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ILRI
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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: Busia Township. (*Busia District, Kenya*).

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2003

Natural Resources Institute

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF MAPS

LIST OF TABLES

OVERVIEW: FITCA Project

The regional project FITCA (Farming in Tsetse Controlled Areas) has a general objective to integrate tsetse control activities into farming practices of rural communities such that trypanosomosis problem can be contained to the levels that are not harmful to both human and livestock and be 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 an 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, monitoring indicators and methodologies, as well as 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 from 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:

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GENERAL INTRODUCTION

Western Kenya is densely populated due to the presence of fertile lands and the long-term occupation of the area by people. The area has been under cultivation for many generations. Busia district of western Kenya borders Uganda on the west, Teso district to the north and lake Victoria to the south. Mt. Elgon a major landmark in the area is to the north of Busia town. Lake Victoria is some 70 kilometers to the south. Subsistence agriculture is the main human activity that supports livelihoods in the region. Farmers produce cereals, cassava and pulses both for home consumption and for cash in the local market. Sugar cane, tobacco and pepper are grown primarily as cash crops by some farmers

The area is relatively dry and its characterized as a cotton growing area in the agro-ecological zones classification (Jaetzold and Schmidt. 1983). Rainfall is bimodal with short rains falling between March and May and the long rains falling between October and December. Crops grown include cassava, maize, sorghum, sweet potatoes and a number of other annual subsistence crops grown on a small scale.

The selected EMMC site in Busia is a Town Ship Division that borders Busia town and part of which is a suburb of the town. There is intensive land cultivation in this division due to a relatively high population resulting from the proximity to town. Many people in the division live in their homes in a rural set up, while working in the town either in formal employment or in self-employment in business.

In addition to cultivation, livestock keeping is common in the division. Livestock kept are mainly indigenous breeds and cross-breeds. Several farmers especially close to town have started raring exotic cattle in an effort to improve productivity and get better returns from their small plots of land.

Within the study area, land parcels were mainly less than five acres but away from town, land parcels were relatively larger in size ranging from an average of 5 to 20 acres. There were more and more bushes as one left the town. However, the bushes were heavily

harvested for woody plants leaving only the short thin-stemmed plants. The major reason for harvesting was to provide firewood and for construction. It was evident in the field that people cut green-woody plants and dried them for firewood either by sun on their home compound or near the fire. In many places firewood was collected from dead or dry pieces of wood. It has been argued previously that firewood collection is not a primary cause of deforestation since firewood collectors harvest already dead woods. This argument was based on the fact that no observation had been made to demonstrate that trees were cut down primarily to provide firewood (O'Keefe and Munslow 1989).

There were very few tall trees in Busia due to heavy harvesting and lack of replanting. Where they existed they comprised only young plants of exotic species like *Grevellea robusta*. The only big indigenous tree that was present in one of the study sites is one Ficus tree and a number of sprouting Makhamia trees all young because harvesting does not let them grow. Most of the indigenous trees were very young (some as seedlings) as they were harvested while very young. Soils appeared to have little nutrients, as there was very little litter accumulation or recycled into the soil. Erosion was evident, as the topsoils appeared dominated by loose sandy particles. In many places the top soil was compacted and very hard. The major source of erosion here was surface runoff and wind erosion. Lack of tree cover also increased wind erosion.

Harvesting of grass for house thatching was very common. Most of the houses were grass thatched. Houses roofed with iron sheets were very few compared to the grass-roofed ones. Due to the high demand for tall grass for thatching, it was very rare. In some homes there were areas set aside for preserving grass for thatching. This was evident around one of the plots where we had to move our sampling point some 400m eastwards because the area where our sampling point landed was in an area with only the tall grass for thatching. However the grass was short, as it had been cut recently. People living away from the farm(s) inhabited most areas with natural vegetation. Woody plant harvesting and heavy grazing by the neighbours heavily disturbed such areas.

This region is still seriously affected by animal trypanosomosis but rarely by sleeping sickness. FITCA-Kenya project started in July 1999. It promotes the participation of farmers in tsetse control activities through adoption and self-use of two major techniques:

1. Use of impregnated nets around cattle barns where dairy cows remain in zero-grazing units. Two hundred farmers have been identified and receive convenient material, insecticide and extension service.

2. Community crush pens where cattle are sprayed with insecticides twice a month and graze freely within the grazing areas. Sprayed animals act as moving live targets for tsetse flies and thus control tsetse in the grazing areas.

In addition to the above, farmers are encouraged to keep draught animals for ploughing to enable them till the land for crops. For animal traction, farmers need healthy animals. The project is therefore screening cattle for trypanosomosis and treating all the sick animals.

OBJECTIVES

The primary objective of FITCA - EMMC is to evaluate the environmental situation in the FITCA areas, identify key issues that need to be addressed in order to make farming a sustainable business, and empower farmers to monitor and mitigate the negative changes in their land. To do this EMMC team has combined GIS based mapping of land use patterns; field assessment of key vegetation resources to determine the composition, abundance and distribution; and a rigorous information gathering on historical changes as can be recollected by the residents. These detailed information at the village level, will be scaled out at a landscape level using satellite image analysis.

This report presents results of the ground assessments on land use mapping, vegetation studies and household surveys.

STUDY HYPOTHESIS

This study is based on FITCA philosophy of using livestock as an entry point to rural development. In general FITCA promotes livestock development along with other development activities related to farming that would improve food security, reduce poverty and the general welfare of the communities in the project areas. 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 stated 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 therefore changing the patterns of land use and altering ecological processes depending on the types of fodder crops planted and the extent to which they are cultivated.

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) due to more settlements, higher population and land subdivision.

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.

5. Tsetse control technologies have direct impacts on the environment especially due to insecticides use.

PART

1

GPS Mapping

Busia Township EMMC/FITCA Study Area, Kenya
(March 2003)

INTRODUCTION

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 through mapping using available methods for change detection especially on land use/land cover over time. Maps can be created or derived using either ground survey or remote sensing methods.

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 for land use change for monitoring and management purpose. The information will also be used in training and classification of high-resolution satellite images for mapping wider EMMC and FITCA study areas.

Busia township is one of the three EMMC study sites in Busia and Teso districts of western Kenya province (*Map 1*). The two districts are on the western part of the province bordering Uganda and Lake Victoria. Western Kenya is a densely populated area, with agriculture being the main activity in the region. Farmers produce cereals and cassava for consumption and for the local market while sugar and tobacco are the main cash crops. Farmers also keep both grade and local breed cattle.

Within the study site, FITCA is promoting zero grazing by the introduction of treated nets around cattle pens in the (zero) grazing units. The expected associated indicators of change include conversion of existing land use (e.g. fallow and bushes) into napier grass and other fodder plants.

STUDY AREA

The mapping site is located in Mayenje sub-location of Township location in Busia district (*Map 2*). The mapped area is within 4 Km from Busia town centre. Due to its proximity to the town it is highly populated and serves as one of the town suburbs. Many of the landowners have subdivided their land into small plots of about 0.25 acre, which

they sell out to new settlers who need land mainly for building homes for themselves or for rent. As shown below (*Table I -1a,b*), the population within the township area increased by about 30 % within a duration of 10 years between 1989 and 1999.

Table I - 1a: Human Population Numbers in Busia Township

Sub location	**Area Km^2**	**Total Pop 1999**	**Total Pop 1989**	**Density 1999 / Km^2**	**Density 1989 / Km^2**	**House holds 1999**	**House holds 1989**
Mayenje	15.20	7,679	5,962	505	369	1,632	1,161
Mjini	7.00	17,479	13,341	2,497	2,700	4,380	3,324
Totals	**22.2**	**25,158**	**19,303**	**3,002**	**3,069**	**6,012**	**4,485**

Source: Central Bureau of Statistics Kenya, population census 1999

Table I - 1b: Human population of neighbouring sub-locations in the Township

Sub location	**Male**	**Female**	**Total**	**Area Km^2**	**Density / Km^2**
MUNDIKA	3330	3766	7096	22.60	313.98
ESIKULU	3910	4354	8264	21.20	389.81
MAYENJE	3686	3993	7679	15.20	505.20
MJINI	8582	8897	17479	7.00	2497.00

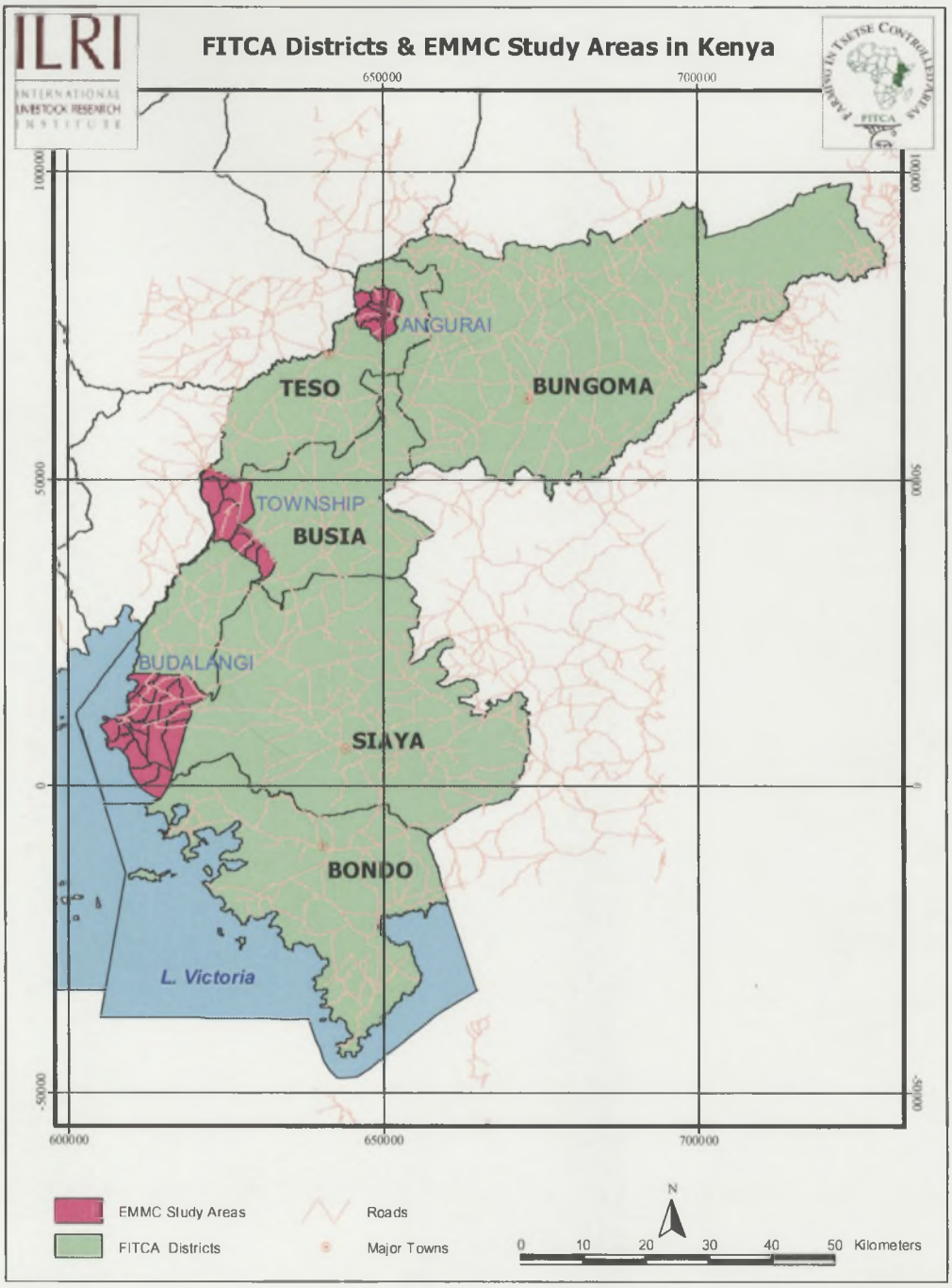
Source: Central Bureau of Statistics Kenya, population census 1999

The Township division is within two-agro ecological zones (*Table I -2*) namely: -
The Lower Midland Sugar Cane zone (LM1) which is warm and humid, good for sugar cane, fair for maize and too wet for cotton and the Lower Midland Marginal Sugar cane zone (LM2), which is warm and sub humid and good for maize but fair to marginal for sugar cane (Jaetzold and Schmidt 1982). The area mapped using GPS was fully in LM1 Zone.

