INTEGRATED NUTRIENT MANAGEMENT IN IGANGA DISTRICT, UGANDA: DIAGNOSIS BY PARTICIPATORY LEARNING AND ACTION RESEARCH

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PREFACE

Maintaining and improving soil fertility and productivity on small farms are among the highest priorities for enhancing food security and incomes of rural populations in Africa. Yet the technology has long existed by which these goals can be achieved, at least in principle, and explanations for the generally low rates of their adoption by farmers therefore need to be sought elsewhere.

This initial diagnostic report comes from one national field site of an on-going project of the systemwide program on Soil, Water and Nutrient Management (SWNM) of the Future Harvest Centers of the CGIAR. The project started from the hypotheses that farmers need to be directly involved in taking an integrated approach to adapting technologies to meet farmers' diverse needs and situations, and that methods for disseminating the results may also need adjustment to local circumstances.

Like many natural resources management research activities, this study involves three intimately related dimensions: technologies, social capital and research methods. Like all such activities in which CIAT is involved, it also brings together the necessary range of partners: in this case, several programs of Uganda's national agricultural research organisation (NARO), non-governmental organisations and farmer research groups in the case study area, and international organisations. For financial support for the overall study and for this publication, we are grateful to the Bundesministerium fur Wirtschaftliche Zusammenarbeit und Entwicklung (BMZ).

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We also wish to thank the Principal and Deputy Principal of Ikulwe District Farm Institute (DFI) for kindly allowing us to use the institute facilities and for their active participation in the meetings and the data collection.

Many researchers from NARO Institutes (Kawanda Agricultural Research Institute, Namulonge Agricultural and Animal Production Research Institute, Forestry Resources Research Institute), Makerere University's Faculty of Agriculture, CIAT and many extension workers from the Departments of Agriculture, Forestry, Fisheries, and Health in Iganga district and some NGOs working in the district (Africa 2000 Network/UNDP Project, Sesekawa Global 200 and IDEA) facilitated the data collection exercise. We are very grateful to all of them for their good team-work spirit, dedication and cooperation.

Finally we are grateful to the German Federal Ministry for Technical Cooperation (BMZ) for financially supporting this project.

ACRONYMS

A2N	-	Africa 2000 Network
BMZ	-	German Federal Ministry for Technical Cooperation
CABI	-	Commonwealth Agricultural Bureau International
CIAT	-	Centro Internacional de Agricultura Tropical
CICARD	-	Cornerstone Institute for Commercial Agriculture and Rural Development
ECF	-	East Coast Fever
DFI	-	District Farm Institute
ECOFA	-	Eastern Coffee Farmers Association
FORI	-	Forest Research Institute
ICRAF	-	International Centre for Research on Agroforestry
IDEA	-	Investment in Developing Export Agriculture
IFPRG	-	Ikulwe Farmers Participatory Research Group
IFPRI	-	International Food Policy Research Institute
IK	-	Indigenous Knowledge
IIED	-	International Institute for Environment and Development
ILCA	-	International Livestock Centre for Agriculture
INM	-	Integrated Nutrient Management
ITK	-	Indigenous Technical Knowledge
KARI	-	Kawanda Agricultural Research Institute
NAARI	-	Namulonge Agricultural & Animal Research Institute
NCD	-	Newcastle Disease
NGO	-	Non Governmental Organisation
PEARL	-	Project for Enhancing Adolescent Reproductive Life
PLAR	-	Participatory Learning and Action Research
PRA	-	Participatory Rural Appraisal
RFM	-	Resource Flow Map
TSBF	-	Tropical Soil Biology and Fertility Programme
UNDP	-	United Nations Development Programme
UNFPA	-	United Nations Fund for Population Activities

SUMMARY

"Improving integrated nutrient management practices on small farms in Africa" is a project that aims to enable small-scale farmers in pilot sites in several countries to profitably reverse nutrient depletion of their soils by increasing their capacity to develop, adapt and use INM strategies, and to improve the participatory skills and tools of research and extension personnel to support that process.

As a first step, a Participatory Learning and Action Research (PLAR) process was initiated in Imanyiro sub-county of Iganga District, selected as the study area for Uganda, in September 1999. The objectives were to introduce concepts of PLAR, and develop and fine-tune tools and methods for participatory diagnosis of soil fertility management.

A team of researchers, extension agents, NGOs and farmers from three parishes conducted the diagnosis phase. Facilitators interviewed more than 100 farmers, after initial team building and skills development. Participants reviewed tools, including introductory village meetings, village maps, transect walks, organisation diagrams, wealth ranking and gender analysis, soil diversity analysis, farm classification and resource flow maps. Farmers identified and ranked main agricultural constraints, and proposed solutions.

Wealth ranking by farmers grouped villagers into resource endowment groups to be used in interpreting soil fertility management decisions and needs. Social organisations in Imanyiro included 24 groups formed around issues such as women groups, church or religious groups, welfare, farmer research groups and fish farming. Men and women farmers in separate groups analysed access to and control of resources and benefits.

Village territorial mapping showed that the upper parts of the catena were low in soil fertility, and planted to bananas, coffee, maize, onions, cassava, beans and soybeans. Soil conservation measures included grass fallow and trees scattered on farmland, with crop pests and land overuse as main constraints. Potential improvements suggested by farmers were improved fallow a low cost, and Tephrosia fallow to control mole rats. Comparable assessments for other parts of the catena showed fertility and productivity increasing lower down; in the valley bottom, soil fertility status was good but constrained by continuous cultivation without fertiliser use. Potential improvements suggested were introduction of leguminous fallow and use of inorganic and organic fertilisers. Farmers identified 8 soil types by local indicators.

Soil diversity classification led farmers to prioritise 12 fertility constraints. Drought was followed by lack of knowledge and skills on soil fertility management, low natural soil fertility, soil borne diseases and pests, and high cost of inorganic fertilisers. Farmers identified and ranked 8 indicators/causes of soil fertility decline. Strategies that farmers suggested for addressing soil fertility decline included use of green manure (e.g. mucuna and canavalia), inorganic fertilisers, agroforestry trees, fallows, compost manure, mulching, crop rotations and terracing. Soil fertility management diversity among households was identified by farmers, and characterized by use of fertilisers (organic and inorganic), soil erosion control measures, green manures, fallow and agroforestry. Farms/households using four or more of these measures were considered "good" (class I); farmers using one to three measures were considered "average" (class II); while those not using any of these measures were considered "poor" (class III). Out of 569 households only 20 (3.5%) were in class I, 10% in class II and the majority (87%) were in class III. Most farmers were not carrying out any improved soil fertility management practices, despite previous research and dissemination in the area.

Integrated nutrient management in Iganga district, Uganda: Diagnosis by participatory learning and action research.

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1.0 INTRODUCTION

1.1 Background information on Iganga District

Imanyiro sub county of Bunya County is located at 0^0 35^1N, $32^0$$29^1$ in Eastern Uganda. The district lies at an altitude of 1070-1161 meters above sea level and covers an area of about 11,113km^2. According to the 1991 census there was a population of 945,783 (484,704 female and 461,079 male) persons. The district has a bimodal rainfall pattern varying from 1250 to 2200mm (average 1345mm for 22 years) per annum. The first rains occur between March to the end of June and the second rains between August and November. The district has tracts of fertile land within the Lake Victoria Crescent. The northern and north-eastern parts of the district have poor sandy soils which can only support cereals and root crops. The soils at Ikulwe District Farm Institute (DFI) in Imanyiro sub county are reddish brown sandy loams and sandy clay loams on red (gritty) clay loam and laterite (Harrop, 1970). Most soils have a low organic matter content and are deficient in N and P (Fischler, 1997).

1.2 Objectives

The specific objectives of the diagnostic phase of participatory learning and action research were:

- Introduce the concepts of participatory learning and action research (PLAR) on integrated nutrient management (INM).
- Develop and fine-tune tools and methods for participatory diagnosis of soil fertility management.
- Set up a PLAR process for INM in Imanyiro sub county in Iganga District.
- Implement the diagnostic phase of PLAR process for INM in Imanyiro sub county in Iganga district.

1.3 Methodology

A multidisciplinary team of researchers, extension agents, NGOs and farmers from three parishes (Buyemba, Mayuge and Magada) in Imanyiro Sub County of Iganga District in Eastern Uganda conducted the participatory learning and action research process (Defoer and Budelman, 2000). Facilitators interviewed more than 100 farmers. The facilitators are shown in the Appendix. The first day was for team building since team members had different skills, experience, and backgrounds with little knowledge of participatory approaches in research and development. It was devoted to reviewing aspects of participatory rural appraisal (PRA),

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participatory learning and action research (PLAR) and introducing methodological tools for analysis (Theis and Grady, 1991; Pretty *et al.*, 1995). The participants reviewed tools including introductory village meetings, village maps, transects, organisation diagrams, wealth ranking and gender analysis, soil diversity analysis and farm classification, resource flow models and the closing village meeting (Defoer *et al.*, 2000). The team facilitators were sub-divided into five sub-groups, namely: socio-economics, crops, livestock, landuse/agroforestry, and soils. These groups conducted group and individual interviews with farmers for the second and third day. A checklist proposed by the facilitators guided the interviews. The main issues covered in the checklist were socio-economic issues, crop production, soils, landuse/agroforestry and livestock production. The five groups were reduced to four on the fourth day to conduct resource flow mapping with three soil fertility management classes of farmers.

