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Farming in Tsetse Controlled Areas
FITCA

Environmental Monitoring and Management Component

E M M C

Project Number: 7.ACP.RP.R. 578

Assessment of land use, vegetation and human perceptions on environment on environment: Buyuba -Busiri (Namwendwa *Sub County, Kamuli District, Uganda*).

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Overview: FITCA Report

The regional project FITCA (Farming in Tsetse Controlled Areas) has a general objective to integrate tsetse control activities into the farming practices of rural communities such that the problem of trypanosomosis can be contained to the levels that are not harmful to both human and the livestock and are environmentally gentle and integrated into the dynamics of rural development and are progressively handled by the farmers themselves. The Inter-African Bureau hosts the project for Animal Resources of the African Union (AU-IBAR) and covers areas with small scale farming in Uganda, Kenya, Tanzania and Ethiopia.

EMMC (Environmental Monitoring and Management Component) is the environmental component of FITCA. It is implemented by ILRI in collaboration with CIRAD (as member of SEMG, Scientific Environmental Monitoring Group). This regional component has been charged with the responsibility of identifying of monitoring indicators and methodologies, as well as the development of an environmental awareness among the stakeholders. It contributes to propositions of good practices and activities mitigating the impacts and rehabilitating the threatened resources likely to result directly or indirectly of tsetse control and rural development.

The FITCA EMMC project was written by Dr. Robin Reid of the International Livestock Research Institute (ILRI) a future Harvest Centre supported by CGIAR (Consultative Group for International Agricultural Research).

The present report has been prepared under the responsibility of the leading group of EMMC:

- Dr Bernard Toutain, agronomist, coordinator
- Dr Joseph Maitima, ecologist

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General Introduction

Namwendwa Sub County is one of the FITCA -EMMC site selected mainly due to the high incidence of human sleeping sickness. According to reports from Namwendwa local council chairman there were about 23 deaths in less than two years (1999 and 2000) caused by human trypanosomosis. These records are the highest human sleeping sickness cases ever to be reported in Uganda.

Basoga people who are generally cultivators occupy Kamuli district. They grow maize both as a cash crop and a subsistence crop along with several other crops like sweet potatoes and cassava. Unlike the Teso people in Sororti district who grow cassava as cash crop, the Basoga grow maize as a cash crop and since maize is their staple food it also serves as the main source of food.

Buyuba Busiri was selected as a site FITCA EMMC land use mapping site because FITCA Uganda was implementing activities likely to have immediate environmental changes in the landscape. These activities are pasture development where they are introducing fodder crops like Napier grass. FITCA Uganda is also introducing oxen and ploughs for land preparation in Buyuba Busiri. These activities are likely to empower the farmers to till more land and thus reduce the amount of bush and fallow in the area. To create room for pastures farmers will have to reduce land under other crops leading to more intensive cultivation.

As seen in the maps in this report much of the land in the study area is already under cultivation. Although farmers still possess large pieces of land most farmers have cultivated all their land. Cultivation of maize as cash crop requires large farms in order to produce enough to sell because harvest per acre usually low. Harvest gets lower year after year because of repeated cropping on the same plots and low farm inputs. The problem of land is acute in the area at present and is going to escalate as the young generations that are the majority of the population take up their share of land to produce their own food and generate income for their own.

FITCA Uganda has already mobilized communities in the village to do communal spraying of livestock using insecticides. Although livestock disease (Nagana) was not

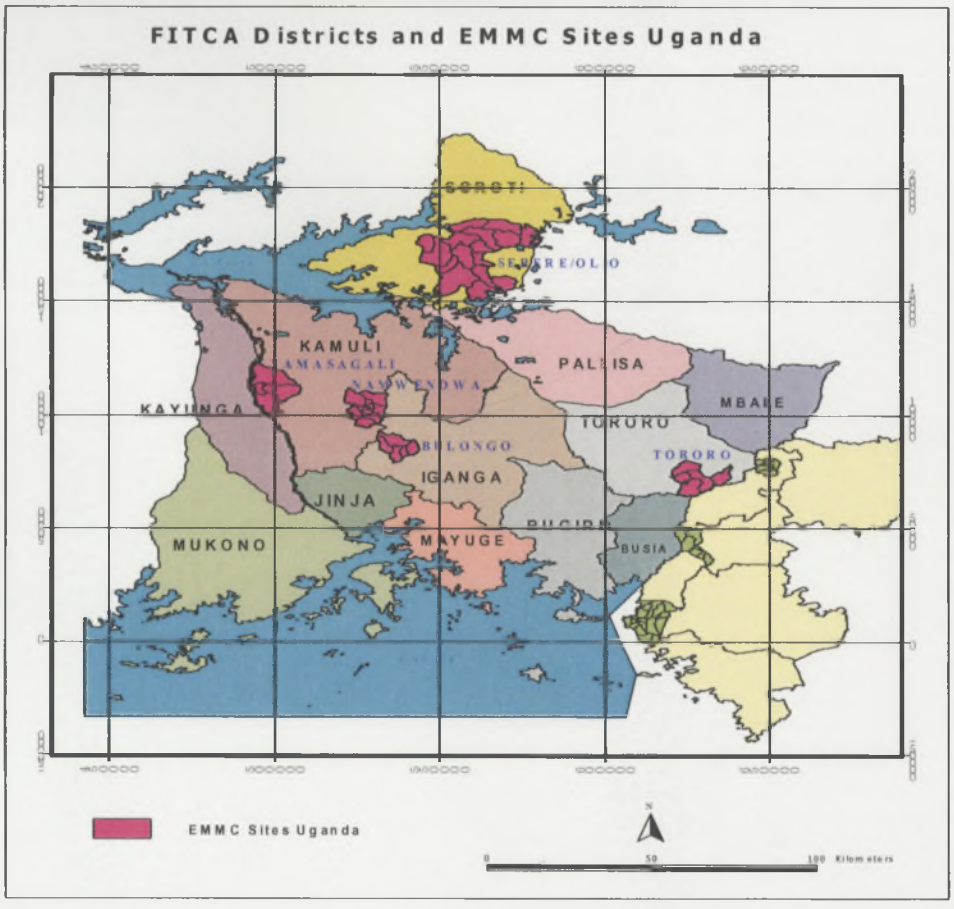
particularly a big problem, livestock is considered to be a host for tsetse and therefore a reservoir for the pathogens coursing human sleeping sickness.

Buyuba Busiri is located in a relatively wetter climate that receives moderate rainfall due to its location in the area that receives conventional rainfall from lake Victoria that is the major source of precipitation for the southern part of Uganda. Cotton growing had been introduced in the area but had declined due to poor markets. However, there has been a recent attempt to promote production of the cash crop to benefit from new opportunities in emerging markets. Currently only a few homes have started growing cotton. According Agro-ecological Zones and farming systems in Uganda, Kamuli lies under the zone describes as Banana-Robusta Coffee System which comprises of equable climate and evenly distributed rainfall on medium to high productivity soils. Vegetation is mainly forest/ savanna mosaic with pastures suitable for intensive livestock development. Banana, Coffee and maize are the main cash crops with root crops on the increase. Livestock is not generally integrated into the system but it can be an important source of income (World Bank 1993 and NEMA 1996.).

People, Occupation and Technologies

People in Kamuli belong to the Basoga tribe that is one of the major ethnic groups of Uganda. They occupy several other districts neighbouring Kamuli and all speak Busoga and are distant relatives of the Baganda the most populous tribe in Uganda. Basoga people practice mixed farming, cultivating crops and raring livestock but more as cultivators than livestock keepers. It is not known whether the less dependence on livestock is due to the problem of trypanosomosis or it is a cultural adaptation. Although poverty rate is high comparatively the Basoga are comparatively better placed than the Teso in Akoroi village (Maitima, et al. 2003)

Map 1: FITCA districts and EMMC sites Uganda



Objectives

The overall objective of FITCA project is to promote farming activities in tsetse controlled areas so that land use activities would maintain the flies to low densities and the prevalence of both animal and human trypanosomosis kept low. Tsetse infested areas are marginal areas where production systems operate at very narrow ecological ranges and are very susceptible to disturbance. As an example most tsetse control areas are characterized by medium to low and unreliable rainfall, poor vegetation cover, poor soils, and generally degraded lands. These areas have generally been neglected as low potential areas by the regional governments and as such there are no proper guidelines on how to use land in a sustainable way. Land use and settlement in these areas require an environmental monitoring in order to detect changes as they occur and a management programme to mitigate the negative impacts.

EMMC is therefore designed to fulfill this role. The initial objective of EMMC was to understand the environmental settings of FITICA project areas in the participating countries, design an approach to conduct environmental analysis in selected sites to provide baseline information for scaling up to landscape level analysis. This exercise is also aimed at providing data from which ecological constraints to agricultural production can be identified and communicated to the land users (farmers) in a format that they can understand in order to monitor and manage changes in their farms.

Hypotheses

This study is based on FITCA philosophy of using livestock as an entry point to rural development. In general FITCA promotes livestock development to improve food security keep reduce poverty along with other farming activities. FITCA operates in tsetse-infested areas where either or both human and animal trypanosomosis are prevalent and are a considerable constraint to farming. These tsetse and trypanosomosis infested areas are usually marginal lands where land based production systems operate within narrow ecological ranges beyond which environmental degradation prohibits realization of the expected economic benefits. This study is therefore designed to test several hypotheses. Some of these hypotheses are shown below:

1. Availability of animal traction will increase farmer's ability to till the land and therefore increase the cultivated area, reduce vegetation cover and change the composition, distribution and structure of plant species.
2. Increase in the number of livestock under zero grazing will increase demand for fodder and therefore more land will be used in feed production.
3. Improved profitability of livestock keeping will attract more people to keep livestock and therefore increase competition on the use of natural resources (land, plants, water and soil).
4. Since tsetse abundance is linked to specific habitats, successful trypanosomosis control measures will discriminately reduce those habitats thus depriving the ecosystem some of the goods and services derived from those habitats.

PART

I

GPS Mapping Report

Buyuba-Busiri Village
Namwendwa Sub County
Kamuli District
Uganda

EMMC/FITCA Study site
Uganda

2003

INTRODUCTION TO LAND USE MAPPING

The objective of Environmental Monitoring and Management Component (EMMC) is to develop an information system and methods for monitoring the direct and indirect effect of farming in tsetse controlled areas (FITCA). One way of monitoring is to determine land use and land cover patterns over space to provide a benchmark upon current situation can be understood and future changes can be deciphered. Mapping is done in away that it will allow detection of changes if the exercise is repeated at a later date. The map is designed to be a ground assessment for temporal remote sensing analysis on land use land cover over time.

The main objective in this ground GPS mapping is to capture the area and the distribution of various land use land cover at farm level. This will lead to deriving the required baseline indicators of land use change for the monitoring and management purposes. The information will also be used in training and classification of high-resolution satellite images for mapping the wider EMMC and FITCA study areas.

Namwendwa is one of the four EMMC study areas in Uganda located in Kamuli District of Uganda (*Map I -1*). It is highly settled and widely cultivated with a few scattered bushes and fallows. FITCA efforts in Uganda are mainly targeting reduction of Human trypanosomosis rather than livestock's (EMMC Report 2002). The area has one of the highest incidences of human sleeping sickness. FITCA is putting a lot of effort to control the disease by supporting the community to clear the bushes and supplying them with animals and tools for animal traction. The major indicators of change expected are conversion of fallows into grazing lands and farmlands.

STUDY AREA

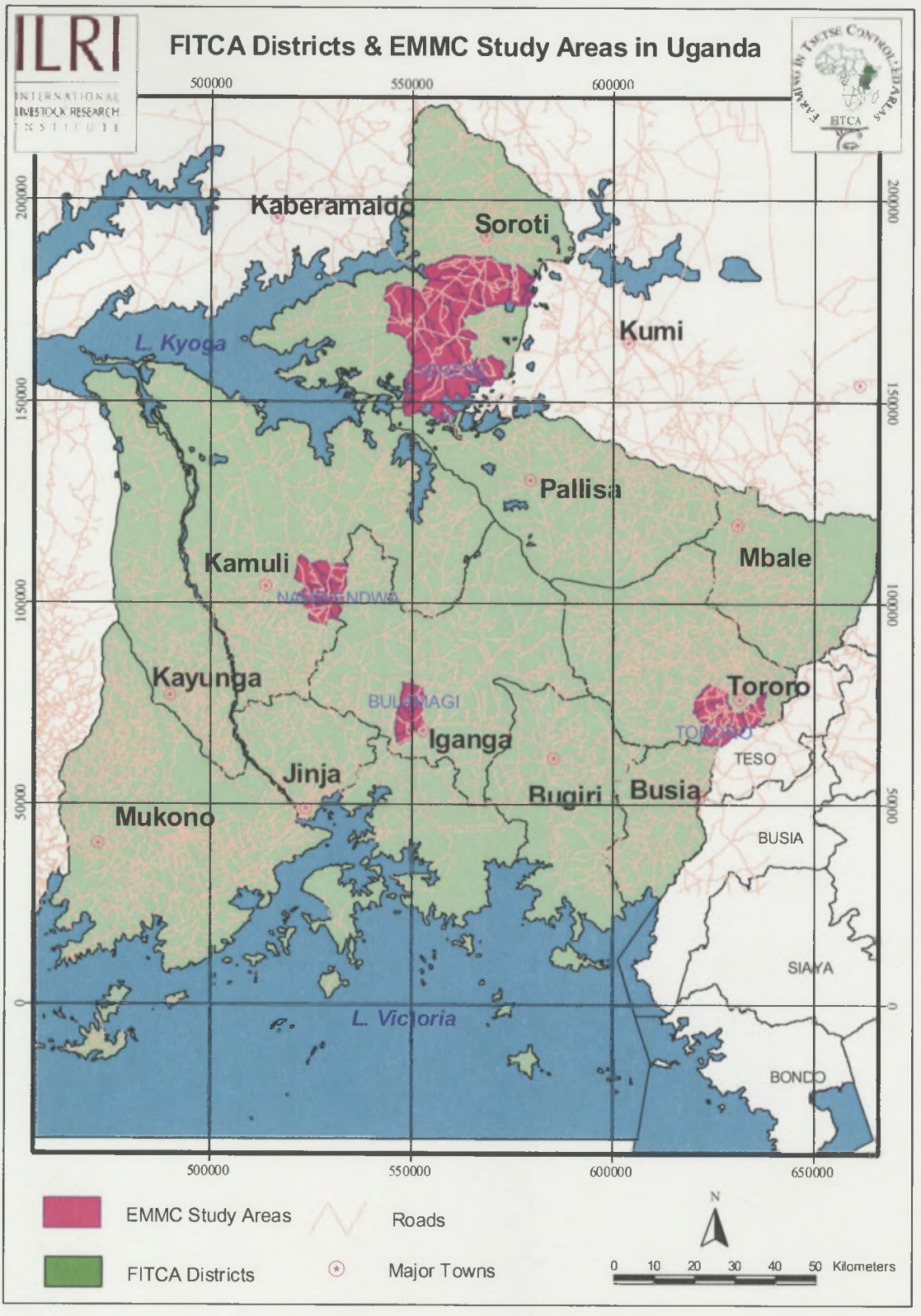
Buyuba -Busiri mapping site is located in Ndalike parish, in Namwendwa sub-county, in Kamuli district of Uganda (*Map I -2*). It is situated about 25 Km north east of Kamuli town and about 7 Km from Namwendwa county headquarters near Ndalike shopping center. The village is highly populated with a density of about 150 people per Km^2 (*Table I -1*).