Table I - 2: Area under different AEZ in Busia Township location

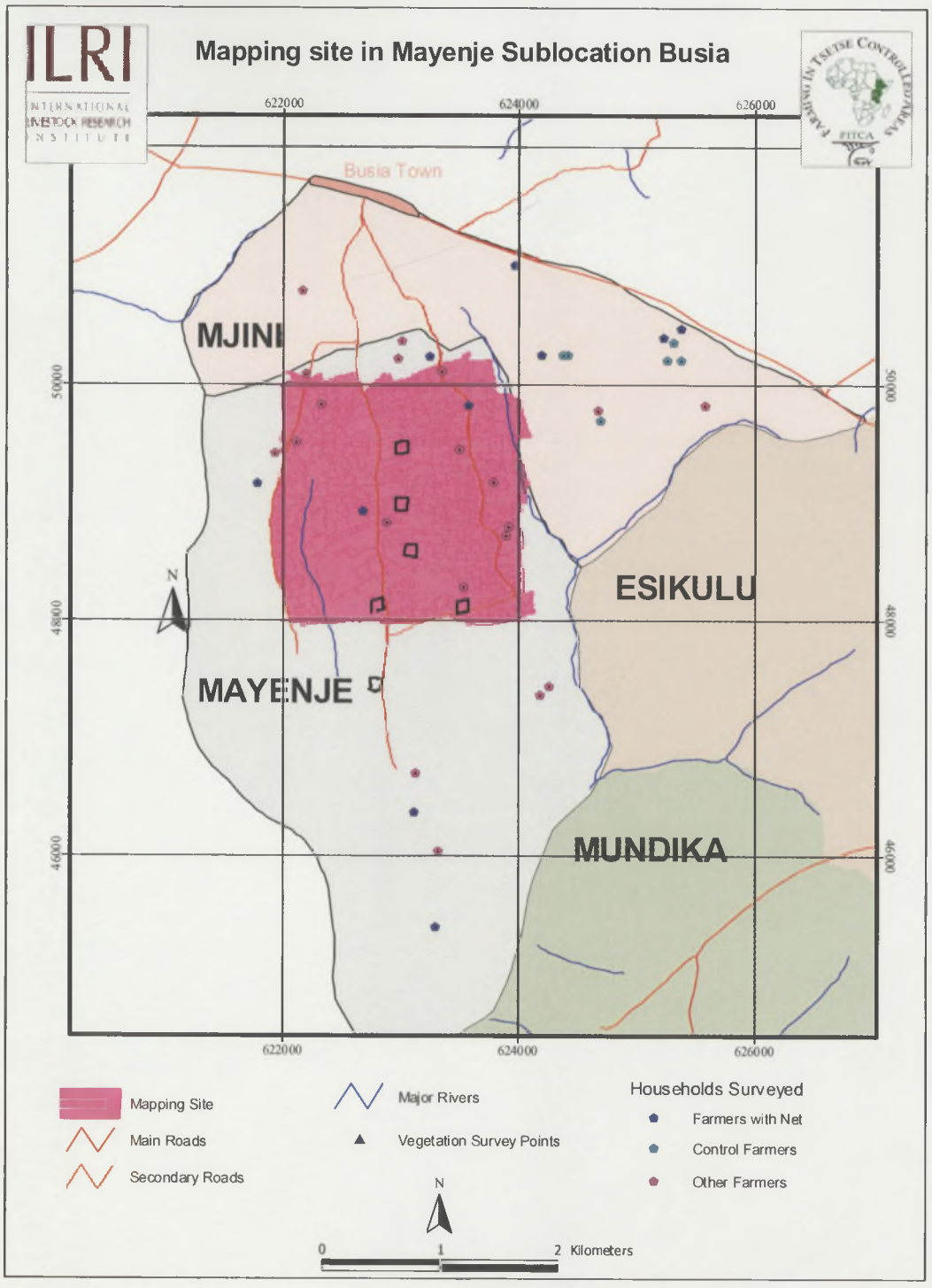
Sub location	**LMI** **Km^2**	**LM2** **Km^2**
Mayenje	13.68	1.52
Mjini	7.00	0

During the mapping period, most people were in the process of preparing their land for their first season annual crop(s) planting. The only crops in the farms consisted of cassava, banana, sweet potatoes, and some vegetables in the swampy areas.



Map 1: EMMC Study Areas in Kenya

Map 2: Mapping Site in Busia Township



Fieldwork

The mapping was accomplished using hand held Global Positioning Systems (GPS) as explained in the method report. Five people including four locally recruited trainees for ten days between 4th and 15th March 2003 did the work. The first two days were spent training recruits on GPS application and manipulation in land use mapping. The remaining eight days were spend in actual data capture and storage. Monitoring and verification maps were printed from facilities provided by Busia FITCA offices located in the town.

During the survey we only had one vehicle available for personnel transportation within the site. The vehicle was shared between the mapping group, the vegetation survey group and the household survey group. We managed to organise the work although it was quite inconveniencing to have only one vehicle for all field groups. Mobile phone network availability though assisted quite a lot in the organisation and communication within the site.

The mapping exercise took place during a dry period when farmers had just started preparing their land for the next planting season. The farms were mostly empty with some only planted with semi / perennial crops such as cassava, bananas and sweet potatoes. The possibility of misclassifying cropland into fallow or grazing land was high unless it was already ploughed. The presence of previous years crop remnants assisted in identifying the possible crop whenever there was confusion orelse such areas were simply classified as 'other crops'.

During this mapping exercise we had not made prior arrangements with the administration thus the community was not pre-informed but after a discussion with the chief, he allowed us to engage two village elders (Ligulu) on a full time basis in informing the community as we did the work. Consequently, we had problems during the first day but as more farmers were informed, things went smoothly by the third day. The mapping group members also took the initiative of informing the farm owners before commencing the farm mapping exercise clear any doubts. Most farmers thought we were

surveying their land for some ulterior motives. In summary it is very important to inform the people before commencement of any ground mapping exercise.

RESULTS

An area of about 4.3 Km^2 was mapped within Mayenje sub location. A total of 265,988 meters (266 Km) was walked to track 835 polygons of various land use and cover types. The main classes identified included cultivated areas, built up areas and natural areas.

The major land use classes are shown in (*Table I -3 and Figure I -1*) and the detailed cover classes are shown in (*Table I - 4 and 5*) and the corresponding maps.

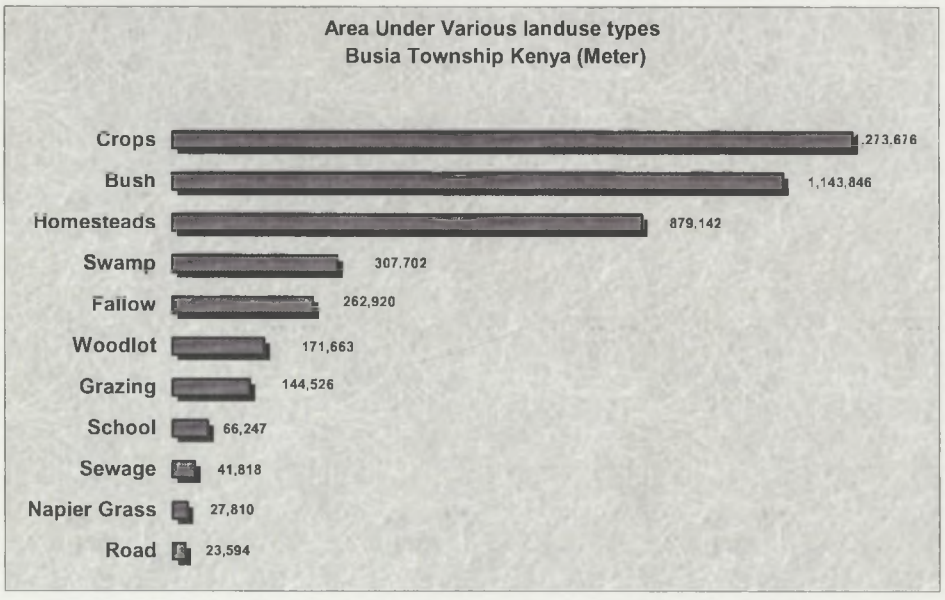
Cultivated areas or cropland (30 %)

Cultivated areas covered about 30 % of the total with cassava contributing about 10 %. As mentioned earlier most farms were empty as others were being ploughed. There was a mixture of many crops within the homesteads hence the area of cropland was actually higher than stated in the tables. Also some parts of the swamp were being utilized for growing a mixture of crops such as arrowroots, sugar cane and vegetables. We also identified and mapped the few and small pockets of Napier grass (animal feed) this being one of the important indicators of change expected due to FITCA activity of encouraging zero grazing in the area.

Table I - 3: Major Land use area cover (Busia Township)

Cover Type	***Area in (M^2)***	***Ratio Of total***	***Percentage of Total***
Grazing	144,526	0.03	3.32
Woodlot	171,663	0.04	3.95
Fallow	262,920	0.06	6.05
Swamp	307,702	0.07	7.08
Infra +Home	1,010,800	0.23	23.27
Bush	1,143,846	0.26	26.33
All Crops	1,301,486	0.30	29.96
Totals	**4,342,942**	**1.00**	**100.00**

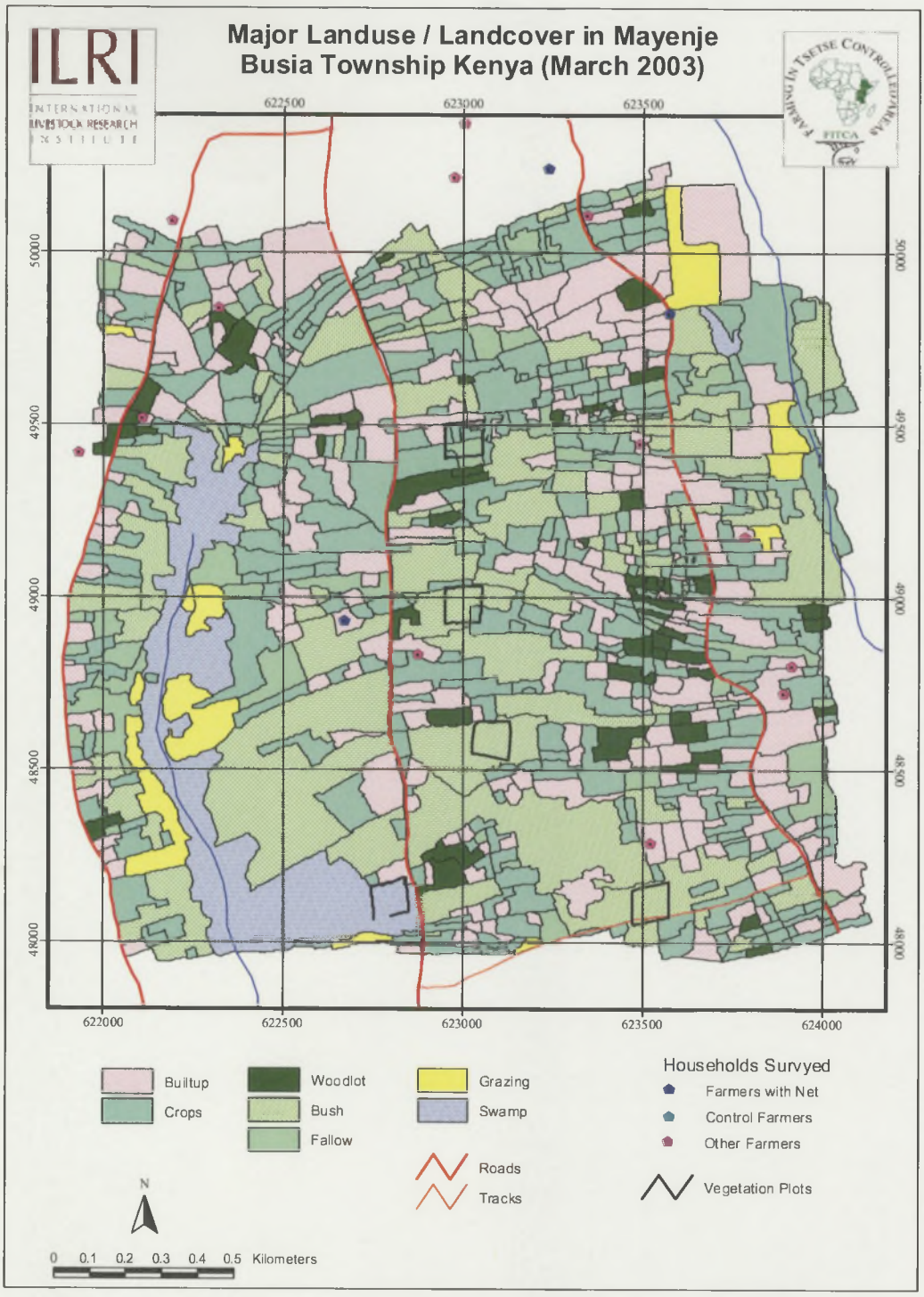
Fig. I -1: Bar graph of area cover of major land use types



Built up Areas (20 %)

Mayenje was a highly settled area due to its proximity to busia town. The built up areas were mainly made up of homesteads contributing about 20 % of total. The homesteads consisted houses, cattle sheds, woodlots, fruits, bananas, cassava and other crops. Some homesteads and even farms were fenced while others had thick hedges making the mapping work difficulty. The rest of built up area was made up of schools, the urban council sewerage processing plant and the roads/reserves.