The facilitators held group discussions followed by plenary presentations after the farmer interviews to share the field findings, build team consensus on ways to improve the procedure and agree on the next day's activities. The fifth day was for the village meeting and the findings from the various groups were presented to the farmers to cross check on the accuracy and acceptance of the information gathered during the exercise. The farmers belonging to each soil fertility class presented to other farmers their farm resource flow maps during the plenary session. Farmers also identified and ranked the main agricultural constraints in the area and proposed solutions to the problems during the group meeting on the fifth day. The farmers agreed on the need for a planning phase before implementing the experimentation phase prior to the next rainy season.

2.0 SOCIO-ECONOMICS

2.1 Wealth ranking

2.1.1 Wealth ranking in Kavule village

A wealth ranking exercise was carried out in Kavule village in Imanyiro Sub-county to categorize all households within the village in groups representing levels of wealth and to identify locally the causes for:

- Changes within a group.
- Changes that enables a household to move from one group to another (both up and down).
- Changes in the distance between the groups (hypothesis: richer grow richer and vice versa).
- To explore levels and sources of income across the classes of farmers in each village and assess how soil fertility and soil fertility strategies relate to wealth categories in the village. Already identified indicators were compared with the locally applied indicators, and locally available resources at household level were identified as the basis for stratifying households.

The methodology used was that developed by Grandin (1988). Four knowledgeable elderly farmers (two women and two men) from Kavule village carried out the exercise with the assistance of the whole group from the same village. A village list from the Local Chairman (LC) and updated by the group was used for the exercise. Cards were made and, on each, a name of the household head and a number were written using the village list. These cards were used to rank households in different wealth groups. Farmers generated a list of wealthy, medium wealth

and poverty indicators. Using the generated indicators, farmers grouped all village households in five groups as shown below:

- Group 1 Very wealthy households.
- Group 2 Wealthy households.
- Group 3 Fairly wealthy households.
- Group 4 Poor households.
- Group 5 Very poor households.

2.1.1.1 Wealth indicators

The generated wealth indicators included:

- Good looking - when someone looks healthy.
- Smartness - a person puts on good clothing and looks smart.
- Permanent house - the house is constructed with blocks, roofed with iron sheets and has painted walls.
- Transport - owns a car, motor cycle or a bicycle.
- Eats well - usually buys and eats meat, fish and other 'good' foods.
- Cattle ownership - owns cattle.
- Goat ownership - owns goats.
- Married – a man married to several women.
- Keeping money (cash) in the bank.
- Hires labour - employs people to work for him or her.
- Pays school fees for his children.
- Several crops produced.
- Electricity in his or her house.
- Employed or when a person has employed children who give her/him financial assistance.
- Access to everything she/he needs.

2.1.1.2 Medium wealth indicators

- Bicycle ownership.
- Semi-permanent house with iron sheet roof, wattle and mud walls.
- Goat ownership.
- Pays school fees for children up to primary (P7-seven years at primary school).
- Eats reasonably well - buys meat or fish but not very often.
- Has coffee trees.
- Treated hair - a person treats her hair.
- Reasonable amount of land.
- Owns cattle.

2.1.1.3 Poverty indicators

- Dresses badly - a person puts on one shirt and one pair of trouser and does not change clothes.
- Owns little land (0-1.5 acres).
- Owns grass thatched house (has iron roof but with mud walls).

- No house.
- No land.
- No livestock (cattle, goats or other types of livestock).
- Does not want to work.
- Lack of responsibility - does not look after his wife and children.
- Sleeps badly - lacks blankets and mattresses.
- Does not pay tax.
- Works as casual labourer for survival.
- Children do not go to school – can not pay school fees.

2.1.1.4 Wealth indicators rankings

The farmers ranked the wealth indicators in order of their usefulness in distinguishing between classes, as shown below. Land was considered most important, followed by money and the type of crops grown. The type of labour used was ranked as the least important indicator considering wealth.

1. Land
2. Money
3. Type of crops grown
4. Type of house
5. Marital status
6. Ability to pay school fees
7. Means of transport used, e.g. own a car, motorcycle
8. Cattle ownership
9. Type of labour used

2.1.1.5 Changes in wealth groups

Farmers observed some changes in members of group 1(very wealthy group) to group 2 (wealthy group). Some of the reasons they gave for the deterioration of these households in their wealth status are given below:

1. Poor budgeting of resources by farmers with some farmers using the resources wastefully without saving for the future.
2. The head of the household dies and his son/heir misuses the inherited resources.
3. Thieves steal property from the well endowed households.
4. Womanising as a cause of wealth deterioration, as some men spend a lot of money on their girl friends and end up depleting their resources.
5. Alcoholism results in depletion of wealth because alcoholics do not invest in productive work. This is also associated with living a luxurious life.
6. Disasters such as fires.
7. Sickness, as household income is spent without additional revenue.
8. Drought.
9. Witchcraft and cursing of crops so that they do not yield much was also identified as one cause of loss of wealth.
10. Wars also cause loss of property through destruction and looting.
11. Committing crime the person pays fines, can be jailed and loses time for productive work.

2.1.1.6 Wealth group characterization

The wealth groups were characterised according to the number and size of resources the members own, as shown in Table 1.

Table 1. Wealth groups in Kavule village, Mayuge Parish

Indicators		**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**
Land	Size	20-30 acres	7-10 acres	2.5-3 acres	1-2.5 acres	0-1.5 acres
	Household frequency	Majority	Majority	Majority	Majority	Majority
Cattle	Numbers	Do not farm, these are traders	3-4 improved/exotic 5-10 local	3-4 local	1-2 local	0
	Household frequency	All	Majority	Majority	Majority	Majority
House	Type	Block walls, iron roof with ceiling	Block walls and iron roof	Block walls and iron roof	Grass thatched	Grass thatched
	Household frequency	All	All	Majority	Majority	Majority
Labour	Type	Hired labour	Hired labour	Family labour	Family labour	Work as casual labourers
	Household frequency	All	Majority	Majority	Majority	All
Ability to pay school fees	Education level	Up to University	Up to University	Up to tertiary Institution	Up to P7	None
	Household frequency	Majority	Majority	Majority	Majority	All
Marital status	Type	Married	Married	Married	Married	Married
	Household frequency	All	All	Majority	Majority	Majority
Money	Possession	Yes	Yes	Yes	Have something	No
	Household frequency	All	All	All	Majority	All
Means of transport like bicycle, motor cycle, cars	Ownership	Cars, bicycles, and motor cycles	Cars, bicycles, motor cycles	Bicycles	Bicycles	None
	Household frequency	All	Majority	All	Majority	All
Crops grown	Type	Do not farm, traders	Several crops	Variety of crops	Subsistence	One crop
	Household frequency	All	All	All	Majority	All

Some households had risen to a higher wealth group for the following reasons:

1. Hard working households are more productive and move up the wealth ranks. Thus a person determined to achieve something, works hard, achieves it, and shifts from poor to wealthy. When a person admires others who are okay, this person works hard to achieve what he/she has admired and by doing so improves his/her standard of living.
2. People who budget their financial resources are able to save and invest.
3. Households with children who are wealthy are able to improve on their standard of living.
4. Increased production of crops and other farm produce for sale increases household income.
5. Training / learning from resource people is believed to impart knowledge to farmers and thereby increase on their production and improve on their standard of living.
6. When farmers acquires skills / experience / challenges they can use them to produce more and change their wealth status.

2.1.1.7 Relative development between groups

Farmers discussed some general trends within the different wealth groups. The very poor people were becoming poorer whereas the poor were becoming fairly wealthy. The fairly wealthy group was changing to wealthy while wealthy members were changing to very wealthy and the very wealth people were becoming more and more wealthy.

2.1.2 Wealth ranking in Magada village

Wealth ranking was also carried out in Magada village with the aim of categorizing all households within the village into groups representing wealth levels. Eight people (4 women and 4 men) participated in the exercise. Farmers were divided in 6 groups of different wealth levels. Group one is composed of very wealthy people, group two wealthy people, group three is of fairly wealthy people, group four is of poor people, group five has very poor people, and while group six is composed of extremely poor and desperate people.

2.1.2.1 Wealth indicators

The following indicators were listed and used by the farmers to categorise the above groups, as shown in Table 2.