Table I -1: Human population numbers in Ndalike and neighboring parishes

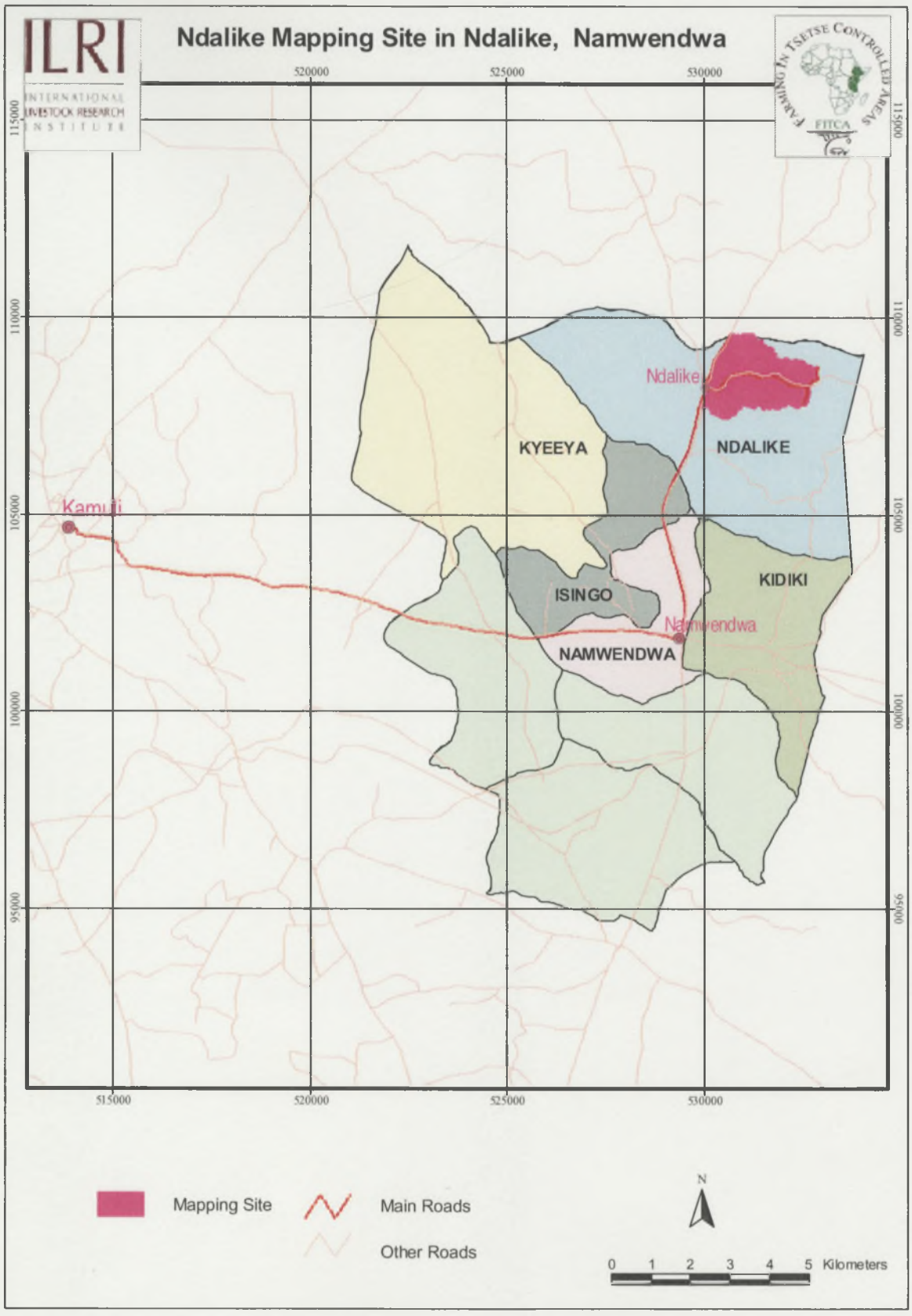
Parish Name	**Area Km^2**	**Male**	**Female**	**Totals 1991**	**Density / Km2**
Ndalike	31.24	2,303	2,378	4,681	149.84
Kyeeya	33.06	2,700	2,819	5,519	166.94
Isingo	10.20	957	1,010	1,967	192.84
Kidiki	14.75	1,552	1,669	3,221	218.37
Namwendwa	10.03	1,361	1,506	2,867	285.84

Source: Population census Uganda, 1991

Map I -1: EMMC Study Areas Uganda



Map I -2: Mapping Site Ndalike Kamuli



FIELDWORK

The mapping was accomplished by using hand held Global Positioning Systems (GPS) as explained in the methodology report. The work was done by seven people including six locally recruited trainees and was done for a period of ten days between 7th July and 16th July 2003. The first two days were spent training the recruited assistants on GPS application and manipulation in land use mapping. The remaining days were used for actual data capture and storage. Monitoring and verification maps were being printed using a portable printer every evening after the work in the sites. This reduced delays experienced in Soroti and Busia fieldworks where maps had to be printed in computer shops in the nearby towns every morning before the start of work. There was no mobile phone network in the village and it was quite difficult to contact each other during the mapping work. We operated on two vehicles for transporting personnel within the site and at least this assisted in faster communication even without mobile connection.

Fieldwork took place during the month of July when farmers were about to start harvesting maize and other crops. Maize crop was the dominant type of cultivation and was high hence reducing the visibility within the fields. This created problem in identifying and mapping smaller land use cover types or other mixed classes within the bigger maize fields. We tried as much as possible to avoid this problem of omission by walking inside the extensive fields looking for any missed types or mixed classes.

RESULTS

An area of 4.1 Km^2 was mapped within Buyuba-Busiri village of Namwendwa sub-county. A total of 305,850 meters (305 Km) were walked to map a total of 1150 polygons of various land use and cover types within. The main classes identified included cultivated areas, built up areas and the natural areas.

The major land use classes are shown in (*Table I -2 and Figure I -1*) and the detailed cover classes are shown in (*Table I -3 and 4*) and the corresponding maps.

Cultivated areas or cropland (68 %)

Cultivated areas covered over 68 % of the total mapped land. Out of this, maize was the most extensive with over 35 % cover of the total and contributing about 50 % of the cultivated lands. Maize was intercropped with most of the other annual crops and was grown even within the perennials such as coffee and bananas and within homesteads. Other major crops grown included coffee, banana and sweet potato contributing about 30 % of the total surveyed area. Sweet potato was the next most extensive food crop after maize occupying about 10 %of the total. Coffee farms were mostly neglected and they existed as a mixture of bushes, trees or woodlots. Cassava is also grown mostly intercropped with maize.

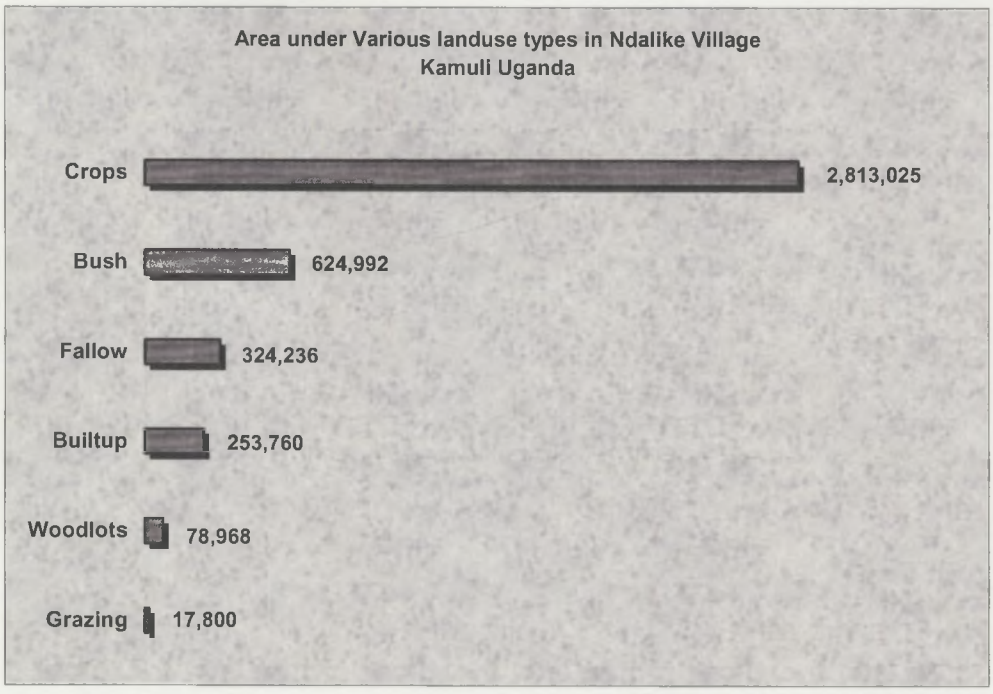
Built up Areas (6 %)

Buyuba-Busiri is a highly settled area. The built up areas were made up of mainly homesteads and two shopping centers. The homesteads consisted of houses, coffee, fruit trees and woodlots. There were also other food crops within the homesteads such as maize, beans, cassava and sweet potato. The homesteads are mostly distributed along the main tracks with a much more efficient utilizing of land for building houses. This has reduced land fragmentation leaving most of the land away from roads for cultivation. There are no fences or hedges around the homesteads or the farms making the mapping work easier.

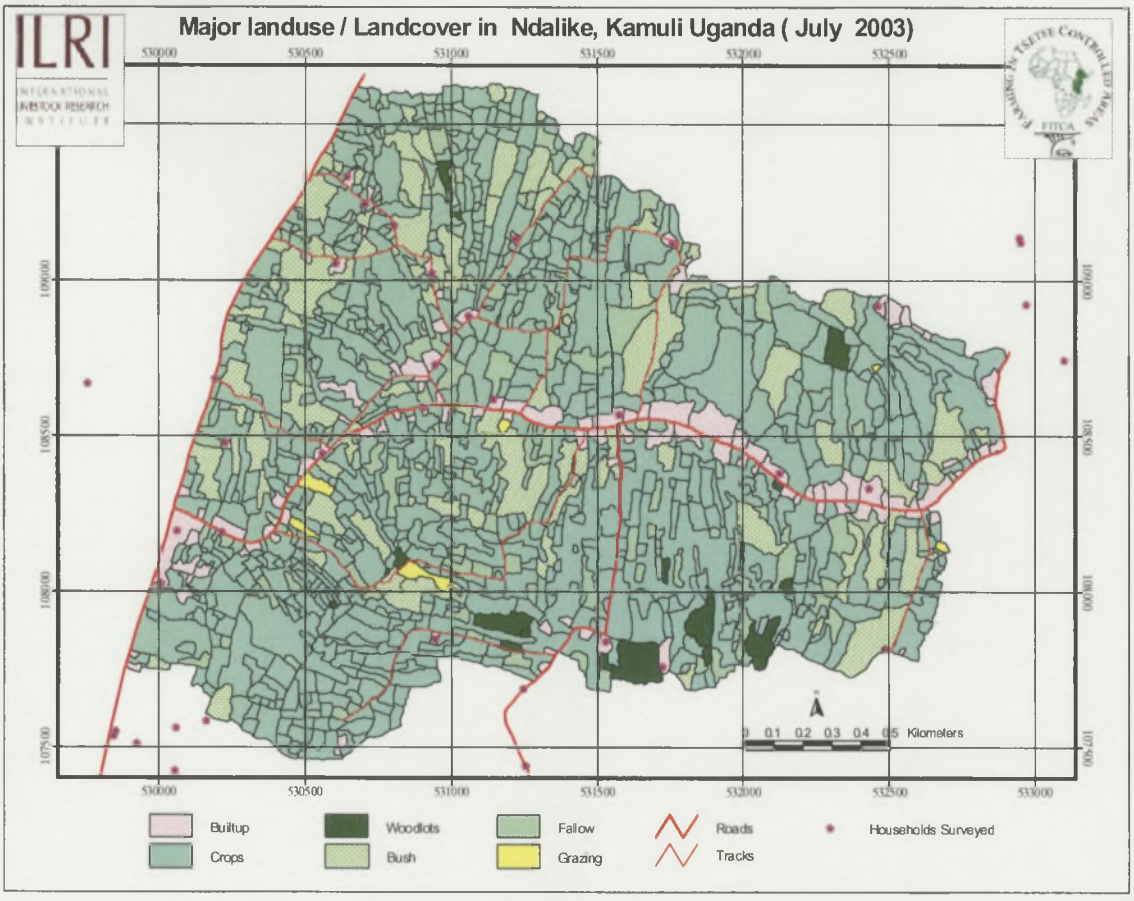
Table I -2: Major Land use area cover (Buyuba-Busiri, Kamuli)

Class	Count	Area (Meters)	Ratio of total	Percent of total
Grazing	7	17,800	0.0043	0.43
Woodlots	18	78,968	0.0192	1.92
Builtup	119	253,760	0.0617	6.17
Fallow	134	324,236	0.0788	7.88
Bush	103	624,992	0.1520	15.20
Crops	769	2,813,025	0.6840	68.40
	1,150	**4,112,780**	**1.0000**	**100.00**

Figure I -1: Bar graph of area cover of major land use types



Map I -3: Major Land use Classes in Ndalike



Natural areas (25 %)

Natural areas were dominated by small pockets of bushes covering about 15 % of the total scattered allover the study area. This class was a mixture of pure closed bushes (*lantana camara*) and more open bushes having a mixture of woodlots and open grazing areas. Bushes are also to be found within the neglected coffee farms though these were classified as coffee crops. The next major class was the old and young fallows with mixtures of trees and other herbaceous plants. Finally this category also consisted of a few grazing areas and natural woodlots.