Map 3: Major Land use Classes Busia Township



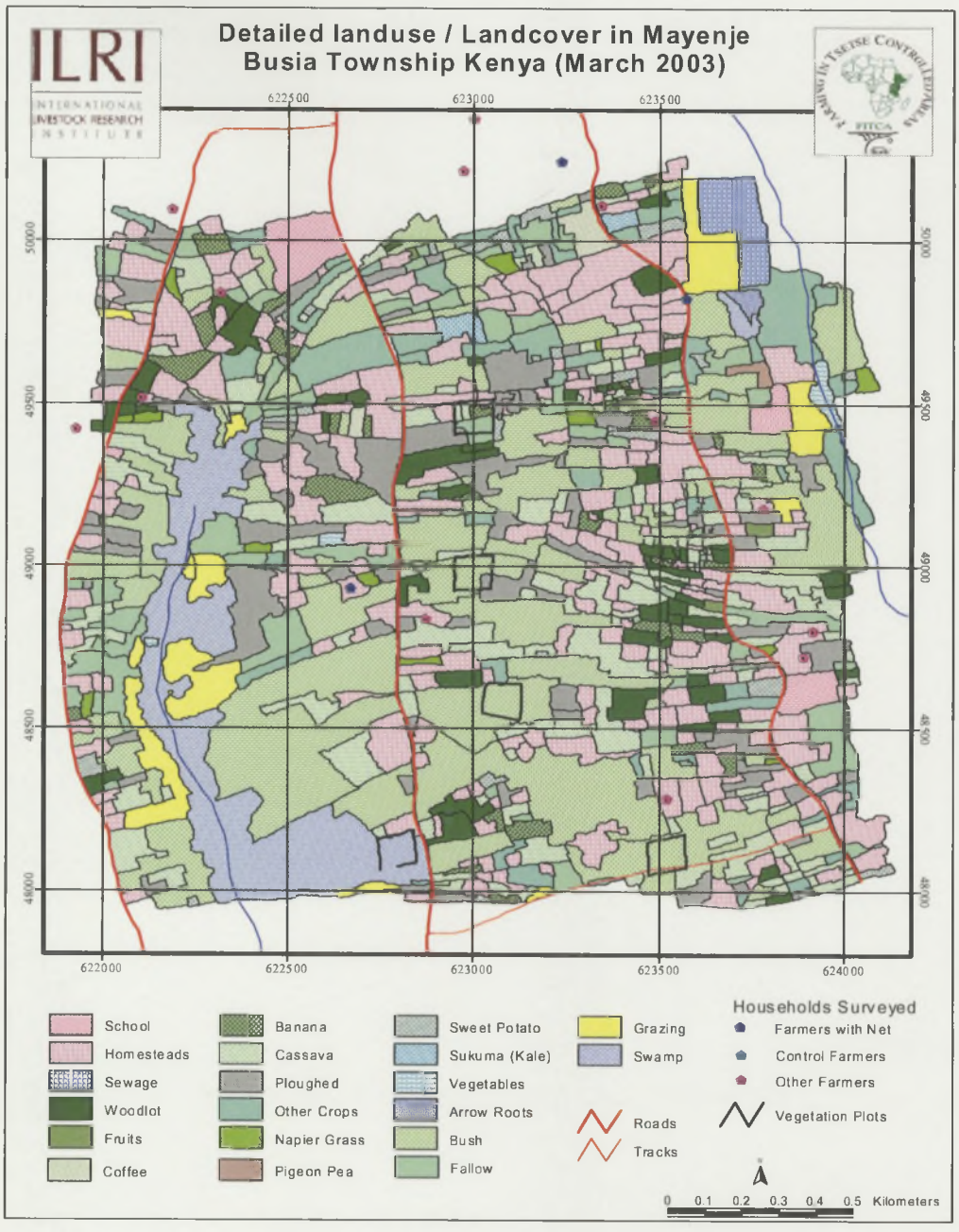
Natural areas (46 %)

Lantana camara bushes covered about 26 % of the total dominated natural areas. These were mainly pure bushes mixed with fallows and some grazing lands. Swamp and related vegetation covered over 7 % with the remaining natural areas (13%) consisting of fallows, woodlots and grazing lands. The swampy areas were highly utilised for grazing and as a source of thatching grass and firewood.

Table I - 4: Detailed Land use area cover (Busia Township)

Landuse Class	Polygon Count	Area (Meters)	Percent of total	Average Area	Minimum Area	Maximum Area
Pigeon Pea	1	5,005	0.12	5,005	5,005	5,005
Fruits	3	5,484	0.13	1,828	788	2,898
Arrow Roots	1	5,632	0.13	5,632	5,632	5,632
Vegetables	5	12,771	0.29	2,554	62	9,099
Sukuma (Kale)	3	15,762	0.36	5,254	1,648	9,278
Coffee	3	19,448	0.45	6,483	1,460	14,363
Road/Reserve	3	23,594	0.54	7,865	3,761	10,413
Napier Grass	13	27,810	0.64	2,139	483	4,071
Sewage	1	41,818	0.96	41,818	41,818	41,818
Sweet Potato	38	52,039	1.20	1,369	22	5,487
School	4	66,247	1.53	16,562	1,412	35,732
Banana	32	90,640	2.09	2,833	81	11,868
Grass	14	144,526	3.33	10,323	1,897	32,276
Woodlot	57	171,663	3.95	3,012	167	14,101
Fallow	61	262,920	6.05	4,310	243	22,218
Crops	55	264,665	6.09	4,812	610	38,002
Swamp	2	307,702	7.09	153,851	7,326	300,376
Ploughed	83	357,148	8.22	4,303	664	30,734
Cassava	140	445,082	10.25	3,179	154	17,765
Homesteads	229	879,142	20.24	3,839	74	19,811
Bush	87	1,143,846	26.34	13,148	141	175,269
Totals/Averages	835	4,342,942	100	14,291	22	300,376

Map 4: Detailed Land use Classes Mayenje



Ground Survey Land-use 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 4,342,942 M^2 (4.3 Km^2). The cultivated areas, which included annual and perennial crops, occupied about 30 % with annuals and perennial crops occupying each 15 % of the total (*Table I -5*). The natural (semi) areas occupied over 46 % with the remaining 23% for settlements and other infrastructures.

Table 1 - 5: Ratios of Natural and Cultivated areas

Land use classes	Area (Meter Square)	Percent of total	Re-class
School	66,247	1.5	Built up
Road/Reserve	23,594	0.5	Built up
Sewage Plant	41,818	1.0	Built up
Homesteads	879,142	20.2	Built up
Built up	**1,010,801**	**23.2**	
Grazing	144,526	3.3	Natural
Woodlots	171,663	4.0	Natural
Fallow	262,920	6.1	Natural
Swamp	307,702	7.1	Natural
Bush	1,143,846	26.3	Natural
Natural	**2,030,657**	**46.8**	
Crops (others)	264,665	6.1	Annual
Arrow Roots	5,632	0.1	Annual
Vegetables	12,771	0.3	Annual
Sukuma Wiki (Kales)	15,762	0.4	Annual
Ploughed	357,148	8.2	Annual
Annuals	**655,978**	**15.1**	
Fruits	5,484	0.1	Perennial
Coffee	19,448	0.4	Perennial
Banana	90,640	2.1	Perennial
Napier Grass	27,810	0.6	Perennial Semi
Pigeon Pea	5,005	0.1	Perennial Semi
Sweet Potato	52,039	1.2	Perennial Semi
Cassava	445,082	10.2	Perennial Semi
Perennials	**645,508**	**14.7**	
Cultivated	**1,301,486**	**29.8**	
Grand Totals	**4342942**	**100.0**	

CONCLUSION

The FITCA activity of promoting zero grazing in this area is very relevant and conforms with the land use change that is taking place around Busia town. The land use is changing from pure cultivation to a mixture of cultivation and housing for the urban workers. Land is being subdivided into smaller plots of about 0.25 of an acre for single family or for building rental houses. If the FITCA supported farmers are successful, then there is ready market for the milk product among the workers and the new settlers.

Table I –6 Calculated X and Y Shifts

	X	Y
Busia	621,049.81	51,847.39
	621,134.54	51,540.89
Average	-84.73	306.50

Part

II

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

Busia Township

Busia District

Kenya

EMMC/FITCA Study Area

Kenya

2003

INTRODUCTION

Busia landscape is characterized by low elevated land, a recipient of drainage from highlands in the north. Much of the district is dominated by floodplains along which several major rivers pass as they feed water into lake Victoria. There are several conical shaped hills that are as a result of Pleistocene volcanic activities that affected the entire basin of lake Victoria (Pickford, 1982; 1986). These hills are highly eroded due to lack of adequate vegetation cover on the steep slopes of the hills. Many of these volcanic hills have numerous exposed rocks after the top soil was removed by water on surface runoff.

Effects of man on vegetation in this lake basin area goes back to prehistoric times when man adopted iron smelting technologies and used them widely to burn wild bushes as a strategy to hunt large game. This extensive use of fire in bush burning and iron smelting is thought to have contributed to the spread of savannah during the last two millennia (Maitima 1997). The occupants of this region might have changed several times in the past but for most of the time the area was occupied by cultivators who used grazing and fishing only as a supplement to their food sources. The current occupants have lived in the region for many generations and their main occupation is farming but along the shores of lake Victoria grazing and fishing are the main occupations.

Within the study site land parcels are small to medium sized on the range of 2 to 20 acres increasing as one leaves town. There are more and more bushes as one leaves the town. However, the bushes are heavily harvested of woody plants leaving only the short thin-stemmed ones that are not of much economic value. The major reason for harvesting is to provide firewood for cooking and for burning bricks. Construction of houses is of course another reason but since there are not many houses under construction, the major reason for wood harvesting is firewood.

Trees are extremely few in the study area as the major vegetation in the uncultivated areas are shrubby bushes most of which are grazing areas. Around a few homesteads there are exotic plants planted along the hedges of their home compounds. The only large indigenous tree found in one of the plots studied in the area was one *Ficus tree*. This tree

might have been preserved due to the cultural beliefs among many African tribes-that the tree is sacred. The most common indigenous tree is a species of Makhamia that is widespread in the cultivated areas but almost always, as sprouting young plants that are young because harvesting does not let them grow to maturity. Makhamia tree is used mainly for house construction as its straight and non-branching and it has the ability to bend without breaking especially the young ones. Most of the indigenous trees were very young, some as seedlings as they were harvested while very young.

One reason why firewood is required in large quantities is for burning building bricks. Although there are not many houses built with bricks in the rural study area, it serves as a source of building bricks to the neighbouring town where there are many brick houses. Generally soils are poor in nutrients as there is very little litter accumulation or recycled organic matter into the soil. Erosion is evident as the top soils appear to be dominated by loose sandy particles. In many places the top soil is compacted and hard forming a conglomerate. The major source of erosion is surface runoff but wind erosion could be a factor especially during the periods when the fields are ploughed and have exposed loose soils.

Harvesting of grass for thatching of houses is very rampant. Most of the houses are grass thatched. Within the study area away from town, houses roofed with iron sheets are very few compared with the grass roofed. Despite the numerous grass-roofed huts the amount of tall grass suitable for thatching is very scarce. In some homes there are areas set aside for preservation grass for thatching.

Most of the areas where natural vegetation is still available are the areas where owners lived away from the farm. Harvesting of woody plants by neighbours and heavy grazing heavily disturbed such areas.

Vegetation in the study area is highly fragmented by cultivation and settlements. There is no area with original or undisturbed vegetation. What remains as non-cultivated areas are

either bushes of old fallow dominated by *Lantana camara* or grazing areas with grass and herbaceous species that are only a few seasons after cultivation.

Reasons for vegetation studies

This study aims at documenting the status of the environment in Busia (a FITCA project area), assess the diversity and abundance of plant species in different distribution patterns and report on the impacts of human activities on vegetation. Further, this work aims at identifying the causes of land degradation within Busia township (a FITCA area), with a view of developing environmental or ecological frameworks to sustain human settlements and farming practices. This will develop a baseline for monitoring impacts of tsetse control on environment. It is expected that tsetse control through FITCA initiatives will result into higher livestock numbers, increase income of the farmers and provide draught power for working in the farms including digging, that will enable tillage of more land. In Busia town, the focus of FITCA is to promote zero grazing by introduction of netted cow pens. This approach is expected to increase the number of grade cows to promote diary production. The study therefore is to assess the composition and structure of vegetation in the study area to provide a base upon which land use planning can be made in view of increasing livestock numbers and changing livestock breeds.

METHODS

Vegetation survey in Busia township was conducted in six monitoring plots measuring 1 hectare in area. These assessment and monitoring plots were established with an intention of developing a baseline upon which future assessment could be done to determine changes over time. It was an assumption that with the adoption of FITCA tsetse control activities, substantial changes in land use will occur for example expansion in area under pastures, cultivated land and an increase in pressure on natural resources with an increase in human activities.