Group 1 - Very wealthy

- Exotic cattle
- House made of brick walls and iron sheet roof
- Car
- Goats and chickens
- More than 10 acres of land
- More than 1 acre of banana plantation
- Coffee field

Group 2 – Wealthy

- One crossbred cow
- House made of bricks and iron sheet roof

- Coffee field
- Motorcycle and/or bicycles
- Goats
- Chicken
- More than 5 acres of land
- 0.5 acre of banana plantation

Group 3 - Fairly wealthy

- 1 acre of coffee
- House made of mud and wattle walls but with iron sheet roof
- Bicycle
- 1-3 goats
- 1-2 local cattle
- 2-3 acres of land
- 3-5 chicken

Group 4 – The poor

- 10-20 coffee coffee trees
- Grass thatched house with mud and wattle walls
- 10-20 banana plants
- 0.25 acre of land

Group 5

- acres
- Grass thatched house with mud and wattle walls

Group 6

- No land, livestock, coffee or means of transport, and are mainly dependent

Table 2. Wealth group characterisation in Magada village, Magada parish

Indicators	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Group 6**
Land	10-20 acres (majority)	5-10 acres (majority)	5-3 acres (majority)	2-1 acres (majority)	0-1 acres (majority)	0 (majority)
Cattle	5-10 Local 0-2 exotic (majority)	3-5 Local (majority)	1-3 local (majority)	1-2 local (majority)	Nil (all)	Nil (all)
House	Block walls, iron sheet roof and painted (all)	Block walls, iron sheet roof and painted (majority)	Block walls with iron sheet roof (minority)	Mud walls with iron sheet roof and not painted (majority)	Grass thatched with mud and wattle walls (majority)	Nil (dependents) (majority)
Transport	Car (all)	Motorcycle- (minority) Bicycle - (majority)	Bicycle (majority)	Bicycle (minority)	Nil (all)	Nil (all)
Coffee	2-3 acres (majority)	2-2.5 acre (majority)	0.25 –1 acre (majority)	0 –0.25 acre (minority)	Nil (all)	Nil (all)
Bananas	1- 1.5 acre (majority)	0.5 acre (majority)	0.25 acre	Nil (all)	Nil (all)	Nil (all)
Pigs	Nil (all)	1- 2 (minority)	1-2 (minority)	0-1 (minority)	Nil (all)	Nil (all)
Poultry	10-20 (majority)	5- 10 (majority)	3-6 (majority)	3-6 (majority)	1-2 (minority)	Nil (all)
Goats	5-10 (majority)	1-5 (majority)	1-3 (majority)	0-1 (majority)	Nil (all)	Nil (all)
Rabbits	Nil	10-20 (minority)	10-15 (minority)	5- 10 (minority)	Nil (all)	Nil (all)
Sheep	Nil	Nil	Nil	1 (one person)	Nil	Nil

2.1.2.2 Wealth indicators rankings

Wealth indicators were ranked using pairwise ranking and the results were as presented below:

1. Land
2. House
3. Coffee
4. Cattle
5. Transport
6. Bananas
7. Pigs
8. Goats
9. Poultry
10. Rabbits

2.1.2.3 Changes in wealth groups

There were some changes in all wealth groups. More people in group 1 maintain their wealth, while a few of them deteriorate to group 2. Reasons for maintaining wealth include having enough resources, working hard, good planning and fear to be ashamed if they drop to a lower group. However, a few people who change to group 2 do so because of poor management of their resources.

The majority of group 2 members are moving to group 1, will a few of them remaining at group 2 level. The reason for changing is the desire for more wealth and hard work. Those who do not change stay like that because they fear to take risks and plan poorly for their resources. A majority of group 3 members are rising to group 2 (with a minority of them going down to group 4 because they are energetic and dynamic people who desire more wealth. Most people in groups 4 and 5 are deteriorating, with very few of them rising to a higher group. The reasons for deterioration are a lack of resources, and old age. Those in these groups who rise are hired as casual labourers. However, most members of group 6 are deteriorating because such people are lazy, do not want to work, or are not married and as a result resort to alcoholism and marijuana.

2.1.2.4 Relative change between groups

Groups 1, 2 and 3 are becoming wealthier, while most people in groups 4 and 5 are becoming poorer, with very few of them becoming wealthier. Group 6 members are deteriorating.

2.1.3 Wealth ranking in Buyemba village

Farmers in Buyemba village were divided into four wealth groups. These include: group one composed of very wealthy people, group two consisting of wealthy people, group three made up of fairly wealthy people and group four composed of poor people.

2.1.3.1 Wealth indicators and group characterization

The following indicators were listed and used by the farmers to categorise the groups, as shown in Table 3.

Very wealthy (group 1)

- Own more than 10 acres of land
- 50 local cattle or 2 exotic cow
- House made of block walls, iron sheet roof, painted and supplied with electricity.
- more than 3 acres of coffee
- cars, motorcycle, bicycle and wheel burrows
- sugar cane plantation
- maize milling machines
- banana plantation
- Educated from primary 7 to university

Wealthy (group 2)

- Own 5 – 10 acres of land
- 1-2 local cattle
- House made of block walls, iron sheet roof but not painted.
- 0.25-1 acre of coffee
- Bicycle
- 3-5 goats
- 5-30 chicken
- 5-15 children
- enough food for home consumption
- Employed by government or private companies and get salary

Fairly wealthy (group 3)

- Own 1 - 5 acres of land
- House made of mud and wattle walls, iron sheet and grass thatched roof
- 10-20 plants of coffee
- bicycle
- 2-3 goats
- 10-20 chicken
- Employed as casual labourers

Poor (group 4)

- Own no land (but can borrow from neighbours)
- Has no house
- Thieves, dig graves and sickily

Table 3. Wealth groups in Buyemba village, Buyemba parish

Indicators	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Land	20 acres (majority)	5-10 acres (majority)	1-5 acres (majority)	0-0.25 acres
Cattle	1-5 local cattle- (minority) 1-2 local cattle -(majority)	2-3 local cattle- (minority) 1-2 local cattle (majority)	1-2 Local cattle- (minority) 0-1 local cattle- (majority)	Nil (all)
House	Block and brick walls with iron sheet roof (majority)	Mud and wattle walls and iron sheet roof (majority)	Mud and wattle walls with grass thatched roof -(majority) Mud and wattle walls with iron sheet roof (minority)	Nil (majority) Huts (minority)
Transport	Cars (minority) Bicycle (majority) Motorcycle (minority)	Bicycle (majority)	Bicycle (majority)	Nil (all)
Coffee	1-6 acres (majority)	1-10 acres (minority) 1-5 acres (majority)	1-5 acres (minority) 2-3 acres (majority)	Nil (all)
Poultry	1-3 (majority)	1-20 (majority)	1-10 (majority)	Nil (all)
Food	Enough food (majority)	Enough food	Not enough food	Nil (all)
Education	P.7 (majority) S.4 (minority)	P.7-Diploma (majority) Diploma-University (minority)	P.7 – Diploma (majority) Diploma-University (minority)	0-p.3
Labour	Hire labour for preparing seed bed, weeding and harvesting (majority)	Hire labour (minority)	Family labor	Hired Labourers (majority)

2.1.3.2 Wealth indicators rankings

Wealth indicators were ranked as shown below using pairwise ranking:

1. Land
2. Food
3. House
4. Coffee
5. Education
6. Cattle
7. Transport
8. Poultry
9. Goats
10. Labour

2.1.3.3 Changes in wealth groups

There were some changes in wealth groups. The majority of people in group 1 are becoming more wealthy because they have enough resources, plan very well the use of their resources and they also exploit the poor by buying their produce cheaply and hiring them cheaply as labourers. However, the majority of people in group 2 do not change, while a few people change to group 1 because, in order to rise up, one has to do business and it is difficult for people in group 2 to compete with people in group 1 in this area. In addition, members in group 2 have many children to look after, so they end up spending a lot of money paying school fees. The majority of people in group 3 are changing to group 2 because they are energetic and have desire for more wealth. The majority of people in group 4 deteriorate, while a few people change to group 3 as they lack resources and have lost hope of developing.

2.1.3.4 Relative changes between groups

Households in groups 1, 2 and 3 are becoming wealthier, while those in group 4 are becoming poorer.

2.2 Gender analysis

Gender analysis was carried out in Kavule village. Farmers were divided into two groups of men and women, each working independently of the other. The major objective was to identify the different roles carried out by men, women and children, the time they spend on these activities, the places, where the activities occur and how they are done. Access to and control of resources and benefits was analysed, and social relations among farm households of the village identified.

2.2.1 Activities profile

a) Women's group

The women identified reproductive and productive activities, the gender, time and the place where the activity is done. The daily reproductive activities included: washing / bathing / cleaning the home and utensils and preparing meals and caring for the children. The daily

productive activities included tethering cattle, gardening, slashing, digging and harvesting. It was noted that women leave their beds before their husbands and go to sleep late in the night after everybody in the household has slept. In other words, women work for longer hours than any other member of the household. Women produce for home consumption while men produce for commercial purposes. Some men preferred to have their own gardens, yet wives had to assist them in those gardens. Most men did not do the planting, weeding and harvesting in their wives' gardens. Men who work in offices do not work in gardens.

