference between satellite image acquisition and field observations. To correct for the time factor, it meant that training samples for supervised classification needed to be carefully selected to ensure that the classes they were assigned to from field observations were true representations of the land cover that was captured at the time of satellite image acquisition. The unsupervised classification product was used in conjunction with already carefully examined satellite imagery to identify representative training samples for the supervised classification.

Training samples were collected for land cover categories by identifying and extracting representative samples from the field observations and overlaying them on the satellite imagery. The aerial survey photographs were also useful in accounting for the differences between the 2002 Landsat imagery and actual land cover to date. The training pixels were then selected by a combination of hand digitising

and automated region-growing. The training samples were evaluated for spectral separability in all six bands of the imagery. This process resulted in a refined set of training classes being delineated, all demonstrating a good degree of spectral separability. Other superior methods of separating vegetation classes such as principal components, vegetation indices could be used in future to explore the data further. The classifications were carried out on each image separately and later the classified images were composed to form an image mosaic. This method was selected due to poor spectral separability of training classes determined on the mosaic images, probably resulting from the different times of image acquisition. A matrix of the coincidence classification results from 1985 and 2002 was produced to determine Woody Cover Change during that period (**Figure 3.5**). From this matrix, areas of change (excluding those areas affected by cloud) were identified and broadly categorised as "Increased Woody Cover", "Unchanged Woody Cover", "Decreased Woody Cover" and "non-woody". Where 'non-woody' represents areas, which were neither Woody Cover in 1985 or 2002 as shown in woody cover change map for Northern Uganda from 1985-2002 (**Figure 3.4**) and the woody cover change (1985-2002) classification product maps (**Figure 3.5**).

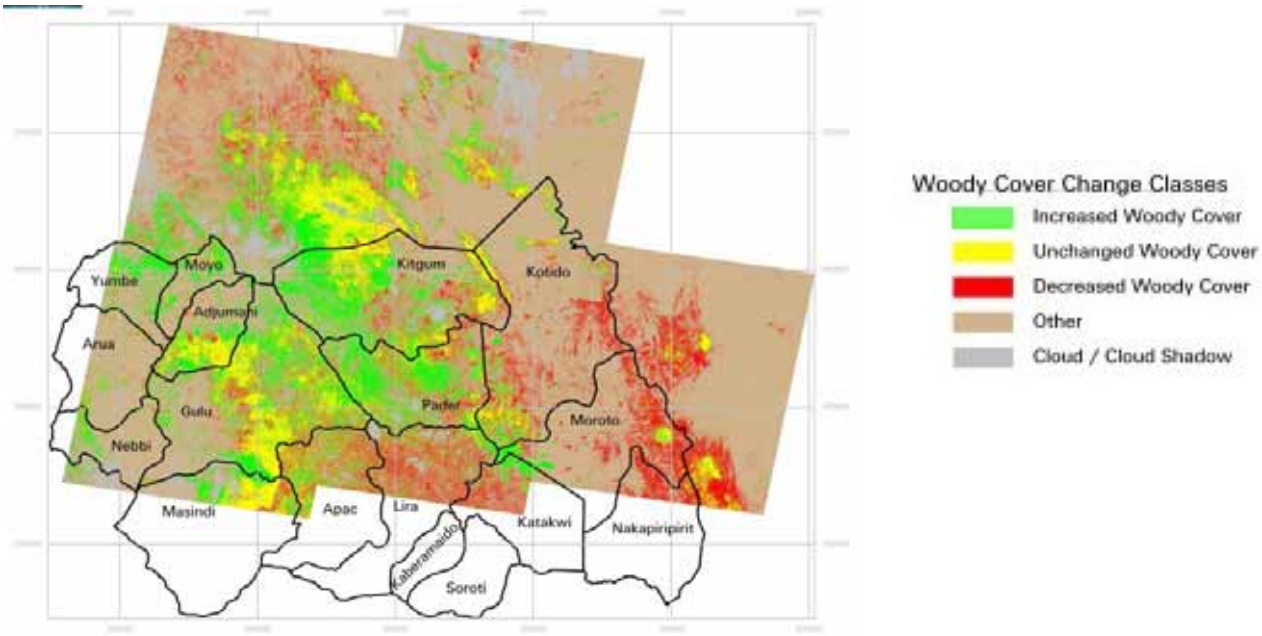


Figure 3.5 Woody cover change in Northern Uganda from 1985-2002.

Evaluation of the land cover type classification was performed visually by comparing the photographs and field observations not used for determining training samples with the classification result. In addition, continuity of the classes at image boundaries was examined. Visual classification resulted in a good and true representative land cover type although some ambiguity does exist between classes, probably arising from the different years of image acquisition. From experience, accuracy is highest for the larger homogenous blocks of land-cover and becomes slightly less for smaller areas of heterogeneous land-cover types.

3.2 Woody cover changes in Northern Uganda

Woody vegetation changes in northern Uganda have been analysed and presented in form of maps and tables. In order to provide a systematic account of the land cover changes, woody cover changes are presented for five analyses; 1. district scale, 2. central and local forest reserves, 3. parks and wildlife reserves, 4. potential corridors, and 5. analyses around heavily settled areas. The woody cover change analysis was summarized and presented in the form of maps and tables.

3.2.1 Woody cover changes in the districts of northern Uganda

There is no doubt that the conflict in northern Uganda has profoundly changed the land cover in the northern Uganda over the course of the last eighteen years (1985-2002). The Remote sensing analysis shows that small-scale woodland cover increases have occurred in the north (**Figure 3.4**). The greatest percentage (12-23%) of woodland vegetation cover increase occurred in the districts of Kitgum, Gulu, Pader, Adjumani, Moyo and Yumbe and to a lesser extent (1-11%) in Arua, Nebbi and Masindi districts (**Figure 3.6**). On the other hand, the districts of Kotido, Apac and Katakwi experienced a decline in woodland cover of 1-12%. Lira and Moroto registered a decline in woodland cover of 13-24% and Nakapiripiriti experienced the worst woody cover loss of 25-36% (**Figure 3.6**).

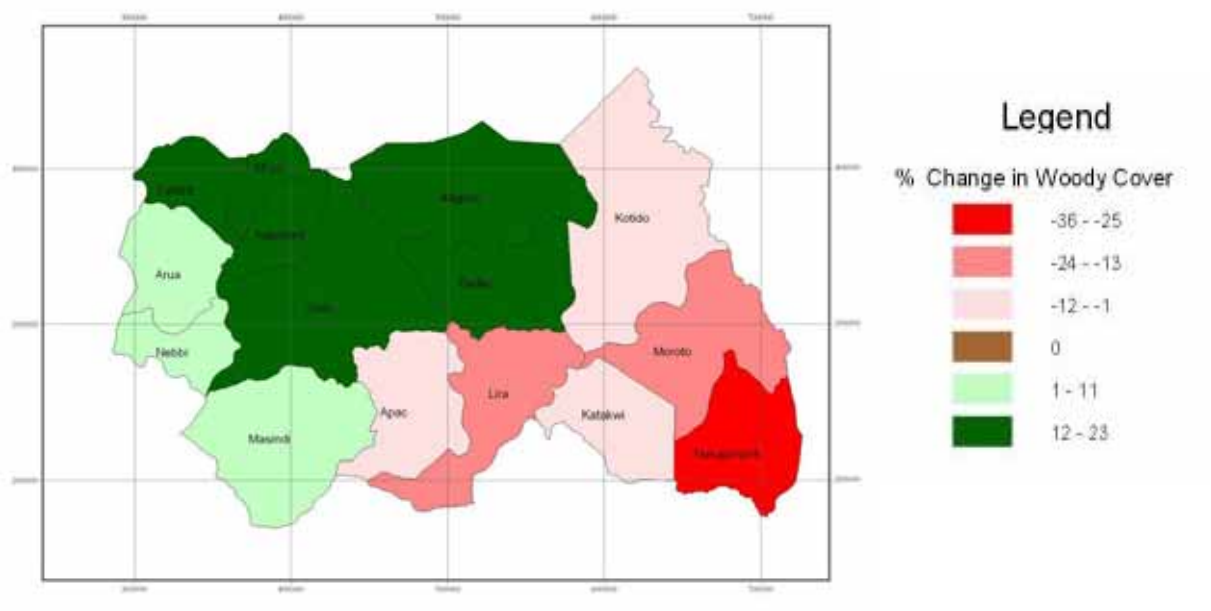


Figure 3.6 Woody cover change (1985-2002) for Northern Uganda districts.

Nakapiripiriti recorded the highest net loss of woody cover of 36% (47,488 ha) followed by Lira district with 80,192 ha (19%). In absolute terms, however, Moroto district suffered the highest loss of woodland vegetation cover of 116,789 ha. The districts of Yumbe (area), and Moyo (area), recorded the highest net gain in woody cover (**Table 3.1**). Given the fact that were unable to ground truth our landsat imagery analysis, it is hard to clearly point out the activities responsible for an increase or decrease in woody cover (e.g. cultivation, livestock grazing, charcoal production). In addition, the resources and time allocated for this study was limited but can only propose a detailed research in future when peace breaks out.

From available reports, NBS (1996, 2003) reported that 83% of Lira's local forest reserves had been either degraded or deforested in their assessment of fuel wood availability. Similarly Gulu, Pader, Kitgum and Apac lost almost 100% of their local forest reserves (NBS, 1996, 2003). Most conversion was of swamps and grassland land cover types to cropland and pasture. IFPRI (2003) concluded that the intensification and expansion of agriculture is by far the most important process affecting the capacity of Uganda's ecosystems to provide goods and services. This is so because a significant expansion of cultivated land is taking place at the expense of natural vegetation, particularly wooded savanna and forest/savanna mosaics.

Possible explanations for the relative increase in woody cover in the northwestern districts of Acholiland could be due to the Lords Resistance Army activities, taking place in the area. Where woody cover has increased is in the places where the LRA have tended to hide out.

Table 3.1 Woody Cover change (1985-2002) by district in northern Uganda

District Name	Area of Decreased Woody Cover (Ha)	Percentage of Decreased Woody Cover (%)	Area of Increased Woody Cover (Ha)	Percentage of Increased Woody Cover (%)	Area of Unchanged Woody Cover (Ha)	Percentage of Unchanged Woody Cover (%)	Total Area (Ha)	Net Change in Woody Cover (Ha)	Net Change in Woody Cover (%)
Nakapiripirit	48993	37	1506	1	7232	5	132462	-47488	-36
Lira	118578	28	38386	9	36250	9	419298	-80192	-19
Moroto	140838	19	24050	3	23962	3	753112	-116789	-16
Katakwi	41505	19	21953	10	8288	4	220655	-19553	-9
Kotido	156105	12	58383	4	77909	6	1317434	-97722	-7
Apac	70661	23	48109	16	73418	24	309673	-22552	-7
Arua	5790	2	19326	6	8223	2	344850	13536	4
Nebbi	3397	1	21162	8	6643	3	258561	17765	7
Masindi	16731	6	43441	16	76735	28	275546	26710	10
Gulu	89066	7	262972	22	303982	25	1205387	173905	14
Adjumani	11323	4	62154	20	68903	22	308966	50831	16
Kitgum	84891	8	273923	27	183943	18	1021285	189032	19
Pader	79432	12	202097	32	102515	16	641108	122665	19
Moyo	4188	2	41664	22	9323	5	185318	37476	20
Yumbe	3388	1	58320	24	4881	2	239179	54932	23

Related to this, the decline in livestock would have resulted in lower grazing pressure leading to woody cover gain. Other factors that might also have contributed to this woody cover increase include the loss of elephants and possible climatic changes. Elephants used to migrate from MNFP through Zoka Forest Reserve to East Madi Wildlife Reserve, then up to Nimule National Park and across to Kidepo Game Reserve (**Figure 2.2**). As a result of the decline in elephant populations since the 1970s and their elimination from this region by the mid 1980s it is possible that this has encouraged regeneration of trees. However, it is also important not to ignore the impact of a suspected increasing aridity in the northeast of Uganda.

Nicholson (2001) examined the climatic and environmental changes in Africa during the last two centuries. Using both systematic rainfall records and proxy information concerning lakes and rivers and the occurrence of famine and drought, it was noted that the most significant climatic change that has occurred has been a long-term reduction in rainfall and nearly all Africa has been affected by increasing aridity, particularly since the 1980s. Nicholson (2001) further noted that the current evidence suggests that changes in the land surface (e.g. vegetation cover, surface albedo, soil moisture) are much more strongly controlled by natural climate variations, such as the recent decline in rainfall, than by human-induced land-use change or degradation. Analysis of the mean rainfall (expressed as a percent departure from long-term mean, with station data averaged over 1^{o} square) for the 8 year period 1980-1997 by Nicholson (1993) showed that north western Uganda recorded high rainfall (>20%) compared to north eastern Uganda which recorded a drop in mean rainfall (>-20%). It is therefore possible that the changes we have observed here may be partly explained by climatic changes but this would need more research to confirm this.

The woody cover loss in the northeast, including Apac and Lira districts could be attributed to an increased expansion and intensification of agricultural and pastoral land use systems as a response to increasing population demand for food and market opportunities. What is much less certain is how and where, and in which periods the intensification and expansion of land use has occurred, and how it might have affected biodiversity values. Even less known in this region are the socio-economic consequences of the changes in land use systems.

3.2.2 Woody cover change in Central and Local Forest Reserves

The woody vegetation change 1985-2002 showed that the land cover of several forest reserves increased in woody vegetation (**Figure 3.7**). The forest reserves that showed significant increases in woody land cover include Mt Kei, Wiceri and Aswa River (20-39%). Otzi Forest Reserve/Wildlife Sanctuary recorded the highest (40-59%) woody cover increase. The rest of the reserves (e.g. Agoru-Agu, Kilak, Era and Zulia) showed low (1-19%) increases in woodland cover. Mt. Moroto FR, showed the highest woodland cover loss of 20-39%, while other forests experienced a loss of 1-19%

(e.g. Nyangea-Napore, Opit, Lwala and Rom). Other small natural forest reserves, particularly around Lira town suffered severe decreases in woodland cover (40-59%).

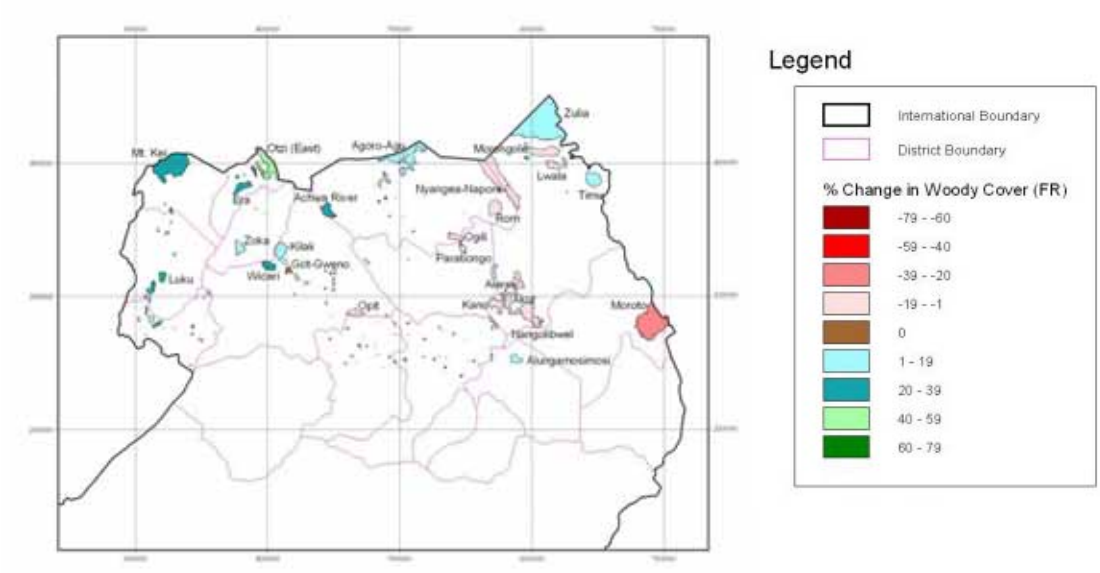


Figure 3.7 Change in woody cover (1985-2002) in the Forest Reserves of Northern Uganda.

It was possible to analyse changes in more details for specific forest reserves. Two are presented below in detail and other forest reserves are analysed with national parks or wildlife reserves in **Section 3.2.3**. 1. Labwor Hills were highly woody with a woodland cover percentage of 25-100% in 2002 (**Figure 3.8**) and little cover of grassland with sparse trees. In particular, in Alerek and part of Nangolibwel forest reserves, the land cover was mainly grassland with <25% woody cover. From the woody cover change map (**Figure 3.9**), it can be clearly seen that the forest reserves that constitute Labwor Hills remained unchanged except for Alerek that showed a decrease in woodland cover.

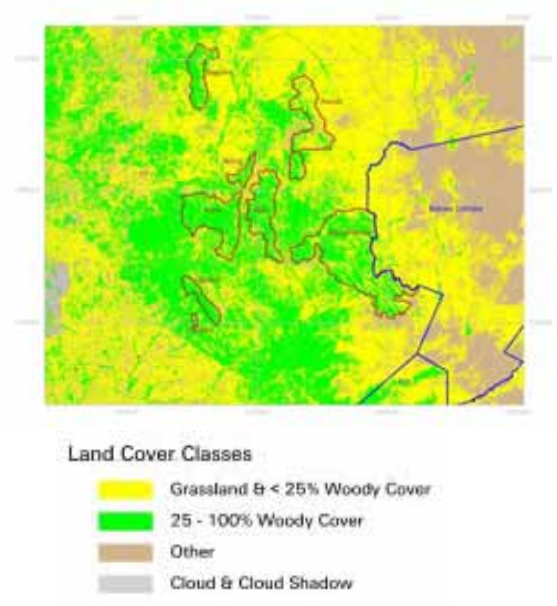


Figure 3.8 Woody cover in 2002 for Labwor Hills.

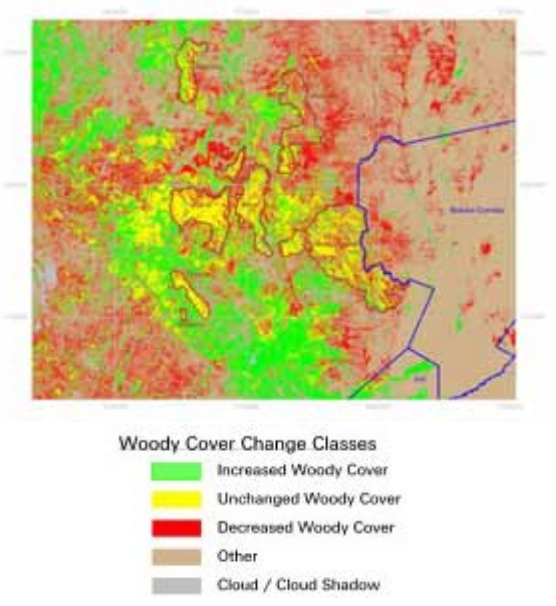


Figure 3.9 Woody cover change (1985-2002) in Labwor Hills.

However, outside the protected areas there was a loss of woodland cover. These areas have been heavily cultivated and settled. It is also important to note that the area houses a number of IDPs, and

the demand for fuel wood, building poles for construction and other allied resources is high. Away from the hills, specifically in the south, there was an increase in woodland cover.

2. Moroto forest reserve was mostly woodland or forest (25-100%), although this cover was confined to the interior of the reserve (**Figure 3.10**). A circle of grassland/woodland (<25%) is found around the more densely wooded area. The land cover for the remaining part of the reserve and outside the reserve was found to be in the 'other' land cover category, which includes cultivation, settlement and bare earth. From the woodland cover change map, it can be seen clearly that the interior to a great extent remained unchanged, registering a slight increase in woody cover (**Figure 3.11**). However, away from the interior, there was considerable loss of woody cover in the reserve, including the surrounding areas.