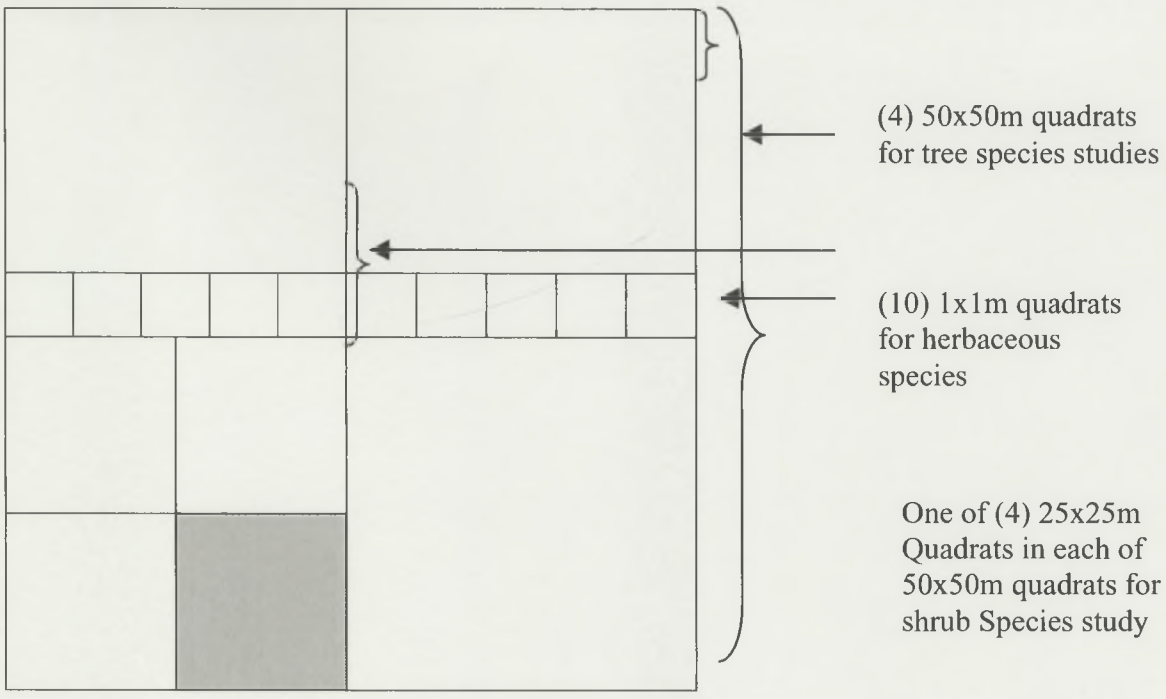
The survey involved identifying trees, shrubs and herbaceous plant species by their botanical or local names (if the botanical name was not readily available in the field). The

local village leaders (*reguruus*) assisted in getting most vernacular names. Plots measuring 100x100 meters were established based on stratified and nested sampling plans, where spots to locate the plots were picked at an interval of 500m along a line-bearing determined by a compass. Ideally these spots were to serve as midpoints for the sampling plots. In most cases the plots were to be moved to the nearest area with natural vegetation because the points fell on cultivated lands or in the middle of a cluster of homesteads that were not ideal for vegetation sampling.

In each plot the number, relative percentage cover and height above ground were recorded for the three distinct canopy covers: trees, shrubs and herbaceous. The herbaceous cover included both the grass and forbs species because as a canopy they were indistinguishable in most cases.

Trees: Analysis of tree species was done in 50x50 meter quadrats within the 100x100 sampling plot. The plot was subdivided into 4 equal parts to create the quadrats. Shrubs were analysed in four 25x25m quadrats in each of the 50x50m sampling quadrats. Initially the four shrub quadrats were located around the midpoint of the plot. This was done for plot two and plots three. However, setting these quadrats took too much time. In the fourth quadrat only one of the tree quadrats was divided into four to create four quadrats of 25x25m and in the fifth plot a strip of 25m was created in the inner part of two adjacent tree quadrats. One of the four 25mx25m quadrats in each of the four plot quarters was used to study shrub species. Therefore in each plot there were 4 quadrats for tree species study and 4 quadrats for shrub species study. Herbaceous species were studied in 1mx1m quadrats. In each plot there were a total 10 quadrats studied for herbaceous species.

Fig. II -1a. Vegetation Sampling plan in Busia



Sampling plot coordinates:

Sampling locations were selected based on stratified sampling plan. The goal was to sample vegetation in non-cultivated areas or in all natural habitats where vegetation was dominated by naturally growing plant species.

Plot 1:

This plot was not sampled due to the farmer-land dispute with neighbours and brothers as they could not accept that we are not surveyors. Vegetation analysis on this plot was skipped but mapping went on.

General description of plot 2:

This plot bordered a homestead. A footpath providing access to adjacent homes was running across the plot. One half of the plot was fallow with part of it being cleared during the time of the fieldwork. The other half was a much older fallow but remains of

more perennial crops like bananas and fruit trees like guavas were present. There was a small thicket surrounding a big fig tree on which there was an anthill. This plot was relatively highly disturbed and had a high diversity of plant species, due to the fact that there was no dominance by a few species.

Coordinates of the plot are as follows:
0622960: 0049490; 0622971: 0049501;
0623057: 0049495; 0622952: 0049399

General description of plot 3
This plot was dominated by medium height stands of *Lantana camara* that were heavily harvested for wood resources. It was located on a piece of land that was owned by someone who lived far away from the area. People living close to the land tended to frequent the land for plants for various uses.

Coordinates of the plot are as follows:
0622956: 0049024; 0623057: 0049030;
0623054: 0048922; 0622952: 0048922

Plot 4: (near teacher's place)
0623033:0048630; 0623126:0048627;
0623120:0048520; 0623025:0048541

Plot 5: (across near grass)
0623474: 0048147; 0623553: 0048169;
0623572: 0048066; 0623475: 0048045

Plot 6: (near a spring)
O622840:0048183; 0622851: 0048083;
0622752: 0048052; 0622748: 0048153

Plot 7: (last near a stream)

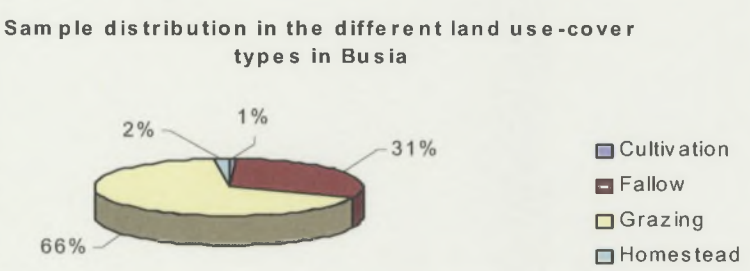
0622835: 0047492; 0622823: 0047391;

0622726: 0047400; 0622736: 0047502

RESULTS

Data collected from the field was analysed using a computer based SPSS programme to determine various study parameters. Results presented below are some of the analyses made from the vegetation data. Unlike other sampling areas, vegetation on cultivations was not sampled in Busia because the fieldwork was done during a dry season. There were no weeds in the fields at the time of sampling.

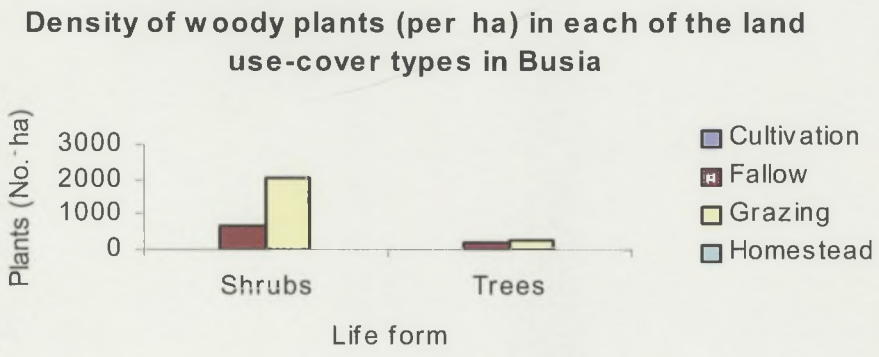
Number of quadrats sampled in each of the general land use-cover types in Busia				
	Cultivation	Fallow	Grazing	Homestead
Herbaceous	1	17	40	2
Shrubs	0	8	16	0
Trees	0	8	16	0



About 2/3 of the sampled area was on grazing land. The distribution of sampling areas was influenced by a desire to understand the composition and the diversity of plant species in the grazing areas of Busia EMMC sites. About 1/3 of the sampled area was under fallow.

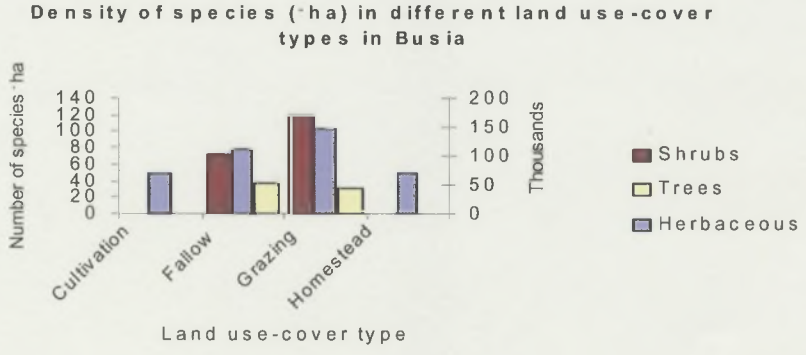
Note: The low sampling effort made in the cultivated areas does not mean that cultivations were few in the area. This low sampling effort was due to the fact that sampling was done during a dry season and most gardens had already been ploughed in preparation for planting.

Fig. II – 1b Density of woody plants (per ha) in each land use/type



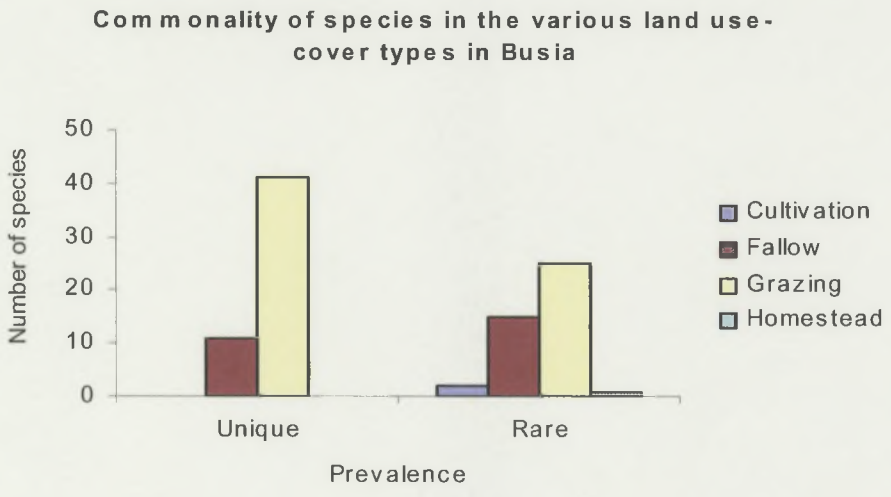
As reported above (*fig II – 1b*) plants in the cultivated areas were not sampled because fieldwork was done during a dry season. The density of woody plants reported here were only those in the grazing areas and fallow lands. As seen above there were extremely very few woody plants in the Busia township area due to the heavy harvesting in both the fallow land and the grazing areas. Most of the woody vegetation comprised of shrubs in the grazing areas.

Fig. II – 2 Density of species (ha) in different land use/type



There was a higher richness of tree and shrub species in grazing than fallow areas. This pattern was contrasted sharply by the percentage cover in the respective land use types, where shrub cover was markedly more in fallow than grazing land, while that of trees remained the same in both. This was a strong evidence of deliberate bush management in the grazing land, perhaps aimed at eradicating tsetse-breeding sites. In addition, grazing may produce a similar net effect where browsing animals may control the vegetative growth of bushes.

Fig. II – 3 Commonality of species in the various land use/type

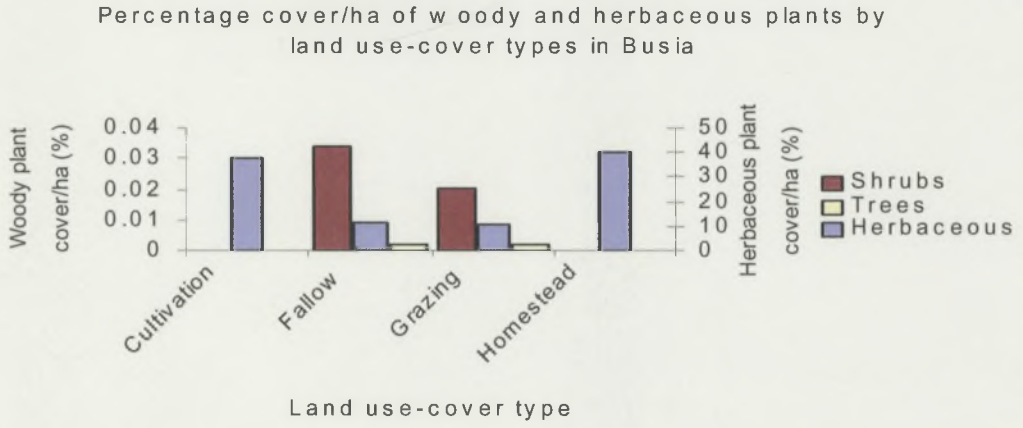


Species unique to a land use-cover type were those that appeared in more than one quadrat of that land use-cover type, while the rare species occurred in only one quadrat of that land use-cover type alone.

NB: The sample size in cultivated and the homestead use-cover types was too small for certainty (95% CL) in this analysis. This analysis disregarded the number of quadrats obtained in the various land use types. Nevertheless, the results indicated conspicuous absence of unique species in cultivated and homestead areas, while the rare ones were equally low in these land use-cover types. This may suggest that species prevailing there were commoners. The two rare species in the cultivated area were *Phyllanthus niruroides* and *Ipomea batata*, while in the homestead, *Eleusine indica*. *P. niruroides* was

characteristically common in shallow and disturbed soils. *I. Batata* was a versatile food crop that could withstand disturbance while *E. indica* was a common grass around the homesteads. Grazing areas had more unique species than fallow. A similar situation was also observed on rare species. There were more rare species in the grazing areas than in the fallow.