The daily activities of women are shown in Figure 1 and Table 4 below:

Figure 1: Daily activities for women in Kavule village

Figure 2: Daily activities for men in Kavule village

Table 4. Daily activities as profiled by women in Kavule village

TIME	ACTIVITY	WHO	PLACE
6.00 a.m.	Wake up	Woman	At home
6:00-6:10	Bathing	Woman	At home
6:10- 6:30 a.m.	Sweeping houses and compound	Women	
6.30-6:40	Washing dishes	Woman	At home
6:40-7:00	Boiling tea for husbands and children	Woman	At home
7:00 a.m.	Tethering cattle	Woman	Own land or others land
7:00 –11:00 a.m.	Gardening	Woman	Own land
11:00-11:30 a.m.	Collecting food	Woman	Own land
11:30-11:40	Tethering goats	Woman	Own land
12:30-2:30	Cooking lunch	Woman	At home
2:30-2:40	Bathing	Woman	At home
2:40-3:00	Taking tea	Woman	At home
3:00-4:00	Eating lunch	All household members	At home
4:30-6:30	Gardening	Woman	At home
6:30-8:00	Collect food for supper, collect water, fire wood	Woman	Garden
8:00-10:00	Cooking supper	Woman	At home
9:00-9:30	Bathe and wash children, warm water for the husbands	Woman	At home
10:00-10:30	Eating supper	All members of the household	At home
10:30-12:00	Putting utensils inside the house	Woman	At home
12:00-6:00 a.m.	Sleeping		
The following activities are not done daily			
Any time	Slashing	Man/woman	Own land
No fixed time	Digging	Man/woman	Own land
No fixed time	Harvesting	Man/woman	Own garden
No fixed time	Transporting using bicycles and baskets	Man	To home
No fixed time	Selling	Man	At home
No fixed time	Keeping money	Man/some women	At home

Note:
If a man keeps money it is not given back to women as it is spent on school fees and other essentials.

Women sell produce in small quantities without the knowledge of their husbands. Older children eat supper but young ones eat leftovers from the morning meals/lunch. Women work more hours than men (they go to bed after 12:00 mid-night but wake up to look after the children).

b) Men's group

Assessment of gender roles

Men identified the following daily reproductive activities: morning and evening prayers, washing face and bathing, cleaning compound, taking meals, visiting friends/leisure, building homestead, producing children and sleeping. The productive daily activities included: tethering animals, monitoring fields, land preparation, planting, weeding, harvesting, transport harvests home, threshing, thinning and grazing animals (Figure 2 and Table 5).

Table 5. Daily activities as profiled by men in Kavule village

Activities	**Man**	**Woman**	**Boy**	**Girl**	**Where**	**When**	**Time spent /day**	**RP or P**
A. Household activities								
Morning & evening prayers	✓	✓	✓	✓	Home	Daily	25 min	RP
Washing face & bathing	✓	✓	✓	✓	H	D	40 min	RP
Cleaning compound	✓	-	✓	-	H	D	15 min	RP
Tethering animals	✓	✓	✓	-	H	D	10 min	P
Monitoring fields	✓	✓	-	-	H	D		P
Field activities: - land preparation (cleaning bush & digging) - planting, weeding, harvesting, transport, harvests home, threshing, thinning	✓	✓	✓	✓	H	S S S	 4½ hrs	P
Feed animals	✓	✓	✓	✓	H	D	20 min	P
Taking meals (breakfast, lunch, supper etc)	✓	✓	✓	✓	H	D	2 hrs	RP
Visiting friends/leisure	✓	-	-	-	O	D	2 hrs	RP
Building homestead (once in a while)	✓	-	-	-	H/O	S	-	RP/P
Producing children	✓	✓			H	S	I hr	RP
Sleeping	✓	✓	✓	✓	H	D		RP
B. Community activities								
Working on village paths	✓	-	-	-	Out	When-ever demand arises	-	
Cleaning village water wells	✓	✓	-	-	Out			
Attending burial ceremonies	✓	✓	-	-	Out			
Attending village meetings & training's	✓	✓	-	-	Out			
Building schools, churches, mosque	✓	✓	✓	✓	Out			
Defective role when an alarm is raised	✓	-	-	-	Out			

Key: O=Outside, RP=Reproductive, H=Home, P=Productive, D=Daily, S=Seasonal

2.2.2 Seasonal labour calendar

a) Women's group

Women worked out their labour requirements throughout the year. Three peak periods were identified: March-April when planting and weeding maize, beans, sweet potatoes, bananas, coffee and soybeans. Another labour requirement peak period occurs between June and July, when farmers harvest beans, maize finger millet, and groundnuts, and some farmers also do bush clearing. September and October are also very busy months of the year when farmers are planting and weeding their second season crops.

Figure 3: Seasonal labour calendar for women in Kavule village

Note:

- January and December- during this time women farmers do early land clearing and some late harvesting of their crops.
- February – land clearing continues and sowing of finger millet.
- March and April –these busy months of the year: women farmers plant and weed maize, beans, sweet potatoes, bananas, coffee and soyabeans
- May – weeding is done mostly in this month.
- June – women harvest beans, maize, finger millet and g/nuts.
- July and August – this is another peak period of labour requirements. It involves clearing land and harvesting maize.
- Then the cycle begins again.
- It was noted that most work is done by women (especially planting, weeding and harvesting).
- It was also noted that during the rain season there is a lot of work to do.
- Rearing of animals was said to add more work for women.

b) Men's group

Men also identified three peak periods of labour requirements. These included: March and April, when men are busy planting, weeding, pruning and thinning, plus some marketing. June and July are very busy months of the year for men farmers as they harvest, dry, thresh and market their produce in this period. October is also very busy month in which men weed, prune and thin their crops. January, May, August and December were identified as the months when men do not have much work.

Figure 4: Season labour calendar for men in Kavule village

- January – land is prepared, which involves bush clearing, burning trash and digging.
- February –involves 1st and 2nd ploughing and some planting.
- March – April – men are busy planting, weeding, pruning and thinning, and some marketing.
- May – involves some weeding and other simple activities.
- June – July – men are busy harvesting, drying, threshing and marketing farm produce.
- August –involves late harvesting, some land preparation and continues up to September.
- September – planting continues up to October.
- October – men are busy weeding, pruning and thinning.

- November – harvesting (usually less than 1st seasons harvests), marketing, land preparation for millet.
- December – involves late harvesting and land preparation for millet continues.

2.2.3 Access and control profile

a) Women's group

Access to and control over resources used in a home, as identified by women, are presented in Table 6.

Women listed the following resources they use in a home: land, money, hoes, sauce pans, knives, cattle, goats, education, poultry, time, movement and energy. They noted that men, women, boys, girls, widows, first, second and third wives have access to most of the resources, except that women, boys, girls, 2nd wife, 3rd wife have limited access to time and no access to movement and energy resources. However, it was noted that, women could access energy (labour especially of children) when their husbands are not around. As regards control of resources, it was noted that women, boys, girls, first wife, second wife and children from first and second wives do not control any of the resources shown in Table 6. Men justify this by saying that when a woman is married she brings nothing with her to the man's home, and therefore she owns nothing in a man's house.

Access to and control over benefits

Women farmers listed the benefits that exist in their households as money, food, ghee, meat, cow dung, cattle, goats, pigs, poultry, maize, coffee and beans. It was noted that men, widows, and their children have access to all benefits in the households. The children access money and farm used for school fees. However, children have no access to coffee. It was realised that widows have access to all benefits in their households because they are essentially the heads of the households. The first and second wives had access to food items and cow dung, but not to cattle, goats, pigs, poultry and coffee (benefits which bring in money). It was noted that when there is plenty of foods e.g 10 bags of beans, a man can give his wife one bag or refuse her to sell anything, in other words it becomes a man's crop, because he is the one who sells it. Some women had access to money, whereas others did not.

Men and widows control all the benefits in their households and other members of the household need their consent. Therefore, women, first and second wives, and children had no control of any benefit in their households.