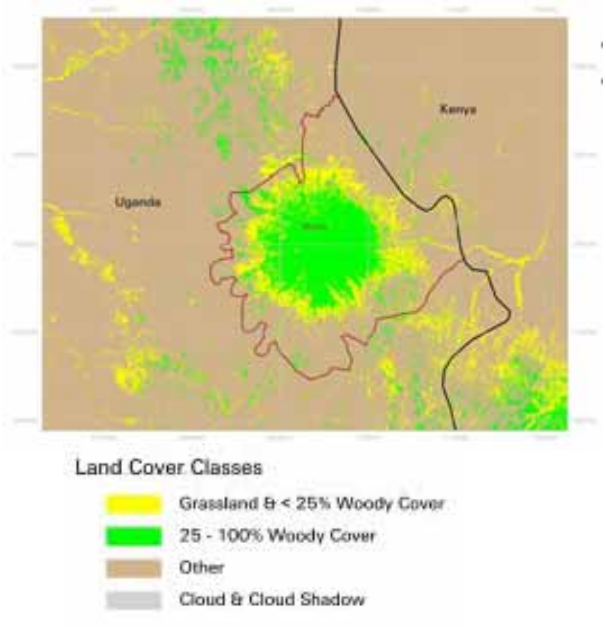


Figure 3.10 Woody cover in 2002 for Moroto Forest Reserve.

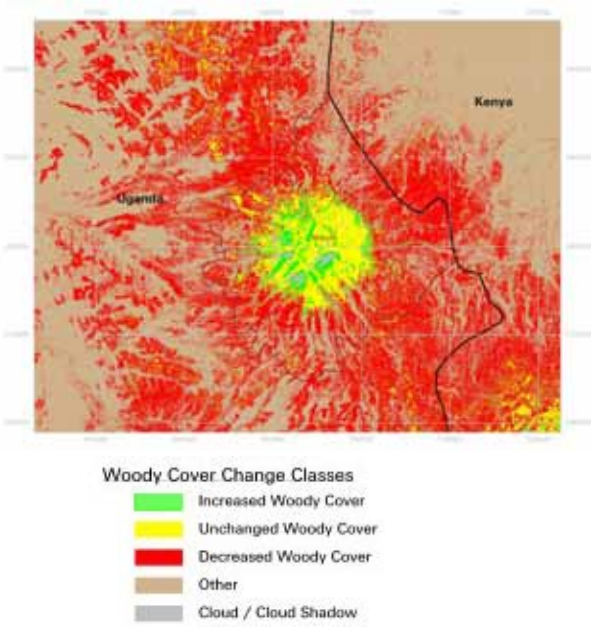


Figure 3.11 Woody cover change (1985-2002) in Moroto Forest Reserve.

Detailed analysis of the net woody change in the forest reserves, showed a significant conversion of 28,632 ha (6.3%) of woody cover to grasslands with mixed cultivation and/or settlement and a net increase of 36,604 ha (8.1%) woody cover (**Annex 3**). Very few forest reserves showed no change in woody cover. Adero and Ongom central FRs lost over 60% of woody cover and Moroto FR, the most biodiverse Forest Reserve in northern Uganda (**Chapter 2**), registered a net loss of 35% (17,178 ha) of woody cover (**Annex 3**). Of those forest reserves that recorded a net increase in woody cover, Otzi recorded the highest gain of 43% (7803 ha) while Mt Kei increased by 33%, (7949 ha). The two forest reserves also double as wildlife sanctuaries. Other central forest reserves that demonstrated significant gain in woody cover include Aswa River (29%), Wiceri (33%) and Zoka (17%) (**Annex 3**). As found for Districts, forest reserves located in the northeast showed a severe decline in woody cover unlike those in the northwest of Uganda which showed an increase.

3.2.3 Woody cover changes in Parks and Wildlife Reserves

A similar pattern was observed within the parks and wildlife reserves. Murchison Falls National Park, Ajai WR, East Madi WR, Lomung CHA, Iriri CWA, Mt Kei and Otzi wildlife sanctuaries registered an increase in woody cover (**Figure 3.12**). Matheniko and Bokora WR suffered a decline in woody cover. Kidepo Valley NP on the other hand, showed little change in woody cover. Otzi WS/FR registered the highest increase in woody cover of 40-59% while Matheniko WR recorded the highest loss (20-39%).

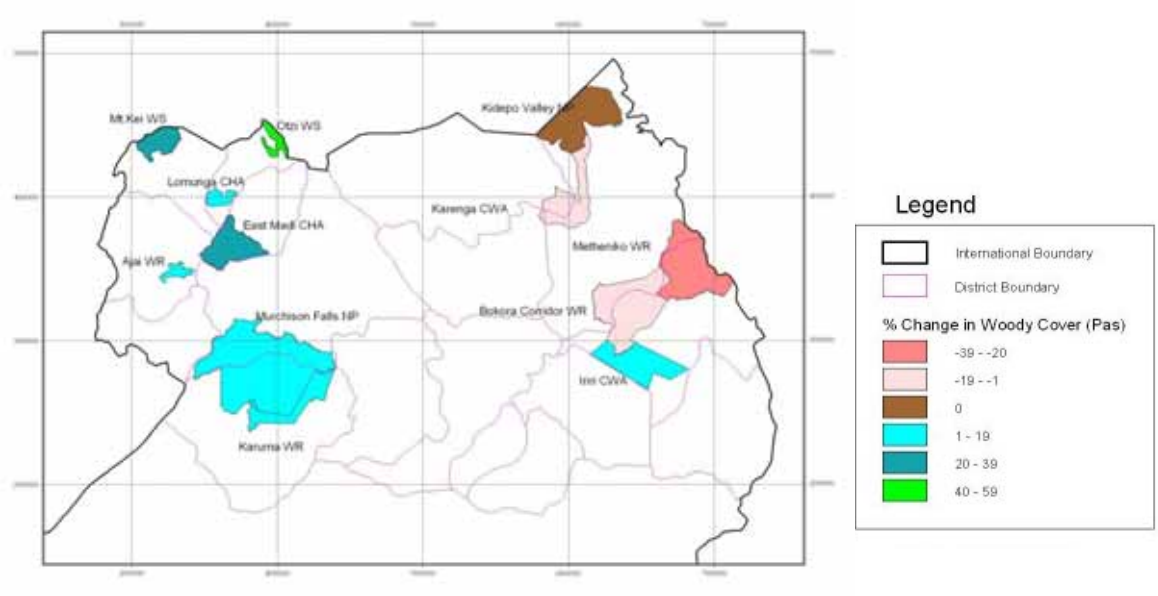


Figure 3.12 Woody cover change (1985-2002) in National Parks and Wildlife Reserves of Northern Uganda.

In all parks and wildlife reserves, there was a total net increase in woody cover of 114,022 ha (9.2%) and a net loss of 49,239 ha (4.0%). Of this share, Matheniko WR registered a net loss of 34,305 ha (20%) while Kidepo Valley NP recorded 1074 ha loss (**Table 3.3**). The highest net gain in woody cover was in Otzi and Mt. Kei Wildlife Sanctuaries/Forest Reserves of 43% and 42% (8067 ha) respectively. Most of the lost woody cover has been replaced by grasslands with sparse trees (<25% woody cover). Loss of woodland cover could be attributed to increasing aridity, grazing and probably fires with encroachment. The increase in woodland area of the parks and wildlife reserves could be attributed to better management by UWA, particularly enforcement against illegal activities as well as the decline in elephants. However, because of the insecurity in some of these areas, reduced access to the park resources might also be a reason.

Table 3.2 Woody Cover change (1985-2002) in Parks and Wildlife Reserves of Northern Uganda

Protected Area Name	Area of Decreased Woody Cover (Ha)	Decrease in Woody Cover (%)	Area of Increased Woody Cover (Ha)	Increase in Woody Cover (%)	Area of Unchanged Woody Cover (Ha)	Percentage of Unchanged Woody Cover (%)	Total Area (Ha)	Net Change in Woody Cover (Ha)	Net Change in Woody Cover (%)
Matheniko WR	35009	20	704	0	2575	1	175848	-34305	-20
Karenga CWR	8358	9	1963	2	2346	2	95613	-6395	-7
Bokora Corridor WR	10245	6	1706	1	831	0	181685	-8539	-5
Kidepo Valley NP	2376	2	3450	2	4651	3	142969	1074	0
Lomunga WR	598	4	1060	7	526	4	14947	462	3
Karuma WR	675	2	2461	7	28026	84	33255	1786	5
Iriri CWR	2128	2	7799	8	494	0	103035	5671	6
Ajai WR	450	2	3618	20	283	2	18467	3168	18
Murchison Falls NP	7449	2	67670	20	50641	15	345129	60221	18
East Madi WR	4433	5	26464	32	27901	34	83086	22031	27
Mt.Kei WS/FR	244	1	8186	34	1281	5	23879	7942	33
Otzi WS/FR	478	3	8545	45	2851	15	18808	8067	42

It might be expected that smaller protected areas would have been more likely to lose a greater percentage of woodland cover because of access by people. The correlation between percentage change and area of the protected area was computed using the Statistical Package for Social Scientists (SPSS) but there was no significant difference for the whole of northern Uganda. This is probably because of the variation between Districts in woody cover increase and decrease (**Figures 3.7 and 3.12**) and between protected area categories. However tests of various protected area category partialling out the effect of districts could not explain any relationship between area and percentage change in woody cover. Mean percentage woody cover change did vary between categories of protected area with the average for LFRs being a loss (-6.9%), while others showed gains on average:

CFRs (+3.2%), NPs (+9%) and WRs (+8.3%). Local Forest Reserves have therefore been hardest hit in northern Uganda.

3.2.4 Woody cover changes in potential corridor sites

In **Chapter 2** the area between Murchison falls National Park and East Madi Wildlife Reserve, which was formerly the Kilak CHA and Aswa-Lolim CHA, was identified as a potential site for corridor establishment (**Figure 2.4**). The land cover map for East Madi and Kilak Hills FR showed the area had registered a proportionally high amount of the denser category of woodland cover (25-100%) in 2002 with very little cultivation and settlement. There was an increase in woody cover in East Madi WR between 1985/6 and 2002 but little change in the Kilak Hills FR (**Figure 3.14**). To the south of East Madi in the corridor region, much of the habitat was grassland with sparse woody cover (<25%). There was little increase in woody cover in this region, most of it being grassland.

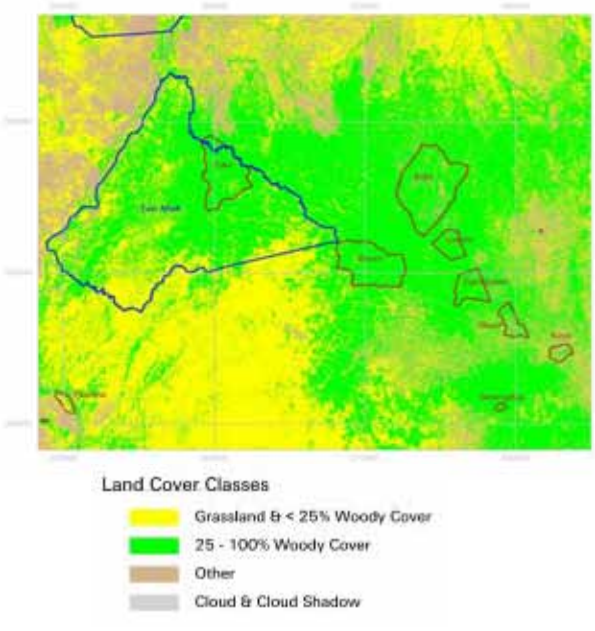


Figure 3.13 Woody cover change (1985-2002) in East Madi and Kilak Hills Wildlife Reserves

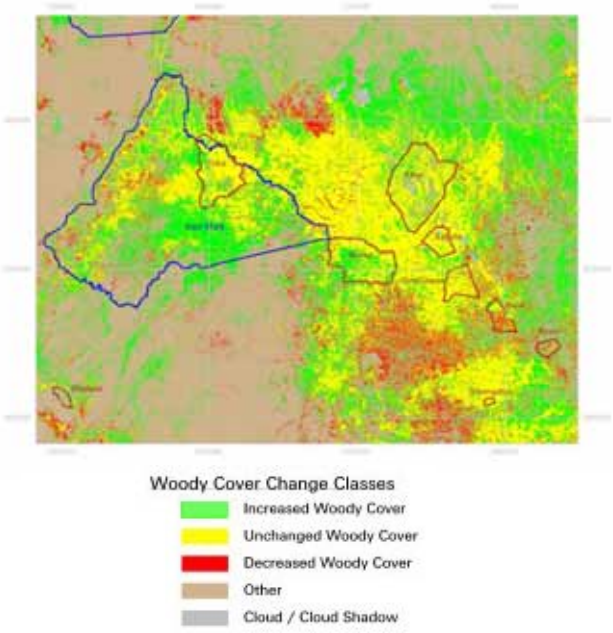


Figure 3.14 Woody cover in 2002 for East Madi and Kilak Hills Wildlife Reserves

3.2.5 Woody cover change around main urban centres (Gulu, Kitgum and Lira Towns)

During the conflict period, people have moved to the main urban centres and IDP camps to escape the fighting. As a result it would be expected that woody cover loss would have increased around these areas. The results for three of the main urban centres where people have sought refuge during the conflict: Gulu, Kitgum and Lira towns are presented below. Woody cover is still reasonable around Gulu (**Figure 3.15**) The change map also shows that around Gulu, there has been a considerable increase in woodland cover immediately North of Gulu town and scattered woody patches all around the edge of what could be described as 'Greater Gulu' (**Figure 3.16**). It is important to note that most of the increase in woody cover appears to have occurred away from the main roads. However, around the immediate vicinity of Gulu Town itself, and around IDP camps there has been a decrease in woody cover. In addition, there was considerable decrease in woody cover in a few concentrated areas about 30 km to the west and south west of Gulu Town.

The situation to the south of Gulu as illustrated from the overall woody cover change map (**Figure 3.22**) shows that there was extensive loss of woody cover. This is interesting because there are a lot of smaller forest reserves in this area, which also seem to have been affected severely. This can be explained by presence of IDP camps and the fact that people fleeing the LRA activities have settled in and around Gulu. As such, there has been a considerable amount of pressure exerted on the natural resources around these two towns to provide for agricultural activities, settlement and grazing of

livestock. Thornton and Pieles (1980) who made an estimate of the population of Gulu and Kitgum town in 1980 reported that the towns had 14,958 and 4,961 people respectively. Gulu and Kitgum town now supports 119,430 and 41,821 people respectively (UBOS, 2002), which represents 88% population increase over a period of 25 years.

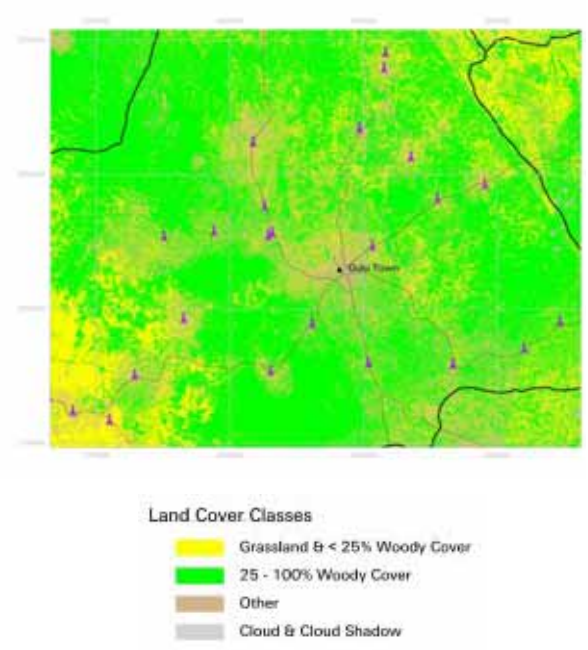


Figure 3.15 Woody cover in 2002 for Gulu Town. Known IDP camps are marked with triangles.

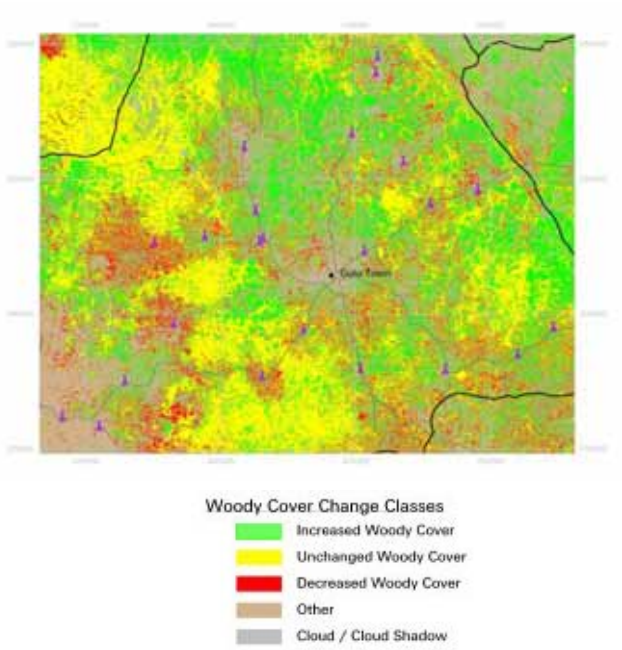


Figure 3.16 Woody cover change (1985-2002) in Gulu Town

A similar pattern can be seen for Kitgum. Much of the area around the town has reasonable woody cover (25-100%), particularly to the north and west (Figure 3.17). The loss of woody cover has been far more centralised around the town centre compared with Gulu and woody cover increased more around the edges, particularly to the west and to a certain degree the south (Figure 3.18). The grasslands that were prominent to the northeast of Kitgum in 2002 have been sparsely colonised by woodlands but there have been losses around IDP camps. The IDP camps shown in these Figures are those that have GPS readings for their location. No map exists in Uganda yet that shows all the IDP camps.

The situation around Lira Town was very different to that of Gulu and Kitgum. From the 2002 satellite imagery Lira was mainly covered by grassland and scattered woodland (<25% woody cover), much more so than the other two towns (**Figure 3.19**). Grassland was very extensive east of Lira town and the vegetation much more woody to the west (**Figure 3.19**). The woody cover change (1985-2002) clearly shows that Lira has undergone very severe woody cover loss with very few scattered patches of unchanged woody cover (**Figure 3.20**). Patches of increased woody cover are noticeable northeast of Lira town.

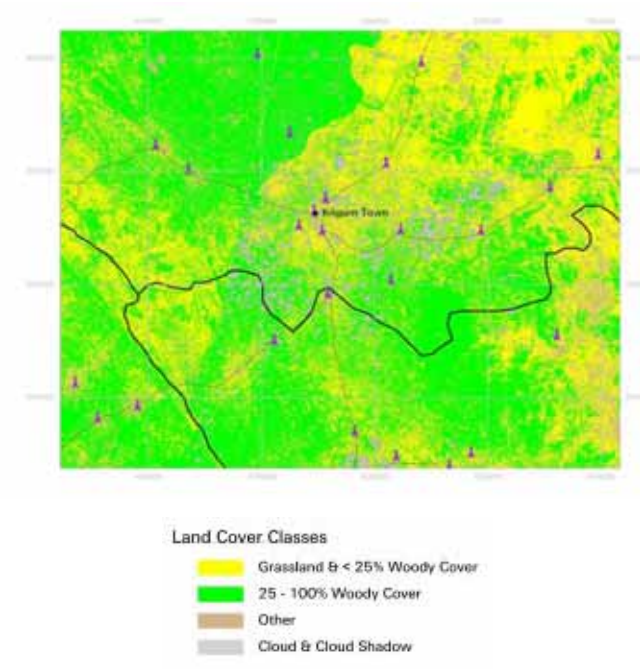


Figure 3.17 Woody cover in 2002 for Kitgum Town. Known IDP camps are marked with triangles

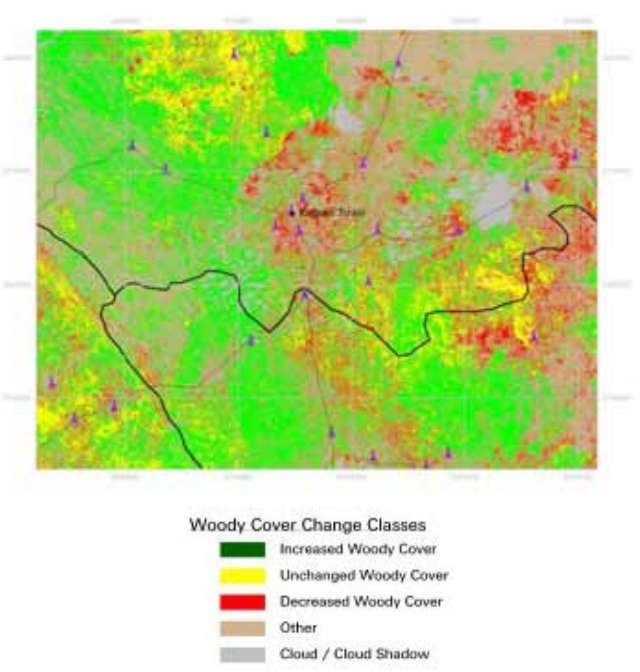


Figure 3.18 Woody cover change (1985-2002) in Kitgum Town.