Fig II – 4 Percentage cover/ha of woody and herbaceous plants



•Woody plants were missing in the cultivated and homestead areas, suggesting greater impact of these use type on woody vegetation unlike grazing and fallowing. It could be related to low recruitment of samplings and unsustainable harvesting pressure on tree species. On the other hand, the lesser bush cover in grazing and homestead areas compared to other land use types point to some degree of bush control relatable to tsetse control.

•Herbaceous layer was nevertheless common in the cultivated and homestead. Since non of the two land use cover types hosted unique or rare species, it was likely that the dominant herbaceous layer was composed largely of commoners and/or invasive species, which thrivd best in highly disturbed land.

•Overall the herbaceous layer may be the major component that influenced the ecological dynamics under the prevailing land use-cover types, since it constituted the dominant

vegetation type although it covered less than 40% of land. This may suggest susceptibility of soil to wind and water erosion and nutrient transfer/loss in the area, plus high evapo-transpiration considering that over 60% of land was bare. The organic carbon component may also be low, considering that low soil moisture that was likely to persist there limited decomposition rates of the little organic materials available leading generally to infertile soils.

•The general lack of woody plants particularly trees species in the area was suggestive of semi arid conditions where composition of woody plant species may vary much more markedly as a function of soil moisture than as a function of prevailing land use-cover type. This supported the hypothesis of committing larger areas to grazing in order to meet the feed requirement for the animals while at the same time accommodating fluctuations in forage that are likely to subsist alongside poor rainfall patterns.

Fig. II – 5 Percentage cover of different vegetation types

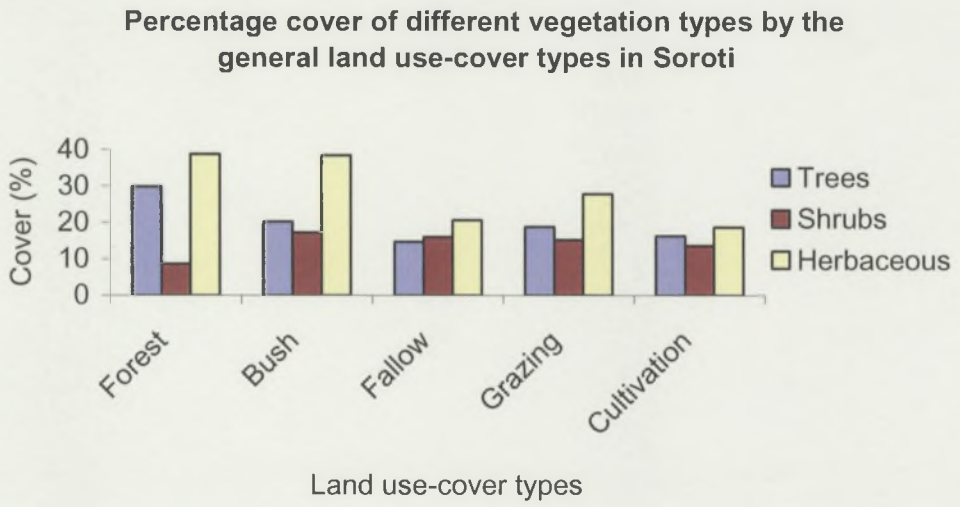


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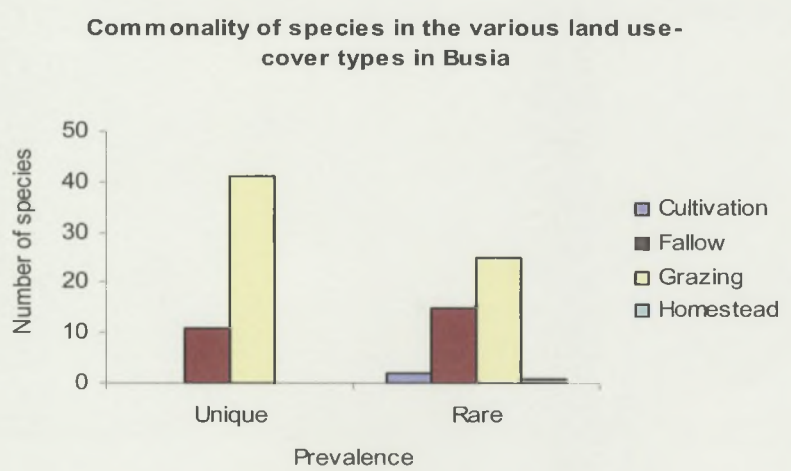
Fig. II – 6 Commonality of species in the various land use/types in Busia



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NB: The sample size in cultivated and the homestead use-cover types was too small for certainty (95% CL) in this analysis. This analysis disregarded the number of quadrats obtained in the various land use types. Nevertheless, the results indicated conspicuous absence of unique species in cultivated and homestead areas, while the rare ones were equally low in these land use-cover types. This may suggest that species prevailing here were commoners. The two rare species in the cultivated area were *Phyllanthus niruroides* and *Ipomea batata and Eleusine indica* in homesteads. *P. niruroides* was characteristically common in shallow and disturbed soils. *I. Batata* was a versatile food crop that could withstand disturbance while *E. indica* was a common grass around homesteads.

Tree cover

The study area had very little tree cover. The few trees in the area were exotic species comprising mainly of fruit trees and a few woody species for domestic use. Among the fruit trees were *Mangifera indica* (mango trees) and Citrus sp. (orange trees). Among the wild tree species were species of *Ficus* and *Makhamia*. Except *Ficus* that was found to grow to maturity, all other trees growing in the field were immature as a result of harvesting. In almost all cases, plants known to be trees were growing as shrubs with multi stemmed bases after the original trees were cut for domestic use.

The most common use of trees found in the area was house construction, charcoal making and as firewood for burning of bricks. Due to scarcity of woody plants, trees were not a source of firewood.

Shrubs

Bushes of *Lantana camara* and *Tithonia* were the most common in the area. These bushes were mainly old fallows or patches with long histories of disturbance and abandoned land. There were no natural bushes in the study area. Bushes were almost devoid of tree species. These bushes were sometimes burned especially when some part was to be converted to cultivation.

Shrub species were used for construction and as a source of firewood. During the fieldwork people were observed cutting fresh branches of *Lantana camara* which they dried near a fire place or by spreading out in the sun, so as to use for firewood at a later date.

DISCUSSIONS

Plants are an important component of natural resources in the environment as they play various critical roles in the functioning of an ecosystem. Through photosynthesis processes, they synthesize organic matter that all consumer organisms including man depend upon for their living. Primary production materials from plants recycle in the soil and accumulate over the years to form a substrate upon which two interrelated and complex food chains depend; the detritus food chain and the grazers food chain that include the plants themselves. Different species of plants have different nutrient requirements and it is partly due to the composition of nutrients in the soil substrate that different farming systems have different vegetation types (Maitima et al. in Preparation). Variation in vegetation types in turn affect the type and composition of animal species in the ecosystem including mammals, birds and insects that directly or indirectly depend on the plants either for food or for shelter (Pomeroy, et al 2003; Mugatha 2002).

Farming on the other hand depend on the diversity of all of these organisms that play different roles in the ecosystem. The more complex an ecosystem is, the less degraded it is and thus the more productive it is (Maitima and Olson, 2002). Unfortunately the effects of farming and other human activities on the environment tend to reduce this complexity

and thus reduce the productivity. In order to develop a sustainable land use system it is therefore important to assess the ecological status of the land use with a view of detecting the constraints of production and enhance the capacity of the land users to monitor the changes and mitigate the effects of those that are negative.

In the study site whose results are presented here, general observation was that there were hardly any plant resources left alone to fulfil the critical roles to the environment as highlighted above but even to satisfy the demands of the people for their various basic needs. These basic human needs like energy, shelter and food that are responsible for the current situation are short term compared to the ecological goods and services that the plants provide that are long term and of common good to the community rather than the short term gains that benefit individuals.

There was an urgent need for planting more trees in the area to satisfy both the human basic needs and the ecosystem goods and services. This need is even of more urgent due to the introduction of dairy zero grazing in the area by FITCA. There was a big demand for milk in the adjacent Busia town, which has no diary factory. As the diary industry continued to develop, growing of livestock fodder was increasing with the increase likely to reduce the amount of land that was currently under fallow and shrubby.

The low vegetation cover has exposed soils to surface runoff and are therefore highly eroded leaving sandy particles with little organic content to support agricultural production.

PART

III

Human Perceptions on Environmental changes

BACKGROUND INFORMATION

Trypanosomosis is a major constraint to livestock production in Africa. Large areas of fertile land are infested by tsetse flies making animal and crop agriculture production difficult. In order to increase crop and livestock production while reducing the incidence of sleeping sickness in the area, FITCA- K is involved in tsetse and trypanosomosis activities. However, sustainable control is only possible if strategies used do not affect the environment negatively. FITCA - EMMC was formed to strengthen the capacity of the local people to monitor any changes in the environment emerging as a result of tsetse and trypanosomosis control. The program was therefore designed to ensure that the environments' attributes were not either adversely affected directly by the control activities or by the production systems arising through removal of the disease constraint.

FITCA Kenya has employed varied control strategies in different areas depending on the production system including crush-pens, netting of zero-grazing units, treatment of sick animals. In Township division, netting of the zero-grazing unit and treatment of sick animals were the major strategies employed by the farmers.

OBJECTIVES

The overall objective was to collect baseline data in the FITCA area, which would help in monitoring the environmental changes resulting from FITCA-K activities.

METHODOLOGY

Area of Study

The study was conducted in the Township division, one of five divisions in Busia district. Other divisions in the district were Bundalangi, Butula, Nambale, Matayos and Funyula. The division is curved out of Matayos division in 1999. It covers an area of 19 Km square (1900 ha) of which 1750 ha is arable land. According to 1999 census the human population was 24 625 people. Temperatures of 26 C and a mean rainfall 1500 p.a characterize the climate. It is located within two-agro ecological zone, LM1 and LM2. The division has one location that is divided into two sub-locations, Mjini and Mayenje. It is also one of the three EMMC sites in Kenya (others are Angurai, and Bundalangi).

Method Used

A list of farmers involved in FITCA Kenya programs was obtained from the FITCA office. A questionnaire was developed and administered to all the 17 farmers in the FITCA-K zero grazing programs. In order to increase the sample size, other farmers not involved in the project were interviewed. A total of 36 farmers were interviewed. For ease location of the households, the divisional livestock officer was recruited to accompany the sociologist. Data obtained from the questionnaire was entered in the computer using MS access and analyzed using SPSS statistical package.

RESULTS

Background Information of Respondents

Personal information of the household heads in terms of their age, occupation, and level of education was summarized in the following graphs. The information was compared on the bases of gender.

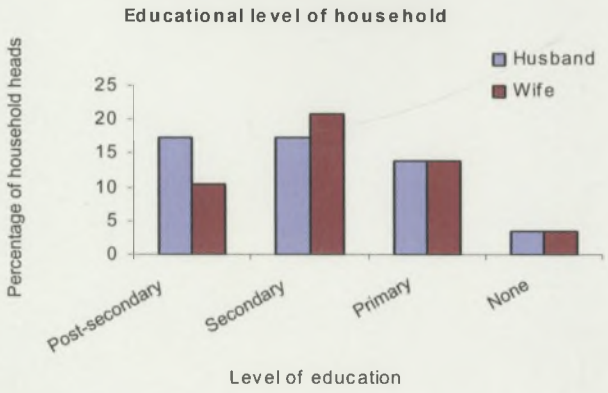
Fig III – 1 Age categories oh household heads

Most of the household heads were aged between 31 to 50 years but women formed the majority of the household heads in this age category. Above the age of 50 years more men than women are household heads. Men between the age 31 and 50 are mainly employed away from homes leaving their wives at home.

Education level of household heads

The majority of the household heads had received some formal education, with most of them having reached the secondary level. See *fig III -2* below

Fig III – 2 Education level of household



Occupation

Changes in occupation were recorded as shown in the following graph. More people had joined farming over the years. Such could be attributed to people leaving employment due to retirement and retrenchment. Twenty-six respondents (72.2%) practiced mixed farming, others animal-based eight (22.2%) and only one crop-based farmer.

Fig. III – 3 Occupation now and ten years ago

Land and Crop Management

Land Ownership

As shown in the following graph most farmers owned less than six acres of land with a majority falling in the range of 0-2 acres. There was a slight disparity in land ownership over the last ten years, only fifteen respondents had not experienced either increase or decrease in land area. Various reasons were attributed to such disparities as summarized in the following *table III - 1.*

Fig III –4 Land Ownership

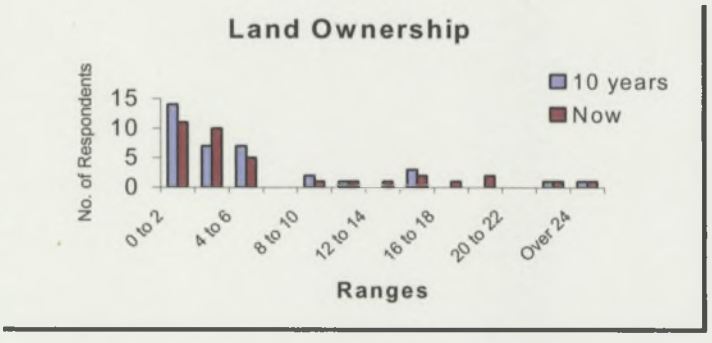


Table III - 1: Reason for differences in land ownership now and 10 years ago.