Map I -4: Detailed Land use Classes Ndalike

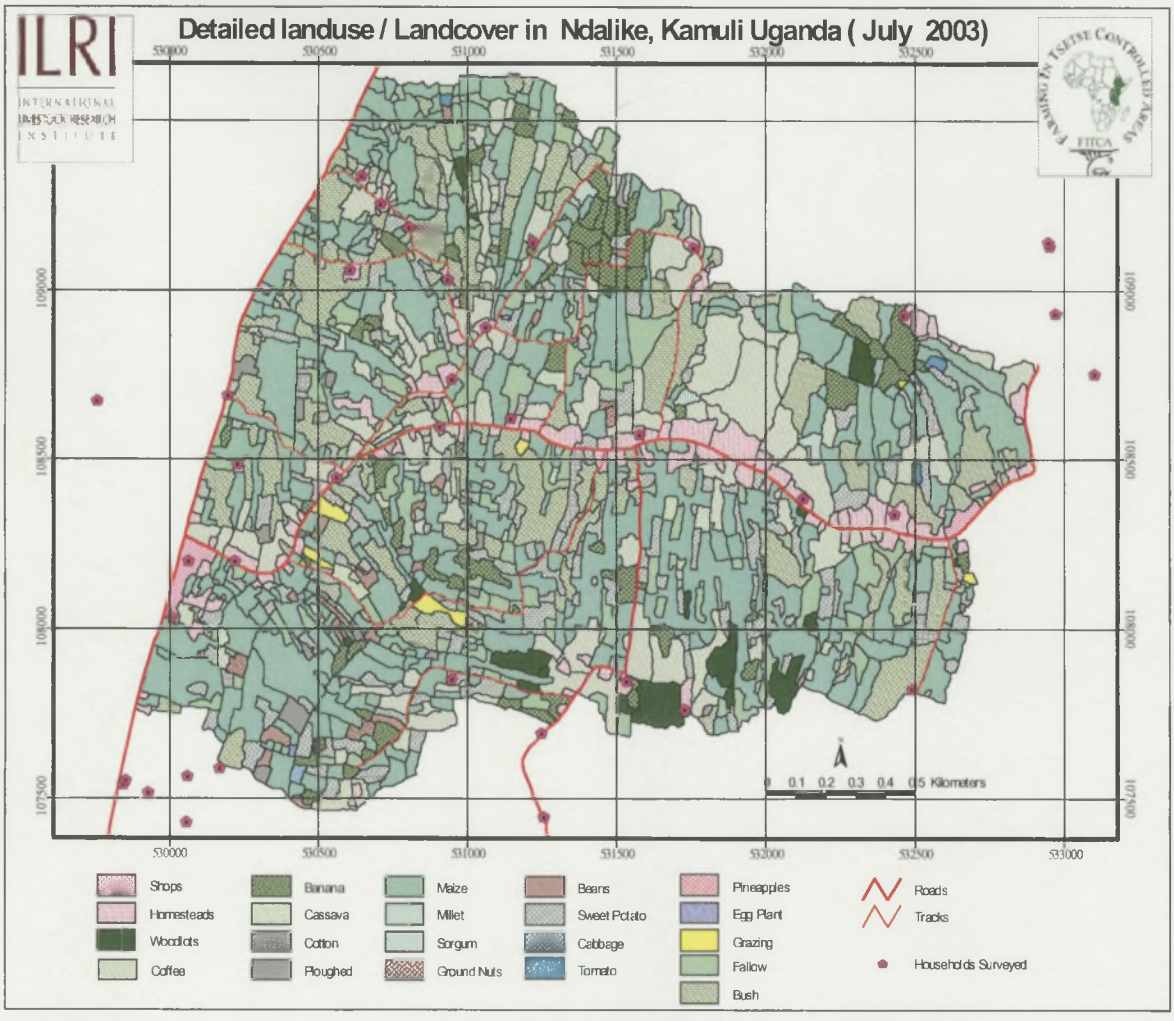


Table I -3: Detailed Land use area cover Buyuba-Busiri

Landuse Class	Count	Area (Meters)	Percent of total	Average Area	Minimum Area	Maximum Area
Egg Plant	1	758	0.02	758	758	758
Pineapples	1	1,378	0.03	1,378	1,378	1,378
Cabbage	1	2,297	0.06	2,297	2,297	2,297
Sorgum	1	3,373	0.08	3,373	3,373	3,373
Tomato	3	5,368	0.13	1,789	1,275	2,217
Millet	5	9,437	0.23	1,887	608	4,384
Ground Nuts	10	16,768	0.41	1,677	426	3,705
Grazing	7	17,800	0.43	2,543	362	6,441
Shops	2	21,255	0.52	10,628	5,903	15,352
Cotton	8	28,668	0.70	3,584	1,331	8,802
Beans	22	28,938	0.70	1,315	209	3,832
Ploughed	20	32,651	0.79	1,633	376	6,627
Cassava	30	50,031	1.22	1,668	366	5,467
Woodlots	18	78,968	1.92	4,387	303	19,320
Banana	73	211,244	5.14	2,894	265	13,393
Homesteads	117	232,505	5.65	1,987	171	14,050
Fallow	134	324,236	7.88	2,420	277	14,735
Sweet Potato	195	382,457	9.30	1,961	208	7,965
Coffee	115	577,782	14.05	5,024	589	42,217
Bush	103	624,992	15.20	6,068	281	38,865
Maize	284	1,461,877	35.54	5,147	127	108,707
	1,150	4,112,780	100.00	3,067	127	108,707

Ground Survey Change indicators

The important parameters that can indicate change over time include the variation in terms of percentage cover between; natural areas/cultivated areas; area under perennial crops/annuals; size of farm fields and many others. These indicators combined with other complementary indicators derived from remote sensing and vegetation surveys are to be used to evaluate the environmental change over time (EMMC Report 2002). In this baseline survey, the total land area mapped was 4,112,780 m^2 (4.1 Km^2). The cultivated areas, which include annual and perennial crops, occupy about 68 % with annual and perennials crops occupying 38% and 30% respectively (*Table I -4*). The natural areas occupy over 25% with the remaining 6 % for settlements and other infrastructures.

Table I -4: Ratios of Natural and Cultivated areas

Land use Class	Area (Meters Square)	Percent of total	Re-class
Shops	21,255	0.52	Built up
Homesteads	232,505	5.65	Built up
Builtup	253,760	6.17	
Grazing	17,800	0.43	Natural
Woodlots	78,968	1.92	Natural
Fallow	324,236	7.88	Natural
Bush	624,992	15.20	Natural
Natural	1,045,995	25.43	
Egg Plant	758	0.02	Annual
Pineapples	1,378	0.03	Annual
Cabbage	2,297	0.06	Annual
Sorgum	3,373	0.08	Annual
Tomato	5,368	0.13	Annual
Millet	9,437	0.23	Annual
Ground Nuts	16,768	0.41	Annual
Cotton	28,668	0.70	Annual
Beans	28,938	0.70	Annual
Ploughed	32,651	0.79	Annual
Maize	1,461,877	35.54	Annual
Annuals	1,591,511	38.70	
Banana	211,244	5.14	Perennial
Coffee	577,782	14.05	Perennial
Cassava	50,031	1.22	Perennial Semi
Sweet Potato	382,457	9.30	Perennial Semi
Perennials	1,221,515	29.70	
Cultivated	2,813,025	68.40	
Grand Totals	4,112,780	100.00	

Table I –5: Calculated X and Y Shifts

	X Y Before Download	X Y After Download	X Y Shifts	Average X	Average Y
X	531179	531259.86	-80.86	-81.055	309.46
Y	108519	108209.49	309.51		
X	532416	532497.25	-81.25		
Y	107818	107508.59	309.41		

Part

II

Analysis of vegetation composition, diversity and structure in Busia township tsetse control area, Kenya

Buyuba Busiri Village

Kamuli District

Uganda

EMMC/FITCA Study Area

Uganda

INTRODUCTION

Kamuli district and Namwendwa Sub-County in particular was identified as one of the sites for implementing environmental monitoring of the FITCA project (site STC reports- Lacroix *et. al.* and Maitima *et. al.*). Reasons for selecting this sub county of Kamuli district were based on the prevalence of human sleeping sickness in the sub county that was the highest in the country. According to medical records in the local health centers there are 23 confirmed casualties of death in a span of less than two years. Since there are many undiagnosed deaths in the villages, it is thought that the number of casualties could be much higher than recorded in the health centers. This selection was also guided by a decision by Uganda FITCA project to put more emphasis on human trypanosomosis, as it was a big threat to livelihoods.

However, during the time when consultants were evaluating and recommending sites for implementation of EMMC it was not clear which specific villages within Namwendwa environmental analysis should be done to provide indicative data for environmental monitoring. One reason for not selecting a specific village at that time was the need to link EMMC activities with FITCA project activities that had not been formulated by that time. By the time EMMC consultants report on site selection was prepared, FITCA Uganda was in the process of designing activities for different regions.

During the period for this survey, consultations and discussions were made on the activities underway for Namwedwa in order to identify areas to implement EMMC activities. At the same time a reconnaissance survey was done within the sub county to identify environmental situations and assess areas where tsetse control interventions may have a most severe environmental impact. Within Namwendwa, Ndalike parish had been earmarked for two interventions that require environmental monitoring. These two interventions are: 1) pasture and animal feed development; 2) promotion of animal traction. According to interviews with Namwendwa Sub-County Chairman (EMMC team visit to Namwendwa Administration on Monday July 6th 2003) Ndalike parish was the most affected by trypanosomosis within Namwendwa. Following these consultations and discussions with stakeholders it was decided to locate EMMC ecological and land use-mapping activities in Buyuba Busiri village.

Site-specific introductory issues

Buyuba Busiri is located east of Namwendwa shopping center and some 25 kilometers from Kamuli Township. The area is highly cultivated with only scanty areas with bush cover. The village like other parts of Namwendwa and probably the entire Kamuli district is without natural undisturbed vegetation due to cultivation. Cultivation is mainly digging and weeding by hand using a hoe and panga respectively. Crops grown are mainly maize, sweet potatoes, and with scattered patches of land with cassava. Around most homesteads there are gardens with bananas, often intercropped with coffee. In almost all cases where fallow exists there were coffee trees neglected in the bush as old fallow. Based on field assessments of the productivity during the field land is highly fertile as demonstrated by maize harvest in the previous and current seasons. While maize is the main cash crop in the area, a few farmers were planting coffee during the time of the fieldwork for this study.

FITCA Uganda had identified some 10 farmers who were to clear 3 acres of bush each to plant pasture seeds for animal feed. The project is to supply the seeds to the farmers for planting. This will give rise to 30 acres of managed pastures within the village. It is expected that other farmers will learn and obtain seeds from the 10 farmers so that in the successive seasons more land will be under managed livestock pastures. Out of the 10 farmers participating in pasture development, 5 will supplied with 2 oxen and a plough each by FITCA for use in promotion of animal traction. Again it is expected that this will have a multiplier effect in the successive seasons and years.

PURPOSE OF STUDY

Like in other EMMC sites (Busia, Soroti reports) the purpose of this study was to develop an ecological basis upon which an environmental monitoring system can be developed to sustain farming activities after tsetse control. Buyuba Busiri is highly cultivated and after FITCA interventions changes may lead to intensification of land use activities.

Ecological changes associated with land use intensification include loss of soil fertility as land is not allowed to fallow, and loss of above ground biodiversity. These changes affect productivity in a gradual process such that a farmer will realize the negative impacts only

when it is too late for an economical intervention. This is in deed the case in semi-arid areas like FITCA regions where environmental processes operate under narrow ecological limits of economic viability.

The long-term objectives of this study are therefore to identify and define these limits with a view of developing a framework for ecological interventions to maintain and sustain agricultural production in FITCA areas. In more short terms this study is aimed at developing an ecological baseline or an environmental profile upon which future changes can be assessed.

METHODS

The location of sampling plot for vegetation and landscape analysis was selected on site based on landscape form, land use characteristics and the distribution of natural vegetation in the region.

A total of six sampling plots comprising of two in natural non grazed habitats, two in natural grazed habitats and two in cultivated habitats, were selected each consisting of 1 hectare in area. The plots were selected at random and nested in land cover categories.
Each plot was further divided into four (4) grids in a row each measuring 50x50m giving rise to a plot measuring 50x200m. Vegetation characteristics in the form of species types, composition and abundance in each of the three life forms (trees, shrubs and herbs) were analyzed and recorded in standardized field data sheets.

Study on plant species diversity was done using standard quadrat sampling methods. The study was done in the three life forms and canopy stratifications i.e., tree, shrubs, and herbs. Sampling of trees was done using 50x50m quadrats, shrubs by use of 25x25m quadrats and herbs by use of 1x1m quadrats.

All the four 50x50m quadrats in the plot were analyzed for tree species. In each of the four grids / tree quadrats one 25x25m quadrat was sampled for shrub species. The ten 1x1m quadrats were sampled two in each of the four quadrats and the remaining two were made on the dominant land cover or land use in the area. In each of the quadrats studied information on species present was collected as per life form. Estimates on percentage cover per quadrat for each species present was made by visual observation and expressed as a percentage of the total quadrat area. The above ground height of each individual plant in the quadrat was estimated visually.

Fig II –1 Photo showing a tsetse trap in the area where cattle graze

Fig. II –2: *Sampling plan*

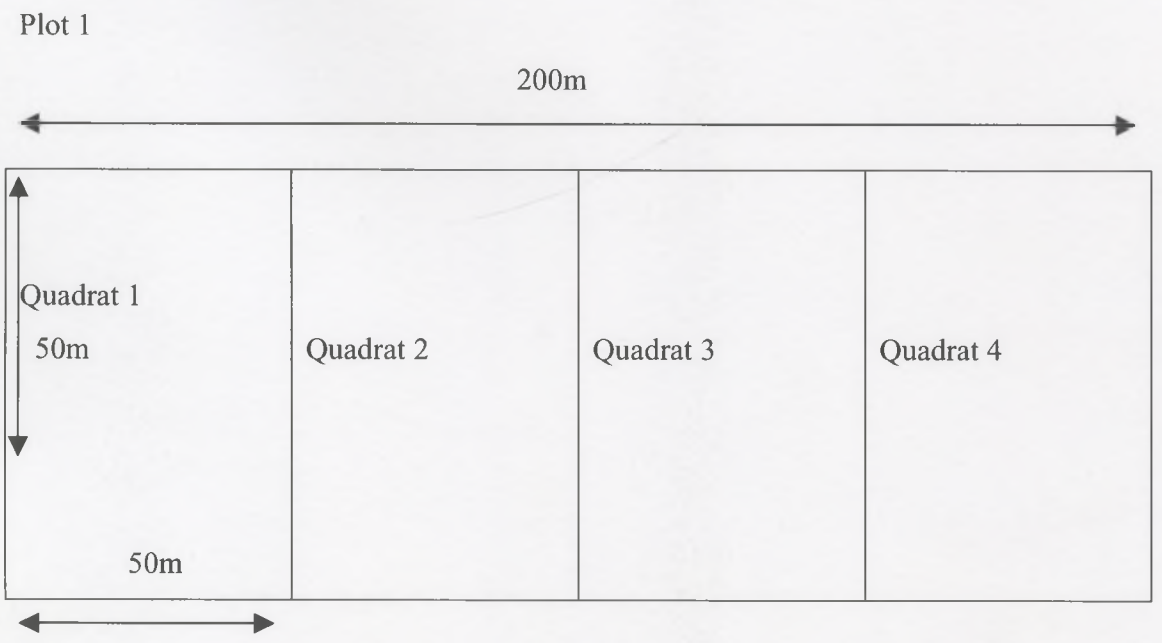


Fig. II –3: *Photo showing charcoal burning*

RESULTS

Vegetation data from the field were computerized into a database showing the names of plant species sampled, counts of each species in a the quadrat, heights of each individual plant counted and the relative percentage cover for each plant. This database has been used to determine various aspects of plant biodiversity. Apart from providing baseline information for future analysis of land use change impacts on vegetation, the database will provide information on the present status of plant composition, structure and functions in the study area.