Table 6. Access to and control over resources used in households for the women's group in Kavule village

Resources	**Access**								**Control**							
	Men	Women	Boys	Girls	Widows	First wife	Second wife	Third wife	Men	Women	Boys	Girls	Widows	First wife	Second wife	Other children
Land	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Money	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Hoes	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Sauce pans, knives	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Cattle	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Goats	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Education	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Poultry	✓	✓	✓	✓	✓	✓	✓	3	3	-	-		3		-	-
Time	✓	Limited	Limited	Limited	✓	✓	Limited	Limited	3	-	-	-	3	-	-	-
Movement	✓				✓				3	-	-	-	3	-	-	-
Energy	✓				✓				3	-	-	-	3	-	-	-

Table 7. Access to and control over benefits for the women's group in Kavule village

Benefits	**Access**								**Control**							
	Men	Women	Boys	Girls	Widows	First wife	Second wife	Other children	Men	Women	Boys	Girls	Widows	First wife	Second wife	Other children
Money	✓	Some	Fees	Fees	✓	Some	Some	Fees	3	-	-	-	3	-	-	-
Food	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Ghee	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Meat	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Cow dung	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-
Cattle	✓	-	✓	✓	✓	-	-	3	3	-	-	-	3	-	-	
Goats	✓	-	✓	✓	✓	-	-	3	3	-	-	-	3	-		-
Pigs	✓	-	✓	✓	✓	-	-	3	3	-	-	-	3	-	-	-
Poultry	✓	-	✓	✓	✓	-	-	3	3	-	-		3	-	-	-
Maize	✓	✓	✓	✓	-	✓	✓	3	3	-	-	-	3	-	-	-
Coffee	✓	-	-	-	✓	✓	-	3	3	-	-	-	3	-	-	-
Beans	✓	✓	✓	✓	✓	✓	✓	3	3	-	-	-	3	-	-	-

b) Men's group

Access to and control over resources and benefits as identified by men are presented below (Tables 8a and 8b). Men identified the following resources used in their households: land, animals and poultry, money, houses, radio, transport facilities (e.g. bicycle, farm implements hoe, panga, axe, wheel barrows, knife etc), kitchen utensils, time, chairs, iron box and lantern. It was noted that all men, women, boys and girls have access to these resources. However, it is only men who control the resources.

The benefits identified in the households included: income, food crops, cash crops (e.g. coffee, milk, eggs, meat), education and organic fertilizers from animal waste. Men, women, girls and boys have access to all the benefits in the households except that women and men do not access education (as shown in Table 8). It was noted that men control all the benefits in the households. While women, boys and girls do not control any benefit in the household.

Table 8*a*. Access to and control over resources for the men's group in Kavule village

Resources	**Access**				**Control**			
	MA	**FA**	**FC**	**MC**	**MA**	**FA**	**FC**	**MC**
Land	3	3	3	3	3	-	-	-
Animals & poultry	3	3	3	3	3	-	-	-
Money	3	3	3	3	3	-	-	-
Houses	3	3	3	3	3	-	-	-
Radio	3	3	3	3	3	-	-	-
Transport facilities (bicycles)	3	3	3	3	3	-	-	-
Farm implements (hoe, panga, axe, wheel barrows, knife, etc)	3	3	3	3	3	-	-	-
Kitchen utensils	3	3	3	3	3	-	-	-
Time	3	3	3	3	3	-	-	-
Water	3	3	3	3	3	-	-	
Chairs, iron box, lantern	3	3	3	3	3	-	-	-

Table 8*b*. Access to and control over benefits for the men's group in Kavule village

Benefits	**Access**				**Control**			
	MA	**FA**	**FC**	**MC**	**MA**	**FA**	**FC**	**MC**
Income	3	3	3	3	3	-	-	-
Food crops	3	3	3	3	3	-	-	-
Cash crops (coffee)	3	3	3	3	3	-	-	-
Milk	3	3	3	3	3	-	-	-
Eggs	3	3	3	3	3	-	-	-
Meat	3	3	3	3	3	-	-	-
Educate children	3	3	3	3	3	-	-	-
Organic fertiliser from animal waste	3	3	3	3	3	-	-	-

FA = Female adult, MA = Male adult, FC = Female child, MC = Male child

2.3. Village organizations

Farmers organize themselves in many ways that need to be understood if one is to work effectively with them. Organization diagrams were developed in Imanyiro sub-county to identify the major organizations e.g. self-help groups, women, youth and church groups. Traditional structures such as clans, of which villagers are members, were also identified to explore the links among these organizations, and also external groups to access farmers' information and communication networks. These organizations can be used to facilitate knowledge and technology dissemination. They provide a forum for discussing and exchanging ideas and disseminating information to a large audience. These organizations also play a role in stimulating community participation in various activities, since there is a greater potential for mobilization as they have established linkages within the village that facilitate common action.

The farmers in Imanyiro identified 24 different groups, which were composed of farmers from the sub-county. They varied in size from a handful of members to an entire village. The groups were formed around issues that affected the members and these included women groups, church or religious groups, welfare, farmer research groups and fish farming (Table 9).

Table 9. Village organizations in Imanyiro

Organizations in the villages	**Village**
Gema Kumivino Development Society	Mugeri
Kantu Group	Kavule
Buyemba Women Association (BWA)	Buyemba
Muno Mukabi	Matuba
Agali Awamu	Bukasero
Akena Group (fish farming)	Bukawongo
Kavule Development Community Group	Kavule
Ikulwe Bean Farmers Association	Ikulwe
Bukasero Youth Group	Bukasero
Kuguminkiriza Women Group	Matuba
Muno Mukabi	Mugeni Church
Muno Mukabi	Mayuge Church
Dembe Women's Group	Mayuge Church
Bakusekamaja Women's Association	Mugeri
Bukasero Women's Group	Bukasero
Magada Women's Group	Magada
Mayuge Adult Literacy Association	Mayuge
Magada Itente Farmers Group	Magada
Kyebando Farmers Association	Kyebando
Baise Kantu	Magada
Muno Mukabi	Magada
Literacy Classes	Magada
Kyebojja Kobona	Magada
Naigezi Women's Club	Magada

2.3.1 Organizations in Kavule village

Only two organizations were identified in Kavule village and these were Kantu and Kavule Development Groups (Figure 5). Kantu consists of a majority of members of the village, while Kavule Development Group consists of all men in Kavule who plan development activities. However, these organizations do not interact with any external organization.

Figure 5: Social organizations in Kavule village

2.3.2 Organizations in Buyemba Village

Farmers identified ten social groups in Buyemba village (Figure 6). Six of these groups were women groups. Ikulwe farmer participatory research group (IFPRG) was identified as the most central organization that cut across most of the groups and consists of about 50 members. This is a farmers research group that produces bean seeds. Members conduct research on beans, Canavalia, Kisimbisimbi, Crotalaria, Mucuna, Lablab and Tephrosia (*Muluku*). Many farmers join IFPRG because the organization trains its members on modern farming and new technologies. It provides farmers with improved crop seeds. Most of its members are active - only 20% members are passive. Its sources of information are KARI (Kawanda Agricultural Research Institute), Namulonge Agricultural and Animal Research Institute (NAARI) and CIAT. Participating farmers voluntarily provide funds, labour equipment for their research activities. Several internal and external organizations interact with Ikulwe Farmer Participatory Research Group.

Kantu organization is also a very important organization in Buyemba village. It has about 300 members and assists during funerals. When members lose a relative, they inform the chairman of Kantu. Members assist in funeral arrangements. Men construct shelters, dig graves, make cash contributions, carry the body to the grave and bury it. Women bring water, cook and serve food.

Figure 6: Social organizations in Buyemba village

2.3.3 Organizations in Magada village

Farmers in Magada identified seven social groups:-

1. Baise Kantu Group
2. Muno Mukabi Group
3. Literacy Classes Group
4. Magada Womens Group
5. Itente Farmers Club
6. Kyebojja Kobona Group
7. Naigezi Womens Club

Some farmers are members of associations from outside the village that include PEARL (UNFPA), CIAT-INM-BMZ Project, Africa 2000 Network and Eastern Coffee Farmers Association (ECOFA).

Baise Kantu is a community group and all people in the village are members. This is a welfare group that assists members of the community during funeral and burial arrangements. Members of the community contribute mainly food and firewood. Women collect water and assit to cook for mourners and provide company, comfort and courage to the bereaved family while men construct graves and shelter. Members meet and contribute funds when necessary. This association does not contribute to agricultural development in the area.

Muno Mukabi group has similar activities to Baise Kantu and assists members who have problems and this group has no contribution to agricultural development. Magada and Naigezi Womens groups are drama and agricultural associations. Women members are engaged in activities that include crop and livestock production and making bricks.

Itente and Kyebojja Kobona farmers groups are involved in agricultural activities that include poultry production. The members of the group contribute funds to sustain their activities. The Literacy Classes Association is a group that trains adults to read and write (adult literacy).

PEARL (UNFPA) is a health education organisation for the youth. The youth are encouraged to engage in income generating activities that include farming. The association is funded by UNFPA.

2.4 Household income and expenditure

2.4.1 Source of income

The following were identified as sources of income by farmers in Kavule, Buyemba and Magada villages:

- Crop production was the most important source and contributes about 55% of the total income. The most important crops were coffee, maize, beans, soybean, cassava, millet, cocoa and passion fruit.

- Livestock production contributes 20% of the income.
- Employment and bicycle repairing contribute 10% each to the household income.
- Business contributes 5% (Figure 7).
- Other activities that bring income to households are: brick making, building, fish farming, labour and employment in maize mills.