Reasons	More %	Less %
Bought	65.2	0.0
Sold	0.0	17.4
Grabbed	0.0	4.3
Subdivision	0.0	13.0

As shown in the above table more than half of the respondents had bought land more land in the last ten years.

Land Allocation

In order to establish the area of land allocated to different uses, farmers were asked to state the area set-aside for each land use. As shown in the following table, fallow and crop production accounted for the biggest share of land use.

Table III - 2: Area under different land uses

ALLOCATION	**Percentage**
Homestead	8.6
Crop	63.5
Fodder	23.4
Fallow	64.6
Grazing	20.5
Woodland	9.9

While most of the farmers, (33) cleared the bush using pangas and/or axes only three-used bush burning as a method. A comparison of different methods of land and crop management over the last ten years was made and the results are presented in *table III - 3* below

Table III - 3: Methods of land preparation, planting and weeding now and ten years ago

Methods	**Land management**					
	Preparation		**Planting**		**Weeding**	
	Now	**10yrs ago**	**Now**	**10yrs ago**	**Now**	**10yrs ago**
Hoe-Ox-Plough	18.2	25.8	0.0	12.3	0.0	1.6
Hoe	22.7	9.1	53.8	29.2	55.6	42.9
Ox-plough	6.1	6.1	0.0	0.0	0.0	0.0
Ox- Plough -tractor	0.0	3.0	0.0	0.0	0.0	0.0
Tractor	3.0	1.5	0.0	0.0	0.0	0.0
Mixed	3.0	0.0	0.0	0.0	0.0	0.0
Hoe-tractor	1.5	0.0	1.5	1.5	0.0	0.0
Hoe-broadcasting	0.0	0.0	0.0	1.5	0.0	0.0

The use of hoe in land preparation, planting and weeding had increased over the last ten years while the use of ox plough for similar purposes had declined. Among the respondents ten owned oxen and ox-plough compared to only three and four respectively at the time of study. Seven of them attributed the difference to death of oxen from diseases.

A variation was also noted in the sources of seeds today in comparison to ten years ago for there was an increase in the number of farmers who bought seeds.

Table III - 4: Sources of seed now and ten years ago

Source of seed	**Ten years ago**	**Now**
Market	11	25
Selection from harvest	18	10

The utilization of pest control and fertilizer were also compared. Ten years ago only 7 farmers used pest control on their crops compared to 16 farmers applied the same today. There was also an increase in the number of farmers using fertilizer today see details in the *table III - 5* below.

Table III - 5: Utilization of fertilizers now and ten years ago

	Now (No. of farmers)	**Ten Years ago** (No. of farmers)
Fertilizer	9	8
Manure	19	9
Both	7	0
None	1	12

According to most farmers (26) the yields had deteriorated in comparison to ten years and this was despite the fact that there was an increase in the utilization of manure and fertilizer.

Table III - 6: Harvest storage and preservation

	Storage		Preservation		
	Now	**Ten Yrs**		**Now**	**Ten Yrs**
Granary	1	19	**Chemical**	17	6
			Ash	0	3
Sack	29	8	**None**	9	11

From the above (*table III – 6)*, it is clear that there are changes in the harvest storage and preservation. There was a shift from storage in the granary to storing the harvest in sacks with equally an increase in the number of farmers preserving their harvest using chemicals.

Processing

The number of farmers who either used hand or machine for processing their harvest had increased while there was a substantial decrease in the number of those who used sticks however, more than three quarters processed by hand (*see table III -7*).

Table III - 7: Method of Processing

Method	**Now**	**Ten years ago**
Hand	22	9
Machine	4	1
Sticks	9	18

There was general decline in the number of farmers who sold their crop produce today in comparison to ten years ago. Only fifteen farmers reported that they used to sell their produce ten years ago compared to eight today.

Priciple Crops Grown by the farmers

The principle crops grown by the farmers included maize, cassava, beans and fodder.

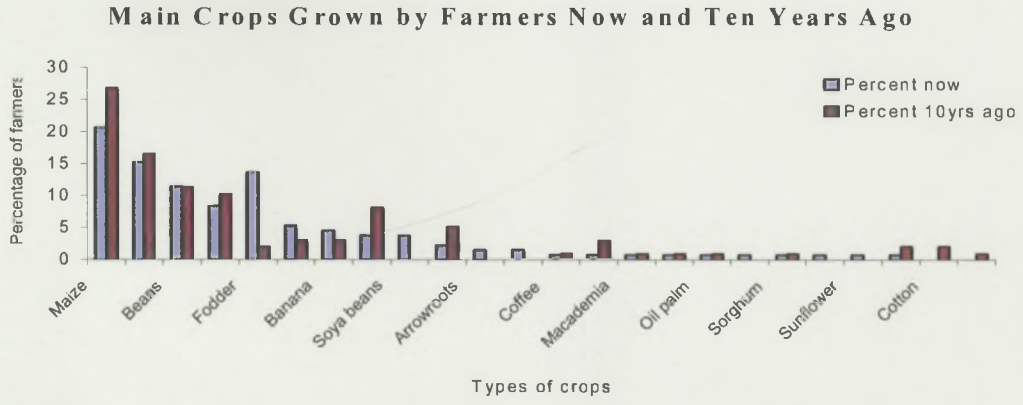
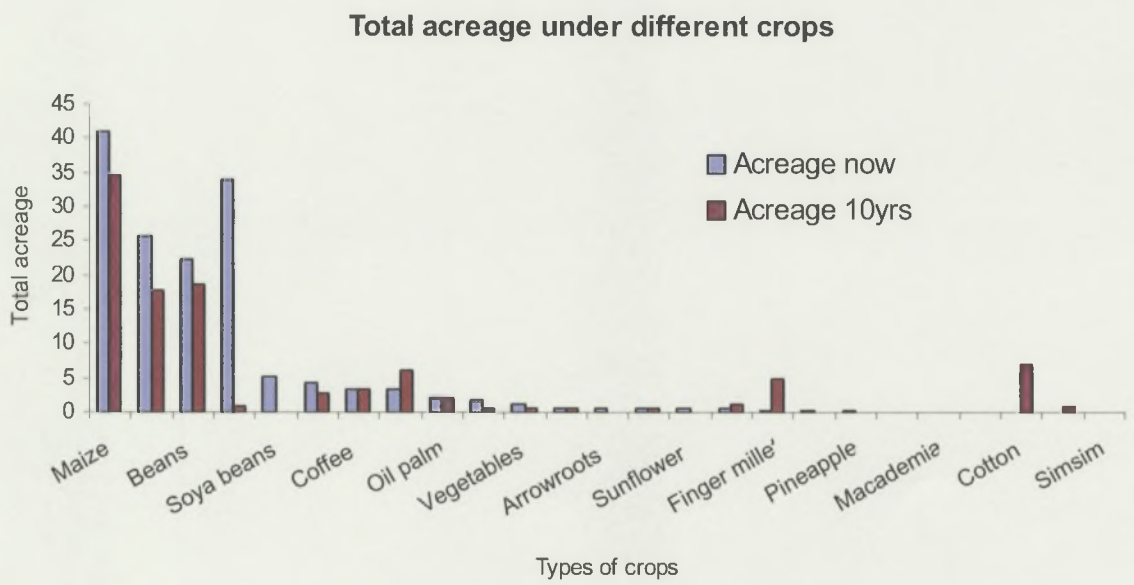


Fig. III –5 Main crops grown by farmers now and ten years ago

While there was increase in acreage under these crops other crops like finger millet and cotton experienced extreme decline. The acreage under fodder crop rose tremedously other important crops have been introduced in the area such as soyabeans and arrowroots (*Details are in the graph below*)

Fig. III –6 Total acreage under different crops



Methods of Cropping

Farmers were asked to state the methods of cropping they applied on their farms and the reasons for such preference. When the three methods of cropping were compared intercropping was the method practiced the majority. See details in the following graph.

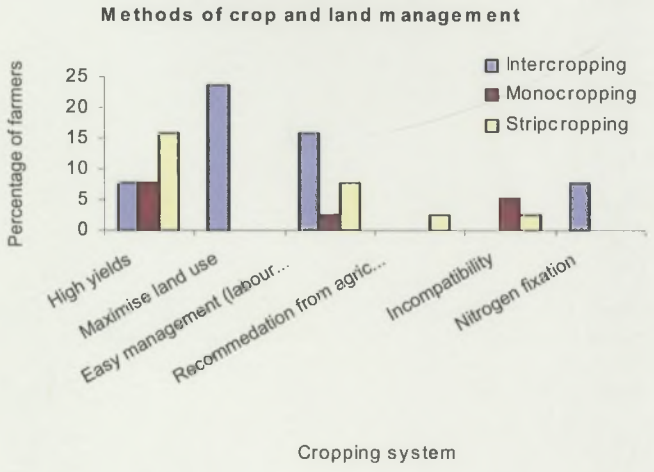
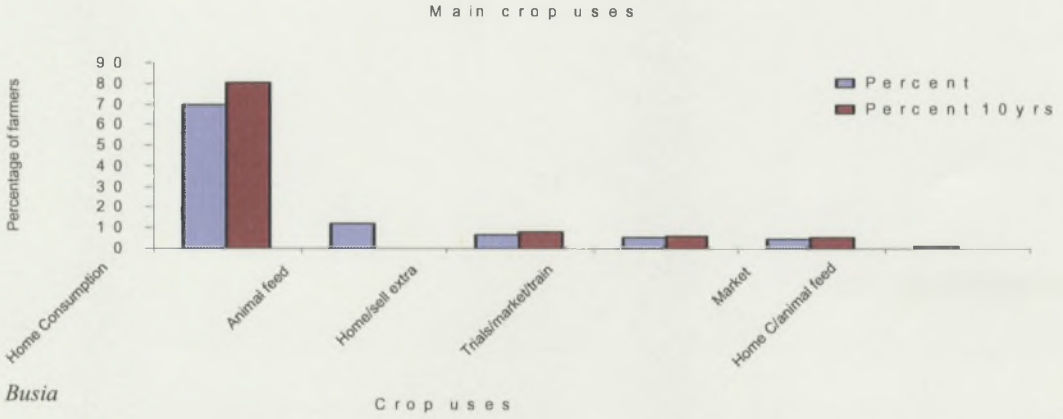


Fig III - 7 The main uses of Crops

From the following graph, it was clear that most of the farmers grew crops for home consumption. Exclusively crop production for market and even the selling of extra were not only limited but had also declined over the years. Production of crops for feeding cattle seem to have emerged over the years possibly due to zero grazing form of cattle keeping.

Fig. III –8 Main crop uses



REASONS	TYPE OF CROP													
	Beans	Cassava	Coffee	Cotton	Finger millet	Ground nuts	Maize	Millet	Njugu Mawe	Onions	Simsim	Sorghum	Sukuma wiki	**Total**
Diseases		4				1								**5**
Poor market price		1	1	6	4					1			1	**14**
production cost					1		1							**2**
Poor yields		3		1	4	4		2	1	1				**16**
Changed diet		1			1									**2**
Labour intensive					3			3				1		**7**
Less land						1								**1**
Pests		1				2								**3**
Climate change	1			1										**2**
Other											1			**1**
Total	**1**	**10**	**1**	**8**	**13**	**8**	**1**	**5**	**1**	**2**	**1**	**1**	**1**	**53**

Table III - 8: Crops that Farmers have Stopped Growing and Reason Given

The above *table III - 8* shows the crops that some of the farmers had stopped growing and their reasons for doing so.

The main crops included finger millet (13) Cassava (10) ground nuts (8) Cotton (8) millet (5). There were various reasons why the crop production of the cited crops had been stopped. The main reasons included the following; poor yields 16, poor market 14, labor intensive 7 diseases 5 and pests 3.

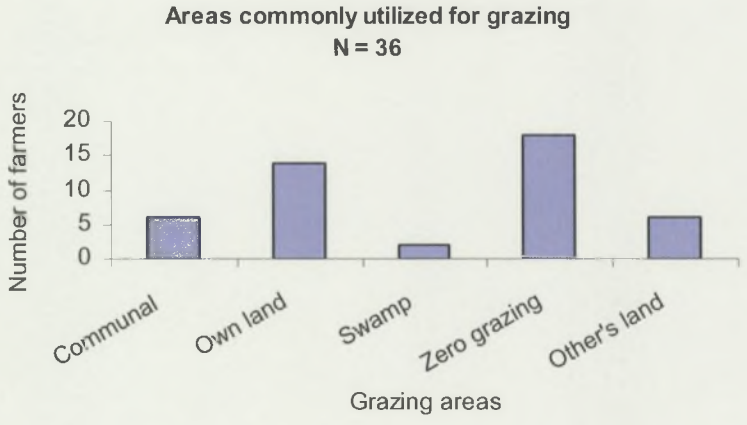
Livestock

Table III – 9 livestock

	Cross breed cattle	Donkey	Goats	Graded cattle	Native cattle	Pig	Sheep	Total
MORE								
Income				7		9		**16**
AI/Breeding	6			3	1		1	**11**
Bought			1	3	1		3	**8**
Animal products				2	1	2		**5**
Labour			1	2			1	**4**
Disease resistance						1		**1**
Draught power		1						**1**
More grazing land			1					**1**
Total	**6**	**1**	**3**	**17**	**3**	**12**	**5**	
LESS								
Disease	2	1	5	1	16		6	**31**
Less grazing land/Forage			7		2		6	**15**
Poverty			3		2	2	4	**11**
Upgrading					1			**1**
Labour					1			**1**
Conflict with neigbours						1		**1**
Total	**2**	**1**	**15**	**1**	**22**	**3**	**16**	
NONE								
Diseases			2	1	4		2	**9**
Grazing land					3			**3**
Poverty							2	**2**
Labour			1		1		1	**3**
Cost of feed						1		**1**
Theft/Lost		1			1			**2**
Slaughtered							1	**1**
Conflict with neighbors			1			1		**2**
Total	**0**	**1**	**4**	**1**	**9**	**2**	**6**	

Results from the above (*table III -9)* show a highest increase in graded cattle. Reasons attributed to this were desire for income generation (16), Breeding (11) and buying (8). Notable decline was mainly reported in native cattle, sheep and goats. Reduction was mainly attributed to diseases (31), reduction in pasture and forage (15) and poverty (11). The farmers were asked to state areas they mainly utilized for grazing their cattle. The graph below reveals that zero grazing has emerged as an important method of cattle keeping in the area.