The results presented here are part of the analysis that are being done on this data base to assess the impacts of current land use practices on vegetation with a view of acquiring information on how sustainability of farming practices in the area can be enhanced especially after the current FITCA interventions start to influence land use.

Fig II –4: Quadrats sampled in various land use types

QUADRATS SAMPLED IN VARIOUS LAND USE TYPES			
Land use type	Herbaceous	Shrubs	Trees
Bush	10	7	7
Cultivation	30	20	11
Fallow	12	4	5
Grazing	6	1	1

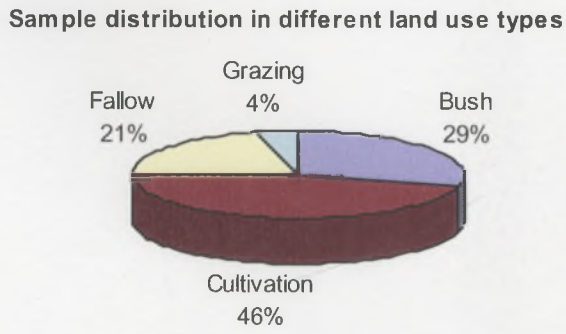
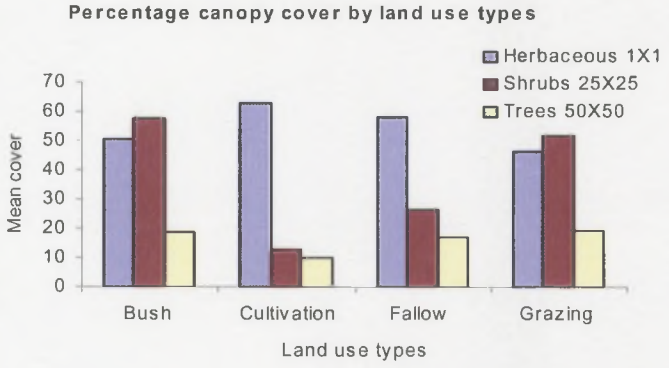


Fig. II –5: Sample distribution in different land use types

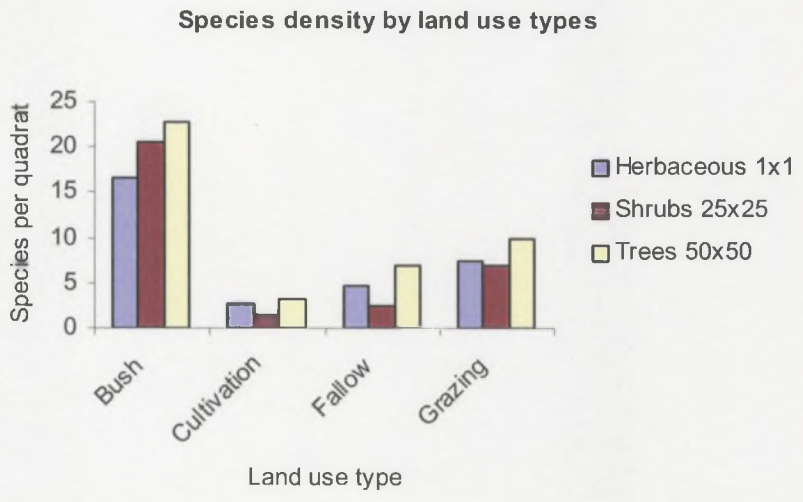
This figure shows the proportions of the areas sampled in Buyuba-Busiri Village of Kamuli. The proportions reflected in this diagram do not indicate the importance of the land use in the area but rather the distribution of samples in the sample size. The sample size was determined by the diversity of landscapes within a particular land use.

Fig. II –6: Percentage canopy cover by land use types



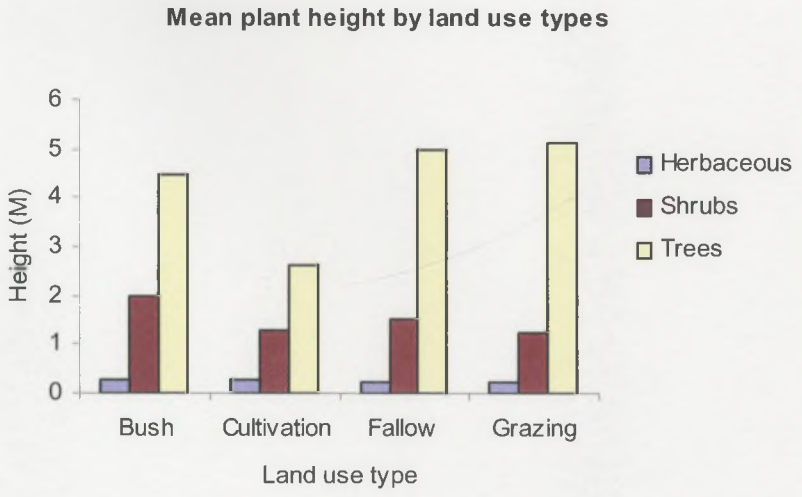
This diagram shows the percentage cover of different species per land use type. The most dominant land cover in the area is cultivation. Within cultivations tree cover is very minimal accounting for less than 10 % of the total vegetation cover in the area. However, tree cover is generally low in all the land use types in the area. Perhaps of more significant variant between the land use types is the cover by shrubs. Shrubs cover in the cultivation is approximately 10% about 25% in the fallow while in the bush and grazing it is over 50%. Herbaceous appear to be common in all land use types.

Fig. II –7: Species density by land use types



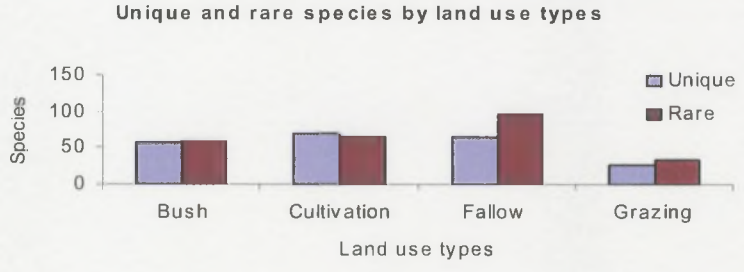
This report again shows that cultivation has the lowest density of plant species. Areas left as bush have the highest density of plant species. Since there are no bushes that are not disturbed this observation indicates that vegetation within the bushes is young as there may be no dominance of canopies by certain species.

Fig. II –8: Mean plant height by land use types



This graph shows that land use change has no effects on herbaceous vegetation but has a very slight effect on the heights of shrub species. The height of trees however, appear to be lowest in the cultivations and highest in the bush. It is also observed that the height of trees is not beyond 5meters in height. This indicates that trees are not let to mature to full heights due to heavy harvesting for construction, firewood and burning of bricks.

Fig. II –9: Unique and rare species by land use types



Unique species are those that occur in adjacent quadrats while rare species are those that are observed not to occur in the adjacent sampling areas.

The figure above shows that species in the grazing area are more even in species types that in the bush and cultivation. Fallows have more rare species than any other land use perhaps due to regeneration of vegetation during the fallow period. The proportion of unique to rare species is highest in the fallow perhaps due to less disturbance.

DISCUSSIONS

Kamuli landscape is dominated by cultivations. Most of the area consists of individual farms that are seasonally cropped with different types of crops. The main crop however, is maize, nuts, sweet potatoes and cassava. Sorghum is planted but in a very small scale.

Vegetation in the cultivated areas comprises mainly of herbaceous species and few shrub species in areas where cropping has not been done, and in areas along the roads and streams. A unique feature in the area is the observation that there are no trees in the cultivations. Most farms are bare of tree cover. This may be attributed to the fact that growing of maize does not require shade. According to farmers in the area maize does not do well when planted under the shade of trees. The only shades that seem to be tolerated are those from fruit trees mainly mango trees (*Mangifera indica*).

There were areas seen with tall trees but charcoal burning was rampant as shown in the photos of charcoal burning practice and heaps of logs being prepared for charcoal burning.

The lack of adequate tree cover in Kamuli might worsen as people adopt to the use of oxen in ploughing. Experience from areas where animal traction is used in ploughing point to the fact that trees are obstacles to animal motion when ploughing especially the indigenous species that may not be in rows. It is therefore possible that when oxen become more available and ploughing with oxen become more popular some of the trees currently in maize plantations will be cut to reduce obstruction.

PART

III

Human Perceptions on Environmental changes

HOUSEHOLD INFORMATION

Age of Household Head

The most frequent age category for the household heads was 31-35, and surprisingly was constituted only by husbands. The other age categories were 36-40, 46-50, and 51-55, all with correspondingly lower proportions of wives. The age classes of 26-30, 56-60 and 61-65 constituted only husbands. At a national level, the majority of household heads are in the age group of 26 – 49 years (Uganda National Bureau of Statistics, 2003). These findings are shown in *Figure III -1.*

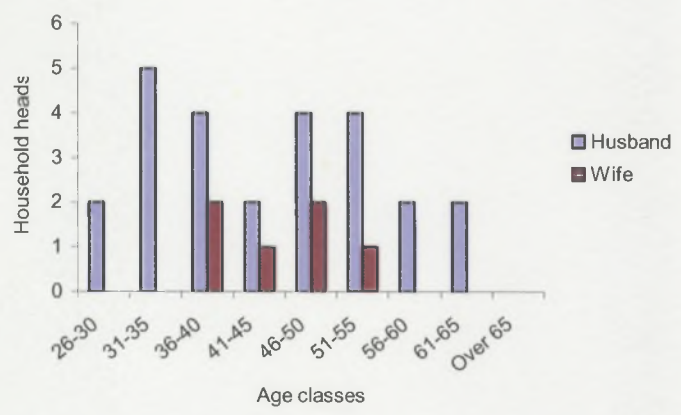


Fig. 1. Age of household heads in Buyuba-Busiri village, Kamuli District

Education level of household heads

Primary level education is the most common educational attainment for both husbands and wives. Less than five households had heads with secondary and post secondary levels of education. Similarly, less than five households had heads with no education at all, and there more wives than husbands in this category. The education levels of household heads will increase in future as a result of the current government policy of free primary education. These findings are shown in *Figure III -2.*

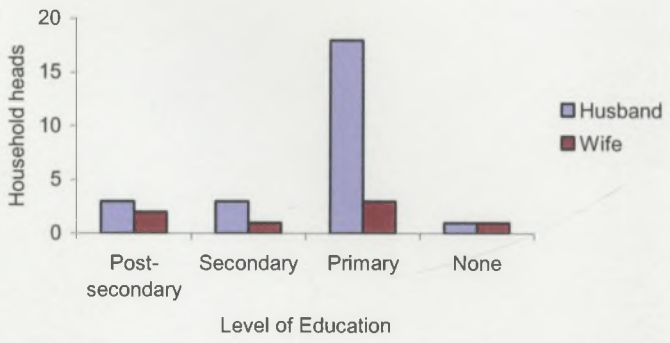


Fig. III-2. Education level of household heads in Buyuba-Busiri village, Kamuli District

Duration of stay by households in the area

Most of the households have stayed in the area for over twenty years, while less than five households have lived in the area for 10-20 years and approximately the same number have stayed in the area for less than 10 years. These findings are shown in *Figure III -3.*

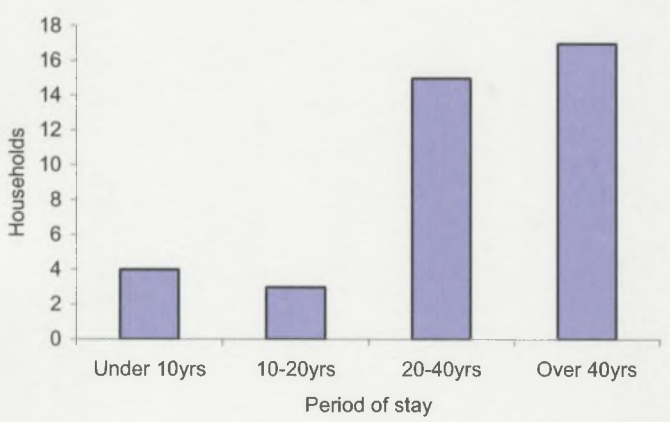


Fig. III-3. Length of stay by households in the area in Buyuba-Busiri village, Kamuli District

LAND USE ACTIVITIES

Main Occupation

The main occupation of the household heads for the last ten years was farming. However, farming as an activity has increased in the last ten years while employment and trading have declined. Surprisingly, school attendance was only an activity of the past and is not currently important. These findings are shown in *Figure III-4*. Eighteen households practice mixed farming, sixteen-practice crop based farming while less than five-practice animal based farming These findings are shown in *Figure III-5*.