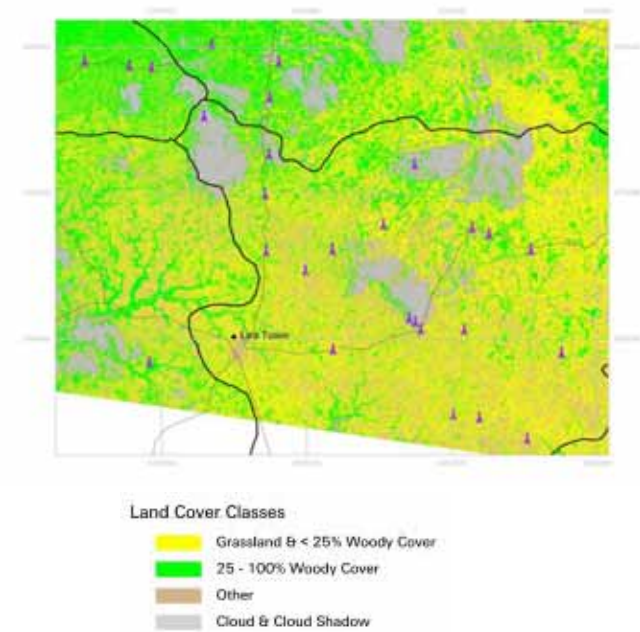


Figure 3.19 Woody cover in 2002 for Lira Town. Known IDP camps are marked with triangles

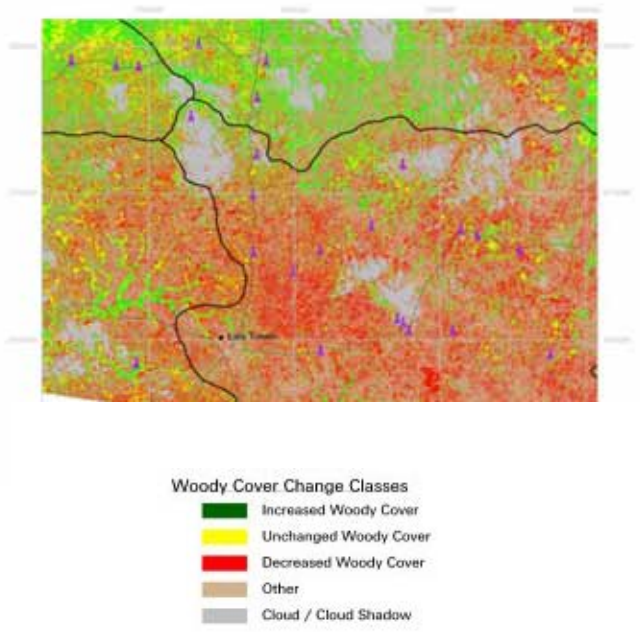


Figure 3.20 Woody cover change (1985-2002) in Lira Town.

Many Local and Central Forest Reserves that still exist as gazetted protected areas in Lira district were grossly affected in terms of woody cover loss. These reserves were gazetted specifically to protect the water catchments for both domestic use and agricultural production. These very different results could be explained in three ways; 1) the loss in woody cover is due to the increased population of people moving south from Gulu and Kitgum districts for protection and safety; 2) purely land use changes motivated by the increased demand for services and goods, for example, the demand for urban expansion, need for agricultural land and fuel wood to feed the population of Lira town, which increased from 9,122 in 1980 to 80,879 people (UBOS, 2002); and 3) increasing aridity resulting from

climatic changes. On the other hand, woodland increase could be attributed to the presence of deliberately spared Shea nut trees (*Vitellaria paradoxa*), which are common in the region. The tree species is known to occur in the whole of northern Uganda and is of commercial value as its seeds are used for the production of Shea nut butter. Secondly, it could be explained by the increase in plantation/woodlot establishment by private individuals in response to declining fuel wood sources and increased demand for the wood.

3.3 Conclusions of the assessment of woody cover changes

These results show that the debates about whether the LRA conflict has been beneficial or detrimental for the environment are both true. Where people have had to flee fighting woodland has regenerated and woody cover increased. Where people have settled (IDP camps and urban centres) where the UPDF can protect them they have harvested the available woody cover to construct shelters and use for fuel wood. This is the overall large picture. However, the results show that at a more detailed level the picture is not quite as simple. Within Districts and protected areas there has been a general increase in woody cover in the west of the northern part of Uganda and a decrease in the east. Why this is so is unclear but it may be partly a result of the conflict but this alone does not explain the increases in Yumbe and Moyo districts, which have been little affected by the conflict. Increases in woody cover in the west may be partly due to global warming because rainfall is higher in the west than the east of northern Uganda and there is evidence of declining rainfall (450-800 mm) in the semi-arid areas (MAAIF, 1999; Kakuru, Okia and Okorio, 2004, Nicholson, 2001).

The changes in the east may be due to the high numbers of livestock and overgrazing associated with a breakdown in the nomadic practices in Karamoja region (MAAIF, 1999). Increases in the west may also be due to the loss of elephants in western Uganda and their impacts on woody vegetation. It should be noted that the environmental changes in northern Uganda cannot solely be inferred from changes in land use and woody cover, and long-term monitoring of indicators such as biodiversity, vegetation types and weather patterns is recommended. Which of these are true or how much each contributes to these findings will require more detailed research.

There has also been major loss of woody biomass in the districts of Lira and Apac to the south which may be partly caused by the conflict and people fleeing south but may be also due to expanding human populations and the general demand for land that occurs elsewhere in the country. This area will become critically short of supplies of fuel wood and building materials unless some investment by Government and Donor agencies is made into reforestation and tree planting schemes or into incentives to encourage people to invest in tree plantations. Many of the forest reserves that have lost their trees were established to conserve watersheds and there may well have been impacts on water supply to people living around these reserves.

CHAPTER FOUR

4.0 CONSERVATION OF LANDSCAPES AND TRANSBOUNDARY PEACE PARKS

It is well recognised in the conservation literature and in practice that the larger and the better connected protected areas are to others, the more likely they are to remain intact with viable populations of species in the long term (Mackinnon and MacKinnon 1986). We therefore identified which protected areas form larger contiguous blocks of protected areas with the aim of proposing a more coordinated management of these areas to ensure viable wildlife populations.

4.1. Landscapes of northern Uganda

In **Chapter 2** we identified two main landscapes in northern Uganda. The Kidepo Landscape includes the Kidepo Valley NP, Nyangea-Napore, Rom, and Morungole FRs and Karenga CWR. The Murchison-Budongo Landscape includes Murchison Falls NP, Budongo FR and Karuma and Bugungu WRs (**Figure 2.3**). This second landscape has the possibility to link up with East Madi WR if the area between is managed in some way as a corridor for wildlife. The Matheniko, Bokora, Pian-Upe WRs Irirri CWR, and Napak FR are also contiguous protected areas in eastern and southern Karamoja but are not considered further here because much of the landscape is outside northern Uganda. During the UWA protected areas assessment the possibility of linking East Madi to West Madi was considered but it proved to be very difficult (R. Lamprey pers. comm.) but it could still be considered as an option. Possible interventions are discussed in **Section 5.2.4.**

The advantages of managing these larger landscapes are that certain species may need the area of protection in order to maintain viable populations. For instance lion numbers, a species that every tourist wants to see, are slightly above 200 in Murchison Falls NP and between 30-50 lions in Kidepo Valley NP. The lions in Kidepo Valley occasionally move to Kidepo Game Reserve (Sudan) and back to Uganda. Ensuring the conservation of a larger landscape will mean that such species have a better chance of viability. Other species that require large areas for survival would include elephants, cheetah, wild dog, and chimpanzee.

Looking at these larger landscapes it became clear that there are several protected areas in southern Sudan that border with protected areas in Uganda. Transboundary management of these areas could create more landscapes of conservation value.

4.2. Transboundary Natural Resource Management and Peace Parks

Transboundary Natural Resource Management (TBNRM) is a process that aims to minimize conflicting resource-use policies and practices within ecosystems that are divided by international frontiers or by national property or land-use zoning boundaries (Griffin *et al*., 1999). It has also been defined as any process of collaboration across boundaries that increase the effectiveness of attaining natural resource management or biodiversity conservation goal(s) (van der Linde *et al.*, 2001). There is already an agreed position that TBNRM is an effective tool for natural resource management and biodiversity conservation, where shared cross-border threats can be jointly managed and mutual benefits can be gained through collaboration (Cumming, 1999; Griffin *et al*., 1999; Lanjouw *et al*., 2001; Sandwith *et al*., 2001). Peace Parks are protected areas that are transboundary in nature but have an additional goal to promote peace.

The World's first International Peace Park was established in 1932, linking the Glacier National Park in the United States with Waterton Lakes National Park in Canada, managed and implemented under a Memorandum of Understanding (MoU) through a combination of internal and transboundary

management activities (van der Linde *et al*., 2001). By 2001, the number of identified adjoining protected area complexes had reached 169 in 113 countries including 667 individual protected areas (Zbicz, 2001). As of 2001, Africa alone had identified 35 landscapes involving 34 countries, including 148 individual protected areas (Zbicz, 2001). The first post-colonial African Transfrontier Park between Botswana's Gemsbok National Park and South Africa's Kalahari–Gemsbok National Park, was initiated by Kgalagadi Transfrontier Park Foundation to be managed under a bilateral agreement. Following the progress of creation of transboundary areas, IUCN's World Commission on Protected Areas developed concepts and guidelines for Transboundary Protected Area collaboration and management (Sandwith *et al.*, 2001).

The potential opportunities and experiences of TBNRM have been analysed and discussed by several authors (Biodiversity Support Program, 1999; Griffin *et al*., 1999; Lanjouw *et al*., 2001; Sandwith *et al*., 2001). Such benefits include the maintenance of linkages in the ecological landscape that support ecological processes and functions (e.g. hydrological systems, biological corridors), promote sustainable land use management and economic development, enhance management of migratory species and shared water resources, promote cultural reintegration, and build trust amongst actors within nations and between nations. Peace or border parks on the other hand, serve primarily three main functions namely promotion of peace, improvement of natural resource management and the preservation of cultural values (McNeil, 1990). International, transnational and border parks and similar protected landscapes have a potential for reducing international border tensions and creating conditions, which make peace. The creation and management of protected areas need not wait for peaceful conditions or for agreeable partners on both sides of a border (McNeil, 1990). However, the specific aim of peace parks is to lead to, and helps to maintain peace among nations and communities. In northern Uganda and Southern Sudan the creation of peace parks could help reduce military pressure and encourage cross border collaboration, which would build stronger and more lasting relationships between these two countries. It would encourage peaceful means of conflict resolution of disputes over natural resource.

In Uganda, the International Gorilla Conservation Programme (IGCP) has been supporting TBNRM in the Virunga Volcanoes and Bwindi-Sarambwe region that involve Uganda, Rwanda and the Democratic Republic of Congo (DRC) with a major focus on wildlife conservation (particularly the Mountain Gorilla) and natural resource management. The Wildlife Conservation Society has developed a program of support to transboundary collaboration between Uganda and DRC further north in the remaining 95% of what has been termed the "Great Virunga Landscape", comprising the Virunga Park (Congo) and Queen Elizabeth, Rwenzori and Semuliki National Parks in Uganda (Plumptre *et al*., 2003). This initiative is coordinated by the protected area authorities, UWA (Uganda) and ICCN (DRC) to manage and control illegal cross-border resource use and trade. Other transboundary initiatives include collaboration between Uganda and Kenya on Mt Elgon, and between Uganda and Tanzania for the Sango-Bay and Minziro Forest Reserves (Nabanyumya *et al*., 2003). There is therefore a precedent for transboundary collaboration in Uganda and a lot of experience in how to develop collaboration between countries. However, no peace parks have been created in Uganda and therefore there is no prior experience of creating these in this region of Africa.

4.3 Potential Peace Parks in Northern Uganda

Three potential sites were identified in this study where peace parks could be established: 1. Otzi FR – Nimule National Park; 2. Imatong Massif and 3. Greater Kidepo. A summary of the three sites is made here.

4.3.1 Imatong massif Peace Park

Agoro-Agu Forest Reserve (Uganda) and Imatong Forest Reserve (Sudan) is one of the potential sites for a transboundary peace park (**Figure 4.1**). Agoro-agu Forest Reserve is situated in Lamwo County in the extreme north of Kitgum district in Uganda. Covering an area of 236 km^2 it is contiguous with Sudan's Imatong Mountains. The vegetation of the reserve has been broadly classified as dry

Combretum savanna, forest-savanna mosaic and dry montane forest. The reserve supports 254 trees, 76 birds and 66 butterfly species. It has seven tree and shrub species found nowhere else in Uganda. The Imatong Forest Reserve covering a total area of 1,032 km^2 is located in the region of Equatoria and contiguous with Agoru-Agu Forest Reserve in Uganda. The Imatong Mountains are known for the occurrence of biodiversity of high conservation value, including the 13 endemic sub species of mammals out of 154 species and five sub species of the 566 bird species recorded in the area. Of the one thousand nine hundred fifty nine plant species recorded from this area, 25 species are endemic. More information is given on this Forest in **Annex 1**.

The largest proportion of the Imatong massif is predominantly forest and dense woodland with increasing grassland cover on the Ugandan side at the edge of Agoru-Agu FR (**Figure 4.1**). Most of the woody cover has remained the same since the mid 1980s (**Figure 4.2**).

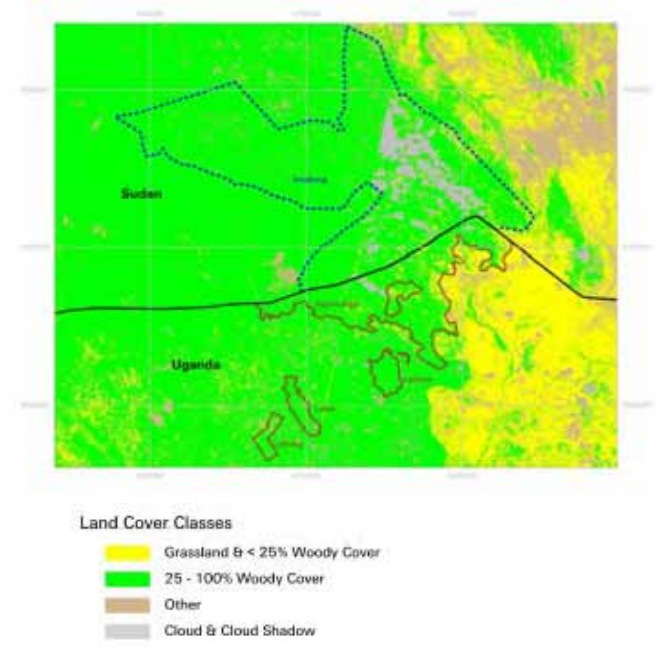


Figure 4.1 Woody cover in 2002 for Agoro-Agu and Imatong Mountains.

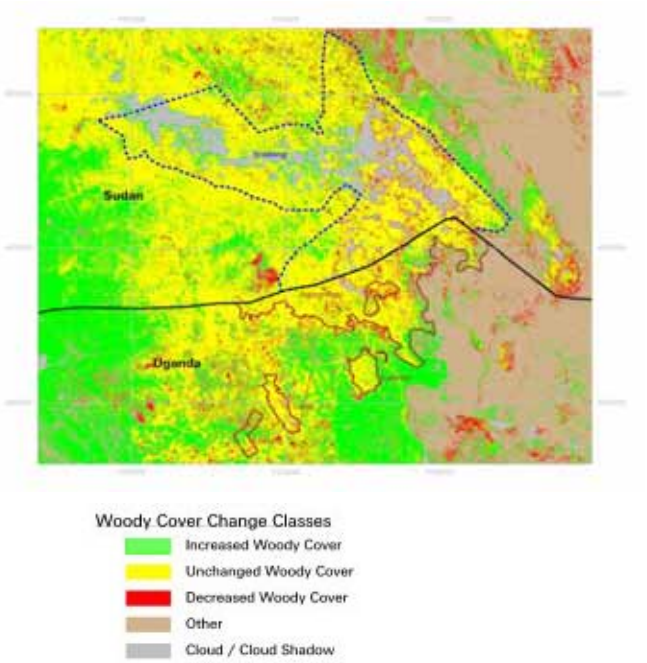


Figure 4.2 Woody cover change (1985-2002) for Agoro-Agu and Imatong Mountains.

4.3.2 Greater Kidepo Peace Park

The second potential site includes the Kidepo Game Reserve located in southern Sudan and contiguous with Kidepo Valley National Park in Uganda. Kidepo GR covers an area of 2,000 km^2, which includes the Dongotona Mountains to the west and the southern part of Didinga hills to the east (**Figure 4.3**). The vegetation of the reserve is mainly grassland and small shrubs. On the hills are forested areas dominated by *Podocarpus* tree species. The reserve supports threatened mammal species such as elephants and African wild dogs, which have been observed to move from this reserve to Uganda. The Kidepo Landscape in Uganda includes Kidepo Valley NP, Karenga CWR, Nyangea-Napore, Morungole, Rom and Zulia Forest Reserves situated in the northeast of Karamoja (**Figure 4.3**). All these protected areas together cover a total area of 3,700 km^2. Kidepo Valley NP and Karenga CWR are known for their scenic beauty and the presence of elephants, lion, cheetah, zebra, giraffe and occasionally African wild dogs venturing in from Sudan. The forest reserves support 10% of tree species and 20% of birds of conservation value in Uganda. At least each of the forest reserve hosts more than one tree and shrub species known to occur in the reserve and not recorded elsewhere in Uganda. As such, the Kidepo complex is very rich in species of biological value for northern Uganda.

Analysis of the changes in woody cover since 1985 indicates there has not been much change in this potential peace park region (**Figure 4.4**).

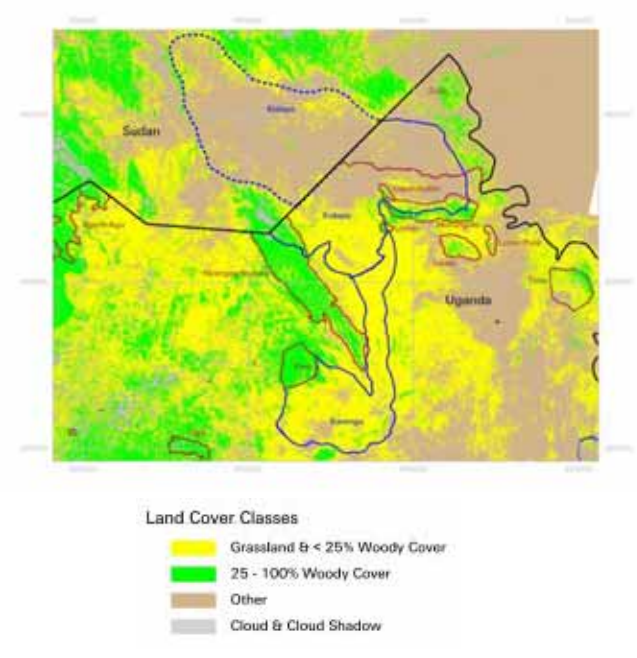


Figure 4.3 Woody cover in 2002 for Kidepo Landscape and Game Reserve (GR).

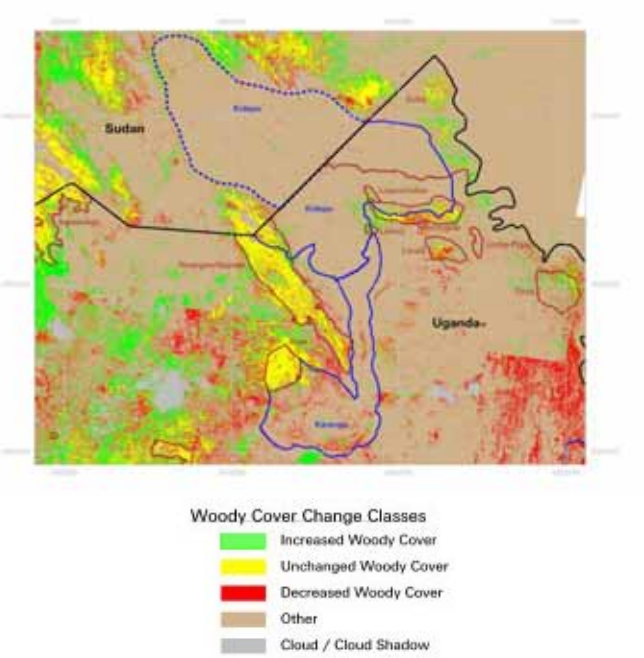


Figure 4.4 Woody cover change (1985-2002) for Kidepo Landscape and Kidepo GR.