Fig III – 9 Areas commonly utilised for grazing



Natural Resources

Fuel Sources

Table III - 10: Fuel Sources Now and 10 yrs Ago

Fuel sources	**Now** **No. of respondents**	**10 yrs ago** **No. of respondents**
Charcoal	30	20
Dry wood	32	23
Electricity	6	3
Gas	9	4
Maize Stalks	1	3
Millet & cassava stalks	0	1
Napier stalks	1	0
Paraffin	34	25
Swamp Vegetation	1	0

As shown in the above *table III -10* the most important sources of fuel were dry wood, charcoal and paraffin. Utilization of charcoal recorded the highest increase of the number of users.

The fuel sources were ranked according to the level of use details are provided in the following *table III -11.*

Table III - 11: Sources of Fuel ranked

Source	**RANKING ORDER OF FUEL SOURCES**				
	1	**2**	**3**	**4**	**5**
Charcoal	16	13	1		
Dry wood	18	12	1	1	
Electricity		1	4		1
Gas		2	1	5	1
Maize Stalks				1	
Nappier stalks					1
Paraffin		6	22	5	1
Swamp Vegetation					1

From the above *table III -11*, dry wood was ranked highest (18) in rank 1, while charcoal was ranked first in rank 2 (13) while paraffin was ranked 22 in rank 3.

Wildlife and Vegetation

Wildlife Species

The main wildlife species mentioned by respondents were monkey (12), mongoose (7), snakes (7), and mole (6), which were mainly found in the bushes or on the farms.

Vegetation

Most of the farmers (86%) claimed to have noted changes in the vegetation on their farms. Of those who stated that they had noted changes in the vegetation the presence of striga weed and stunted growth were the main indicators. Other details are presented in the following table.

Table III - 12: Indicators of Vegetation Changes

Indicators	**No. of respondents**
Striga	19
Coach grass	5
Poverty grass	2
Poor yields	5
Stunted growth	19
Loss of species richness	1

Table III - 13: The Main Plant Species Highlighted by Respondents

	Today **No. of respondents**	**10 yrs ago** **No. of respondents**
Bush		
Lantana camara	20	7
Mapera/fruit	6	5
Siora	4	5
Tithonia	4	4
Fig tree	1	6
Musegese	0	6
Mvule	1	4
Grass		
Amasinde	9	19
Coach grass	8	6
Lukhafwa (Star grass)	8	9
Ruvembe	6	14
Rubuko	2	3
Swamp		
Leeds	8	11
Papyrus	11	9
Riseme	4	4
Chikhoma/palms	1	12

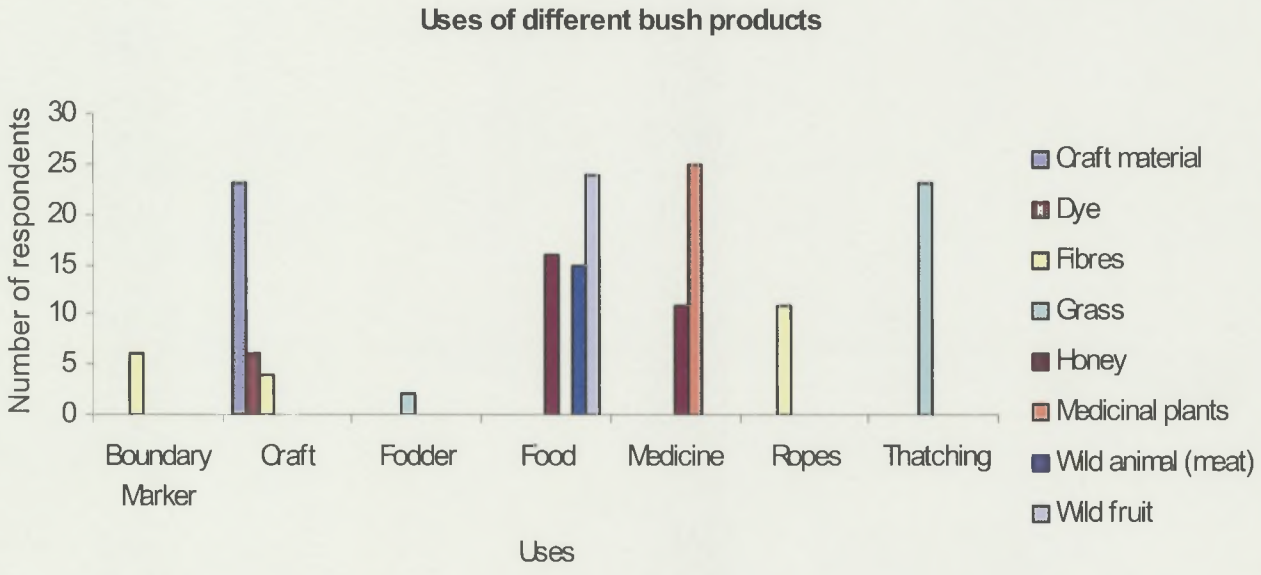
The result showed that among the current plant species in the bush *Lantana Camara* was mentioned by a majority of respondents. In comparison to ten years ago, an increase in the number of respondents who cited *Latana camara* was also evident.

Table III - 14: Utilization of bush products

	Utilization	
Product name	**Now**	**10yrs**
Craft material	24	24
Dye	3	10
Fibres	13	23
Grass	16	26
Honey	6	19
Medicinal plants	17	25
Wild animal (meat)	5	15
Wild fruit	11	26

As shown in the above table only the utilization of craft material had remained steady while all other products had declined. For all the products, availability was more difficulty than in the past. The products were obtained for various uses as shown in the following graph

Fig. III –10 Uses of different bush products



Water Sources

Attempts were made to establish and compare the sources of water during dry and wet over the last ten years. Results are presented in the following graphs.

Fig III – 11 Source of water during the wet season

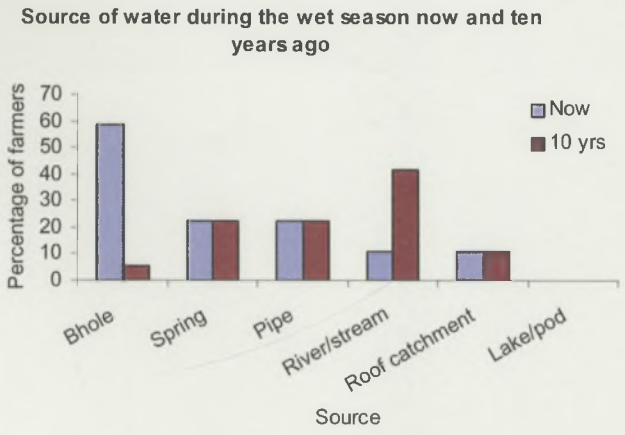
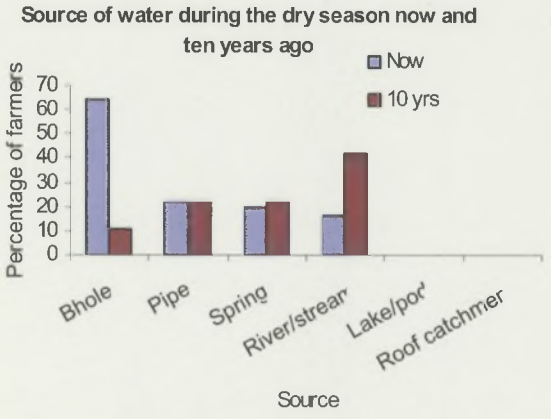


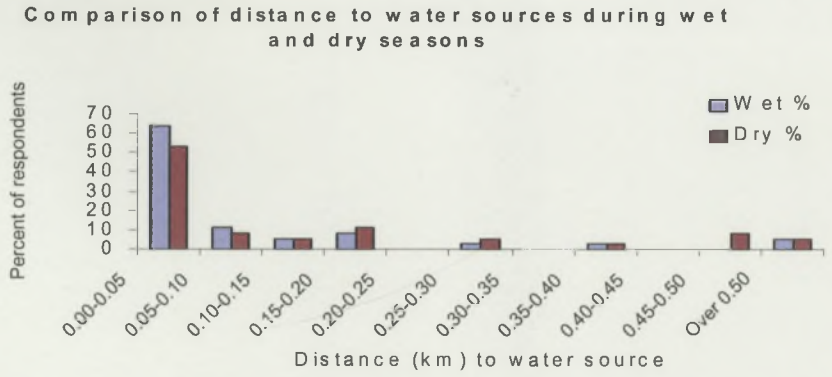
Fig III – 12 Source of water during the dry season



The results from the above graphs reflect a major change in respondent's sources of water with vast majority fetching water from boreholes during either of the two seasons.

The distance between the household and water source during the two seasons was also compared. As shown in the following graph, water sources were not far from most households for either of the season.

Fig. III –13 Comparison of distance to water sources



The respondents' perception of water quality was assessed in terms of pollution, cleanliness, taste and safety. Details are presented in the table below

Table III - 15: Water Quality

	Status	**Percentage**
Pollution	Fairly Polluted	19.4
	Not Polluted	72.2
Cleanliness	Dirty	2.8
	Fairly clean	25
	Very clean	66.7
Taste	Fairly good	16.7
	Very good	77.8
Safety	Safe	77.8
	Unsafe	22.2

From the above table, it is clear that most of the people interviewed perceived their water to unpolluted, very clean and safe for their consumption.

DISCUSSION

Land and Livestock Management

Increased access to land was the most important change noted in land ownership. The increase in land area corresponded to the increase in the number of people who had changed their occupation to farming over the last ten years. The noted changes could be attributed to people leaving the formal employment due to either retrenchment or retirement thereby resorting to farming as a form of occupation.

There were changes in land preparation methods with a notable increase in the utilization of hoe. The foregoing was due to the death of oxen from livestock diseases. Records show that the division was located in trypanosomosis disease foci, which may imply that livestock died from trypanosomosis. In a study by Bukachi (et al 2002) in the division, 90% of the farmers in the group discussions had lost their cattle during 1998-1999 trypanosomosis outbreak.

Changes in the sources of seed, land and crop management were noted. The training by the extension service workers from the Ministry of Agriculture especially the Farmer Field Schools (FFS) program could be the cause of the observed changes (Bukachi *et al,* 2002). Through the FFS farmers undertake farming activities from land preparation all through to harvest preservation. New farming skills have thus been acquired through FFS.

There was not only an increase in the number of farmers growing the main crops (maize, beans, cassava, fodder) but also the acreage under such crops. While these crops were mainly grown for home consumption, there was little selling of any extra in comparison to ten years ago. This may be attributed to either decline in crop yields or the collapse of cotton and coffee industries, which were grown exclusively for market. The notable rise in the number of farmers growing fodder may reflect an increase in the number of farmers keeping graded cattle as well as a changed trend towards zero-grazing type of livestock production. Moreover, limited grazing land and forage were cited as reasons for reduction in cattle numbers. It goes without saying that farmers may have increased the acreage under fodder as a way solving the

problem. Reports of increased fodder and graded cattle are documented in Busia District Dairy Development Report of 2002.

Important variations in animals were the reported increase in number of graded cattle and pig. These were seen to be more economically viable since they were kept for income generation. A decline in native cattle, sheep, and goat was also reported largely attributed to disease outbreaks.

Utilization of Natural Resources

The continued use of the two most important sources of fuel dry-wood and charcoal was likely to have negative effect on the environment for they would led to indiscriminate felling down of trees. Scarcity and high cost of purchase were the main factors that forced some of the farmers to plant trees hence a change in the source of dry-wood from bush to own farms.

While most of the respondents had noted changes on vegetation, a majority of them cited stunted growth and the emergence of striga weed. The fore-mentioned are indicators of soil infertility arising from over use of the same. On the current plant species, increase in the number of respondents was only reported in *Lantana camara* and *mapera.* The former said to form a good tsetse habitat in the area. General decline in the indigenous trees was due to the demand for fuel and timber whereby there was felling with limited replanting. Rutto *et al,* (1997) also reported a considerable decline in natural vegetation and secondary bush encroachment due to direct and indirect human activities in Busia. It such a reduction that may have led to reduced plant and wildlife species in the area. The few wildlife species mentioned by most farmers (monkey, snakes, moles, and mongoose were involved in human-wildlife conflicts to some extent.