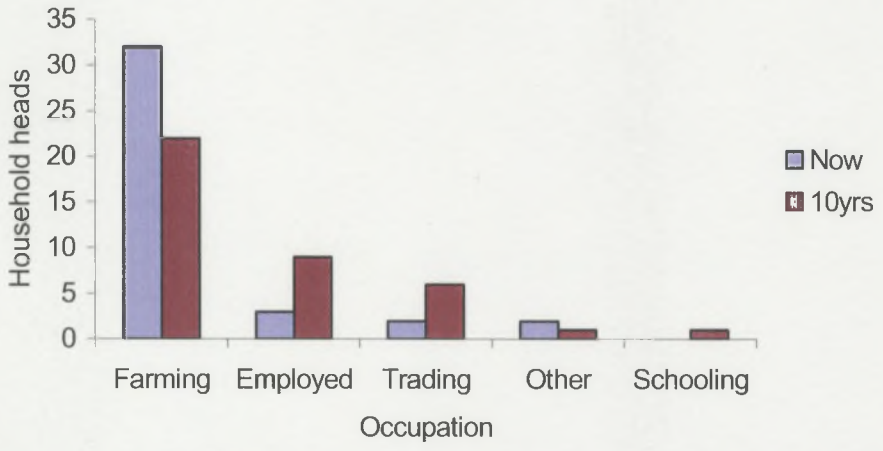


Fig. III- 4. Main occupation of the household heads now and ten years ago in Buyuba-Busiri village, Kamuli District

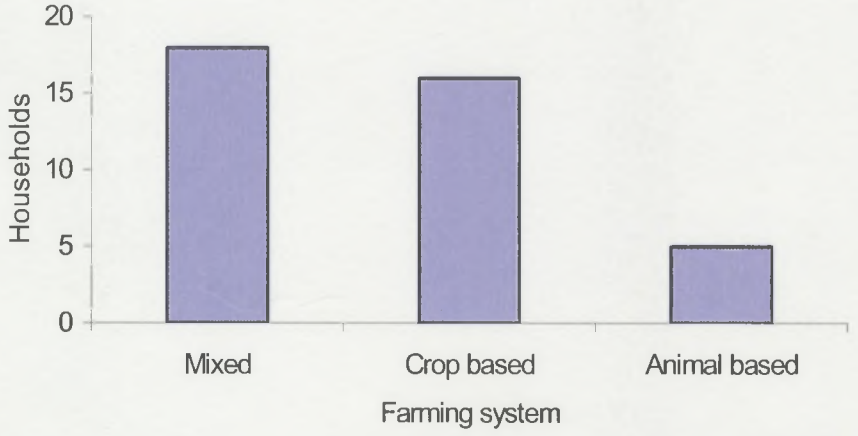


Fig. III- 5. Farming systems practised by households in Buyuba-Busiri village, Kamuli District

As is typical of the African traditional culture, husbands are the main managers of both crop and livestock enterprises in almost all the households surveyed. It was only in less 15 households where wives were the managers. As seen in the other districts visited, wives appear to be the main decision makers in crop enterprises, while husbands appear to dominate decision making in livestock issues. These results are shown in *Figure III-6*.

Fig. III-6. Management of livestock and crops on a daily in Buyuba-Busiri village, Kamuli District

Land Ownership

Land availability is a critical issue in most parts of the country as population continues to grow at over 3% per annum. In Kamuli district, Buyuba-Busiri village, the majority of households have less than five acres of land. There are more households with less than five acres of land now compared to ten years ago. This situation is likely to worsen as the human population continues to grow.

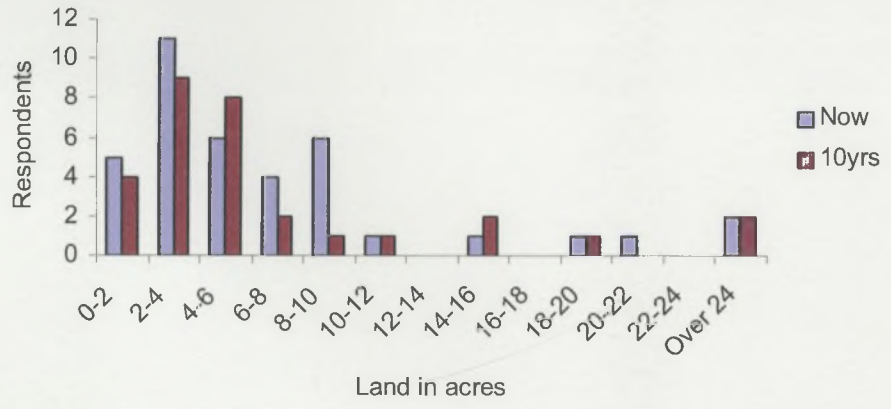


Figure. 7. Ownership of land now and ten years ago in Buyuba-Busiri village, Kamuli District

Renting and hiring of land is a common phenomenon Kamuli District. The majority of farmers today hire one acre of land or less, while very few hire more than two acres. An interesting observation was that there were more farmers hiring land as compared to those renting land. This is a clear indicator of scarcity and unequal access to land in the area. There were no farmers hiring land in the range of eight acres and above. These findings are shown in *Figure III-8.*

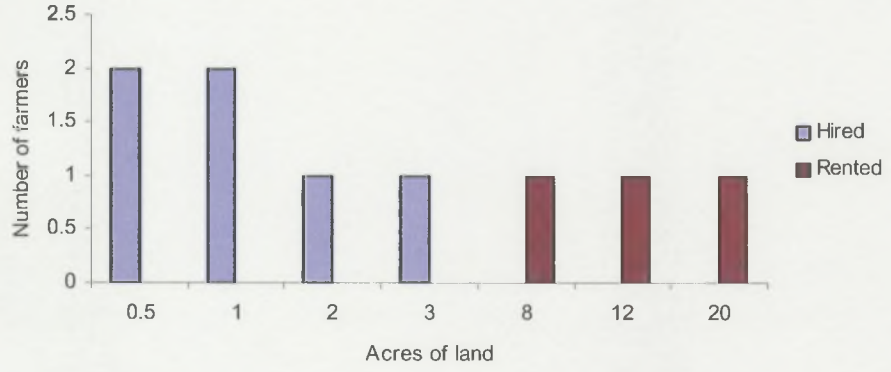


Figure. 8. Acres of land hired or rented by farmers in Buyuba-Busiri village, Kamuli District

The main land use activity in Buyuba-Busiri village is crop production, followed by grazing and forests. Fallowing is limited due to land shortage in the area. Land is continually cultivated throughout the year to sustain the ever-increasing families.

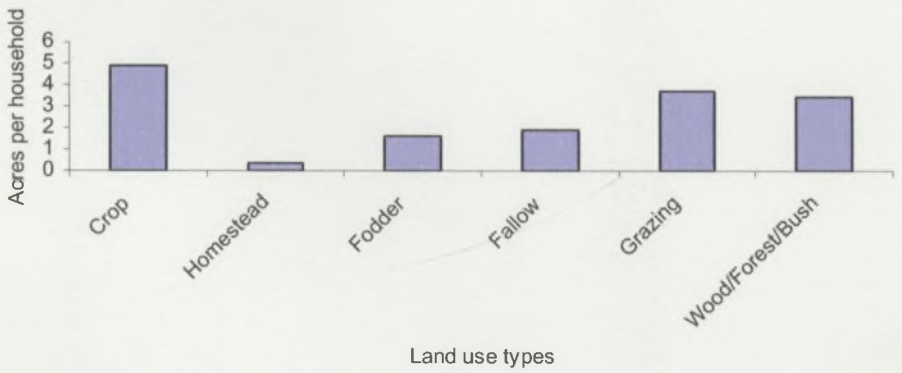


Fig. III -9. Mean allocation of land into different use types by each household in Buyuba-Busiri village, Kamuli District

Crop Production

The main crops grown in both seasons of the year are maize, potatoes, beans and groundnuts. The other crops also grown include coffee, cassava, banana, cotton and millet. Maize, beans and potatoes are the three main staple foods in the area and are also important sources of income. Coffee is also being increasingly produced as a cash crop in the area. For all crops, there are more farmers growing them now than ten years ago (*Figure III-10*). Similarly, the mean acreage for most crops has increased in the last ten years, except bananas, which has declined and cabbage, which is no longer grown in the households sampled (*Figure III-11*).

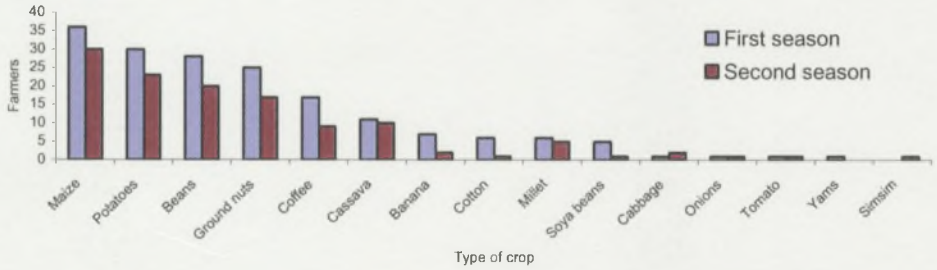


Fig. III-10. Main crops grown in Buyuba-Busiri village, Kamuli District

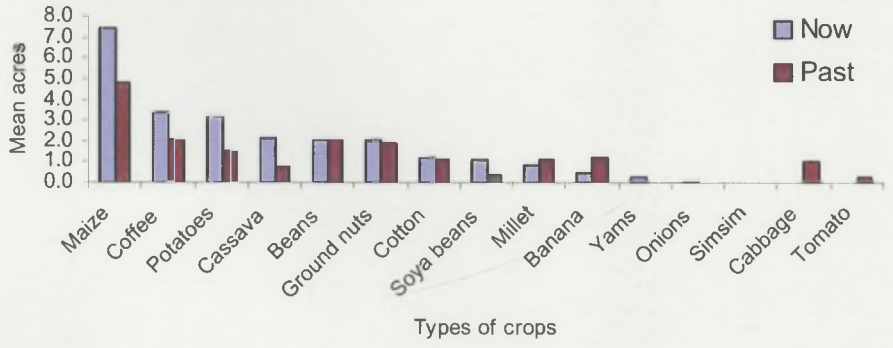


Fig. III -11. Average acres per crop during the first season, now and ten years ago in Buyuba- Busiri village, Kamuli District

The most common cropping pattern is mono cropping followed by intercropping and the system seems to have changed considerably over the last ten years. The majority of farmers today are practicing mono cropping compared to ten years ago. The main sources of seed today include selection from previous harvest, purchase from the market, borrowing from neighbours and friends, and to a limited extent from the Cooperative. All sources of seed appear to have increased in importance over the last ten years. Pest control as a husbandry practice is very limited in use, although it has slightly increased in the last ten years. This could be attributed to the high prices of chemicals and lack of awareness. These findings are shown in *Table III -1*.

Table III -1. Common seed sources, cropping and use of harvest currently and ten years ago during the first season in Buyuba-Busiri village, Kamuli District

N = 175				
		Now	Past	Difference (past-now)
Seed source	Selection	100	67	-33
	Market	33	12	-21
	Borrow	12	4	-8
	Cooperative	7	4	-3
Cropping pattern	Inter	42	21	-21
	Mono	116	67	-49
Pest control	Use of chemicals	3	2	-1
	None	155	86	-69
Harvest use	Home	76	28	-48
	Sale	26	18	-8
	Sale/Home	42	26	-16

The hand hoe is the main land preparation implement today and the situation was the same ten years ago. It is interesting to observe that ox-plough do not appear to be used at all in this village. The hand hoe is also the main implement used for both planting and weeding.

There is very limited effort by farmers to manage soil fertility and this could be attributed to their perceptions about the fertility of their soils. The majority of farmers do not regard soil infertility as a problem in the area. This is shown in *Table III -3*.

Table III -2. Crop and land management now and ten years ago in Buyuba-Busiri village, Kamuli District

N = 154				
Crop / Land management		Now	Past	Difference (past-now)
Land preparation	Hoe	145	132	-13
	Panga-Hoe	2	2	0
	Fire-Hoe	4	4	0
Planting	Hoe	151	138	-13
Weeding	Hoe	143	130	-13
Soil fertility management	Manure	18	18	0
	Fertilizer	1	2	1
	None	131	118	-13
Harvest	Manual	139	131	-8
Labour source	Both	59	16	-43
	Family	81	114	33
	Hired	2	3	1

Table III-3. Soil erosion and soil infertility, causes, indicators and control methods in Buyuba-Busiri village, Kamuli District

		Respondents N = 39
Erosion	Present	29
	Absent	10
Erosion causes	Continuous cultivation	1
	Heavy rains	3
	Topography	25
Erosion control	Mulching	1
	Strip cropping	4
	Terracing	22
	Trash lines	1
Soil infertility	Present	26
	Absent	13
Indicators of soil infertility	Over used soil	2
	Poor crop yields	19
	Stunted growth	3

On the other hand, farmers recognize soil erosion as problem in the area, and this is largely attributed to the topography. Because the area is hilly, there is severe run off in rainy seasons causing massive soil loss. Farmers practice terracing, strip cropping and to a limited extent mulching as soil erosion control measures.

Livestock Keeping

Livestock types and numbers

The main livestock types kept in this village include chicken, indigenous (native) cattle, goats, pigs and dogs. Chicken were the highest in numbers, followed by native cattle, goats and then pigs. A major finding was that all types of livestock have declined in numbers over the last ten years. In fact, no farmer had sheep in Buyuba village at the time of the survey, yet some farmers kept sheep ten years ago. This is shown in *Figure III-13*.

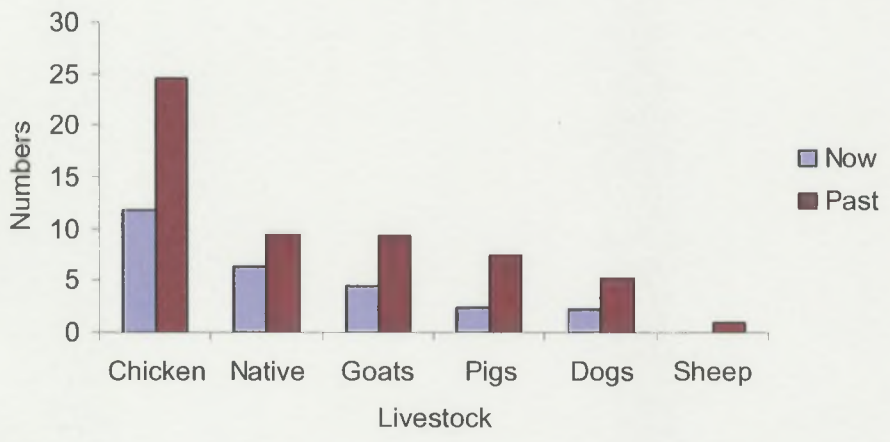


Fig. III-13: Number of animals kept in the past and today in Buyuba-Busiri village, Kamuli District

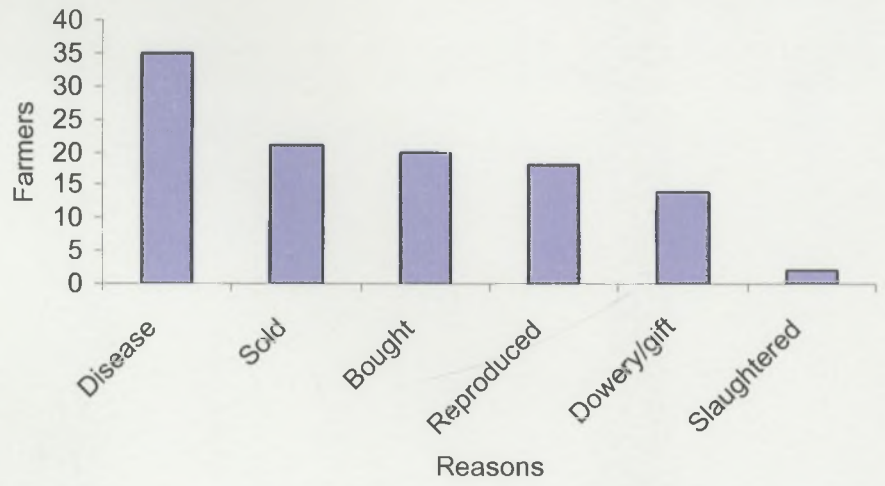


Figure III-14. Reasons for differences in the number of livestock today and in the past in Buyuba-Busiri village, Kamuli District.