4.3.3 Otzi-Nimule Peace Park

Otzi Forest Reserve/Wildlife Sanctuary located in Uganda and Nimule National Park in Sudan constitute yet another potential area for transboundary management (**Figure 4.5**). Otzi Forest Reserve, which lies in Metu County in Moyo district, is located on the escarpment overlooking the confluence of Aswa River and the White Nile. It covers an area of 188 km^2 and its vegetation has been classified as *Butyrospermum-Hyparrhenia* and *Combretum* savanna with undifferentiated semi-deciduous thicket. Otzi is known for the presence of chimpanzees (one of the most northerly populations in Africa) and elephants, but is also rich in other biological taxa, of which 261 tree species (representing 20% of forests in Uganda), 168 birds, 90 butterflies and 44 moth species are known to occur in the reserve. Seven tree and shrub species and three butterfly species have been recorded only in this reserve. Otzi has been identified as an Important Bird Area in Uganda.

Nimule Park, which covers an area of 410 km^2 is located in the extreme south of Sudan close to the Uganda border. The park was specifically gazetted to protect the white rhino, which became extirpated by heavy poaching in the 1970s. It lies between the River Nile and the Uganda border where the Nile leaves Uganda. The vegetation cover was described as mainly deciduous high woodland savanna consisting of *Acacia* spp, *Balanites aegyptiaca* and *Combretum aculeatum.* Riverine woodland found along permanent and seasonal watercourse is composed of *Acacia sieberiana and Borassus aethiopium.* It used to support large population of elephants, which have been severely reduced to 156 due to poaching. Other species of conservation importance include hippos (400) and Uganda kobs (1,830). Elephants used to migrate east to the Imatong Mountains and Kidepo about 50 years ago but their routes have been broken by settlement of people and cultivation.

Woody vegetation cover has been lost in the northern part of Nimule where refugees have been settled but for the rest of the transboundary complex the woody cover has remained constant or increased (**Figure 4.6**). The change analysis shows that outside the protected areas, the woodlands have been lost, particularly in southern Sudan and this is also likely to be due to refugee settlements.

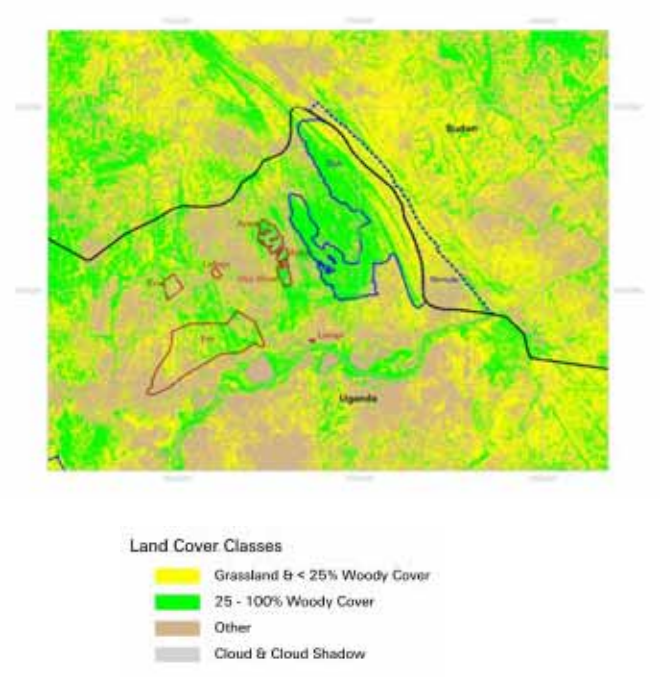


Figure 4.5 Woody cover in 2002 for Otzi and Nimule.

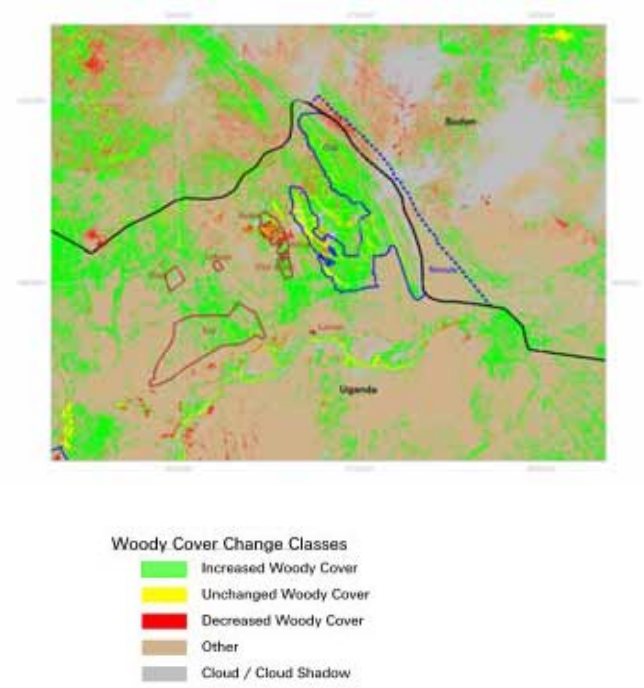


Figure 4.6 Woody cover change (1985-2002) for Otzi and Nimule.

4.4 Elements and process of establishing Peace Parks

The three potential Peace Park areas on the Uganda and Sudan side are already gazetted protected areas, which should make their creation more feasible. Each of the potential sites suffers from a number of threats that are similar in nature. Encroachment in form of settlement and/or cultivation has been noted to occur in most of the protected areas of northern Uganda. Most tribes in the north particularly the Acholi and Karamojong are traditional hunters. In the Imatong Mountains, bushmeat hunting is conducted in three different ways; organised communal hunting, small group and individual hunts (Alipayo, 1985). Another threat is livestock (e.g. cattle, goats, sheep) grazing which occurs inside and outside protected areas.

This section outlines a number of key elements to the overall transboundary process. They include setting goals and objectives for peace parks, stakeholder identification and involvement, roles of stakeholders, levels to be involved, the need for and type of agreements, organisational and individual capacity, communication and enabling conditions and assessment of constraints for peace parks. The reasons for creating a peace park should be clearly defined and agreed upon (e.g. peace building, cultural integration and threats to shared biological and cultural resources - Griffin *et al*., 1999) before they are created. Stakeholder participation is an essential element, although requires considerable financial and time investment; it ensures that key individuals, groups and organisations are involved in an equitable, democratic and effective peace parks process. This may occur both in country and across the border. The purpose is to define interests, roles and responsibilities for the participating groups. The natural resource base and system of land and resource tenure determines the players to be involved in the peace park process (e.g. those to be influence, inherit, beneficiaries, those to interact with development programs, donors and the general public). Thus, the levels of stakeholders to be involved in the process on both sides of the border (e.g. local, district, province, line ministry) will depend on the institutional arrangement and the scale of activities. The roles of the stakeholders need to be clearly spelt out in order to achieve success.

The degree of formality of peace parks agreements needs to be specified. Such arrangements include a bilateral agreement between two countries through line ministries or national agencies, memorandum of understanding (e.g. between wildlife management authorities/natural resource departments) or through a management agency to implement the developed management plan covering the ecosystem considered under a protocol or contingency plan (Griffin *et al*., 1999; Sandwith *et al*., 2001). These agreements encapsulate the purpose, principles and programs for interaction across boundaries but also help to resolve disputes, foster international cooperation, and restoring and maintaining peace.

If any of the three areas described above are to be established as Peace Parks then there will need to be a process of negotiation and the bringing together of protected area managers, institution directors and ministers to develop these parks. This process can be driven by donor support but will work best when the managers are closely involved in the design of the process.

CHAPTER FIVE

5.0 NATURAL RESOURCE MANAGEMENT AND CONSERVATION OPTIONS FOR NORTHERN UGANDA

Synthesizing the results presented in the previous chapters we here propose conservation and natural resource management options for northern Uganda for a time when peace comes to the region. It is clear that there have been environmental changes as a result of several factors that include the LRA conflict, loss of elephants over most of northern Uganda and movement of people to urban centres. These changes have led to both benefits and costs to the environment: in some areas people have left the land and natural vegetation and woody cover have come back as a result whilst in other areas there seems to be greatly increase pressure on the available woody biomass. The recommendations we present here target options for both situations that will improve conservation in northern Uganda and strengthen the management of larger landscapes for the benefit of biodiversity and people.

The recommendations target five areas of Natural Resource management and conservation, namely:

A. Natural Resource Management outside conservation areas

1. Reforestation with both indigenous and exotic species of areas that have been heavily depleted of woody biomass to plan for fuel wood and building needs in future. This would include management of watersheds and for soil conservation.
2. Sustainable management of areas of woodland that have regenerated during the conflict so that they can provide a source of income as people re-establish themselves on their land again.

B. Conservation of protected areas and landscapes

3. Rehabilitation of protected area management in northern Uganda, including infrastructure, capacity and planning.
4. Management of the wildlife corridor area between Murchison Falls NP and East Madi WR.
5. Management of larger landscapes with promotion of peace as a key component (feasibility of establishing Peace Parks).

5.1. Natural Resource Management outside conservation areas

Wildlife resources from protected areas provide immense benefits to the nation and the entire world. Howard (1995) estimated the annual flow of benefits (in US dollars) from the management of Uganda's protected areas to be US$ 9.3 million (7.2 million from timber values, 1.54 million from tourism and one billion from potential game utilisation). Such benefits include the direct values (e.g. fuel wood, medicinal products, fodder, timber, sand/clay etc.) and indirect values (e.g. water catchments protection, soil and soil fertility conservation, climate modifications, carbon sequestration, biodiversity values). For example, a recent study by Bush *et al.* (2004) revealed that forests contribute US$190 million to local people's livelihoods and the combined value of all the ecosystem services and option values was US$127 million. Of this Figure, US$ 34.8 million accrues in the form of watershed benefits, carbon sequestration (US$ 2 million), biodiversity values (US$ 3.3 million) and soil conservation (US$ 56.7 million). However, to realize the benefits, incremental management costs in form of subsidies needed amount to US$ 2.8 billion (Howard, 1995) for Uganda Wildlife Authority and NFA to be able to manage threats to conservation (e.g. encroachment, poaching, fires, illegal cross border trade in endangered species). The fact that protected area management involves such high costs to exclude illegal users, means that external funding is needed to support protected area management and conservation in countries such as Uganda and also that more participatory approaches to conservation management are needed to promote sustainable resource management.

One of the greatest challenges of natural resource management is that 70% of Uganda's natural forests are located on land not owned by the state (i.e. outside forest reserves and wildlife areas), which is referred to as 'private' under private and customary ownership. The landowners manage these resources for private gains yet they supply public goods. The largest proportion of the private and

customary natural forested areas is woodland whose main commercial value is currently charcoal production. These natural forests provide vital subsistence value to the poorest rural communities and are important in maintaining the environment that ultimately supports both a developing rural and urban Uganda. Although protected by both the Land Act (1998) and the 1995 Constitution of Uganda, local forest reserves, which used to be managed under traditional systems of regulation have broken down and user rights are unclear (problems of common property resources). Such forests are not being harvested sustainably and are rapidly becoming degraded or converted to other land uses, particularly agriculture. The loss of these important resources is reducing biodiversity, promoting soil erosion and reducing soil productivity. It also reduces the supply of many forest products on which the poorest people depend, and undermines many of the cultural and social values derived from these forests.

Some of the issues that require looking into as part of natural resource management in northern Uganda include the provision of incentives and an enabling framework to encourage forestry, as a way of reducing uncertainty over future wood needs and harmonizing conflicting government policies. Secondly, there is a need to disseminate laws and regulations regarding land rights, tree tenure and access to natural resources on private land. This will help to reduce the problem of open access use, particularly under the customary land tenure, which lacks clarity on the legal entitlement of ownership. Thirdly, provision of market information for timber and non-timber forest products is necessary for landowners to appreciate the value of natural forests. Building the management capacity of owners, tenants and communities, particularly to manage woody biomass resources more sustainably should be encouraged. Lastly, since pastoralism constitutes one of the most dominant land-uses in most districts of Karamoja and northern Uganda, it is important for this category of users to understand the importance of woodland and watershed management to the livelihood strategies they adopt.

5.1.1. Increasing woody biomass for fuel and building needs in areas of low availability

Of Uganda's 25 million people, 93% depend on wood for their energy needs. With a population growth rate of 3.5 % and a persistent conflict in northern Uganda coupled with the continued influx of refugees resulting from conflicts in Sudan, Congo and Rwanda, there has been widespread loss of woodland and forest. The National Biomass Study (2003) reported that out of 1.7 million ha of Central Forest Reserves in the country, 58,000 ha (5%) have been degraded or depleted. Unlike forest degradation, deforestation was noted to be high in the local forest reserves whose management is vested in the local governments under the Local Government Act, 1997. Average percentage loss of woody cover was also highest in local forest reserves in this study. The National Biomass Study noted that the current 312 million metric tons of biomass in private lands was on the decline (26 million metric tons per year), which will create a deficit of 846,000 metric tons by the year 2025 (NBS, 2003). In addition, a dynamic assessment of available tree biomass in savanna woodlands, which are a major source of commercial charcoal, showed that a total of 1.3 million metric tons from 700,000 ha was being lost annually. Compared with the three million metric tons of wood required for the current levels of charcoal production, a deficit of 1.7 million metric tons must come from other land cover/use such as agricultural land, grasslands and bushland.

This scenario means that the country needs approximately 65,000 ha of timber plantations (Jacovelli, 2005) and 22 million ha of hardwood plantations (NBS, 2003) to meet its fuel wood energy demands. Based on the above projections, National Forestry Authority (NFA), under the new Forestry Policy and Forestry Act, highlighted the need to rehabilitate central forest reserves and also encourage private sector investment in tree planting. National Forestry Authority alone, aims at planting around 25, 000 ha leaving the balance to private investors.

In areas where woodlands have been converted to grasslands or agricultural fields, management of the remaining woody biomass will become increasingly important. Rehabilitation is very likely to be necessary around the main urban centres, particularly around Lira, Gulu and Kitgum towns as well as around Moroto in Karamoja (**Figure 3.11**). There is need to encourage tree planting and management

of woody resources to provide for the increasing fuel wood needs in and around these centres. There will be a need to assess the available woody biomass in this region once peace comes, to measure what is available and the likely production rates of the existing biomass. The Biomass Department within the NFA would be ideally placed to do this type of work as they have established plots across most of the country, but were unable to establish many in Gulu, Kitgum and Pader districts because of the insecurity and conflict. Some of this assessment could already start in Lira and Apac and also Moroto districts where security is reasonable. This work could help refine the image analyses we have undertaken because it would ground truth the classifications and we could possibly create maps of woody biomass availability from the images. Once assessed there would be a need to establish better management of the woody biomass at the household and district levels to ensure that the woody biomass is managed sustainably. As purchasing power increases with peace and development there may be options for plantation management for fuel wood and building poles but initially the market for these will be limited because of the poverty of people in the region. A focus should be made around urban areas initially where individual purchasing power is likely to increase fastest.

Woodland rehabilitation components could include tree farming (agroforestry) for agriculture and livestock production, energy and pole production, collaborative forest management on government forest reserves, communal management of local forests (private, customary, forest dwellers, and pastoralists) and support regulated Non-Timber Forest Products (NTFP) harvesting, production and marketing (e.g. plants, medicinal herbs, minerals, ropes/cords), promote commercial charcoal and firewood production as a source of income and employment. In addition, support to the local governments in planning and development of operational plans for local forests with the aim to promote conservation of biodiversity outside protected areas, promote institutional capacity and cross border collaboration in biodiversity conservation. As such a number of opportunities and incentives, including legal framework, financial subsidies (Sawlog Production Grant Scheme), Collaborative Forest Management (CFM), technical and advisory services, and land access are now in place to facilitate private investment in plantations.

5.1.1.1. Incentives and Opportunities for tree planting

The Sawlog Production Grant Scheme (SPGS) is a special fund from the European Union aimed at offering strong financial incentives to private investors to create plantations for timber production. The investor is required to have a minimum area of 25 ha and a maximum of 500 ha to qualify for funds over a period of three years. During this period, the SPGS pays UShs 600,000/ha/yr (50% of the average establishment costs of commercial tree planting) planted. The second incentive is the possibility of leasing public land. Under the National Forestry Authority arrangement, long-term licenses are being offered to access land in selected central forest reserves for commercial tree planting. Land leases of a minimum of five to 25 years are extended to private developers, where an annual license fee ranging from UShs 14,900 per ha/yr (up to 50 km from the main market centre), Ushs 9,900/ha/yr (up to 150 km) and UShs 6,600/ha/yr for distances over 150 km are awarded. However, individuals/organized groups with privately owned land are also assessed and encouraged to apply for the grant. The third incentive is the provision of seed stocks (both seeds and seedlings) at subsidized rates from the NFA Seed Centre. Communities that are interested in commercial planting but do not qualify for the minimum area required under the SPGS, are offered free tree seedlings from the fund with tangible commitments such as the preparation of their land to a minimum standard (NFA, 2004).

In addition, if the investor purchased the planting materials from NFA, they will enjoy the benefit of selling collected seeds once trees are mature back to NFA (i.e. seed multiplication by farmers). Lastly, the NFA Private Sector wing provides advisory and technical services in the form of training and extension services to tree plantation investors. Also available are regularly published plantation guidelines which are disseminated free of charge (SPSG Administrator per comm.). These cover all the planning and management issues relating to commercial plantations, which in future will form a comprehensive silvicultural manual.

5.1.2. Promoting sustainable management of woody biomass

The area between Gulu and Kitgum, extending further north to Sudan has experienced reasonable woody cover increase (**Figure 3.5**). This area shows an increase because in the 1980s it was mostly being cultivated or grazed. Conventional wisdom suggests that when peace breaks out, people in IDP camps are likely to move back to those areas first. This assumption is based on two suppositions that these areas were; 1) previously farmlands and because of the LRA conflict, were abandoned; and 2) they are fertile according to Uganda's soil fertility map (IFPRI, 2003). If not managed carefully we are likely to see the same scenario as has occurred further south with widespread woodland loss. People returning to this region are likely to be very vulnerable initially to their ability to produce food. If a drought or extended dry season occurs they will require food support to help them establish themselves. The woodlands that have grown up in this region can provide a means to reduce the livelihood risk as they could provide charcoal/fuel wood, which could be sold to urban centres in the region. However, if not sustainably managed this fuel business would be short lived. Development agencies could work with the people to ensure a careful management of the woodlands to supply fuel wood for local and regional needs. Charcoal production, which accounts for 15-20% of the wood supply in Uganda and which is mainly used in the urban areas could be promoted alongside firewood for commercial purposes to provide household income and employment. However, its production is based on simple methods with a very low efficiency (between 8-12% recovery). As such, initiatives to develop better processing and promote energy saving technologies would be better for long-term sustainable management.

5.1.3. Soil conservation and Watershed management

Forests and trees are important agents in maintaining and improving soil fertility and conserving water resources. In Uganda, where most agriculture is rain fed, watersheds are important natural features that need to be protected. The Forestry Policy (2001) is committed to promoting the rehabilitation and conservation of the forests that protect the soil and water in the country's watersheds and river systems. However, many of the Local and Central Forest Reserves that were established for water catchment purposes have lost woody cover since the mid 1980s in the south and east of northern Uganda (**Figure 3.5**). The factors that have driven this loss are unknown for most of the reserves but are likely to be due to human encroachment and collection of fuel wood/charcoal, timber and building poles. In some forest reserves we know refugees have been settled but these are few. From the management side, there is limited awareness of the importance of watersheds both on protected and private lands, and little incentives are available for landowners to protect these watersheds as a public good. The existence of absentee landlords in some of these areas make it even more complex and promotes open access to reserves, and makes it difficult to offer any protection. The result of this loss of woody cover is likely to be a shortage of water resources for domestic and agricultural production, particularly during the drier periods of the year. We would urge development projects to promote the reforestation of these local forest reserves that would stabilize the soil and vegetation cover and at the same time protect the water supply for the local communities in the future.