Not only had the utilization of bush products declined but also their availability become more difficulty than in the past. With more land, being cleared for farming there was a reduction in bushes where the said products were available. Only the utilization of craft material had

remained steady possibly because they are obtained along the marshy and swampy areas where little farming is taking place.

While bore hole was not a important source of water ten years ago it has currently emerged as the main source for most people during either of the two seasons. This may have considerably reduced the distance between the water source and the household. The Government of Kenya in conjunction with Finland government has funded the drilling of most of the boreholes in the district

SUMMARY AND RECOMMENDATIONS

As pointed out in this report there are numerous land use activities in Busia township area. Sustainability of these activities depend on the productivity of the land itself. More land is being cultivated; land preparation techniques are changing to more efficient ways of utilizing the land. More people are settling on the land and varieties of crops and livestock are being introduced. What is finite however, is the land it self. The result of all these changes is that land use is becoming more and more intensive with no room for crop rotation and less and less fallow periods.

Vegetation is highly degraded and can hardly support the ever increasing demands for firewood, fuel, timber and wood for construction leave alone the role plants play in ecosystem services. These are due to cultivation, grazing and harvesting of woody resources.

With the reduction of trypanosomosis and the introduction of new livestock breeds there is likely to be an increase in demand for land both not only for cultivation and grazing but also for planting livestock feeds for the now popular zero grazing. It is certain that all the present campaigns to improve the livelihoods of the rural poor will result in more land being cultivated and more land being used either for grazing or for feed production.

Currently the area is almost devoid of woody resources and in order to meet the demands in wood resources, there is a need for tree planting. Trees recommended for planting are those that have commercial value in timer and livestock feeds. Tree planting is not common in the area, as most farms have no trees of any kind. Farmers should be encouraged to plant trees and shrubs on their farm boundaries to serve as fences and also serve as a source tree products.

One way that could be an entry point in tree planting is to initiate tree nurseries either as communal projects or as individual enterprises to operate at commercial level. The commercial benefit of tree nurseries can be realized if targeting tree species that are of known commercial value either in timber industry or in animal feed quality. Some farmers have set aside small portions of their land to preserve grass for thatching and also for sale to those who need to thatch their house

There is need to sensitise farmers on land use management that are not detrimental to the quality of land. Use of livestock manure for example could be encouraged. Now that livestock will be on the increase manure will be readily available. However, training is required on how to apply manure on the land for better use by crops.

Conservation of water sources is needed. There are springs that provide clean drinking water to people and livestock. These springs are threatened by clearance and burning of vegetation around the wells. In some of the wells sedimentation causes danger of infilling into the water well. There is a need to sensitize the farmers on how to conserve these springs. Cultivation along the rivers is another issue that requires proper advice to avoid drying up of the rivers and contamination of the water. There is need to train the farmers on how to water the animals using basins away from the margins of the wells to avoid the animals eroding the edges of the water source.

Burning of bricks is a business in the area to provide bricks for construction in the nearby Busia town. However, many have abandoned this business due to lack of firewood to burn the bricks. Introducing a tree-planting programme can reduce this problem.

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Appendix 1

List of Plants in Busia

Abrus
Abutilon mauritianum
Acacia hockii
Acacia polyacantha
Acacia sp.
Acalypha volkensii
Acanthaceae
Acrocarpus flaxinifolius
Ageratum conyzoides
Albizia coriaria
Albizia grandibracteata
Allophylus rubifolius
Alysicarpus rugosus
Antiaris toxicaria
Artocarpus heterophyllus
Aspilia pluriseta
Bidens pilosa
Blumea elatior
Brachiaria arrecta
Bridelia micrantha
Bridelia sp.
Callistemon citrinus
Canavalia ensiformis
Carica papaya
Ceiba pentandra
Centella asiatica
Chamaecrista mimosoides
Chloris pychnothrix
Cissampelos mucronata
Citrus (Orange)
Clerodendrum myricoides
Combretum sp.
Combretum zeyheri
Commelina benghulensis
Conyza floribunda
Conyza sumatrensis
Corchorus trilocularis
Crassula schimperi
Crolalaria deserticola
Croton macrostachyus
Cupressus sp.
Cyanotis lanata
Cyanotis lanata-1
Cymbopogon
Cynodon datylon
Cyperus
Cyperus 2
Cyphostema cyphopetalum
Desdemodium 2
Desmodium
Desmodium triflorum
Digitaria abyssinica
Digitaria ternata
Ehretia cymosa
Elensine indica
Emilia discifolia
Englerina woodfordioides
Eragrostis humidicola
Eragrostis termifolia
Erythrina abbysinica
Erythrococca bongensii
Erythrococca bongensis
Euphorbia crotonoides
Euphorbia hirta
Euphorbia tirucalli
Felicia grantii
Ficus asperifolia
Ficus ingens
Ficus sp.
Ficus sycomorus
Ficus thonningii
Ficus vallis-choudae
Ficus(sand paper)
Fimbristylis hispidula
Grevillea robusta
Grewia mollis
Grewia trichocarpa
Guizotia scabra
Gutembergia cordifolia
Harungana madagascariensi
Hibiscus macranthus
Hibiscus vitifolius
Hoslundia opposita
Hygrophila auriculata
Hyparrhenia hirta

Hypoestes forskahlii
Imperata cylindrica
Indigofera
Indigofera spicata
Ipomoea batatas
Ipomoea hederifolia
Jacaranda mimosifolia
Justicia exigua
Justicia flava
Kohautia coccinea
Kylinga nervosa
Labiatae
Labiatae plot 14
Lactuca inermis
Lantana camara
Lantana trifolia
Leersia hexandra
Leonotis nepetifolia
Leucaena leucacephala
Loudetia kagerensis
Mangifera indica
Manihot esculenta
Mariscus macer
Markhamia lutea
Maytenus senegalensis
Melhania velutina
Melia volkensii
Melinis
Milicia excelsa
Mimosa pigra
Musa sp.
Ozoloa like
Ozoroa
Panicum astrosanguineum
Panicum maximum
Papilionaceas plot 7
Paspalum scrobiculatum
Pennisetum(nappier grass)
Phoenix reclinata
Phyllanthus niruri
Phyllanthus odontadenius
Phyllanthus ovalifolius
Phyllanthus sepialis
Phyllanthus sepielis
Phytolacca dodecandra
PlantBotName
Plectranthus comosus
Pseudarthria hookeri
Pseudospondias microcarpa
Psidium guajava
Rhus natalensis
Rhus vulgaris
Rhyncharitrum repens
Rhynchelytrum repens
Rhynchosia minima
Rhyncosia
Ricinus communis
Ruelia patula
Rytigynia neglecta
Sapium ellipticum
Senna bicapsularis
Senna occidentalis
Senna siamea
Setaria megaphylla
Sida acuta
Sida ovata
Solanum incanum
Sorghum arundinaceum
Spathodoea campanulata
Spermacoce sphaerostigma
Sporobolus pyramidalis
Stereospermum kunthianum
Synedrella nodiflora
Syzygium guineense
Tephrosia interrupta
Tephrosia pumila
Terminalia mantaly
Thevetia peruviana
Thumbergia alata
Tithonia diversifolia
Toddalia asiatica
Trema orientalis
Tridax procumbens
Triumfetta rhomboidea
Urena lobata
Vernonia adoensis
Vernonia amygdalina
Vernonia auriculifera
Vigna
Vitex doniana
Vitex sp.
Waltheria indica

Appendix 2

Photos capturing some of the environmental scenarios in Busia District

Photo showing a water well in Busia Township

Water wells like this one are encroached by cultivation and grazing very close to the water point. Paths leading to the water well are used both by people and also livestock. Soil erosion by water running along the path deposit sediments to the water point blocking the water flow.

Photo showing tree cutting in Busia Township

Trees like this are very rare in Busia Township. Due to high demand for timber trees are cut when they are very young.

Photo showing goats feeding on an herbaceous shrub by the roadside

Scarcity of pastures is high in Busia Township. These goats are feeding on an herbaceous shrub by the roadside. *Note* next to the goats is a maize garden that has to be protected by the owner of the goats.

Photo showing a technique for drying young twigs for firewood

Scarcity for firewood has made people to develop a technique of drying young and fresh twigs next to their cooking area. As they cook the cooking fire helps to dry the fresh stems. Note that the stems are also very young and are harvested from shrubs. These twigs are cut purposely for firewood. Firewood could therefore a driving force to deforestation.

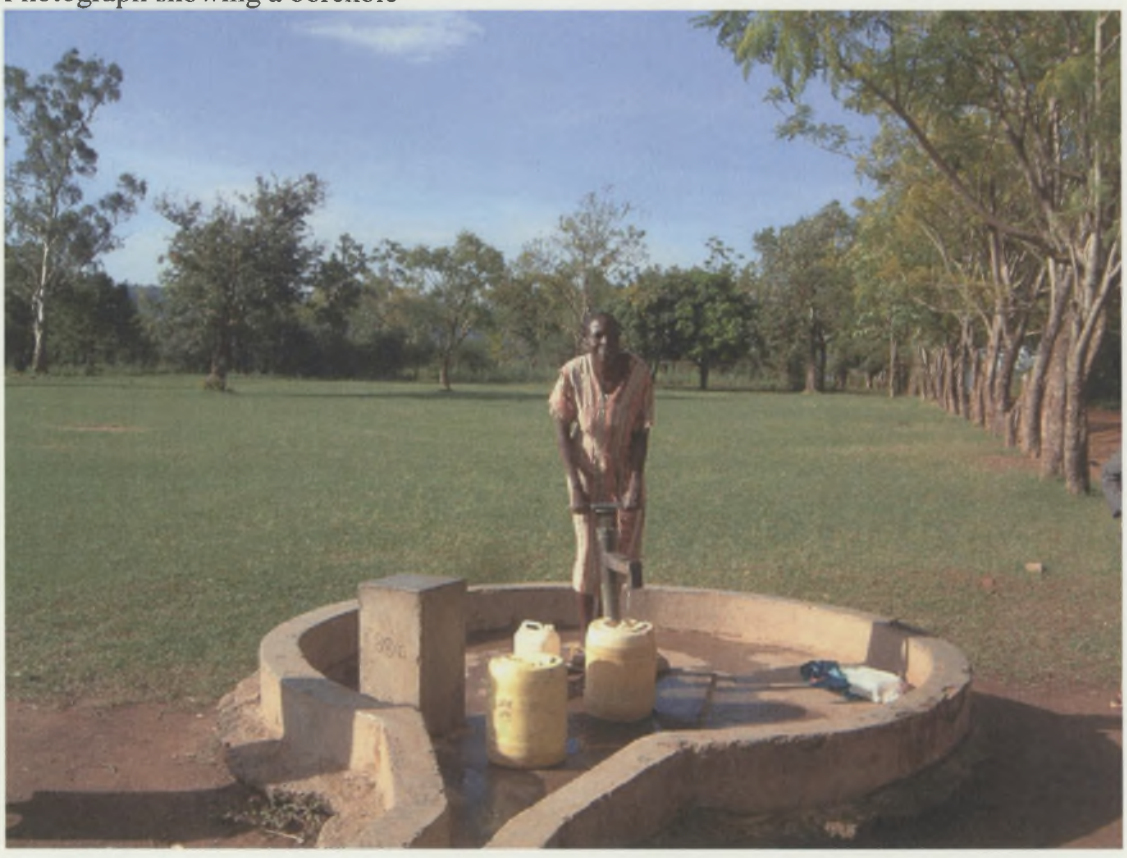
Photo showing animal traction in Busia

Animal traction is used in Busia for ploughing. Better animal health will increase farmer confidence to invest in oxen as a means for cultivating more land. Fallows like this one will not be let to be idle for more that one season. Places for grazing animals will be less and less.

Photograph showing trade in animal traction

Animal traction is not only for own farms. These farmers are driving their animals and the plough back home after working on a neighbour's farm for money. Animal traction is therefore a source of income to the owners of the animals. You do not need to have a cow in order to benefit on animal traction.

Photograph showing a borehole



Due to scarcity of water many shallow wells have been dug in several places in Busia. They are all shallow wells as they are barely 15 to 20 feet deep. Water in shallow wells could be affected by land use and land cover. Some of the negative effects could range from drying up of the wells or contamination from farm chemicals percolating through the soils during the wet seasons. Better land use can help preserve the under ground water.

Appendix 3.

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			

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

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 06. 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		
__		

Circle where choices are given

Household code_____

Enumerator Name_____

Date of interview_____

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?

_____

Circle where choices are given

Household code_____

Enumerator Name_____

Date of interview_____

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	Specics habitat	Reasons

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

Household code_____

Enumerator Name_____

Date of interview_____

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		

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

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**

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

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/ kilometres

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

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?

_____

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

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

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

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				

Circle where choices are given

Household code_____
Enumerator Name_____
Date of interview_____

Thank you very much for participating in the survey

For Enumerator Use Only

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

_____

_____

_____

_____

_____

_____

_____

_____

Household code_____
Enumerator Name_____
Date of interview_____