The main reason given for differences in number of livestock now and ten years was disease. A number of livestock diseases appear to have led to the declining numbers of livestock held, among which trypanosomosis and East Coast fever are suspected to rank highly. Kamuli is one of the districts in the tsetse belt, with highest animal trypanosomosis and sleeping sickness prevalence. The other reasons responsible for the observed trends in livestock numbers as given by farmers were stock selling, buying, reproduction, dowry/gift and slaughter. These findings are provided in *Figure III -14.*

Related and similar to the trends in livestock numbers was the ownership oxen and ox ploughs. The numbers of farmers owning oxen and ox ploughs has reduced by almost 50% in the last ten years. Two of respondents had an ox and ox plough in the past but only one of them still has them now (*Figure III-15*). The main reason responsible for this trend is death, followed by sales (*Figure III-16*).

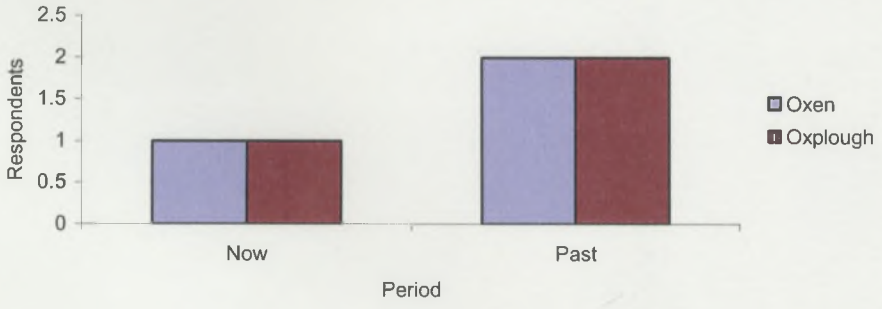


Fig. III-15. Ox and Ox plough ownership now and in the past in Buyuba-Busiri village, Kamuli District

Fig. III- 16. Reasons for differences in ownership of oxen and ox plow now and in the past in Buyuba-Busiri village, Kamuli District

Despite the reduction in numbers of oxen and ox ploughs, the most hired form of traction for cultivation is the ox and ox plough. Five of the respondents hired oxen for cultivation, one hired a tractor and two did not hire either of the two. This is shown in *Figure III-17.*

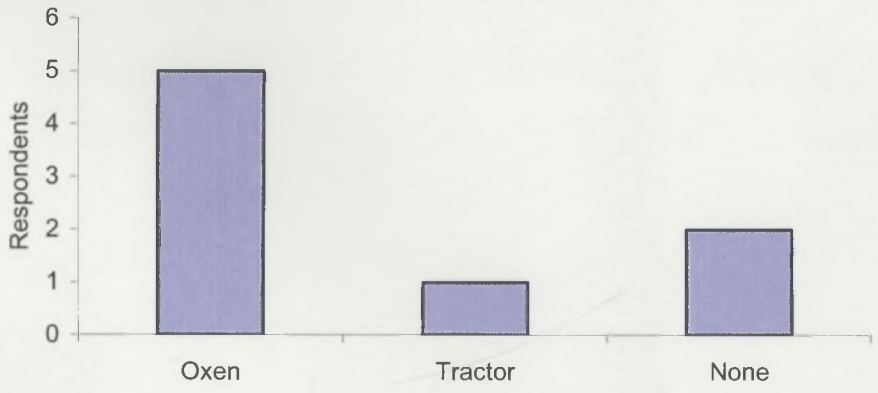


Fig. III-17. Traction for crop cultivation in households Buyuba-Busiri village, Kamuli District

Livestock products

The main livestock products from which farmers obtain income is milk. However, only fifteen households earned income from milk, while two households earned income from selling of calves. None of the households earned income from sales of adult cattle, or renting of ox ploughs, or from sales of manure and skins. This is a clear indicator that cattle keeping is a not a major source of livelihood in the area. These findings are shown in *Table III-4.*

Table III-4. Cattle products and sources of income in Buyuba-Busiri village, Kamuli District

Sources	Respondents N = 39
Milk	15
Calves	2
Adults	0
Ox plough	0
Manure	0
Skin	0

Grazing systems

The main cattle keeping system is free-ranging/tethering and the system does not appear to have changed much in the last ten years (*Table III-5*). None of the farmers are using zero grazing today, as was the case years ago. However, as land availability continues to dwindle, zero grazing is likely to become the only viable system. There are on-going efforts by government through the Ministry of Agriculture, Animal Industry and Fisheries to distribute free crossbred heifers for zero grazing to farmers in the southeastern Uganda, including Iganga District.

Table III-5. System of cattle rearing in Buyuba-Busiri village, Kamuli District

N = 39				
Cattle keeping system		Free-ranging/ Tethered	Zero Grazing	Combined Free-/Zero grazing
Zebu	Now	19	0	0
	Ten yrs ago	22	0	0
Dairy	Now	0	0	0
	Ten yrs ago	0	0	0

There is no marked variation in the use of different grazing resources in the different seasons of the year. Farmers mainly use own pasture and un-cropped land during the dry and wet seasons. There is very limited use of pastures in neighbouring homesteads, and un-cropped land in both seasons of the year now and in the past (*Table III-6*). There is also very limited public land available for grazing today, although it did not exist in the past.

Table III –6: Main grazing areas during wet and dry seasons in Buyuba-Busiri village, Kamuli District

N = 39			
Grazing areas -today		Wet	Dry
Own	Pasture/uncropped land	14	15
	Post harvest cropped	2	2
Neighbours	Pasture/uncropped land	8	8
	Post harvest cropped	2	3
Public land		1	0
Grazing areas – past (ten years ago)			
Own	Pasture/uncropped land	15	15
	Post harvest cropped	1	1
Neighbours	Pasture/uncropped land	7	7
	Post harvest cropped	0	0
Public land		0	0

Water sources

The main water sources for livestock in Buyuba village are wells, lakes/ponds and bore- holes are very limited sources of water for livestock in these areas. This is shown in *Figure III-18.*

Perceived trypanosomosis prevalence and control

Only two respondents perceived trypanosomosis to be a problem, while one did not perceive it to be a problem (*Table III -7*). The majority did not know about the disease. On trypanosomosis control, twelve respondents mentioned the communal crush pen spray programme; three respondents mentioned drugs, while only one mentioned bush clearing as a control measure. An important observation was that respondents did not know of any environmental implications of tsetse control. Only two respondent thought tsetse control could affect soil fertility while one thought control inputs could kill soil microorganisms. These findings are shown in *Table III -7.*

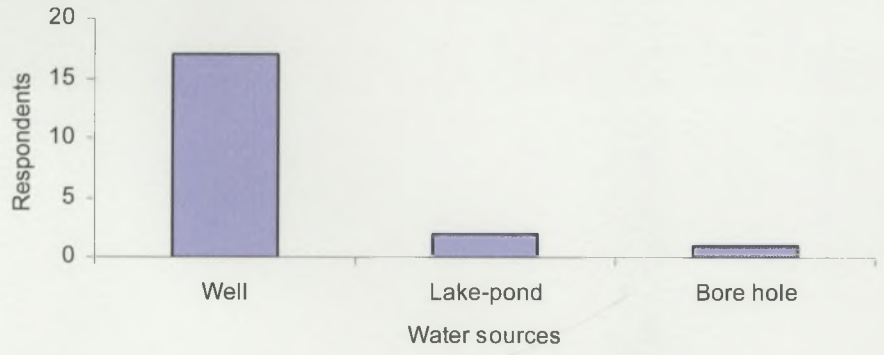


Figure III -18. Watering sources for livestock in Buyuba-Busiri village, Kamuli District

Table III -7. Perceived trypanosomosis prevalence and its control methods in Buyuba-Busiri village, Kamuli Districth

		Respondents N = 39
Is it a problem?	Yes	2
	No	1
Control methods if present	Drugs	3
	Crush pen	12
	Bush clearing	1
Reasons for non-control where present	Lack of know how	1
Implications of control to the environment	Soil fertility impact	2
	Kills soil organisms	1

Vegetation

Knowledge of plant species

Less than ten of the respondents were able to name plant species present in the area today. More than thirty of the respondents were able to name plant species that have disappeared from the area (*Figure III -19).*

Fig. III -19. Knowledge of particular plants in the area in Buyuba-Busiri village, Kamuli District

Wildlife Biodiversity

Changes in wildlife types and numbers

The main types of wildlife found in Buyuba village are birds, mammals, reptiles and rodents (*Figure III -20*). All wildlife types showed a declining trend in numbers in the last ten years, but the magnitude seems not to be very pronounced. Hunting and deforestation are mostly to blame for the dwindling numbers of wildlife (*Figure III -21*).

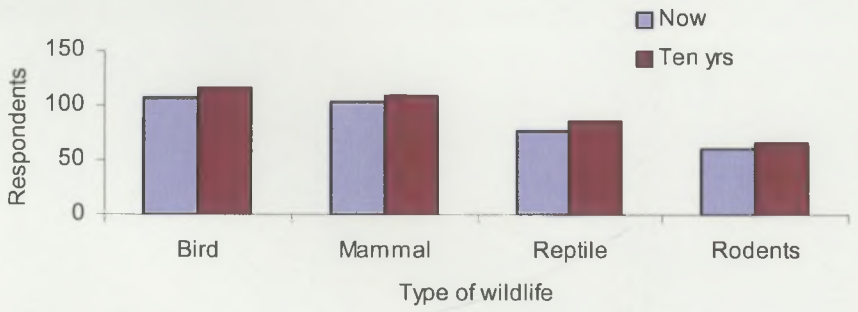


Fig. III -20. Type of wildlife found in the area today and ten years ago in Buyuba-Busiri village, Kamuli District

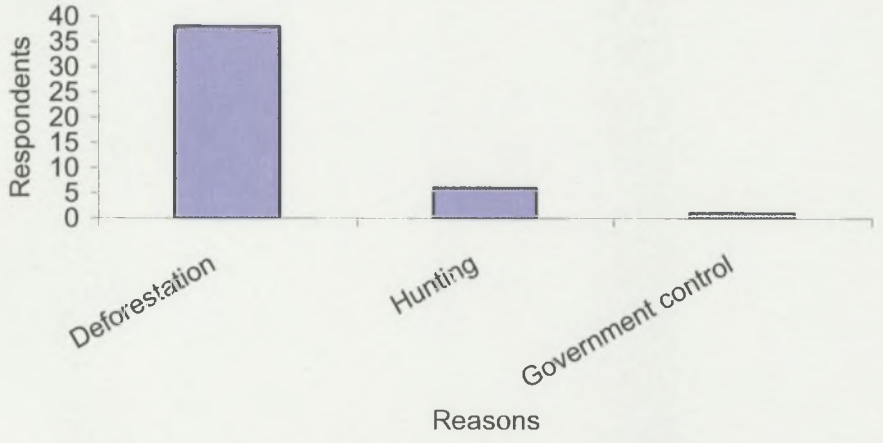


Fig. III -21. Perceived reasons for wildlife disappearance in Buyuba-Busiri village, Kamuli District

Wildlife conflicts

Human/wild life conflicts are a problem in Buyuba village. About fifteen of the respondents rated wildlife conflicts as being of low importance, less than five rated the conflicts as moderate and a similar number rated them as being of major (high) importance. Two respondents thought that there were no conflicts at all (*Figure III -22*). The main source of conflict mentioned was crop destruction, preying of chicken and to a very limited extent poisoning of livestock. The other minor source of conflict mentioned was that wild animals are scary.

Fig. III -22. Human wildlife conflicts in the area in Buyuba-Busiri village, Kamuli District

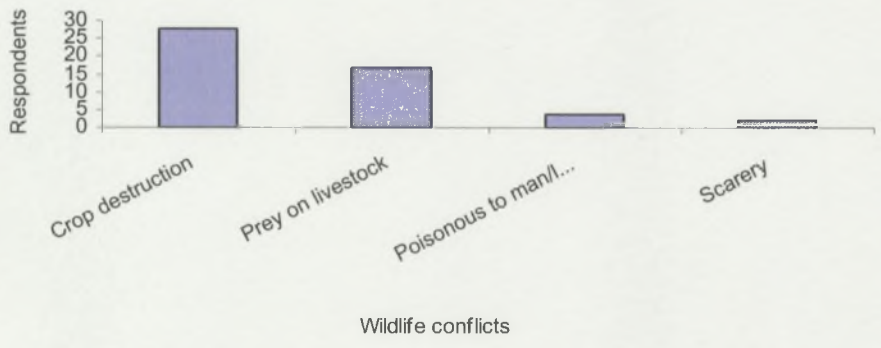


Fig. III –23: The nature of wildlife conflicts in Buyuba-Busiri village, Kamuli District

Water Resources

Domestic water sources

The main source of water for domestic water now is boreholes (*Table III -8*). The use of bore holes as a source of water for domestic use has increased considerably in the last ten years. None of the respondents used bore hole as a source of water ten ago, but now twenty-eight of them obtain water from boreholes. This is a result of efforts by district local governments and Non Governmental Organisations (NGOs) to provide clean water to rural communities. This has led to a corresponding decline in the use of rivers and streams as sources of water for

domestic use. Thirty-seven of the respondents used streams and rivers as sources of water ten years ago but today only one uses these sources in the dry season.

Table III -8. The main domestic water sources in Buyuba-Busiri village, Kamuli District

N = 39			
	Season	Ten yrs ago	Now
Bore hole	Dry	0	28
	Wet	0	28
River/Stream	Dry	1	0
	Wet	0	0
Well	Dry	37	10
	Wet	38	10
Lake/Pond	Dry	0	0
	Wet	0	0
Spring	Dry	0	0
	Wet	0	0
Roof catchments	Dry	0	0
	Wet	0	0
Piped water	Dry	0	0
	Wet	0	0

The perceptions of the majority of respondents indicate that water for domestic is not polluted. Only six respondents thought water was very polluted. Furthermore, the majority of respondents believe their water is clean, safe and that is has a very good taste (*Table III -9*). Only seven respondents regarded the water as having a bad taste, the same number perceived the water as dirty, while nine thought the water was not safe for drinking.