With the increasing reduction in forest cover across districts such as Lira, Apac, and Moroto it is possible this may be leading to lower rainfall and a drying of these areas. Therefore, there is need to engage the local government committees at the district, National Environment Management Authority (NEMA), Wetlands Inspection Division, UWA and NFA who are mandated to ensure protection of watersheds. Identification of critical watersheds followed by their reforestation would be a first step. This should be followed by the provision of incentives for watershed management, and the regulation and monitoring of water pollution levels in the water catchments. In the degraded or deforested areas, economically viable interventions such as agroforestry systems (e.g. mixed cropping with fodder and nitrogen-fixing trees, windbreaks, green manure use) and use of appropriate soil and water conservation technologies will have positive impacts on crop and livestock production. In addition, woodlot establishment and fruit tree growing (such as Shea nut) should be promoted on-farm to provide quick returns for the landowners. Plantations could be encouraged in marginal and degraded

areas including forest reserves under the NFA incentive programs (e.g. private sector partnerships being promoted under Sawlog Production Small Grants Scheme, rehabilitation of degraded forest reserves, and carbon trade).

5.2 Conservation of Protected Areas and Landscapes

5.2.1. Key conservation areas and options for new sites

It is clear that northern Uganda is an important area for biodiversity conservation both nationally and internationally and that the mountain areas are part of a globally recognised hotspot of biodiversity (**Chapter 2**). The key conservation areas identified in **Chapter 2** that are managed by UWA include Kidepo and Murchison Falls parks, East Madi, Matheniko and Bokora Wildlife Reserves. Forest Reserves of conservation value include Moroto, Nyangea-Napore, Era, Agoro-Agu, Rom, Labwor Hills, Morungole, Zoka, Zulia, Otzi and Mt Kei managed by NFA (**Table 2.5**). These areas, together with the smaller forests and wildlife reserves, 'capture' much of the biodiversity that is known to exist in northern Uganda. There is therefore not a great need to think of creating many new reserves or to expand existing reserves. Indeed politically it would be delicate to propose new protected areas because of current fears of loss of land to developers in northern Uganda when peace comes. The one area where it might be worth investigating expanding is around Agoro-Agu Forest Reserve. The area to the west of this reserve contains large expanses of lowland bamboo, which does not occur elsewhere in Uganda. Lokung Forest Reserve was created to protect a representative example of this vegetation type but in the mid 1990s had been severely encroached and the current condition of the reserve is unclear. Lokung should be revisited once peace breaks out to assess whether efforts should be made to ensure its protection or whether it might be better to expand Agoro-Agu west to include some of this habitat type.

5.2.2. Threats to the protected areas in northern Uganda

Most of the protected areas that occur here have been neglected over the past 20 years because of the conflict and consequent insecurity. Many have had no staff on site for many years and as a result they have issues of encroachment, timber harvesting, harvesting of fuel wood, poles and non timber forest products as well as poaching of large mammals and charcoal production. On the aerial surveys we saw encroachment in Agoro-Agu (**Figure 5.1**), Otzi, Nyangea-Napore, and Mt Kei FRs and the NFAs assessment of northern forest reserves shows that many have been encroached and cultivated in part (**Annex 1**). Infrastructure has been destroyed where it occurred apart from Murchison Falls and Kidepo NPs, which have remained relatively intact because of the armed rangers employed by UWA, and their location at the periphery of the conflict area.

Figure 5.1. Encroachment inn Agoro-Agu Forest Reserve

Hunting of bushmeat is also a major threat, particularly where there are still a few large mammals left. Murchison and Kidepo Parks are reasonably protected by UWA but poaching still occurs in these two areas. Elsewhere there is very little protection and bushmeat hunting has driven many of the large mammals to extinction in the forest and wildlife reserves. Where large mammals still occur outside protected areas it would be worth looking at mechanisms that might promote wildlife management as an income generator for landowners. This might include tourism, particularly in Karamoja, which has huge tourism potential or sport hunting and other methods of sustainable wildlife management for meat. The Wildlife Act specifically allows controlled use of

wildlife and a pilot project around Lake Mburo seems to show an increase in species where sport hunting has been licensed by UWA (R. Lamprey pers. comm.).

Fire caused by people is also a potential threat. Over burning can change grassland composition and reduce woodland cover leading to changes in food availability for ungulates. Fire also gradually erodes the borders of forests where grassland meets the forest and can lead to a steady decline in forest area. Consequently the control of fire in protected areas over the longer term is important.

5.2.3. Management needs to rehabilitate the protected areas

Management needs for the protected areas are great and we here list several that we have identified:

1. *Boundary marking*: The needs of many of the protected areas are great. For most in Kitgum, Pader, and Gulu there will be a need to effectively start investing in their management as though they were newly created areas. A critical need will be boundary marking of each of the protected areas when peace comes to allow UWA and NFA to regain control of the management of these areas. This should start as soon as peace occurs because people will start moving back to their lands and into protected areas fairly rapidly once peace occurs.
2. *Investment in infrastructure*: Most buildings have been burnt and destroyed during the conflict and funds are required for rebuilding. Investment in infrastructure, particularly ranger patrol posts in East Madi WR, Agoro-Agu, Nyangea-Napore, Otzi and Mt Kei FRs, is also needed quickly to allow efficient patrolling and establishment of law enforcement in these areas.
3. *Creation of community partnerships*: Many of the people from this region are naturally worried about losing their land for government or private investor schemes. The demarcation of the boundaries of then protected areas will need to be undertaken with the involvement of local communities to minimise friction. Liaison committees need to be established such as the CPI groups that UWA works with in its parks further south.
4. *Capacity building of protected area staff*: the lack of access to these areas for 18 years has meant that there are no permanent staff in the field. There will be a need to recruit staff and finance them initially and train them to a level where they can perform their duties efficiently.
5. *Management planning*: Management plans will need to be developed and implemented, at least for the key sites identified (**Table 2.5**). These should look at the larger landscape in which these protected areas sit (see below).
6. *Improvement of access*: Access to some of these areas is difficult because roads have deteriorated to a point that they are no longer of use or even visible. It may be necessary to support the rehabilitation of these roads to allow NFA/UWA to access the areas. Provision of vehicles will also be a need.

This will necessarily involve significant investment to begin with, however, once the access, infrastructure and staff are in place the running costs will not be so high. While UWA and NFA generate some funding internally they probably cannot invest in this rehabilitation alone and will need support from the international community.

5.2.4. Conservation of the East Madi-Murchison Falls corridor

One of the main areas where large mammals are still found outside protected areas occurs between Murchison Falls National Park and East Madi Wildlife Reserve. In the early 1990s there was a World Bank report that advocated the area be managed for wildlife but plans were shelved because of the insecurity (R. Lamprey pers. comm.). This area used to have some of the most spectacular concentrations of large mammals in Uganda in the 1940s-60s and was one of the main areas Sport Hunters used for their clients. Much of the land was given out under the regime of Idi Amin in the 1970s following the degazettment of the Kilak and Aswa-Lolim CHAs. There is a dispute over who owns land and where. Both Gulu and Nebbi Districts claim to have rights over the area. However, if the land ownership can be resolved there is the possibility of working with the owners to develop a corridor that links Murchison to East Madi with innovative methods to manage the region. There may

even be a way that this could be proposed as a compromise to resolve the dispute between the two parties (e.g. inter-district land use planning). It might be possible to establish some form of wildlife tourism on ranches as has been developed in Laikipia in northern Kenya. Walking safaris and more exclusive safari experiences could be offered to a higher paying clientele if resources were invested initially. Alternatively sport hunting or ranching of wildlife for meat might be promoted to provide financial incentives to maintain wildlife in these corridor areas. Another option might be to work out a compensation scheme or a lease rent/conservation easement for the landowners so that the owners and UWA manage the area under a memorandum of understanding. The Land Act, 1998 permits landowners to join landholdings (joint coupling) to allow joint management, which can be explored to manage the corridor. Each of these options needs to be explored further and this should be started in the near future before Peace breaks out and people start to move out of the IDP camps and into these areas.

5.2.5 Transboundary Conservation and options for Peace Parks

This issue was explored in some detail in **Chapter 4**. Three areas have the potential to developed transboundary natural resource management or Peace Parks: Otzi-Nimule, Imatong Massif, and the Greater Kidepo landscape. Conservation of the Greater Kidepo landscape would conserve species such as the wild dog and cheetah, which are currently at very low numbers together with lions. Creating a larger landscape might help the regions development for tourism provided security can be improved. The Imatong Massif is known to be important for conservation at a global level and there were plans to upgrade its status to National Park in the mid 1980s but the war in southern Sudan prevented this. Transboundary collaboration could be developed to help manage the massif as one unit and to strengthen the conservation of Agoro-Agu in Uganda as a result. Transboundary management of Otzi-Nimule would encourage the conservation of the remaining elephants and ensure that populations of landscape species were more likely to be viable in the long term. Landscape species are those that require large areas of land live at low density and have large home ranges and would include elephants, chimpanzees and hippos in this region.

In order to proceed with the development of any of these transboundary areas there would be a need to bring representatives of the Southern Sudan wildlife Department together with UWA and NFA to start the process of discussing how they might work together to help conserve these areas. It has been found that starting at the field level first tends to create the desire to develop transboundary conservation areas rather than starting with formal agreements between governments. Where the latter have taken place and a directive issued to field staff to implement, there have been problems indicated by case studies in southern Africa (Sandwith et al. 2003). The next steps in the process would be to form a team including staff of UWA, NFA and Sudan Wildlife Department staff to assess each site and the relative merits of transboundary collaboration with the aim of identifying what level of collaboration would take place at each of the three sites.

Further work would be needed to investigate the three options and assess which would be most viable and the level of donor interest in the areas. It would need resources to develop these peace parks and neither Uganda's UWA and NFA nor the fledgling Sudan Wildlife Department have the resources for this. However, the benefits could be great and would help promote peace between Uganda and Sudan as well as ensure a more rational management across these transfrontier landscapes.

5.3 Conservation and natural resource management zoning map for Northern Uganda

Summarizing these results we have produced a map of northern Uganda that highlights these five main intervention areas and shows where they should occur (Figure 5.2). Key conservation options include the creation of a corridor between MFNP and East Madi WR, buffer zone creation around Agoro-Agu FR and strengthening the integrity of parks, wildlife reserves and forest reserves through support to their management through UWA and NFA. Key natural resource management options include the investment in the rehabilitation of areas of degraded woodlands and forests for watershed

management, improved soil conservation and supply of wood needs in the south and east of this region. There is also a need to invest in the sustainable management of woodlands where they have regenerated following the movement of people to IDP camps.

One danger in presenting such a map is that at first glance people become worried about losing land and make accusations about plans for land grabs. We have been careful to emphasise that most of the areas depicted on this map either already exist as protected areas or would be managed by local communities and their political representatives. The only new areas include the management of land between East Madi WR and Murchison Falls NP as a corridor for wildlife, and this could be carried out with the owners of this land once they have been established and the buffer zone around Agoro Agu which might be made in exchange for land in Lokung FR after an assessment (see above).

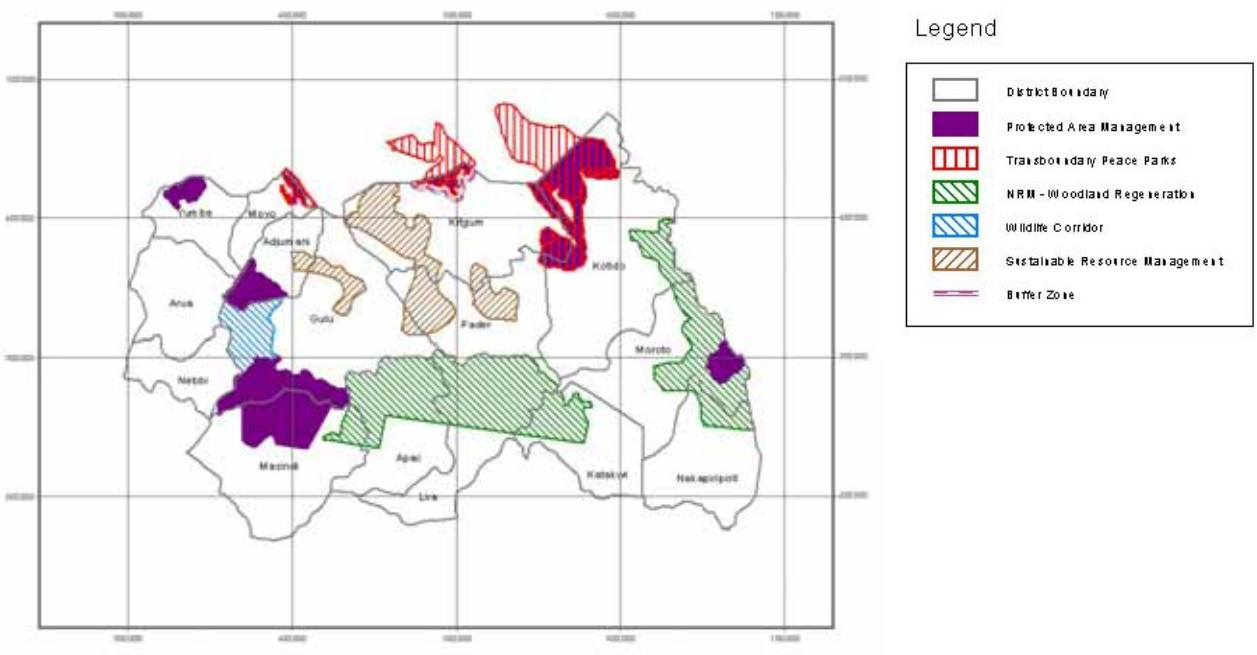


Figure 5.2 Zones that target conservation and natural resource management based on the results of this assessment.

5.4 Conclusions and recommendations

Which general pattern of land cover change in northern Uganda over the last 18 years can be detected from this study? The total area of woodland (trees and shrubs) only increased significantly in the northwest, while the northeast and southern part of the study region suffered major declines in woody vegetation. Another clear trend in all areas was the decline in woody cover in protected areas near human settlements and an increase in those located in the LRA active areas. This implies that when peace breaks out, people are likely to move back to the areas where woody biomass has regenerated and will likely use this to buffer the livelihood insecurity they will face when they return.

Further ground truthing with field visits to sites on the ground would enhance the accuracy of the 2000's image classification both in terms of increasing the identification of heterogeneous land cover classes and reducing the ambiguity between similar classes. This is a recommendation for development of this work, once the security situation in the north has reached a safe level.

In summary, the observations suggest that where the LRA has been most active in the districts of Gulu, Kitgum and Pader, there was a decrease in the amount of land conversion and cultivation in the countryside resulting in the regeneration of woodlands. Whether the massive decrease in woody cover

to the south is a result of people being pushed from the north by the conflict or simply the pattern of land conversion that would have taken place in any case is open to debate and needs more research. What is clear at this point is that such a scenario around Lira has severe implications for the remaining woodlands in the north. Given the decrease in woody cover in the south and the increasing demand for fuel wood (firewood, charcoal) as human population grows, when peace breaks out and people begin to move to the countryside, woodlands in the north will disappear at an alarming rate.

In addition, the loss of forest reserves that used to protect the watersheds will result in reduced livelihood security for the communities and scarcity of water for domestic use. This will increase the pressure on local leaders to demand the degazettment of protected areas to provide land for agriculture and fuel needs. The change in woody cover for each district is a useful administrative tool to guide planning for wood energy demands in future. It can also be used as a guide to indicate the degree of challenge faced by the local population in obtaining fuel wood, and where competition for resources is highest.

The conflict in northern Uganda led to the loss of woody cover around the towns of Gulu, Kitgum and Lira and much of the small central forest reserves around Lira town. Areas that experienced relatively low woody cover loss were those where UWA and NFA maintained a presence with personnel and provided some financial resources. This not only highlights the importance of maintaining a presence where possible, but also the importance of choosing the most important areas for conservation in the first place since these require a long-term commitment. The catastrophic period of the conflict presents an opportunity for District and Government authorities to develop a proper land use plan for northern Uganda allowing for the conservation of wildlife and wilderness as well as development needs. The relative intactness of most of the larger protected areas despite few or no resources available for their management is a testimony to the efforts of the staff of UWA and NFA who have strived to conserve these areas as well as the usefulness of boundaries in reducing encroachment and illegal activities.

Investment in the rehabilitation of conservation areas and in natural resource management in this region will be critical once peace returns. We have provided here a summary of key areas that will require technical and financial support but we also believe that more detailed assessments are needed to fully plan for these inputs. This short consultancy from USAID provides an overview and large-scale understanding of what has happened as a result of the LRA conflict but there will be a need to undertake more detailed assessments in particular areas to better target the investment of resources.

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ANNEX 1 DETAILED DESCRIPTION OF THE LOCATION AND IMPORTANCE OF PROTECTED AREAS IN NORTHERN UGANDA

A.1. National Parks, Wildlife Reserves and Community Wildlife Reserves

A 1.1. North western Uganda

The protected areas of north-western Uganda include several wildlife reserves and one national park; Murchison Falls. These protected areas support a wide range of ecosystems, ranging from medium altitude tropical forests, to *Combretum* woodlands, *Butyrospermum* savanna and papyrus wetlands. Three protected areas adjoin the southern boundary of Murchison, the Bugungu and Karuma Wildlife Reserves, and the Budongo Forest Reserve. To the north, the former Aswa-Lolim and Kilak Community Wildlife Reserves used to extend the Park's wildlife dispersal area into the remote forest and grasslands of East Madi Wildlife Reserve and Zoka Forest Reserve on the eastern side of the Albert Nile. West of the Albert Nile, East Madi and Ajai Wildlife Reserves provide refuge to Uganda Kob and Waterbuck. The area used to support a number of white rhinos, which are now extinct.

Murchison Fall NP, and Karuma and Bugungu WRs

Murchison Falls NP (MFNP), covering 3,860 sq km, comprises a rolling *Combretum* savanna and tall grassland in the centre and north, and dense thickets in the higher and wetter areas in the south. The Victoria Nile flows east-west through the centre of the park. Legal Notice 162 of 1952, which superimposed the Park onto the former Bunyoro-Gulu Game Reserve, declared the area. In 1962 the Bukumi-Bugungu and Karuma CHAs were declared as special hunting zones on the southern edge of MFNP. In 1964 and 1968 respectively, parts of these CHAs were later upgraded to Karuma and Bugungu Game Reserves to more effectively buffer the southern border of MFNP. The Game Department Reports of the 1960s indicate that elephant, buffalo, hippo, reedbuck, hartebeest and lion were common in these two Game Reserves.

Over the last 30 years poaching has drastically reduced the large mammal populations of Murchison Falls NP and its adjacent Reserves. The elephant population has declined from 14,000 to less than 500, buffaloes from 30,000 to 2,500 and hippo from 12,000 to 1,500. Similar trends are found for other species. The reader is referred to the Management Plan compiled by Olivier (1992b) for a detailed description of MFNP and its management problems, and to Lamprey and Michelmore (1996) for trends in wildlife populations. Some 450 bird species have been recorded in the Park, 16 of which have not been recorded in any other National Park in Uganda. The Victoria Nile delta is an important area for shoebill storks. Economically, the park is important for tourism with a magnificent falls, and the Victoria Nile within the Park is a very important fish breeding ground for the downstream fishing areas of Lake Albert.

East Madi Wildlife Reserve and the former Kilak and Aswa-Lolim controlled hunting areas

The expanse of grassland and woodland north of Murchison Falls NP along the east bank of the Nile and further east was once an important wet season dispersal area for elephants (and other game) of MFNP. In the 1950s this East Madi area was declared as the Acholi and East Madi Elephant Sanctuary to give protection to elephants and other wildlife species moving northwards from Murchison Falls NP to the Zoka Forest. Buffalo, Uganda Kob and hartebeest were particularly common, and black rhino and giraffe often encountered. The vegetation comprises Papyrus wetland, small areas of swamp forest with *Phoenix reclinata* palms, and wooded savannas dominated by *Combretum*.

Currently, poaching has drastically reduced large mammal populations in this Reserve. There remain very small populations of hippopotamus, buffalo, Uganda Kob, waterbuck, reedbuck and sitatunga. Olive baboons and black and white colobus are found in the forests. Estimates from a 1995 Systematic

Flight Reconnaissance showed that Aswa-Lolim Game Reserve areas and East Madi WR house 1661 Uganda Kob, Waterbuck (31), Hartebeest (141), Bushbuck (141), Reedbuck (251), Duiker (16) and Warthog (282). Little is known of the avifauna, but Pel's fishing owl is a noteworthy species found here. The protected area is important for biodiversity conservation at the District level. At present the Reserve does not contribute in any way to the national economy. Perhaps the most important local economic activity within the Reserve is hunting. Local communities collect thatching materials and poles from the Reserve.