Figure 7: Sources of income in Imanyiro

2.4.2 Household income expenditure

The major household expenditure was on school fees 50%. This is followed by clothing 10%, health costs 10%, farm inputs 10%, transport 10%, tax 5% and food 5% (Figure 8).

Figure 8: Household expenditure in Imanyiro

It is important to note that a large part (50%) of the men's income is spent on children's school fees. Women's income is spent on children's clothes, pencils and exercise books when husbands are not around. Women also buy themselves clothes and treat their hair in beauty salons.

2.5 Other socio-economic issues

Farmers in the 3 villages of Kavule, Buyemba and Magada do not have access to credit facilities. Some farmers in Buyemba village buy and use fertilizers. No farmers in the other two villages use fertilizers. Farm produce (maize, beans and groundnuts) are sold in Iganga town, although some transactions are carried out between farmers. However, farmers are usually offered very low prices for their produce. Farmers do not store produce because of financial demands that include paying school fees and hospital bills.

Generally, men make decisions on the fate of farm produce. Men also make decisions on soil management practices, but both men and women implement them.

2.6 Farmers' problems, possible solutions and opportunities

2.6.1 Problem identification

Farmers from the three villages (Kavule, Buyemba and Mayuge) identified the major problems affecting them in their villages. The list of problems included: farming is not profitable, poverty, poor water sources, lack of tractors, low prices for produce, disease and food problems. The problems were ranked using pairwise ranking (Table 10).

Table 10. Pairwise ranking of farmers problems in Imanyiro

Problems	**FP**	**P**	**W**	**T**	**LP**	**D**	**PF**		**Score**	**Rank**
Farming not profitable (FP)		FP	FP	FP	FP	FP	FP	FP	6	1
Poverty (P)			P	P	P	P	P	P	5	2
Poor water (W)				T	LP	D	PN	W	0	7
Lack of tractor (T)					LP	D	PN	T	1	6
Low prices for produce (LP)						LP	LP	LP	4	3
Diseases (D)							PN	D	2	5
Poor nutrition (PN)								PF	3	4

The results indicate that farmers consider farming not to be a profitable activity. Other main problems are poverty, low prices, poor nutrition, diseases, lack of tractors and poor water.

2.6.2 Potential solutions to the problems and opportunities

Farmers discussed potential solutions to their problems. These are presented below:

I. Potential solutions to the problem that farming is not profitable are:-

a. Plant high value crops e.g. passion fruit, cowpeas and ginger.
b. Planting improved crop seeds.
c. Practising sustainable agriculture using modern technologies.
d. Reduce costs of agricultural inputs.
e. Access to credit facilities.

II. Potential solutions to the problem of poverty are:

a. Access to credit facilities in terms of seeds, fertilizers, agricultural chemicals and cash.
b. Training in technical skills.
c. Training through demonstrations for quick adoption and implementation of technologies.
d. Monkeys and other wild animals should be controlled and scared away from crops.
e. Provision of video-aids and sensitizing the community on improved agricultural technologies.

III. Potential solutions to the problem of low prices.

a. Government should provide good marketing strategies.
b. Construction of improved food stores.
c. Pest control for stored produce.
d. Proper storage facilities for maintaining the value and standard of crops produce.
e. Cooperative marketing systems.

IV. Potential solutions to the problem of poor nutrition are:

a. Growing and producing a variety of crops.
b. Implement whatever they learn during training.

c. Training in nutrition and cooking techniques.
d. Men should allow women to attend and participate in training and workshops.

The main opportunities in the area were identified as:

a. Availability of a District Farm Institute at Ikulwe as a demonstration and training site.
b. Ikulwe Farmers Participatory Research Group in Ikulwe village.
c. Availability of Agricultural extension agents in the sub-county who should put more effort in training and disseminating technologies to farmers in the area.

3.0 CROP PRODUCTION

3.1 Crops grown in Imanyiro sub-county

Farmers in Imanyiro sub-county grow a wide range of crops for food and income. During the PRA exercise, a group of farmers identified 21 different crops grown. They ranked the top ten crops as coffee, bananas, maize, cassava, groundnuts, sweetpotatoes, beans, millet, cocoyams and rice, in that order (Table 11). Other crops mentioned were pumpkins, vegetables, cocoa, sugarcane, soybean, yams, sesame, fruits, vanilla, mulberry and Irish potatoes.

Table 11. Pairwise ranking of the most important crops in Imanyiro sub-county

	Ma	**Be**	**Sp**	**Ca**	**Bn**	**Mi**	**Ri**	**Cf**	**Cy**	**Gn**	**Score**	**Rank**
Maize (Ma)	-	Ma	Ma	Ca	Bn	Ma	Ma	Cf	Ma	Ma	7	3
Beans (Be)		-	Sp	Ca	Bn	Ma	Be	Cf	Be	Be	3	7
Sweet potatoes (Sp)			-	Ca	Bn	Sp	Sp	Cf	Sp	Gn	4	6
Cassava (Ca)				-	Bn	Ca	Ca	Cf	Ca	Gn	6	4
Bananas (Bn)					-	Bn	Bn	Cf	Bn	Bn	8	2
Millet (Mi)						-	Mi	Cf	Mi	Gn	2	8
Rice (Ri)							-	Cf	Cy	Gn	0	10
Coffee (Cf)								-	Cf	Cf	9	1
Cocoyam (Cy)									-	Gn	1	9
Groundnuts (Gn)										-	5	5

Farmers also discussed how some of the main crops compete for production resources (land, capital, labour and management). The highest competitor for the resources was coffee, followed by maize, bananas, groundnuts, beans, cassava and sweet potatoes (Table 12).

Table 12. Crop competition for the four production resources

Crop	**Land**	**Capital**	**Labour**	**Management**	**Total score**	**Rank**
Maize	4	3	4	2	13	2
Coffee	4	3	3	4	14	1
Sweet potatoes	1	2	3	1	7	6
Bananas	1	3	3	4	11	3
Cassava	2	2	2	1	7	6

Beans	2	2	2	2	8	5
Groundnuts	1	3	3	3	10	4

4 = Highest score, 1 = Lowest score

The highest competitor for the four production resources was coffee, followed by maize, bananas, groundnuts, beans, cassava, and sweet potatoes in that order. Land allocation to crops was highest for maize (32%) followed by coffee and bananas at 21% each, cassava and beans at 10% each (Figure 9). Wortmann *et. al.*, (1998) found that land use for different crops in Ikulwe was banana (20%), maize, cassava and fruits (20% each), beans, coffee and vegetables (7% each), sweet potato (6%) and other crops (16%).

Figure 9: Land allocation to major crops in Imanyiro sub-county

3.2 Crop production constraints

Farmers were also asked to list the constraints that they face when producing crops and they gave a list of 10 constraints:-

- lack of tools
- small pieces of land or limited land
- poor soils
- poor farming methods
- pests and diseases
- poor marketing
- lack of capital
- unpredictable weather
- lack of extension services
- weeds

When these production constraints were ranked, lack of extension services (LES) emerged as the most serious problem, followed by unpredictable weather (UW), lack of capital (LC), lack of tools (LT), pests and diseases (PD), poor marketing (PM), poor farming methods (PFM), poor soils (PS), weeds (W) and limited land (LL) (Table 13).

Table 13. Pairwise ranking of the crop production constraints in Imanyiro sub-county

	LT	**LL**	**PS**	**PFM**	**PD**	**PM**	**C**	**UW**	**LES**	**W**
Lack of tools (LT)										
Limited land (LL)	LT									
Poor soils (PS)	LT	PS								
Poor farming methods (PFM)	LT	PFM	PFM							
Pests and diseases (PS)	LT	PD	PD	PD						
Poor marketing (PM)	PM	PM	PM	PM	PD					
Capital (C)	C	C	C	C	C	PM				
Unpredictable weather	UW	UW	UW	UW	UW	UW	UW			
Lack of extension services	LES	LES	LES	LES	LES	LES	LES	LES		
Weeds (W)	LT	W	PS	PFM	PD	W	C	UW	LES	

Score	5	0	2	3	5	5	6	8	9	2
Rank	4	10	8	7	4	4	3	2	1	8

Farmers were asked to suggest possible solutions to these constraints, and came up with several solutions for each constraint. Their suggestions are summarised in Table 14.

Table 14. Possible solutions to the crop production constraints raised by the farmers of Imanyiro sub-county

Problems	**Possible solutions**
Lack of skills / ignorance	• Access to extension services. • Form groups where farmers can be taught/trained. • Exposure visits / tours. • Training in farm planning and simple management.
Lack of capital	• Access to credit facilities. • Communal work that reduces financial requirement for labour.
Poor marketing	• Access to market information • Planning farm activities • Co-operative marting
Lack of tools / inputs	• Accessibility through rural stockists. • Mobilised groups where inputs can easily be delivered.
Pests and diseases	• Avail extension services to farmers. • Develop skills in the control of pests and diseases. • Access to inputs. • Adhere to the proper planting calendar.
Poor soils	• Avail extension services to farmers. • Training or develop skills in good soil management. • Exposure visits. • Access to inputs.
Limited land	• Skills in maximum utilisation of land. • Hiring more land. • Farm planning.