Table III -9. The perceived quality of water in Buyuba-Busiri village, Kamuli District

N = 46		
		Respondents
Pollution level	Not Polluted	27
	Very polluted	6
Cleanliness	Dirty	7
	Fairly clean	5
	Very clean	25
Taste	Bad	7
	Fairly good	6
	Very good	25
Safety	Safe	30
	Unsafe	9

Seasonality of access to water

The majority of households in the village move less than half of a kilometer to fetch water in both the dry and wet seasons (*Figure III -24*). The number of households within this range increases in the rainy season meaning that water becomes more easily accessible at shorter distances. In the wet season, for example, households with iron-roofed houses are able to harvest rainwater and use it for domestic purposes.

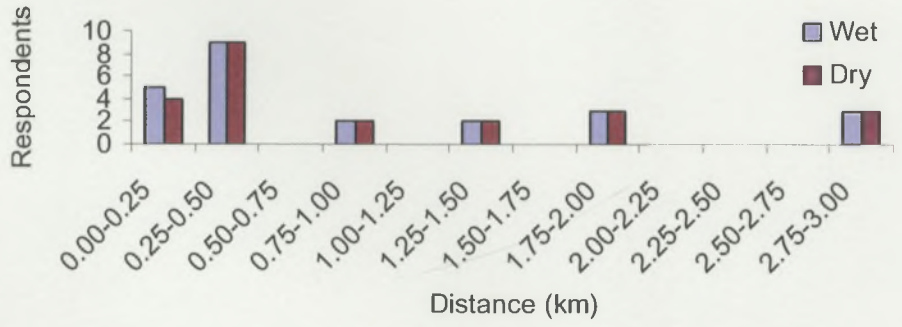


Fig. III –24: Distance to domestic water sources from the households during wet and dry seasons in Buyuba-Busiri village, Kamuli District

Fuel Resources

Fuel sources

There are three main sources of fuel, namely bush, paraffin and, to a very limited extent, own trees. The use of these fuel sources appears not to have changed much in the last ten years. The number of respondents who used bushes as a source of fuel ten years ago is similar to the number that uses them today. There was however a slight decrease in the use of paraffin as a source of fuel, probably due to the increasing price. On the other hand, there has been a slight increase in the use of own trees, which could be attributed to restrictions on encroachment in natural forests.

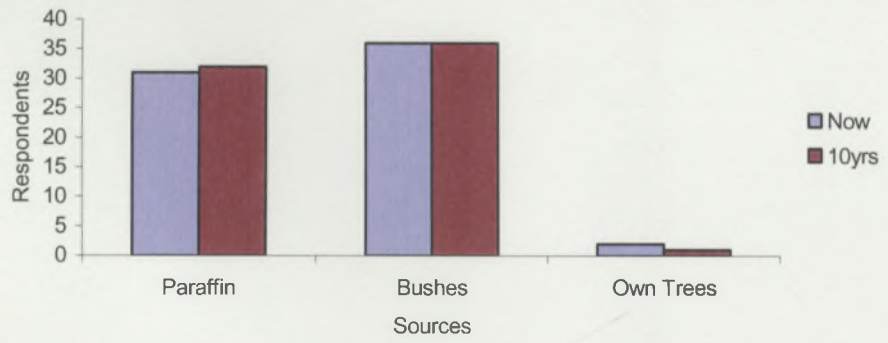


Fig. III –25: Sources of fuel by importance/usage in Buyuba-Busiri village, Kamuli District

Table III -10. Fuel related environmental variables now and ten years ago in Buyuba-Busiri village, Kamuli District

N = 39		
Environmental factors		Respondents
Natural forests availability	Present	2
	Absent	37
Natural forest access	Present	0
	Absent	39
Forest cover trends	Decreased	37
	No Change	2
Reasons for observed trends in forest cover	Crop cultivation	2
	Population pressure	36

Availability of fuel related environmental products

The majority of respondents believe natural forests are disappearing, which could be a result of human encroachment for purposes of agriculture, logging for timber and charcoal making. Similarly, many respondents believe that access to natural forests is very limited now compared to the situation ten years ago, and this again could also be attributed to government

restrictions. It was also observed that the forest cover has decreased mainly as a result of encroachment by cultivators and population pressure (*Table III -10*).

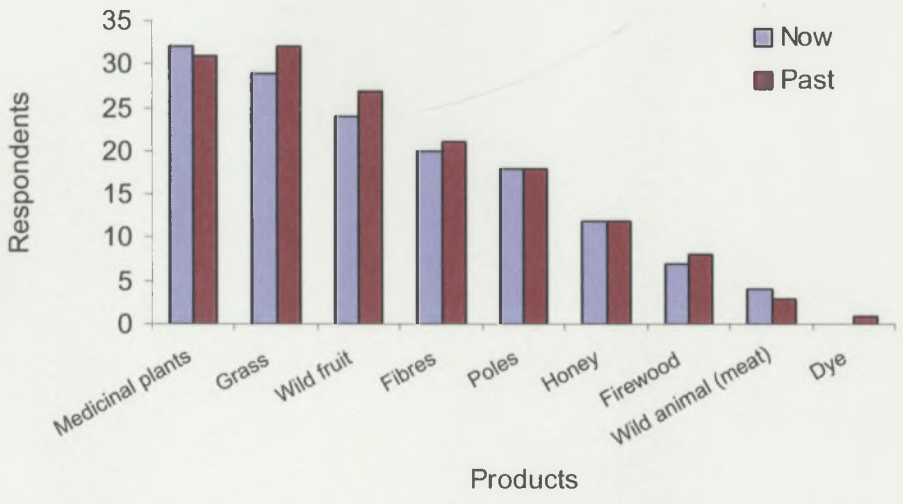


Fig. III –26: Forest/bush products obtained in Buyuba-Busiri village, Kamuli District

Forest Products

The main forest products include medicinal plants, grass, wild fruits, fibre and poles. The other minor products include honey, firewood and wild animals (game meat). There was a slight reduction in the number of households who obtained grass, wild fruits, fibre, firewood and wild animal meat from the forest. The use of forests as a source of medicinal plants only slightly increased in the last ten years. This could be a result of recent government efforts to recognize and support traditional healers and herbalists.

Table III –11: The perceived level of availability of forest and bush products in Buyuba-Busiri village, Kamuli District

N = 158				
Product	Difficult		Easier	
	Now	Past	Now	Past
Dye				1
Fibre	9		11	21
Firewood	6		1	8
Grass	21	2	7	30
Honey	10	1	1	11
Medicinal plants	18	2	11	29
Poles	17		1	19
Wild animal (meat)	3			4
Wild fruit	14	3	10	24

The availability of forest and bush products has considerably changed in the last ten years. The perceptions of respondents indicate that it is now difficult to obtain most of the products compared to the situation ten years ago (*Table III -11*). The most difficult products to obtain now include grass, medicinal plants, poles and wild fruits.

SUMMARY AND RECOMMENDATIONS

Kamuli district has been settled for many centuries and many generations. The current occupants of Kamuli are mainly cultivators but most all people have cattle. The main crops grown are maize, sweet potatoes and cassava. Maize is grown both as a cash crop and as a food crop, while sweet potatoes are grown mainly for home consumption but in the absence of other commodities for sale in need of cash sweet potatoes can be sold in the local markets.

Livestock kept are the local indigenous varieties that are to some extent tolerant to the local diseases. Most livestock graze freely in the designated areas left uncultivated or left as fallow.

During dry seasons cattle roam around in the field where maize has been harvested to feed on the herbs and maize stalks.

Farm sizes are large enough to make growing of maize viable at the moment, it is not certain how long this will remain possible because population structure shows that there are many more you people than old people. When these young people take up land to cultivate their own crops land will be scarce and viability of maize cultivation as cash crop will decline. There is therefore a need to diversify crop varieties towards those that do not require much land for adequate production.

Most of the land available is cultivated except for a few places where individuals may have larger pieces than usual or the owners are away and have left their land unutilized. These areas are mainly the focus for grazers who have not enough land for their livestock.

Land is fertile but areas under sweet potato cultivation are exposed without sufficient vegetation cover especially when the crop is young. These areas are prone to erosion by rain and wind. Where sweet potatoes are planted on slopping ground this erosion is severe. It is there recommended that planting of sweet potatoes on slopping ground must be accompanied by erecting of terraces and or planting of hedgerows on contour lines.

There is a problem of water in the area. Most people depend on water from boreholes to feed the animals and for their own domestic use. These bore holes are shallow wells that can be affected by changes in environmental conditions on the ground surface. Survival of these bore holes depend on the presence of adequate vegetation cover on the ground surface. There is a need therefore to plant trees within the cultivated areas to provide this service.

Unlike Akoroi Village, Buyuba Busiri is well served by a good all weather roads that link the village with the rest of the country. This provides a good access to markets for their farm products.

As noted in *part II* of this report there is a general scarcity of woody plants in Kamuli. This scarcity has been occasioned by over exploitation of plant resources for various uses associated with human settlements in the area. There is a need to initiate tree planting in order to satisfy the current demand for plant resources

It is pleasing to note that FITCA Uganda is implementing a livestock feeds programme in the area by providing seeds for planting to provide fodder. This will assist in providing supplemental feeds for the animals and perhaps provide an impetus for zero grazing and introduction of better yielding livestock breeds. However, according to the farmers in Buyuba–Busiri village planting of these pastures is planned to be in the already existing bushes and thickets. Farmers have already started to clear bushes for this purpose. If this continues all bushes in Kamuli will be converted into pastures planted with monospecies. Efforts must be made to conserve some bushes especially along the swamps and along the river valleys for soil and biodiversity conservation.

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Appendix 1.

List of plants sampled in Buyuba Busiri village

Acacia gerrardii
Acacia hockii
Acacia senegal
Acacia seyal
Acacia sieberiana
Achyranthes aspera
Aerva lanata
Ageratum conyzoides
Albizia coriaria
Albizia zygia
Allophylus abys
Amaranthus dubius
Annona senegalensis
Arachis hypogea
Aristolochia elegans
Artocarpus integrifolia
Asperangus africanus
Aspili kotschyi
Asystasia gangetica
Basella alba
Bidens pilosa
Brachiaria brizantha
Brachiaria decumbens
Bridelia micrantha
Bridelia scleroneuroides
Capsicum frutescens
Cardiospermum ha
Carica papaya
Carissa edulis
Cassia didymob
Cassia hirsuta
Celosia trigyna
Centrosema pubescens
Chamaecrista kirkii
Citrus sinensis
Clerodedrum rotundifolius
Combretum binderanum
Combretum ghaselense
Combretum molle
Commelina benghulensis
Conyza floribunda
Crabbea velutina
Cyathula prostrata
Cyperus alba
Cyperus denadatus
Cyphostemma adenocaula
Cyuthula prostrata
Desmodium incanum
Desmodium repandum
Digitaria abyssinica
Digitaria diagonalis
Digitaria longiflora
Digitaria velutina
Dioscorea caya
Dioscorea dumetorum
Draceana fragrans
Drymaria cordata
Dyschoriste radicans
Emilia coccinea
Enlangea pulchea
Erythrina abyssinica
Erythrococca bongensis
Euclea divinorum
Euclea latidens
Euphorbia heterophylla
Euphorbia hirta
Ficus brachypoda
Ficus exasperata
Ficus mucuso
Ficus natalensis
Ficus ovata
Ficus thonningii
Flueggea virosa
Galinsonga parriflora
Gloriosa superba
Glycine soy
Glycine wightii
Grewia mollis
Grewia similis
Guizotia scabra
Gyanura scandens
Hewettia sublobata
Hydrocotye mannii
Hymenocardia acida
Hypoestes vex
Imperata cylindrica
Indigofera spicata
Ipomoea acuminata
Ipomoea batatas
Jatropha curcus
Justicia exigua
Justicia flava
Kigelia africana
Lantana camara
Lantana trifolia
Leucas martinicensis
Lonchocarpus laxiflorus
Mangifera indica
Manihot esculenta
Markhamia lute
Maytenus senegalensis
Melhania velutina
Milicia excelsa
Mondia whitei
Musita albizia
Oldenlandia herbacea
Ophomenus hirtellus
Oxalis corniculata
Panicum maximum
Papaya carica
Pentas longiflora
Phaseolus vulgaris
Phyllanthus capillaris
Phyllanthus niruri
Physalis micrantha
Pilliostigma thonningii
Priva cordifolia

Pseudechinolaena polystac
Pseudocedrella kotschyi
Psidium guajava
Psorospermum febrifugum
Rhus natalensis
Rhus vulgaris
Rhyctenium repens
Rhyncharitrum repens
Securidaca longiflora
Senecio discifolia
Sesamum indica
Setaria homonyma
Setaria sphacelata
Sida acuta
Sida ovata
Sida veronicifolia
Solanum incanum
Solanum macrocarpon
Sorghum vert
Sorghum vulgare
Spathodea campannulata
Spermacoca princei
Spilanthes mauritiana
Sporobolis pyramidalis
Staganotonea araliacea
Steganatonea arauacea
Stereospermum kunthianum
Strychnos innocua
Synedrella nodiflora
Syzygium cuminii
Tamarindus indica
Terminalia brownii
Terminalia velutina
Thunbergia alata
Tridax procumbens
Triumfetta rhomboidea
Tylosema fagolossum
Urena lobata
Vangueria acutiloba
Vangueria apiculata
Vernonia amygdalina
Vernonia campanea
Vernonia lasiopus
Vigna luteola
Vitex doniana
Xanthosema esculenta
Zea mays
Zornia pratensis

Field names for plants being identified

Acacia-black,spine,whitsh
Acalypha -small
Acalypha sp.
Adenostemon
Agave-small
Albizia(like tar.)
Allophykis-shiny
Annona-big lves
Ariseama
Cassia-2pair lves
Cassia-big lves
Cassia-brownred lves
Cissus sp.
Clerodendron
Coffea
Combretum
Combretum-hairy
Commelina-big lves
Corchorus-linear lves
Crotalaria sp.
Crotolaria
Cyanotis sp.
Cyperus sp.
Desmodium sp.
Desmodium-single leaf
Digitaria (3)
Digitaria ?
Digitaria 2
Digitaria-small
Drypetes ?
Drypetes sp.
Eriosema
Euphorbiaceae-unidentifd
Ficus sp 2
Ficus sp.3
Ficus-big lves
Ficus-elogated lves
Ficus-wavy margin
Fimbristylis sp.
Fimbristylis-5 heads
Gardenia jovis-tonantis
Gisesbeckia
Grewia small lves
Guttiferae
Indigofera
Jasminum
Kakunda's plant
Kankunda
Kigelia sp.
Lactuca
Lonchocarpus
Lukka
Mariscus
Mucuna
Mullugo
Musa sp.
Musita
Nkontambale
Oldenlandia
Oleaceae
Orthosiphon
Palisota
Panicum-hairy small
Pap- white hair margn
Pavetta
Pentasia
Pentas-linear lves
Phyllanthus nmulariifoliu
Phyllanthus pseudo-niruri
Phyllanthus-purple
Plumeria
Pycreus sp.
Setaria-big lves
Stachys
Tephrosia
Terminalia (yll lves)
Terminalia sp.
Terminalia-hairly below
Terminalia-yellow veins
Trimeria

Appendix 2.