Ajai Wildlife Reserve

The area around the Obei swamp in Arua District (then West Nile District) was declared a White Rhino Sanctuary in 1961, and was upgraded to a Game Reserve in 1965. According to the GD report of 1961, "this newly created sanctuary of some 60 square miles (about 150 sq km) in area has been established primarily to give protection to the white rhino. It includes the so-called 'Ajai's Island' and a surrounding tract of savanna bush and swamp land, which together comprise the most important remaining white rhino habitat in Uganda". By the 1970s Ajai GR supported over 100 white rhinos, all of which were wiped out in the 1979 war. The Wildlife Reserve is now heavily settled, with some 5,000 people living within the reserve, or cultivating within it. It is not clear how many people were resident in the Reserve at the time of establishment, how many received permits to continue residence, or where the borders of the Reserve actually are. Parties heavily hunt the reserve from local parishes, and large mammal populations have been decimated.

A 1.2. North Eastern Uganda

The Wildlife Protected Areas of North-Eastern Uganda comprise the Kidepo Valley National Park, Karenga Community Wildlife Reserve, Bokora, Matheniko, Pian-Upe Wildlife Reserves, and historically the North and South Karamoja Controlled Hunting Areas. Karamoja constitutes a major savannah ecosystem, through which, in former times, wildlife migrated on a seasonal basis. The entire Karamoja region, covering some 27,700 sq.km, used to be gazetted for wildlife, as national park (Kidepo Valley), three wildlife reserves (Matheniko, Bokora Corridor, Pian-Upe) and three former Controlled Hunting Areas (North Karamoja, South Karamoja,). These protected areas were declared in the 1950s and 60s to conserve the large herds of resident and migratory wildlife of the region, including buffalo, eland, giraffe, oryx, topi, hartebeest and zebra. Overlapping with the wildlife protected areas of Karamoja is a number of important forest reserves, established primarily to conserve Juniper and *Podocarpus* forests on mountaintops and hillsides.

In eastern and southern Karamoja, there remains an enclave area for large mammals with a very limited distribution in Uganda (Lamprey *et al.*, 2003). The eastern part of South Karamoja WR was the last refuge of lesser kudu in Uganda, whilst the 'toe' of Pian-Upe WR still retains Karamoja's last roan and topi populations. Buffalo, hartebeest, zebra and eland are also present. This area remains chronically insecure but serves as a buffer zone between the Pokot and the Karamojong pastoral people, the area has afforded some protection to wildlife. The Eland from Lake Mburo were translocated to Kidepo in the year 2003. Implementing wildlife conservation in these areas will be challenging, as problems of insecurity will have to be addressed.

Kidepo Valley National Park

Kidepo Valley NP is located in Kotido district and covers an area of 1,436 sq.km, has very important wildlife population with species found nowhere else in Uganda such as cheetah and wild dog. The park is secure although some species such as zebra and eland have declined and the cause is attributed to lion predation of small populations (Lamprey et al., 2003). The Park supports a diverse large mammal population including lion, elephants, buffalo, giraffe, zebra, hartebeest, eland, Guenther's dik dik and oribi. Bright's gazelle and lesser kudu are found in small numbers. Wildlife populations are healthy in the Narus Valley. In Kidepo Valley large mammals have been hunted out by poaching

(local SPLA militias and others). Four hundred and sixty three bird species have been recorded in the park making it at an ecosystem that supports a very high diversity of birds. This is the only National Park in Uganda with ostrich (numbers are very low).

Matheniko and Bokora Wildlife Reserves

In real terms the wildlife reserves of Karamoja are completely devastated. The areas are used by heavily armed Karamojong herders for the grazing over 150,000 cattle and 100,000 sheep and goats. Matheniko Wildlife Reserves, which lies in the districts of Moroto and Kotido, occupies an area of 1,573 sq.km. The landscapes of the Matheniko WR is characterised by open plains, with rugged mountains along the edge of the Dodoth-Karimojong escarpment on the border with Kenya. It is one of the driest area in Uganda, and the only protected area in Uganda supporting the tree and grass steppe vegetation class, and *Acacia-Commiphora* woodland and thicket. The area was declared to protect resident herds of oryx, and migratory zebra and eland that moved into the Reserve each wet season from Pian-Upe through the Bokora Corridor WR. Wildlife has now been virtually eliminated by poaching, except for a few gazelle, bushbuck, and duiker. However, nine buffalo have been seen in the Reserve recently (never before recorded here), probably having been driven in by poaching in the south and west. MUIENR (1996) recorded 108 bird species in one site (*Acacia* woodland) in this Reserve. In general the avifauna will have similarities to that of Kidepo Valley NP. In terms of overall conservation importance, the Wildlife Reserve (WR) is of national importance for biodiversity conservation.

Bokora Wildlife Reserve located in Moroto district occupies an area of 2,145 sq.km comprised almost entirely of the 'vegetation on sites of impeded drainage' class of Langdale-Brown *et al* (1964), with *Acacia seyal* and *A. drepanolobium*, with *Setaria* and *Pennisetum* grassland. The Reserve was established to give protection to herds of topi, eland and zebra moving north from Pian-Upe in the wet season. However, large mammal species have now been virtually eliminated by poaching, except for a few oribi, gazelle, reedbuck and occasional hartebeest and buffalo (from Pian-Upe). Bokora and Matheniko are the only protected areas that support the Bright's gazelle (a race of the Grant's gazelle). With fewer than 100 Bright's gazelle remaining (probably in Africa), these areas are still important for conservation. The gazelle survives because they inhabit the dry northern areas, and can survive without water. They therefore avoid the areas where Karamojong herd their stock. This zone (extending east into Matheniko) also constitutes the remaining range of ostrich in Karamoja, and ostrich breed in the north, near Toror Hills. No bird species list has been compiled for this reserve.

In March 1983 Eltringham and Malpas (1983) carried out an aerial survey of the protected areas of Karamoja, and reported that wildlife populations were greatly reduced, and that people were beginning to settle within the game reserves. Again, aerial surveys conducted in October 1995 and June 1996 (Lamprey and Michelmore 1996) during both the dry season (October) and wet season (June) showed that the wildlife populations of Karamoja had been devastated by poaching, and that many areas had been encroached by human settlement. The oryx which used to live in this region have been entirely exterminated. Similarly the giraffe and zebra became extinct in 1995 (Table A1). Today, the wildlife reserves of Karamoja constitute vital seasonal grazing areas for the Karamojong.

Table A1. Population estimates for some large mammal species in 1968, 1983, 1995/96 and 2003 in Kidepo Valley NP, Matheniko and Bokora Corridor Wildlife Reserves.

Species/variable	Kidepo	Matheniko WR			Bokora Corridor WR			Totals All Reserves			
	1967	196	1983	1995/96	1968	1983	1995/96	1968	1983	1995/9	2003
Elephant	600										
Buffalo	2,000	0	0	0	0	0	0	40	0	365	**20**
Eland	300	309	0	0	1,338	1,200	0	3,245	1,200	50	**74**
Gazelle	350	499	440	*5*	318	927	*97*	919	1,367	120	50?
Giraffe	400	157	0	0	207	96	**5**	1,263	205	15	0
Hartebeest	3,000	77	0	0	1,104	544	*50*	2,206	853	298	**108**
Kob		0	0	0	15	256	*40*	151	365	150	?
Kudu	n/a	10	0	*39*	0	0	0	10	0	39	0
Oryx		281	96	0	70	80	0	351	176	0	0
Lion	50										
Reedbuck	n/a	0	0	0	10	288	0	410	705	1,978	?
Roan	120	0	0	0	58	0	0	445	254	15	**7**
Topi		321	0	0	1,335	32	*1*	3,601	775	101	10
Waterbuck		0	0	0	11	0	0	138	18	0	0
Zebra	500	9	0	0	977	0	0	3,322	798	101	10?
Ostrich		58	137	*5*	158	640	*105*	248	922	165	6
Cattle		n/a	17,261	65,570	n/a	22,197	51,173	n/a	39,458	136,26	n/a
Huts		n/a	1,745	1,198	n/a	130	1,752	n/a	1,875	5,635	n/a
Cheetah	25										
Sheep/goats		n/a	3,381	20,945	n/a	6,730	34,386	n/a	10,111	58,939	n/a
Camels		n/a	0	2,608	n/a	0	0	n/a	0	2,608	n/a

Data sources: Game Department (1968), UNP (1971), Eltringham and Malpas (1983), Lamprey and Michelmore (1996), PAA (unpubl.), Lamprey (2003). The 1995/96 estimates are approximate, as numbers were very low for conducting SRF surveys. Numbers in italics are averages for the 1995/96 surveys. Numbers in bold indicate where precise numbers were known. The 2002 estimates are based on regular over flights and discussions with UWA field personnel. n/a = not counted, not available

A. 2. Forest Reserves

Mount Kei Forest Reserve

Mount Kei Forest Reserve covers 384 km^2, lies in Koboko and Aringa counties in Arua district in the West Nile region of northern Uganda. Despite its name, Mount Kei is an extremely flat homogeneous area where two small hills (Kei and Chei) rise just two hundred meters above the savanna to provide an altitudinal range of 915 to 1332 metres above sea level (Davenport and Howard, 1996a). The forest is broadly classified as dry *Combretum-Terminalia-Loudetia* savanna and *Butyrospermum-Hyparrhenia dissoluta* savanna woodland (Langdale-Brown *et al*., 1964). Although not very biodiverse, the reserve is notable for its relative abundance of rare and restricted-range species and is therefore of considerable conservation importance. Mt Kei was formerly a white rhino sanctuary, and the reserve used to harbour an abundance of big game including elephant, hippopotamus, buffalo, leopard and hyena until the late 1970s (Game Department, 1973). It is now both a wildlife sanctuary and a forest reserve and is jointly managed by UWA and NFA. At the time of the Forest Department biodiversity survey, only smaller numbers of antelope such as oribi (*Ourebia ourebia*) and reedbuck (*Redunca redunca*) were reported present (Davenport and Howard, 1996a). During the aerial survey conducted by UWA in 2002, the same mammals could not be seen (Lamprey *et al*., 2003). Hunting is undertaken with the help of dogs and nets. On the other hand, some species are relatively abundant including klipspringers (*Oroetragus oroetragus*), baboon (*Papio anubis*) and rock hyrax (*Procavia sp*). The local people claim that a small group of chimpanzees (*Pan troglodytes*) inhabit the southern section of the reserve and Midigo hill (possibly coming from Sudan) but this needs to be verified.

Mt Kei is ranked the 25th biodiverse forest reserve of all the 65 forests inventoried by the Forest Department surveys (Davenport and Howard 1996a). Two hundred and twenty nine tree and shrub species (Lwanga, 1996a), 175 bird species (Matthews, 1996a), 22 small mammal (Dickinson and Kityo, 1966a) and 126 butterfly species (Davenport, 1996a) are known to occur in the reserve. Four hundred and eighty seven hawkmoths (Sphingidae) and 199 silkmoths (Saturniidae) species were recorded (Howard, 1996a). Three tree species namely *Aeschynomene schimperi*, *Combretum racemosum* and *Morinda titanopylla* were recorded in no other site. The reserve, however, contains

five species of trees and shrubs that according to the Flora of Tropical East Africa are restricted to floral region U1 in East Africa (that is, *Morinda titanophylla, Combretum schweinfurthii, Isoberlinia doka, Daniellia oliveri* and *Entada Africana*). One of the plants listed as vulnerable by IUCN under the current RedData species (ww.redlist.org; Hilton, Taylor, 2000) known as *Afzelia Africana* (Leguminosae) occurs in Mt Kei and Otzi Forest Reserves. In addition, a little known shrew *crocidura somalica* captured nowhere else during the inventory, was found to exist on Mount Kei. Four moth species were recorded here for the first time in Uganda, including two silkmoths (*Rohaniella pygmea*) and *Micragone cana*) and two hawkmoths (*Platysphinx piabilis* and *Polyptychus coryndoni*) (Howard, 1996a).

The main threats to the reserve include agricultural encroachment and seasonal hunting. The situation was made worse due to the civil war in Sudan and the movement of refugees and traders between Uganda and Sudan. Evidence of various human activities was observed in a number of locations in Mount Kei. These include hunting, settlement, grazing, cultivation and forest product harvesting. It was reported that access to forest products from Mount Kei such as building poles, medicinal plants, cloth dye, honey and local gold mining along the Kaya River do occur (Davenport and Howard, 1996a; NFA field staff pers comm.).

Agoru-Agu and Lokung Forest reserves

Agoru-Agu Forest reserve is situated in Lamwo County in the extreme north of Kitgum district (Uganda Department of Land and Survey, 1960-1970). The forest lies approximately 60 km north of Kitgum town. Lokung Forest reserve also lies in Lamwo County 15 km south west of Agoro-Agu. Agoru-Agu and Lokung Forest reserves cover 236 km^2 and 14 km^2 respectively. The altitudinal ranges for Agoru-Agu and Lokung are 1100 to 2700 and 1020 to 1060 meters above sea level respectively (Davenport and Howard, 1996b). Agoru-Agu is entirely bounded to the north by the international border with Sudan and to the south by the limit of hills, and is contiguous with Sudan's Imatong Mountains. While Lokung forest is bisected by the Madi Opei to Lokung road, which extends to the Sudanese border 25 km to the northwest. The vegetation of the reserves has been broadly classified as dry *Combretum* savanna, forest-savanna mosaic and dry montane forest for Agoru-Agu and lowland bamboo-dominant moist thicket for Lokung (Langdale-Brown *et al*., 1964). The flora and fauna of the reserves is not especially diverse (Davenport and Howard, 1996b) although very limited surveys were made because of insecurity.

Two hundred fifty four tree and shrub species (Lwanga, 1996b), 76 bird species (Matthews, 1996b), 11 mammals (Dickinson and Kityo, 1996b) and 66 butterfly species (Davenport, 1996b) are known to occur in Agoru-Agu. In Lokung, 85 tree and shrub species, 54 bird, 13 mammals, 51 butterfly and four moth species (Howard, 1996b) were recorded. Of the species known from both reserves, eight (seven in Agoro-Agu and one in Lokung) were uncommon and unique to these reserves (Davenport and Howard, 1996). It was noted that the survey did not cover enough of the reserve and areas close to the border where the reserve spreads to Sudan into the extensive Imatong Mountains (Matthews, 1996b). *Uranomys ruddi* (Rudd's Mouse) and C*rocidura denti* are rare species recorded only from Lokung.

Evidence of human activity was observed in both Agoru-Agu and Lokung Forest Reserves. Agoru-Agu was reported to be extensively encroached (both temporary and semi-permanent housing, gardens, shambas and schools) throughout the lower and medium altitude areas (Davenport and Howard, 1996b), particularly in the southern and eastern areas. Domestic livestock including dogs, chicken, goats and cattle were found present in the area. This situation is exacerbated by the presence of both the Lords Resistance Army (LRA) and the Sudanese People's Liberation Army (SPLA) who operate within the reserve. The forest supplies building poles (especially bamboo), honey, bush meat, medicinal plants and firewood to the communities adjacent and the rebels. Lokung was noted to be completely under cultivation (Davenport and Howard, 1996b), due to the available access by road. During the survey period in 1993, evidence of hunting was recorded as many traps were observed. Agoru-Agu is of relatively high conservation value for all taxa. The forest is contiguous with the

Imatong Mountains of southern Sudan, known for their high rates of endemism and unique species composition. Lokung on the other hand (by the time of survey) was heavily encroached and did not support any species deserving particular conservation attention, although, a number of bush babies (probably the *Galago senegalensis*) were reported inhabiting in the reserve (Davenport and Howard, 1996b).

Otzi and Era Forest Reserves

Otzi Forest Reserve is situated entirely within Metu County approximately 18 km north east of Moyo town while Era Forest Reserve lies in West Madi County 8 km south of Moyo. Otzi and Era cover an area of 188 km^2 and 74 km^2 respectively. Otzi Forest reserve is located on the escarpment overlooking the confluence of the Aswa River with the White Nile as it passes into Sudan. It is ranked number 10 in order of biodiversity importance and second to Moroto Forest reserve in Northern Uganda. Era Forest Reserve is situated on the plateau above the Albert Nile. The altitude ranges from 760 – 1667 m for Otzi and 850-1040 meters above sea level for Ezra and both reserves have been broadly classified as *Butyrospermum-Hyparrhenia* and *Combretum* savanna with undifferentiated semi-deciduous thicket (Langdale-Brown *et al*., 1964).

Two hundred and sixty one tree and shrub species (Lwanga, 1996c), 168 bird (Matthews, 1996c), 21 small mammal, 94 butterfly and 44 moth species (Howard, 1996c) are known to occur in Otzi (Davenport and Howard, 1966c). In Era, 145 tree and shrub species are known with two species reported in earlier inventories (Katende unpublished data). Era is rich in other biological taxa of which 113 bird, 15 small mammal, 56 butterfly and 39 moths have been recorded. Otzi and Era Forest reserves together are reported to host 280 tree and shrub species representing 22% of the known tree and shrub species of Uganda. Seven of the tree and shrub species recorded in Otzi and three in Era, are reported to be unique to these reserves. Worth noting is the presence of the primitive and extremely rare cycad *Encephalartos septentrionalis* recorded in Era. In addition, *Afzelia Africana, which has been listed by IUCN as vulnerable,* occurs in this reserve (Hilton-Taylor, 2000). Thus, the two reserves are of high importance in the conservation of a complete assemblage of Uganda's tree and shrub species. In Otzi, three butterfly species (Davenport, 1996c) only occur in this reserve while one mammal (Dickinson and Kityo, 1996c) and one moth species are unique to Era forest reserve. The Ugandan endemic mammal *Crocidura selina* was also recorded in Otzi, only previously reported to occur from Mabira prior to the Forest Department inventory (Nicoll and Rathbun, 1990). More important, *Argiolaus vansomereni* (Lycaenidae), which is endemic to Uganda, occurs in this reserve (Pomeroy *et al*., 2002) although not recorded during the FD inventory.

In terms of human activity, evidence of human impacts was visible particularly illegal harvesting of forest products (honey, building poles and medicinal plants, game meat), encroachment (Otzi) which was confined largely to areas surrounding the enclaves and to a lesser extent at Awado. Compared to Otzi, Era was found to have undergone extensive encroachment (both cultivation and permanent settlement) and this is considered to be a major threat to the integrity of the reserve. Due to the proximity of the reserve to the Albert Nile that supports a fishing community coupled with the high numbers of Sudanese refugees in the area, the forest reserve is a valuable source of timber for construction of canoes, fuel wood and vulnerable to cultivation.

Labwor Hills Forest Reserve

Labwor Hills are a group of neighbouring forest reserves situated in Agago, Moroto and Labwor counties in Kotido district. The hills complex includes Nanglebwal, Akur, Alerek, Ating, Kano and Napono Forest Reserves. They lie 120 km north east of Lira, surrounding Abim and Morulem trading centres and are bisected by the Lira to Kitido road. Labwor Hills cover an area of 437 km^2, with an altitudinal range from 1050 to 1925 m. The forests have been broadly classified as dry *Combretum-Oxytenanthera-Hyparrhenia* savanna woodland. The biodiversity inventory generated two hundred and fifteen tree and shrubs in addition to the 24 species already known from previous records (Forest Department), 139 bird (Matthews, 1996d), 15 small mammal (Dickinson and Kityo, 1996d), 109

butterfly and 43 moth species. Of the 239 tree and shrub species known from Labwor Hills, 28 species are uncommon. Four species have been recorded from this reserve alone where three of them are not in the Flora of Tropical East Africa (Lwanga, 1996d). Four tree and shrub species, three butterfly species and one bird species were recorded that are found no else where in Uganda. The Ugandan endemic *Lepidochrysops labwor* and *Chilades alberta*, although not recorded during the FD inventory are known globally only from this one range of hills (van Someren, 1957; Hilton-Taylor, 2000).

Human activities were observed in Labwor Hills. The fertile soils of the valley bottom surrounding the Labwor Hills Reserve is used for subsistence agriculture growing mostly cassava, groundnuts, millet and sorghum around the lower slopes of the reserves where soils were deep enough to cultivate. In addition, local communities use the reserve for hunting, cattle grazing, firewood, bamboo, building poles, medicinal compounds, collection of wild vegetables and honey. Excessive grazing and lighting of fires during the course of hunting are potentially damaging activities. These activities both place considerable threat on the vegetation of the hills and can contribute to soil erosion and reduction in the efficacy of the area's water catchments properties.