3.3 Cropping calendar and division of labour

Farmers developed a cropping calendar for all the 21 crops grown in Imanyiro sub-county (Table 15). The results indicate that farmers in Imanyiro sub-county are very busy throughout the year. However, women and men in the sub-county share all the work except slashing and marketing of the produce, which are done by men only (Table 16).

Table 15. Cropping calendar for Imanyiro sub-county

Crop	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Maize		P	PW	PW	WH	H	HP	PW	PW	W	H	H
Beans			P	PW	W	H	H	P	PW	PW	WH	H
S. Potatoes		P	PW	PW	P	H	PH	PW	PW	P	PH	H
Soya beans			P	PW	PW	H	P	PW	PW	W	H	H
Cassava	P	PW	PW	PW	PW	PH	P	PW	PW	PW	PW	PH
Bananas	W	W	PW	P	W	H	P	PW	W	HW	HW	W`H
Pumpkins			P	P		H	H	P	P		H	H
Millet	P	PW	W									P
Rice		P	P	P	H	P	PW	PW	H	H	H	
Coffee	H	H	P	PW	W	W	PH	PH	PW	H	H	H
Vegetables	PH	P	P	P		WH	P	PW	P	PW	PW	WH
Cocoa			P	PW	WH	HW	P	P	H	H	H	H
Sugarcane	H	P	PW	PW	H	W	P	PW	PH	PH	H	H
Cocoyams		P	PW	PH	WH	H	P	PW	PW	H	H	
Yams	P	H										P
G. Nuts			P	PW	W	H	P	PW	PW	H	H	H
Sesame			P	PW	W	H	P	PW	PW	H		
Fruits	H	PH	P	PH	H	H	P	P	PH	PH	H	
Vanilla		P	P		H		P	P		H		
Mulberry		P	P		H	H	P	P		H	H	
Irish potatoes			P	PW	WH	H	P	P	PW	HW		

P = Planting, W = Weeding, H = Harvesting, PW = Planting and weeding

Table 16. Division of labour associated with crop production

	M	F	M & F
Slashing	✓		
Clearing & stumping			✓
Opening of land			✓
Seedbed preparation			✓
Planting			✓
Weeding / thinning			✓
Applying fertilisers			✓
Spraying			✓
Harvesting			✓
Drying			✓
Threshing			✓
Storing			✓
Marketing	✓		

Figure 10: Crop production trends in Imanyiro (1980-1999)

Figure 11: Seasonal food availability in Imanyiro sub-county

3.4 Trends in crop production in Imanyiro sub-county during the last 20 years (1980-1999)

The trend in crop production in the last two decades indicate that there have been two peak periods in 1985 and 1995 for coffee, maize and sweet potato, but banana production was highest in 1990 (Figure 10).

Food is most available in the months of June July, August and December to February. These are months that correspond to harvesting time (Figure 11).

3.5 Cropping systems in Imanyiro sub-county

3.5.1 Methods of planting various crops

Farmers were asked to name the various methods they use to plant crops. They indicated that they plant most crops either as sole crops, as intercrops or in strips (Table 17).

Table 17. Planting methods of crops in Imanyiro sub-county

Crop	Sole	Intercrop	Strip cropping
Maize	✓	✓	✓
Groundnuts	✓	✓	✓
Coffee	✓	✓	-
Beans	✓	✓	✓
Sweet potatoes	✓	✓	✓
Cassava	✓	✓	✓
Soya beans	✓		-
Bananas	✓	✓	✓
Rice	✓	-	✓
Number of times	9	8	7

However, during the subsequent discussion and during the transect walk through Kavule village, it was observed that nearly all farmers in the area practice intercropping. All types of crop combinations were observed and the most, which were most common were:

- beans, maize, cassava
- groundnuts, simsim, maize, cassava
- finger millet, sorghum, simsim, cassava, maize
- maize, beans, cotton
- bananas, maize, beans
- sweet potatoes, beans, maize.

When farmers were asked to explain why intercropping is very common in the area, they gave four reasons (Table 18).

Table 18. Reasons for intercropping

Reason	Number of farmers responding
Limited land /land shortage	15
Spreading risks	15
Improving soil fertility	10
Reduction of crop pests and diseases	4

Most farmers in the area practice intercopping because of land shortage, to spread risks and to improve soil fertility. A few farmers also believe that intercropping helps them to reduce crop pests and diseases.

3.5.2 Crop rotation

About 42% of the farmers present during the discussion indicated that they practice crop rotation, indicating that the benefits of crop rotation were:

- to reduce pests and diseases
- to maintain / sustain soil productivity
- to improve soil fertility.

The other farmers said that they do not practice crop rotation because all their land is under permanent crops like coffee and bananas.

3.6 Planting materials / seeds

Farmers reported that the main sources of planting materials / seeds were from their own seeds (saved from crop harvests), neighbours, local markets, farm supply shops and researchers (Table 19).

Table 19. Sources of planting materials in Imanyiro sub-county

Crop	Own seeds	Markets (local)	Farm supply shops	Neighbours	Research
Maize	✓	✓	✓	✓	✓
G. Nuts	✓	✓	✓	✓	✓
Beans	✓	✓	✓	✓	✓
S. Potatoes	✓	-	-	✓	✓
Cassava	✓	✓	-	✓	✓
Soya beans	✓	✓	✓	✓	✓
Bananas	✓	✓	-	✓	✓
Coffee	✓	✓	-	✓	-
Rice	✓	✓	✓	✓	✓

Most farmers get planting materials / seeds from their own seed and also buy seed from the local markets and from neighbours. Farmers have also been exposed to research workers and they get seeds from research institutions. Most farmers (65%) use improved seed / planting materials, whereas few (35%) do not use improved seed. Among the farmers present in the meeting those planting improved seeds / planting materials for some of the crops were: cassava (17), maize (8), beans (8), soya beans (3), and groundnuts **(**3). Cassava was leading because cassava mosaic virus has destroyed all the local cassava varieties. The data also shows that the new cassava and beans varieties introduced through NARO Namulonge and CIAT during the early 1990's were well accepted. The improved seed / planting materials reported to be available to the farmers were: -

Crop	Variety
Maize	Longe 1, Hybrid
Beans	K131, K132
Soya beans	Nam 1, Nam2
Cassava	SS4, Nasse 1 & 2, SS6, BA

Farmers' reasons for using improved seed / planting materials were:

- high yield
- quick maturing (in some cases)
- dressed and therefore good germination.

3.7 Location of different crops planted on the farms

Farmers also indicated the locations on their farms where different crops are grown. Most crops are grown on the upland as shown below:

Crop	Location
Maize	Upland, swamp
Beans	Upland
Groundnuts	Upland
Rice	Upland, swamp
Coffee	Upland
Bananas	Upland
Cassava	Upland
Soya beans	Upland
Vegetables	Upland, swamp

3.8 Diseases and pests of crops

Farmers also enumerated the following diseases and pests:

Crop	Pest and disease
Beans	Blights, Bean fly, stripped beetle, Fusarium, Aphids
Maize	Termites, stalk borers, smuts, maize streak virus
Groundnuts	Rosette, Wilting (Fusarium)
Bananas	Banana weevil, Sigatoka, Fusarium wilt
Coffee	Coffee wilt, Antestia bugs
Cassava	Mosaic, termites, rats
Sweet potatoes	Cut worms, caterpillars, mole, rats
Vegetables	Wilting, blights, fruit borers, loopers, beetles

They pointed out that some of these pests and diseases (e.g. termites on maize) were very serious problems with no solution at the moment, while others (cassava mosaic and mole rats) were being addressed using resistant varieties of cassava and Tephrosia respectively. Farmers appreciated these technologies introduced through past activities of CIAT**.**

3.9 Soil fertility management

Although farmers had ranked soil fertility low among the constraints (see section 3.2), the facilitators felt that this was such an important area in crop production that it deserved further investigations. Farmers were asked to explain how they manage soil fertility on their farms; their responses are presented below (Table 20).

Table 20. Soil fertility improvement measures practised by farmers in Imanyiro sub-county

Soil fertility improvement measures used by farmers	Number of farmers
Planting grain legumes e.g. beans, groundnuts, and soybeans.	9
Planting green manure e.g. Mucuna, Canavalia, Lablab, Crotalaria.	20
Using artificial fertilisers	8
Using compost manure	5
Incorporating grass and crop residues into the soil	8

The most common measure used to improve soil fertility was planting green manure like mucuna, canavalia, lablab, and crotalaria. This is another technology introduced in the area by CIAT, and farmers appreciated its value (Wortmann *et al.,* 1998).