Questionnaire used in socio-economic surveys

ENVIRONMENTAL MONITORING AND MANAGEMENT
COMPONENT (EMMC / FITCA)

Household Survey Questionnaire

Date of interview: _____

Start time_____ End time_____

Household Code No: _____

District: _____

County: _____

Sub-county: _____

Parish: _____

Village: _____

Location of interview: _____

Name of Farmer: _____

Category of Farmer: _____

Household GPS reading: Latitude (N/S) _____ Longitude (E/W) _____

Alt _____

Filled questionnaire reviewed by:

Reviewer's Name	**Date**

Household Information

1. Name of Household head _____
2. Age_____ years
3. Sex 01. Male 02. Female
4. Educational Level 01. None 02. Primary
   03. Secondary 04. Post-secondary
5. How long have you lived in this area? 01. <10 years 02. 10-20 years
   03. 21-40 years 04. >40 years
6. Name of respondent (if different from household head)
   _____
7. What is the ethnicity of the household head? _____
8. How is the respondent related to the household? 01. Husband
   02. Wife 03. Son 04. Daughter.
   05. Other specify_____

9. Household characteristics

Name	Age	Sex (M / F)	Education	Relation with HH	Residency	Work on HH land

Relation with HH
01. Husband
02. Wife
03. Son
04. Daughter
05. Employee
06. Other specify

Work on HH land
01. No
02. Part time
03. Full time

Residency
01. Non-resident
02. Part time resident
03. Full time resident

Education
01. No education
02. Primary level
03. Secondary level
04. Post secondary

Land use

10. What is the main occupation of the household head now?

    01. Farming 02. Trading 03 Fishing 04. Employed

    05. Others Specify_____

11. What was the main occupation of the household head 10-15 years ago?

    01. Farming 02. Trading 03 Fishing 04. Employed

    05. Others Specify_____

12. If a farmer what kind? 01. Mixed 02. Crop based 03. Animal based

13. Who manages the following day-to-day activities?

    (a) Livestock 01.Husband 02. Wife 03. Children

    04. Employee 05. Other family member

    (b) Crops 01.Husband 02. Wife 03. Children

    04. Employee 05. Other family member

14. How much land do you own? _____Acres

15. How much lands have you hired for crop production? _____ Acres

16. How much land have you rented out? _____Acres

17. Were you hiring any land 10 years ago? 01. Yes 02. No

18. Were you renting out any land 10 years ago? 01. Yes 02. No

19. How much land did you own 10-15 years ago? _____Acres

20. If you have more now how did you acquire the additional land?

    01.Bought 02 Inherited

    03. Allocation 04. Other specify_____

21. If you have less what happened to your land? 01. Sold ____ 02. Subdivided

    03. Others specify _____

22. What proportion of your land in acreage is allocated to each of the following?

	Cropped		Un-cropped		
Homestead	Food /Cash crop	Fodder crop	Fallow	Grazing	Bush/forest/wood
_____	_____	_____	_____	_____	_____

Cropping Systems

23. Please provide information on the **principal crops** grown in your farm during the **First season** **(today** and in the **past).**

Today								Past (10 Years Ago)							
Crop	**Unit Acres**	**Seed or Seedling**	**Source of seeds**	**Pattern**	**Crop pest control**	**Yields Units**	**Use of harvest**	**Crop**	**Unit Acres**	**Seed or seedling**	**Source of seeds**	**Pattern**	**Crop pest control**	**Yields Level**	**Use of harvest**

Key

Seed or seedling	Source of seed	Pattern	Pest control	Yields level	Use of harvest
Amount of seed in Kilograms	Market	Mono-cropping	Chemical	More	Sale
No. of seedlings	Selection (from harvest)	Inter-cropping	Traditional	Less	Home use
	Borrow	Strip-cropping	No control	Equal	Sale/home
	Cooperative				

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

24. Please provide information on the **principal crops** grown in your farm during the **Second season** **(today** and in the **past).**

Today								Past (10 Years Ago)							
Crop	**Unit Acres**	**Seed or Seedling**	**Source of seeds**	**Pattern**	**Crop pest control**	**Yields Units**	**Use of harvest**	**Crop**	**Unit Acres**	**Seed/seedling**	**Source of seeds**	**Pattern**	**Crop pest control**	**Yields Level**	**Use of harvest**

Seed or seedling	Source of seed	Pattern	Pest control	Yields level	Use of harvest
Amount of seed in Kilograms	Market	Mono-cropping	Chemical	More	Sale
No. of seedlings	Selection (from harvest)	Inter-cropping	Traditional	Less	Home use
	Borrow	Strip-cropping	No control	Equal	Sale/home
	Cooperative				

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

25. State different crop / land management methods **today** in comparison to **10-15 years ago** in the following categories. Provide the information using at least five most important crops. ***(Important crops are those with higher acreage in comparison to others)***

Crop Name	Land preparation		Planting		Method of weeding		Soil fertility management		Harvesting		Source of labour	
	Past	Today	Past	Today	Past	Today	Past	Today	Past	Today	Past	Today

Key

Land preparation / planting / method of weeding
- Hoe
- Ox-plough
- Tractor

Harvesting
- Machine
- Manual

Soil fertility management
- Fertilizer
- Manure
- Both
- None

Source of labour
- Family
- Hired
- Both

26. How do you clear land (bush) today? 01. Pangas /axes 02. Burning 03. Machine

27. How were you clearing land (bush) in the past? 01. Pangas /axes 02. Burning 03. Machine

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

28. Which crops have since disappeared? State the crops name and explain the reason why you no longer grow them.

Crop Name	Reasons for not growing the stated crops

29. Is there any erosion on your farm? 01. Yes 02. No

30. If yes how are you controlling soil erosion? 01. Terracing 02. Trash lines
03. Strip cropping 04. Other (specify)_____

31. What in your opinion is the cause of soil erosion in your farm? _____

32. Do you think there is soil infertility in your farm? 01. Yes 02. No

33. If **yes** what are the indicators of soil infertility? _____

Livestock

34. State the **number** of animals you kept in the **past** and **today** and give reasons for any differences.

Type	Number of animals		Reasons for differences in past and present livestock numbers
	Past	Today	
Native Cattle			
Graded			
Cross- Breed			
Goats			
Sheep			
Donkey			
Pigs			
Dogs			
Chicken			

35. In the past did you own? 01. Oxen 02. Ox-plough

36. Do you own any now? 01. Oxen 02. Ox-plough

37. Explain the reasons for any differences in **35** & **36** above

_____

_____

38. Which of one of these do you hire most to cultivate your farm?

01. Oxen 2. Ox- plough 03. Tractor 04.None

39. From which of the following livestock products do you make income?

01. Milk 02. Calves 03. Adults

04. Renting of ox-plough 05. Manure 6. Hides and skin

07. Any other specify _____

40. What is your **main system of keeping cattle** now and what was it 10 years ago, if established then? **(Put the answer in the table)**

	Presently	10 years ago
Dairy cattle		
Zebu cattle		

Key
01. Only grazing (free-range or tethered)
02. Grazing with some stall feeding
03. Only stall feeding (zero grazing)

41. What are your main grazing areas during different seasons **today**? (✔)

Grazing areas	Dry season	Wet season
Own pasture/un-cropped land		
Own post harvest cropped		
Neighbours post harvest cropped		
Neighbours pasture/un-cropped		
Public land		
__		

42. What were your main grazing areas during different seasons in the **past?** (✔)

Grazing areas	Dry season	Wet season
Own pasture/un-cropped land		
Own post harvest cropped		
Neighbours post harvest cropped		
Neighbours pasture/un-cropped		
Public land		
___		
___		

43. Where do you water your livestock?

01. Lake / pond 02. River / Stream 03. Spring 04. Bore hole

05. Piped 06. Roof catchments 07 Well

44. Is trypanosomosis disease problem to your livestock?

01. Yes 02. No 03. Unknown

45. Which control measure do you apply for **trypanosomosis**?

01. No control 02. Traps/ Target 03. Bush clearing

04. Use of drugs/chemo-therapeutics 05. Use of pour-on, etc (vector control)

06. Crush pen 07. Net Zero grazing Unit

08. Other (specify) _____

46. If Trypanosomosis is present but **no control measure is employed**, why?

01. Do not know where to get drugs 02. Do not know how to control

03. Drugs are expensive 04. Drugs do not work

05. Other (specify) _____

47. What in your opinion is the implication of the trypanosomosis control method to the environment?

_____

Vegetation

48. Name **three** main plant species found in the area in the past and today in the following habitats.

Species Habitats	**Species Names**	
	Past	**Today**
Bush/forest		
Farms (weeds)		
Swamp / River line		

49. Do you know of any particular plant species that has disappeared or is disappearing from the area? 01. Yes 02. No

50. State any species that has disappeared or is disappearing; it's habitat and explain reason why they are disappearing?

Species Name	**Species habitat**	**Reasons**

Key: Habitats (Bush, Forest, Farm, Swamp, Grassland, River line, ……)

51. State any new plant species that have emerged in the area and explain the cause of their emergency.

Species Name	Species habitat	Cause of emerging

Key: Habitats (Bush, Forest, Farm, Swamp, Grassland, River line, ……)

Wildlife Biodiversity

52. State the wildlife types found in your area in the past and today.

Types Animal Species	Species Names	
	Past	**Today**
Reptiles		
Mammals		
Rodents		
Birds		

53. State the wild life species that disappeared in the area

Wild life Name	Species habitat	Reasons for disappearing

Key: Habitats (Bush, Forest, Farm, Swamp, Grassland, River line, ……)

54. Name any wildlife species that moved in the area recently

Wild life name	Species habitat	Possible reasons for emergency

55. Rate the level of human / wildlife conflict in the area.

01. Very high 02. Moderate 03. Low 04. None

56. What is the nature of human / wildlife conflict

Wild life Name	Nature of conflicts

Water Resources

57. Where was your main source of water **10 years ago**?

During dry season:	01. Lake / pond	02. River / Stream	03. Spring
	04. Bore hole	05. Piped water	
	06. Roof catchment	07. Well	
During wet season:	01. Lake / pond	02. River / Stream	03. Spring
	04. Bore hole	05. Piped water	
	06. Roof catchment	07. Well	

58. Where is the main source of water **Today**?

During dry season:	01. Lake / pond	02. River / Stream	03. Spring
	04. Bore hole	05. Piped water	
	06. Roof catchment	07. Well	
During wet season:	01. Lake / pond	02. River / Stream	03. Spring
	04. Bore hole	05. Piped water	
	06. Roof catchment	07. Well	

59. How would you rate the quality of water in terms of the following pollution, cleanliness, and taste?

a) **Pollution**	01. Very polluted	02. Fairly polluted	03. Not polluted
b) **Cleanliness**	01. Very clean	02. Fairly clean	03 Dirty
c) **Taste**	01. Very good	02. Fairly good	03. Bad

60. Do you consider the water safe for drinking? 01. Yes 02. No

61. How far is the main watering point from the household?

During the wet season _____ meters/ kilometers

During the dry season _____ meters/ kilometers

Fuel sources

62. State your main sources of fuel **10 years ago** and **today**. Rank your **current** sources of fuel in order of importance based on frequency of usage.

Sources of fuel	**10 years ago (✔)**	**Today (✔)**	**Rank**
Dry wood			
Charcoal			
Paraffin			
Gas			
Electricity			
Maize Stalks			
Swamp dry vegetation			
Others Specify			

63. Where did you get fuel 10-15 years ago? _____

64. Where do you obtain fuel today? _____

65. Explain the difference between (63 and 64) _____

_____

66. How much time do you take to gather fuel wood (time for walking to and fro and gathering)? 01. 10 min 02. 30 min 03. 60 min 04. 120 min +

67. Are there any natural forests in this area? 01. Yes 02. No

68. If yes, do you have access to these forests? 01. Yes 02. No

69. What has been the trend of forest cover in the area?

01. Increased 02. Decreased 03. No change

70. What do you think is the reason for the observed trend in forest cover?

_____

71. Apart from timber/fuel what other important **products** do you obtain from the **bush/Forest/uncultivated**?

Product	**Obtained 10 years ago (✔)**	**Obtained Today (✔)**	**General Use /Purpose**	**Level of use Today**	**Give reasons for rare use and not using**
Honey					
Wild fruit					
Wild animal (Bush meat)					
Grass					
Medicinal Plants					
Fibres					
Dye					
Craft Material					
—					
—					

Level of use
Regularly
Rarely
Not used

72. Are these products easier or difficult to obtain today than 10 years ago? Tick appropriately (✔)

Product	**Today**		**10 Years Ago**	
	Easier	Difficult	Easier	Difficult
Honey				
Wild Fruit				
Wild Animal				
Grass				
Medicinal Plants				
Fibres				
Dye				
Craft Material				

Thank you very much for participating in the survey

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1. Do you think the answers from respondent were sincere and truthful?

   01. Very true 0 2. Fairly true 03. Not true

2. Summarize your view of respondent answers in the space provided below.
3. Counter check the questionnaire to ensure that all the questions have been answered
4. Record end time.

Comments from the enumerator

Appendix 3

Photograph of a farmer harvesting maize

Maize is the main crop grown in Kamuli. Maize is grown for food as well as for cash. Maize growing requires large pieces of land in order to produce enough for home consumption and for sale. As discussed in the main text there is need to either diversify agriculture in the area or intensify maize production in order to produce enough

Photograph showing maize plantation with numerous herbaceous weeds

Note that there are not trees and shrubs in maize cultivations. Compare land cover in the maize cultivation and bushes in the background ahead.

Photograph showing bush clearance and planting of cassava

Vegetation clearance is high. Vegetation clearance exposes soil to erosion, loss of biodiversity and excessive loss of soil moisture.

Photo showing a stamp of a Milletia sp. regenerating after it was cut down. Scenes like this are many in the area. Planting trees is needed to replace those that are cut down.

Photograph showing wood being prepared for splitting of timber

Photo showing charcoal burning

Charcoal burning is widespread in the area; it is a source of income for some people. The activity targets mature woody plants preferably indigenous species

Photograph showing Anna conducting a socio-economic survey in a homestead

Photograph showing a typical young crop of sweet potatoes

Note the exposed and aerated soils.