Morungole, Timu and Lwala Forest Reserves

Morungole Forest Reserve, which covers an area of 151 km^2, is situated in Dodoth County in the north of Kotido district. Its altitude ranges from 1140-2749 m above sea level. The forest lies approximately 40 km north of Kaabong Town and is contiguous to the north with Kidepo Valley National Park. Timu Forest Reserve covers an area of 117 km^2 with an altitudinal range from 1700-2020 m also lies in Dodoth County on the edge of the rift escarpment overlooking the Turkana region of northern Kenya. While Lwala Forest is situated 4 km due south of Morungole and covers an area of 59 km^2 with an altitudinal range from 1480-2455 m. The forest reserves are broadly classified as dry *Combretum* savanna with *Juniperus-Podocarpus* dry montane forest and high altitude forest/savanna mosaic. The flora and fauna of the reserves, although not very diverse, are characterised by reasonable number of rare and/or restricted-range species of conservation importance (Davenport and Howard, 1996e).

A combined total of 263 tree and shrub species was recorded. Morungole, Timu and Lwala host about 15% (191 species), 13% (166 species) and 9% (111 species) of Uganda's known tree and shrub species respectively (Lwanga, 1996e). It should be noted that eight of the species recorded in Morungole and six in Timu were unique to these forest reserves and not recorded elsewhere in any of the other inventoried forests (Lwanga, 1996e) while none was recorded in Lwala. As such, Morungole and Timu are indispensable in the conservation of a complete assemblage of Uganda's known tree and shrub species. Ninety-six bird species are known to occur in Morungole. Of these, 39 species were recorded during the FD inventory (Baltzer, 1996). In Timu and Lwala, 61 and 33 bird species were recorded. Morungole was the only forest with forest-dependent specialist species (8% of the total species count), five of which are dependent on intact highland forest (Baltzer, 1996).

A total of 19 small mammal species (5 shrew and 14 rodent) are known to occur in Morungole (12), Timu (12) and five from Lwala (Dickinson and Kityo, 1996e). A butterfly species inventory revealed that Morungole hosts 77 species; four Papilionidae, 19 Pieridae, 16 Lycaenidae, 29 Nymphalidae and nine Hesperiidae (Davenport, 1996e). In Timu, 77 species were registered; three Papilionidae, 17 Pieridae, 20 Lycaenidae, 25 Nymphalidae and 12 Hesperiidae. While in Lwala, 17 species were recorded, that is one Papilionidae, two Pieridae, one Lycaenidae, 11 Nymphalidae and two Hesperiidae. Of these, two butterfly species are unique to Morungole and five (Timu) only occur in this reserve in Uganda. Inventory of the large moths in Morungole forest reserve led to total count of 14 hawkmoths (Sphingidae) and two silkmoths (Saturniidae) species while in Timu, seven species of hawkmoths and one silkmoth species and three hawkmoth species in Lwala were recorded (Howard, 1996e). Most species encountered were common and widespread (mainly migratory) hawkmoths except two restricted-range species recorded in Morungole. Of these, the silkmoth *Imbrasi krucki* is endemic to the East African region, although quite common in the Kenya highlands.

Various human activities were observed in all three reserves during the survey. Morungole was only marginally encroached at the southern section of the reserve (Davenport and Howard, 1996e) in the form of temporary housing and maize cultivation on the lower slopes of the hillside. The insecurity in the area has to a large extent helped to protect the reserve from precarious human impacts. Small numbers of snares and cattle grazing were noted south of the reserve. Timu Forest Reserve was extensively and rapidly encroached as a result of the low insecurity situation in the area. The reserve was formerly protected by virtue of its location between opposing Turkana and Karamojong cattle raiders. Encroachment was concentrated in the western part but with signs of spreading eastwards. At the time, there was some cultivation of maize by the Ik (Tewuso) people on the edge of the escarpment (Davenport and Howard, 1996e). Lwala was subject to minimal human activity in form of grazing of livestock especially on the slopes of the reserve and small maize shambas on the western section of the forest.

Moroto Forest Reserve

Mount Moroto is an ancient volcanic mass rising from the plains in eastern Karamoja. Moroto FR lies on this massif in Matheniko County in Moroto district. Moroto Forest reserve covers an area of 483 km^2 with an altitudinal range of 960-3084 m, its boundaries border with Kenya. The vegetation of the forest reserve was broadly classified as dry *Combretum, Butyrospermum* and dry *Acacia* savannas, with *Juniperus-Podocarpus* dry montane forest (Langdale-Brown *et al*., 1964). The flora and fauna of the reserve is not very diverse but highly characterised by rare and/or restricted-range species. Moroto is the forth most important reserve in Uganda for biodiversity conservation and considered number one of all forests so far surveyed in northern Uganda.

A total of 203 species (28% of Uganda's known tree and shrub species) are known to occur in the reserve. Of these, three tree and shrub species recorded in Moroto only occur in this reserves and nowhere else in Uganda. Two hundred twenty bird species are known to occur in Moroto. Of these, seventy-three are restricted-range species and do not occur in any other forest (Matthews, 1996f) in Uganda. This has been attributed to the geographical position of the three mountains in the extreme east of the country where the vegetation type is more reminiscent of northern Kenya. Among the small mammals, 39 species (9 shrew and 30 rodent) are now known, where 22 species occur in Moroto (Dickinson and Kityo, 1996f). Seven restricted-range small mammal species were recorded from Moroto, four of which are found nowhere else in Uganda and three of which are endemic to the Somali-Masaai region. In Moroto, 106 species of butterflies are known; 4 Papilionidae, 36 Pieridae, 22 Lycaenidae, 35 Nymphalidae and 9 Hesperiidae. Of the species recorded in Moroto, many were of great interest. According to Howard (1996f), 31 species of hawkmoths (Sphingidae) and 14 silkmoths (Saturniidae) are known to occur in Moroto. The forest is of extreme importance owing to its highly representative butterfly fauna. The site accommodates many species recognised as uncommon and/or of restricted-range in Uganda and East Africa.

Human impacts were observed to occur in the reserves. The largest and most established population of Tepes people live within Moroto. Kraals are scattered on the lower slopes and it is in the relatively fertile areas, where streams running down from the mountains continue to bring water into the dry season. The forest at these lower altitudes has been cleared for cultivation and goat rearing. Fuel wood, building poles, medicines (including the narcotic leaf locally called Mairungi) and wild foods were reportedly collected from the forest and many deep waterholes have been established on the lower slopes on the eastern side (Davenport and Howard, 1996f). Gold panning was reported to take place in the rivers. In addition, extensive hunting takes place using guns and dogs predominantly for animals such as bushbucks (*Tragelophus scriptus*), duiker (*Cephalophus* sp) and dil-dik (*Madoqua* sp).

Nyangea-Napore, Rom and Ogili Forest Reserves

Nyangea-Napore, Rom and Ogili Forest Reserves are situated in the districts of Kitgum and Kotido in north-eastern Uganda. Nyangea-Napore lies partly in the county of Doroth in Kotido and in the county of Chua in Kitgum. The reserve covers an area of 417 km^2 of which 62 km^2 lie within the boundaries of Kidepo Valley National Park. The reserve is made up of a narrow chain of hills running south from the Uganda/Sudan with an altitudinal range of 1060-2284 m. The highest peaks are Lonyili (2284 m) on the Sudan border and Kaleri (2233 m) in the Nyangea to the south. The district road between Kaabong and Kitgum crosses the reserve at Karenga. The area was classified as dry savanna woodland vegetation made up *Combretum-Acacia-Themada* savanna. Rom lies in the county of Chua and covers an area of 109 km^2 with an altitudinal range of 1180-2382 m. Rom is the highest peak of the ancient inselberg on which the reserve is centred. The vegetation is generally savanna woodland of *Combretum-Acacia-Themada*, however, in the higher and wetter parts of the mountain *Juniperus Podocarpus* dry montane forest is found. Ogili Forest Reserve lies in the county of Agoga in Kitgum district. It covers an area of 54 km^2 with an altitudinal range of 1060-1992 m. Its vegetation in the lower areas of the reserve is grassland savanna of *Butyrospermum-Hyparrheria dissolute*. In the higher altitude areas, the vegetation is dry savanna woodland of *Combretum-Oxytenanthera-Hyparrhenia.*

According to Davenport *et al.* (1996b), Nyangea-Napore, Rom and Ogili Forest Reserves host about 21% (261 species), 17% (212 species) and 9% (115 species) of Uganda's known tree and shrub species respectively (Lwanga, 1996g). One hundred and fifty four species are known in Nyangea-Napore while 64 species occur in Rom and 50 in Ogili (Baltzer, 1996). Nyangea-Napore supports a moderately high diversity of species but Rom and Ogili support communities of lower diversity. Nyangea-Napore was relatively rich in rare species. A total of 27 small mammal species (6 shrew and 21 rodent) are known, with 25 from Nyangea-Napore, 15 species from Rom and two from Ogili (Dickinson and Kityo, 1996g). In Nyangea-Napore, 129 species of butterflies are known; four Papilionidae, 27 Pieridae, 30 Lycaenidae, 55 Nymphalidae and 13 Hesperiidae. In Rom, 109 species are known to occur; three Papilionidae, 19 Pieridae, 18 Lycaenidae, 54 Nymphalidae and 15 Hesperiidae. Ogili supports 42 species where five are Papilionidae, six Pierida, five Lycaenidae and 26 Nyamphalidae. Altogether 26 hawkmoths (Sphingidae) and 13 silkmoths (Saturniidae) are known to occur in Nyangea-Napore, while six hawkmoths and one silkmoth were found in Rom. Most of the species were predominantly commonly widespread or characteristic of woodland and open habitats. Five restricted-range species taken at Nyangea-Napore include two hawkmoths (*Platysphinx piabilis* and *Rufoclanis numosae*) that had not been recorded from Uganda before.

In terms of human impacts, local communities depend on the reserves as sources of honey, fuel wood, medicinal plants and game meat. Encroachment was noted regarded as a major problem but evident around Karenga and where the road passes to Kitgum. In Rom, the local communities had slightly encroached on the perimeters of the reserve but frequently used the reserve to source similar products. Very little was noted about Ogili, however, the situation was likely to be the same as the other reserves. The three reserves provide an important role of water catchments because of the high altitude and wetter habitats. Hunting was the major threat to the biodiversity in the reserves that needed immediate attention.

A.1.1. Current status of forest reserves in northern Uganda

The National Forestry Authority (NFA) has been assessing all its forest reserves in Uganda and looking at the ecological vlues, threats and accessibility in relation to security in the north. Table A.2 provides a summary of the current status of forests in northern Uganda. Most of the forest reserves offer protection to water catchment, particularly in Acholi districts. To a large extent, human impacts (e.g. settlement, agriculture, grazing, industrial and urban development) are the most threatening activities. However, the NFA in partnership with private developers has embarked on a reafforestation programme in the degraded areas of the reserve, and new plantation establishment is on-going.

Table A.2 Current ecological value and human impacts to Central Forest Reserves in northern Uganda. Source: C.D. Langoya, National Forestry Authority, July 2005.

Zone	District	**Forest Reserves**	**Ecological**			**Biodiv.**	**industrial plantations**	**Bio-energy (for industrial processing)**	**Urban Green/ Wetland**	**Other**	**Encroachment Status**			**Notes**
			Water catchment	*Steep slopes*	*Natural forest*						*No. encroachers*	*% of FR cultivated*	*Livestock*	
Gulu	Gulu	Abera & Abili					X				100	10%		Key industrial plantation; Cultivation by IDP (Unyama Camp)
	Gulu	Amuka			X							0%		Proposed research reserve for Gulu Univ.
	Gulu	Bobi									2000	100%		Marked for private tree farming; has Bobi IDP Camp.
	Gulu	Gulu					X		X		320	20%	25	Located on the Head of Pece stream (draining thru Gulu town), maintain water level for most wells in Pece division; Ungazetted IDP Camp
	Gulu	Gwengdiya	X		X							0%		it located on the head of omer river Supplying wetlands in Zoka forest areas and enter the R. Nile
	Gulu	Keyo	X		X						245	50%		Rivers supplying Gulu town originate here; Cultivation by IDP camp from Keyo
	Gulu	Lagute					X					0%		Ear marked for NFA planting
	Gulu	Lukodi			X							0%		Found on the head of tributory of Unyama river which join Aswa river
	Gulu	Opaka					X					0%		Private Planting & NFA seed orchard
	Gulu	Opit					X				200	15%		Ear marked for NFA planting; IDP Camp & army detach
	Gulu	Opok					X				48	62%		Private Planting & NFA seed orchard
	Gulu	Got-Gweno, Kilak Labala	X		X							0%		Rivers supplying R. Nile originate here
	Gulu	Olwal					X				100	20%		Ear marked for NFA planting; Cultivatiors from Olwal IDP Camp
	Gulu	Wiceri	X			X					200	10%		Rivers supplying R. Nile originate here; Army detach & small IDP camp
	Kitgum	Agoro-Agu	X	X		X						10%		Rivers supplying Agoro, Paluga & Kitgum town originate here. No information due to insecurity
	Kitgum	Aringa River	X									0%		Water catchment for supplying Aringa and Pager River. No information (insecurity)
	Kitgum	Kitgum Plantation (A&B)	X				X		X		100	45%		R. Pager flows through Plantation A&B; Urban dev. in Plantation B
	Kitgum	Lalak	X	X								0%		Water catchment for supplying Aringa and Pager River. No information due to insecurity
	Kitgum	Lokung	X		X							0%		Mostly lowland bamboo; biodiversity

														conservation forest. No information due to insecurity
	Kitgum	Matidi					X					0%		Private Planting
	Kitgum	Pajimu					X				5000	50%	45	NFA planting; IDP Camp & Army school, Barrack
	Kitgum	Paonyeme			X							0%		Lowland bamboo
	Pader	Ogili	X	X		X						0%		Biodiversity; Water catchment forest
	Pader	Ogom			X		X					0%		Rivers supplying R. Aswa originate here
	Pader	Parabongo	X	X							50	1%		Catchment for Agago & Aswa Rivers; IDP & Kalongo Hospital
	Pader	Rom	X	X		X						0%		Biodiversity . . .
	Pader	Nyangea-Napore	X	X		X						0%		Water catchment for supplying Kidepo NP
Moyo	Moyo	Atiya	X	X								0%		Water catchment with streams supplying R. Nile originate here
	Moyo	Ayipe	X	X							47	0.5		Water catchment with streams supplying R. Nile originate here
	Moyo	Era	X	X		X			X		15	1%	700	Core Biodiversity Forest; water catchment (Odraji, Lama, Lukuji, Leya); Mainly settled by Sudanese Refugees
	Moyo	Eria					X				1	1%		Only Teak plantation being developed by NFA in Moyo zone
	Moyo	Lobajo					X					0%		Private plantation development and demo for trials; proposed HQ of Moyo Zone
	Moyo	Otzi East	X	X	X	X					18	0.3%	60	Prime Biodiversity Forest; water catchment; supply Moyo town council & Metu S. County with water; Mainly cultivated by displaced people from Pakele; key streams include Chala, Apipi, Amua, Ayiro, Ubi, Ayido, Awodo
	Moyo	Otzi West	X	X	X	X						0%		Water catchment with streams supplying R. Nile originate here
	Ajumani	Zoka			X	X						0%		Core Biodiversity Forest with a unique flying squiral; water catchment (Zoka, Itiriwa, Esia, Lidwi & Dangani streams);
Lango	Apac	Aboke						X				0%		Fuelwood planation for tobbacco curing by BAT
	Apac	Acet						X				0%		Fuelwood planation for tobbacco curing by BAT
	Apac	Aduku North							X			0%		Planted with Mvule, cassia and Machamia spp.
	Apac	Aduku South							X		80	80%		Bodering wetland; Peri urban plantation; Mostly settled by locals & town expansion
	Apac	Alito								X	30	15%	100	Woodland reserve; partly settled
	Apac	Aloro					X					0%		Plantation by private farmers and NFA
	Apac	Aminakulu					X					5%	300	Plantation development by NFA; Moderate by IDP Camp & Locals

	Apac	Aminkec									2	1%		Woodland reserve; partly settled
	Apac	Aminteng					X					0%		Plantation development by NFA; Moderately grazed
	Apac	Aneneng					X					0%		Plantation development by private farmers
	Apac	Apac							X			100%		Whole forest by urban development
	Apac	Apworocero Arweny								X	96	20%		Woodland; Major encroachment by Locals; plantation development by NFA in Arweny
	Apac	Ayer (1959 Eucalyptus) & Ayer Bala Road						X				0%		Fuelwood planation for tobbacco curing by BAT
	Apac	Ayer Lira Road						X			40	50%		Encroached by Kole youth Groups
	Apac	Bala North							X		50	100%		Whole forest by urban development by Bala Catholic mission
	Apac	Bala South							X		78	5%		Planted with Mvule and Marchamia spp.; permanent buildings within the reserve
	Apac	Gung-Gung & Ojwiting								X				No information due to insecurity
	Apac	Gweri								X	29	5%		Woodland reserve; partly cultivated by the local communities
	Apac	Ilera								X	400	80%	400	Most covered by Agric & settlement; health centre
	Apac	Kulo-Obia			X						80	10%		Natural forest; Major encroachment by IDP & IDP
	Apac	Lela-Olok								X	100	50%		Woodland reserve; used by IDP & Locals
	Apac	Maruzi	X	X						X		0%		High biodiversity area
	Apac	Obel								X	360	50%	175	Moderate encroachment by IDP & Locals; P. school
	Lira	Alit & Ajuka								X			500	Woodland for plantation development; Alit mainly affected by grazing
	Lira	Along-Kongo								X		0%		Woodland forest, minor encroachment
	Lira	Atungulo								X		0%		Woodland forest, minor encroachment, plantation development
	Lira									X		0%		No information due to insecurity in Abuje, Abunga, Acwao, Adero ,Ayami ,Ayito, Epor, Okurango ,Olia, Ogur, Oliduro, Ongom, Otukei
	Lira	Kacung					X					0%		Private planting
	Lira	Lira	X						X		560	20%	800	Encroached by IDP & local communities
	Lira	Ngeta						X				0%		for poles and fuelwood
	Lira	Ocamo-Lum	X							X	300	20%	100	Woodland reserve; On the shore of L. Kyoga
	Lira	Telwa	X							X	20	30%	50	Watercatchment; 2 Primary school; a private farm

A. 3. Protected areas in southern Sudan

Three protected areas in Sudan border protected areas in northern Uganda: Nimule National Park, Imatong Forest Reserve and Kidepo Game Reserve. The biodiversity value of these areas is described below.

A) Imatong Mountains Forest Reserve

The Imatong Central Forest Reserve lies between $3^{o}40^{1}$ and $4^{o}20^{1}$N and $32^{o}30^{1}$ and $33^{o}10^{1}$E with altitude of 3187 m at the peak of Mt. Kinyeti. The reserve is 190 km south-east of Juba situated in the administrative region of Eastern Equatoria and contigious with Agoro-Agu Forest Reserve at the Ugandan border. The 1032 km^2 reserve was established in 1952 to ensure protection of natural forests. The Imatong Mountains cover a range of vegetation types including *Albizia-Terminalia* woodland and mixed *Khaya* lowland semi-evergreen forest up to 1,000 m, and by *Podocarpus* and *Croton-Macaranga-Albizia* montane forest at 1000-2,900 m (Jackson, 1956; Sommerlatte, 1985; Fishpool and Evans, 2001). Above the forest is covered by *Hagenia* woodland, *Erica* thicket and areas of *Oxytenanthera* bamboo. It receives an average annual rainfall of 1500 mm. The Imatong Mountains support a wide diversity of species. The site holds a number of endemic plant taxa including the only known *Zoothera guttata maxis* bird species. Part of the area has been proposed to be gazetted as a National Park and the remainder of the forest reserve is to remain a buffer zone. From Mount Lotuke a series of parks form a broken chain connecting this area with Mt.Elgon and the East African highlands including Morungole, Moroto, Napak and Kadam. The vegetation of Morungole has been noted to have considerable affinities with that of the Imatongs but Podocarpus forest is absent, the dominant species being *Dombeya goetzenii* (Thomas, 1943).

The Imatong Mountains are known for their high biodiversity including several endangered species. One thousand four hundred vascular plants (nearly half the total flora of Sudan) and 12 site endemics are known to occur (Jackson, 1956; Sommerlatte and Sommerlatte, 1988; Friis in prep.). The Savanna woodland supports 20 tree species and three shrub species, lowland bamboo (*Oxytenanthera abyssinica*), *Albizzia gummifera* woodland and *Acacia xiphocarpa* woodland (Jackson, 1956; Sommerlatte and Sommerlatte, 1990). In Talanga, Lotti and Laboni Forests, which constitute the Imatongs, 68 tree and 79 shrub species have been recorded including the endangered Cycad *Encephalortos septentrionalis* Schweinf which occurs on the dry side of the mountains above 1400 m (Jackson, 1958; Harrison and Jackson, 1958). The forest climax tree species are *Podocarpus milanjianus, Olea hochstetten* and *Syzygium* spp. The mammals reported to occur in the Imatongs with greater concentrations in Kipia uplands include the elephants (*Loxodonta Africana*), Bush buck (*Tragelaphus scriptus dodingae*), buffalo, Wild dog (*Lycaon pictus* Temminck), duikers (*Cephalophus caerulus aequatorialis* and *C.harveyi weynsi*), porcupines, bush pig, spotted hyaena (*Crocuta crotuta* Erxleben), striped hyaena (*Hyaena hyaena.* L.), Lion (*Panthera leo* L.), Leopard and Giraffe (*Giraffa camelopardalis.* L) (Jackson, 1956; Mammal Working Group, 1977). Other game include reedbuck, hartebeest, tiang, Grant's gazelle, Oribi, Guenther's dikdik, common eland, greater and lesser kudu, cheetah (Alipaya,1985; Hillman, 1985).

The Imatong Mountains and its companion ranges, the Dongotona and Didinga support approximately 566 bird species, of which 105 species are forest dependent (Fjeldså in press). The Imatong alone supports 36 forest dependent bird species. This places the Imatong Mountains area within the 'hotspot'of the 100 most species rich one-degree cells in Africa. One hundred fifty four mammal species have been recorded in the Imatong, Dongotonas and Didinga Mountains (Friis and Vollesen, inpress). Twelve species of frogs of widespread savanna form and 49 snake species are recorded in the Imatong Mountains area.

The Imatong Mountains, like any other protected area, has suffered considerable human impacts. It is inhabited by the Lotuko and the Lango people in the east and the Acholi in the west, who live on the plains at the foot of the mountains but are now being forced to move into the highlands in search of agricultural land. Already 100 settlements with a population of 35,000 people live in proximity with

the forest reserve boundary. The forest was severely affected by human impacts such as shifting cultivation and fires leading to savanna woodland from closed forest vegetation. Imatong and Lango peoples used to cultivate up to an altitude of about 2100m mainly in the area between Garia, Konoro, Gilo and Katire (Jackson, 1956). Cultivation on the steep slopes has led to serious problems of soil erosion while hunting pressure at the higher altitudes also increased (Fishpool and Evans, 2001). Cattle keeping on the north-east side of the mountains and in a few pockets in the Kinyeti valley used to take place. The eastern foot hills of the mountains were over-grazed. In Lotti forest, timber harvesting of mainly the *Khaya grandifoliola* and *Milicia excelsa* used to take place until 1937 when the forest was proclaimed an International Flora and Fauna Reserve.

Podocarpus milanjianus was harvested until 1940 for timber and poles. During the early 1980s, there were two development projects being implemented in the area: the Upper Talanga Tea Project (1,000 ha) at the west Acholi Mountains adjacent to Ateppi Basin and the Imatong Forest Company (10,000 ha) at Katire and Gilo, which were established inside the reserve. The forest was cleared in favour of exotic tree plantations and tea establishment. The tree species planted then were pinus, eucalyptus and cyprus (Alipayo, 1985). The Imatong Mountains National Park covering an area of 1000 km^2 had been proposed by the government. However, the civil war in the region has made further protection of the area impossible.

B) Kidepo Game Reserve

Kidepo Game Reserve which covers an area of 2000 km^2, is situated to the east of the Imatong Mountains on the Ugandan border and is contiguous with the Kidepo Valley National Park in Uganda. It includes the Dongotona Mountains to the west and the southern part of the Didinga hills to the east between which lies Kidepo Game Reserve, in the valleys of the Kidepo and the Omoro rivers extends north to the Torit-Kapoeta road (Jackson, 1951). The Game Reserve consisted principally of *Acacia* short-grass savanna with low ranges of rocky, scrub-covered hills, while the Dongatona Mountains and Didinga hills supported areas of forest and montane shrubland similar in composition to those of the Imatong Mountains but much smaller in area. The characterisitic tree species of savanna vegetation were *Terminalia brownii Grewia* sp and *Teclea sp* where as the forested area was mainly dominated by *Podocarpus* (Harrison and Jackson, 1958). Threatened or endemic mammals such as cheetah, *Acinonyx jubatus* (Vulnerable), and Elephant *Loxodonta africana* (Endangered) occur in this area. Didinga is heavily settled and plans for gold mining present a potential threat.

There seems to be no recent studies done to show the status of biodiversity, however, earlier reports (Jackson, 1951) indicated that the area used to support large numbers of mammals. For example, Wild dogs have been sited in the area and appear to move between KGR and KVNP in Uganda.

C) Nimule National Park

Nimule National Park is located between 3^o35^1 3^o49^1 N and 31^o48^1 32^o2^1 E in the extreme south of the country on the border with Uganda. The park was established in 1935 as a game reserve and upgraded into a National Park in 1954 (Sudan Government, 1954) specifically to protect the white rhino, which are now extinct. The White Nile forms the eastern border of the park and the buffer zone on the eastern bank is bounded by the Assua River to the north and by the Juba-Nimule road to the east. The Kayu River flows through the park from the Uganda border to the White Nile. The vegetation cover was mainly deciduous high woodland savanna consisting of the *Acacia* spp, *Balanites aegyptiaca* and *Combretum aculeatum.* The Riverine woodland found along permanent and seasonal watercourse was composed of *Acacia sieberiana and Borassus aethiopium.*

The Park is contiguous with Otzi Forest Reserve which is an Important Bird Area (Fishpool and Evans, 2001). Populations of the elephant (Endangered) have been severely reduced by poaching. Other species of conservation importance include the Uganda Kob, *Kobus kob,* Sitatunga *T.spekii* (Lower risk/near threatened), Oribi *Ourebia ourebi* and Reedbuck *Redunca redunca,* which are marked as lower risk/conservation dependants according to the IUCN Red list. A pilot survey of

Nimule National Park was conducted in November 2000 with an attempt to estimate the mammal populations. The results showed that elephants had been reduced from thousands to a mere 156 (New Sudan Wildlife Society, 2000) and the Uganda Kobs (1829) were the most abundant mammal species recorded (Table A4).

Table A4 Population estimates of large mammals in Nimule National Park, New Sudan

Species	Density/km2	Population estimate
Elephant*	0.61	156
Hippo	1.61	413
Uganda Kob	7.14	1829
Duiker	0.46	118
Warthog	1.04	265
Bushbuck	0.12	30
Oribi	0.12	30
Baboon	10.6	2713
Vervet monkey	2.07	531
Jackal	0.12	30
Hyrax	0.12	30
Total		6145

*Elephant number was estimated by use of dung method. Source: New Sudan Wildlife Society, 2000

Before the civil war, the population of Nimule and the surrounding villages was approximately 2000 people manly composed of fishermen, government employees and businessmen. In the year 2000, the population was estimated to be 40,000 (New Sudan Wildlife Society, 2000) most of whom were internally displaced persons (IDPs). The numbers have increased the pressure on the wild resources particularly due to excessive poaching, heavy fishing, harvesting of forest products and grazing around in the park. Many refugees were settled in the northern part of the park.

ANNEX 2. DATES AND IMAGES USED FOR THE CLASSIFICATIONS FROM LANDSAT 7 ETM AND LANDSAT 5 TM.

Sensor	Path	Row	Date
Landsat 7 ETM +	170	58	04 Sept 2002
Landsat 7 ETM +	171	57	26 Aug 2002
Landsat 7 ETM +	171	58	26 Aug 2002
Landsat 7 ETM +	172	57	12 Sept 2000
Landsat 7 ETM +	172	58	12 Sept 2000
Landsat 5 TM	170	58	10 Sept 1984
Landsat 5 TM	171	57	10 Sept 1987
Landsat 5 TM	171	58	01 Sept 1984
Landsat 5 TM	172	57	01 Sept 1987
Landsat 5 TM	172	58	20 June 1984

ANNEX 3. WOODY COVER CHANGE 1985-2002 IN CENTRAL (CFR) AND LOCAL FOREST RESERVES (LFR) OF NORTHERN UGANDA

Name of CFR	Decrease in woody cover (Ha)	% decrease in Woody Cover	Increase in Woody Cover (Ha)	Increased Woody Cover (%)	Area (Ha) of Unchanged Woody Cover	Unchanged Woody Cover (%)	Total Area (Ha)	Net Change in Woody Cover (Ha)	Net Change in Woody Cover (%)
Adero CFR	204	79	5	2	33	13	257	-199	-78
Ongom CFR	146	64	8	3	33	15	228	-138	-60
Adilang LFR	2	54	0	0	0	0	4	-2	-54
Alebtong LFR	7	52	1	6	2	13	14	-6	-47
Ololim LFR	3	51	0	6	0	6	6	-3	-46
Ilera CFR	79	49	5	3	15	10	160	-73	-46
Teiponga LFR	29	48	2	3	5	9	61	-27	-45
Abunga CFR	120	50	15	6	26	11	241	-106	-44
Pader-Palwo LFR	1	40	0	2	0	0	3	-1	-38
Amugo LFR	4	37	0	0	0	0	10	-4	-37
Telwa CFR	142	44	24	8	52	16	322	-117	-36
Moroto CFR	20429	41	3250	7	10368	21	49450	-17178	-35
Aloro (Ngonyeboke) LFR	3	41	0	7	2	22	7	-3	-35
Apala LFR	5	41	1	7	0	4	11	-4	-34
Bala (North) CFR	3	33	0	3	0	3	8	-3	-30
Abako LFR	1	30	0	0	0	0	4	-1	-30
Ngai LFR	1	36	0	9	0	0	2	0	-27
Alito CFR	8	37	2	9	1	6	22	-6	-27
Lela-Olok CFR	78	34	16	7	45	20	228	-62	-27
Aloi LFR	7	29	1	3	0	1	24	-6	-27
Ayito CFR	87	37	25	11	44	19	235	-61	-26
Orumo LFR	2	26	0	1	0	1	6	-2	-25
Epor CFR	75	33	23	10	38	17	226	-52	-23
Ngeta CFR	5	30	1	7	1	3	18	-4	-23
Ayer (Lira Road) CFR	4	30	1	9	4	28	15	-3	-21
Olia CFR	49	22	5	2	17	8	221	-44	-20
Okurango CFR	85	33	33	13	102	40	255	-52	-20
Omoro LFR	4	31	1	10	1	12	12	-2	-20
Paicho LFR	1	32	0	14	1	19	3	-1	-19
Acholi-Bur LFR	1	18	0	0	0	0	4	-1	-18
Olwal CFR	409	29	154	11	744	53	1416	-255	-18
Icheme LFR	5	30	2	12	6	34	18	-3	-18
Obel CFR	71	29	29	12	59	24	244	-43	-18
Alerek CFR	1980	26	716	10	1611	22	7494	-1264	-17
Adwari LFR	4	27	1	9	1	8	15	-3	-17
Bala (South) CFR	2	22	0	5	0	0	10	-2	-17
Ating CFR	317	25	108	8	574	45	1283	-209	-16
Usi CFR	103	23	39	9	240	54	445	-64	-14
Ayami CFR	92	27	47	14	86	26	337	-45	-13
Akileng CFR	128	21	47	8	31	5	619	-81	-13
Adekokwok LFR	2	20	1	7	0	1	10	-1	-13
Lwala CFR	947	16	256	4	783	13	5919	-690	-12
Aneneng CFR	72	27	41	15	104	39	265	-32	-12
Parabongo CFR	453	16	127	4	1813	64	2842	-326	-11
Kano CFR	1441	17	533	6	5539	67	8307	-908	-11
Ogur CFR	3	27	2	16	2	15	12	-1	-11
Orom LFR	1	10	0	0	0	1	7	-1	-10
Acet CFR	59	22	31	12	55	20	267	-28	-10
Nangolibwel CFR	4203	21	2319	12	9064	45	19922	-1884	-9
Opit CFR	1280	25	835	16	1786	35	5108	-445	-9
Ogili CFR	631	12	260	5	4026	75	5337	-371	-7
Koch-Goma LFR	1	18	1	11	1	14	7	0	-7
Lul Kayonga CFR	9	8	0	0	0	0	116	-9	-7
Kaabong LFR	3	7	0	1	1	1	46	-3	-6
Naam-Okora LFR	0	6	0	0	0	0	5	0	-6
Keyo CFR	167	21	123	15	181	23	797	-44	-6
Akur CFR	1051	17	699	11	3551	56	6349	-352	-6
Ragem LFR	8	16	5	10	35	70	50	-3	-6
Ojwiting CFR	71	26	56	21	73	27	271	-15	-6
Morongole CFR	2038	13	1300	8	4600	30	15580	-738	-5
Nyangea-Napore CFR	5151	12	3180	8	25883	61	42352	-1971	-5
Rom CFR	877	8	342	3	9012	83	10912	-535	-5
Jaka LFR	12	24	10	19	15	30	50	-2	-5
Acwao CFR	60	23	46	18	109	42	259	-14	-5
Ayipe CFR	201	22	166	18	265	29	902	-34	-4
Atan LFR	2	18	2	14	1	6	13	0	-4
Lotim-Puta CFR	135	7	72	4	82	4	1922	-63	-3
Apworocero CFR	59	24	51	21	47	19	245	-8	-3
Lalak CFR	151	7	127	6	1870	84	2237	-24	-1
Labongo LFR	0	1	0	0	0	0	6	0	-1
Aboke CFR	3	22	3	22	4	30	14	0	-1
Adjumani LFR	0	0	0	0	0	0	52	0	0
Kuluva LFR	0	0	0	0	0	0	3	0	0
Got-Gweno CFR	165	7	170	7	1864	82	2273	5	0
Nebbi LFR	0	0	0	0	0	0	12	0	0

Achaba LFR	0	13	0	13	0	4	2	0	0
Ayer (eucalyptus) CFR	0	0	0	0	0	0	4	0	0
Ayer (Bala Road) CFR	0	0	0	0	0	0	11	0	0
Palabek LFR	0	1	0	1	0	0	6	0	0
Otwal LFR	0	1	0	2	0	0	7	0	1
Timu CFR	1460	12	1707	14	992	8	12234	247	2
Laropi LFR	0	0	0	2	0	0	22	0	2
Utumbari LFR	2	2	4	4	3	3	84	2	2
Amuka CFR	75	7	97	9	921	82	1121	22	2
Gung-Gung CFR	54	17	60	19	59	19	311	5	2
Alungamosimosi CFR	1060	22	1137	24	457	10	4800	77	2
Agoro-Agu CFR	2152	9	2881	12	16250	66	24577	729	3
Odruwa LFR	0	0	1	3	0	0	20	1	3
Pakwach LFR	0	0	0	3	0	0	15	0	3
Aloro CFR	58	22	65	25	90	34	263	7	3
Zulia CFR	1728	2	4975	5	4153	5	92137	3247	4
Otrevu CFR	1	0	24	4	1	0	580	23	4
Napono CFR	582	15	718	19	1845	48	3805	136	4
Otukei CFR	188	9	260	13	1483	72	2058	72	4
Lul Opio CFR	3	1	14	6	50	19	257	11	4
Lira CFR	25	15	30	19	18	11	162	6	4
Lodonga CFR	1	1	6	5	0	0	112	5	5
Cwero LFR	2	17	2	22	2	21	10	0	5
Gwengdiya CFR	2	1	11	6	160	92	175	9	5
Labala CFR	38	2	144	8	1370	81	1694	106	6
Abera CFR	194	16	271	22	576	47	1219	77	6
Opaka CFR	36	17	50	23	33	15	216	13	6
Bobi CFR	1	15	1	21	2	23	7	0	6
Aber LFR	2	15	2	20	2	15	12	1	6
Barituku CFR	3	2	14	9	1	1	159	11	7
Suru CFR	6	2	36	10	4	1	378	31	8
Erusi LFR	0	0	2	8	0	0	24	2	8
Kitgum LFR	1	12	1	20	0	7	7	1	8
Lopeichubei CFR (DJM)	45	4	153	13	93	8	1142	108	9
Lukodi CFR	19	12	35	22	43	28	157	16	10
Lobajo CFR	0	0	13	11	0	0	118	13	11
Ogom CFR	106	13	195	24	131	16	809	89	11
Gulu CFR	1	1	13	13	1	1	101	11	11
Padibe LFR	1	17	2	29	0	5	8	1	12
Opok CFR	77	14	150	27	100	18	549	73	13
Iyi CFR	235	10	552	23	1139	47	2434	317	13
Nyagak LFR	3	6	8	19	12	27	42	5	13
Kilak CFR	309	3	1811	17	6402	62	10357	1502	14
Wadelai CFR	17	3	97	16	54	9	590	80	14
Pakelle LFR	0	0	1	15	0	0	9	1	15
Matidi CFR	30	12	71	29	63	26	248	41	17
Zoka CFR	111	2	1154	19	4681	76	6199	1043	17
Achwera LFR	0	0	4	17	0	0	24	4	17
Alui CFR	14	2	116	20	225	38	590	102	17
Abili CFR	0	6	2	24	1	12	7	1	18
Lamwo CFR	18	1	477	20	1904	78	2441	459	19
Lokung CFR	154	11	435	30	721	50	1452	281	19
Pajimu CFR	18	10	50	29	8	5	172	33	19
Awere LFR	1	21	3	40	1	14	7	1	19
Nyapea LFR	0	1	2	20	0	0	10	2	19
Eria CFR	0	0	111	20	0	0	548	111	20
Anaka LFR	0	0	1	20	0	0	4	1	20
Laura CFR	180	6	775	28	485	17	2781	595	21
Kulua CFR	18	3	160	25	17	3	629	142	23
Era CFR	6	0	1832	25	95	1	7467	1827	24
Lul Oming CFR	9	2	104	27	73	19	379	95	25
Lomej CFR	26	3	237	31	127	16	774	210	27
Pabbo LFR	0	0	2	28	0	0	8	2	28
Achwa River CFR	102	1	2585	30	158	2	8609	2483	29
Abiba CFR	6	0	604	30	46	2	2039	598	29
Luku CFR	122	3	1324	33	752	19	4025	1201	30
Paonyeme CFR	32	9	148	39	157	42	374	115	31
Atanga LFR	0	0	1	31	0	6	3	1	31
Atura LFR	1	9	5	40	1	11	12	4	31
Mt. Kei CFR	252	1	8201	34	1259	5	24011	7949	33
Wiceri CFR	131	2	2293	35	3956	60	6555	2162	33
Lagute CFR	22	6	137	39	144	41	351	115	33
West Uru CFR	23	8	122	41	91	31	295	99	34
Oliduro CFR	20	9	94	43	68	31	219	74	34
Ajupane CFR	17	4	189	39	120	25	483	172	36
Atiya CFR	5	2	83	40	11	5	210	78	37
Otzi (East) CFR	431	2	8235	45	2767	15	18113	7803	43
Omier CFR	25	1	1154	50	374	16	2328	1128	48
Aringa River CFR	0	1	23	50	23	48	47	23	49
East Uru CFR	12	3	253	52	107	22	483	241	50
Otzi (West) CFR	2	0	241	55	31	7	437	239	55
Aram CFR	2	1	109	73	24	16	148	107	72

ANNEX 4 FIELD DATA RECORDING SHEET

Name:							
Date:							
Waypoint No.	Vegetation type	Cover %	Understory	Canopy height	Photo	Notes	Radar Altitude

Field Data Recording Key

Vegetation Type	**Woody Cover**	**Understory**	**Canopy Height**
Woodland	60% +, 25-60%, 1-25%	Trees	<15m
		Grass	>15m
		Shrubs	
		Crops	
Bush / Thicket	60% +, 25-60%, 1-25%		
Grassland	60% +, 25-60%, 1-25%		
Palm woodland	60% +, 25-60%, 1-25%		
Riverine Forest	60% +, 25-60%, 1-25%		
Large Monoculture - name	60% +, 25-60%, 1-25%		
Mixed Crops - small farms	60% +, 25-60%, 1-25%		
Agroforestry	60% +, 25-60%, 1-25%		
Settlements	60% +, 25-60%, 1-25%		
IDP Camp	60% +, 25-60%, 1-25%		
Bare Rock	60% +, 25-60%, 1-25%		
Papyrus Wetland	60% +, 25-60%, 1-25%		
Grass Wetland	60% +, 25-60%, 1-25%		
Tropical High Forest	60% +, 25-60%, 1-25%		