3.10 Uses of crop residues available on the farms

The use of crop residues, which are available on the farms, has a bearing on nutrient flows. For this reason, farmers were asked to explain how they use crop residues available on their farms. They started by listing the crop residues that are often available, including maize stover, sorghum stover, finger millet straw/trash, sugarcane trash, groundnut plants, banana trash, sweet potato vines, bean haulms and simsim stems. They also listed as the different ways of handling crop residues the following:

- burning
- returning the materials to the fields
- making trash lines /erosion barriers in the fields
- making compost
- using the materials as mulch.

Finally, they matched the uses against each type of crop residues to ascertain the most common methods of disposal (Table 21).

Table 21. Uses of crop residues available on farms in Imanyiro sub-county

	Uses / method of disposal				
Crop residue	**Burning**	**Returning to garden**	**Making trashlines / barriers in the field**	**Compost making**	**Mulching**
Maize stover	4	2	1	1	1
Finger millet trash	1	4	1	1	1
Groundnuts residue	1	4	1	1	1
Sugarcane trash	1	4	1	1	1
Beans trash	4	2	1	1	1
Sweet potato vines	3	4	2	1	1
Banana stover	1	4	3	1	4
Score	15	24	10	7	10
Rank	**2**	**1**	**3**	**5**	**3**

Weighting 4 is most common practice and 1 is least common practice.

Most of the crop residue is returned to the gardens followed by burning. Few people use crop residue for controlling soil erosion, and most farmers did not know how to use crop residues to make compost.

4.0 SOILS

4.1 Mapping natural resources of Kavule village

During group interviews, a group of farmers was asked to draw a resource map of Kavule village in Mayuge Parish (Figure 12). The objectives of the village territory map were to:

- Visualize the boundaries of the village territory.
- Identify and locate the different land units and soil types in the village.
- Locate the different farm-households in the village.
- Analyze use and management of the land.
- Identify differences in soil fertility patterns.
- Analyze the constraints and potentials of the territory in relation to soil fertility and land degradation.

The purpose of the map was to assist with the analysis of current natural resource use and management at the village level. The soil types and land use along the catena were demarcated. The relative importance of the different types of landuse and the reasons for these differences were discussed. Existing erosion control measures and land use areas were demarcated. The map was analyzed to identify the constraints and potential for different types of landuse (physical aspects such as soil quality and slope, and issues such as location and marketing possibilities for the produce) and to decide if communal action for natural resource management activities should be planned (Defoer *et al.,* 2000).

A village transect walk (Figure 13) was later conducted through Kavule village by a group of facilitators and farmers. The main objective of the territory transect was to:

- Identify the diversity of the landscape along the slope.
- Analyse the diversity in soil fertility management along the catena (across the slope).
- Verify and complete findings of the village territory map.

The transect allowed the group to cover the main territory units and soil types. Detailed information was obtained on landuse, crops, livestock, farmers' management practices, soil conservation and agroforestry practices. The main constraints and potential improvement were identified for different parts of the soil catena (Figure 13).

The upper parts of the catena were low in soil fertility and the main soil types were brown loamy soils locally known as “e’ryolukusikusi”. These areas were planted to bananas, coffee, maize, onions, cassava, beans and soybeans. Soil conservation measures included grass fallows and trees scattered on the farmland. Severe termite damage to crops, mole rats, land overuse and fragmentation were the main constraints. Potential improvements suggested by the farmers were improved fallows (as a low cost investment to improve soil fertility status) of and Tephrosia fallows (to control mole rats) (Wortmann *e. al.,* 1998). The middle parts of the slope were also under agricultural production and the main soil types were loams

(*lukusikusi*). The main crops were as in the upper parts of the catena. Soil conservation and agroforestry practices observed were grass fallows, live fences and scattered trees on cropland; soil fertility status was fair. Main constraints mentioned were soil erosion, deforestation and continuous cultivation without nutrient replenishment. Potential improvements suggested included the use of improved fallows and construction of trenches, terraces and other biological and physical soil erosion control measures.

The lowest part of the catena was under agricultural production. Soil types were sandy soils mixed with fine grey clay (*omusenhosenho*). The main crops grown in the lower parts of the catena were coffee, maize, banana, pigeon pea, sweet potatoes, Napier grass, rice and yams. The main soil conservation and agroforestry practices were grass fallows and scattered trees on cropland. Soil fertility status was good, but the principal constraint was continuous cultivation without fertilizer use. Potential improvements suggested were introduction of leguminous fallows and use of inorganic and organic fertilizers.

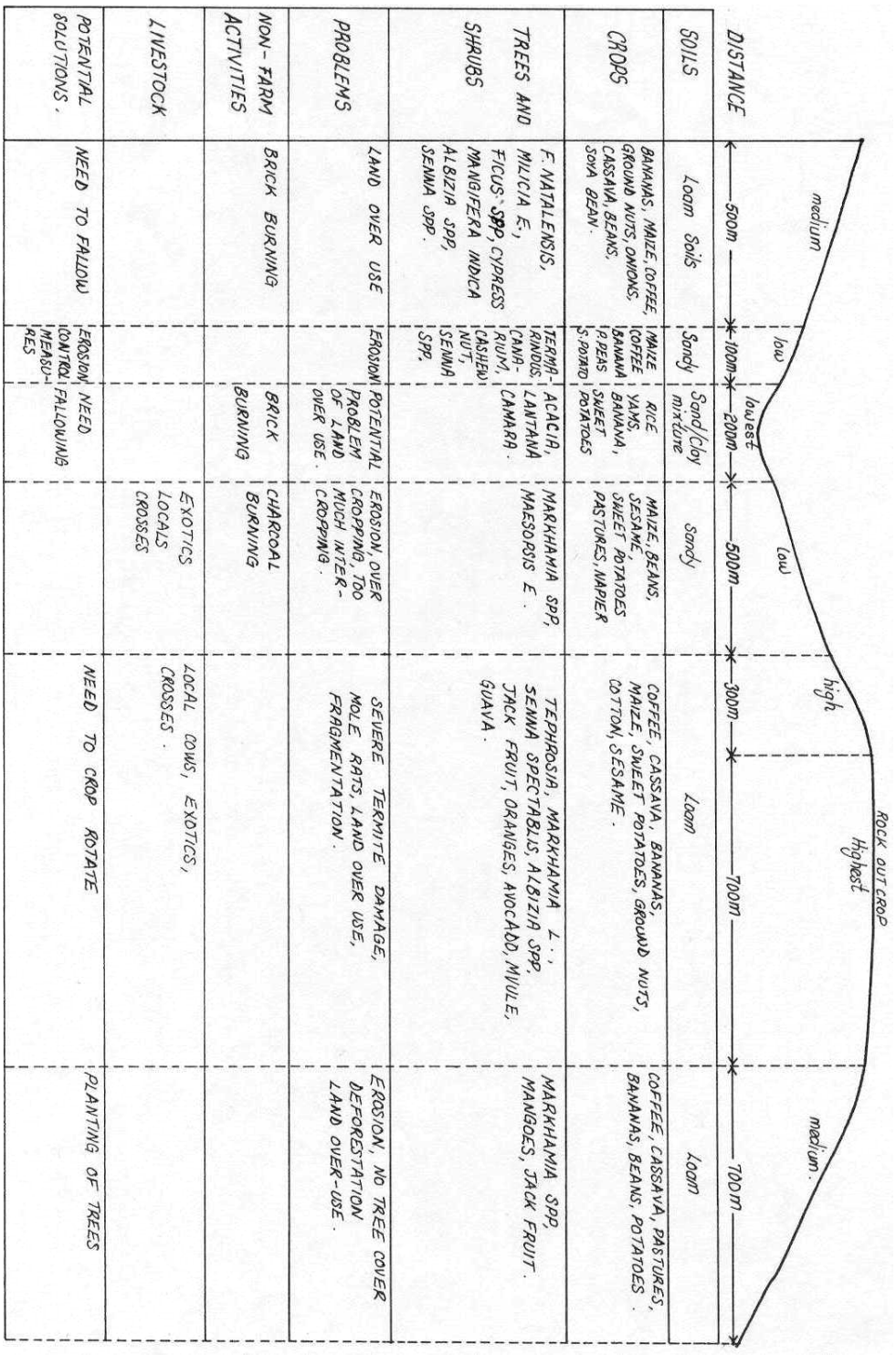
4.2 Farmers' soil classification, description and land use

A group of farmers and facilitators discussed the soil types found in Imanyiro subcountry. A list of 8 different soil types, their descriptions and uses was developed (Table 22). The farmers based their soil classification on colour (e.g. e'lirugavu meaning black soil), texture (e.g. omusenho meaning sand) and presence of stones (e'lyolubale meaning stony soil) or salt (e.g. elyengugo and elyolunyo meaning salty soil). Earlier studies in Ikulwe indicate that farmers differentiate between 14 soil types (Jjemba *et al*., 1993).

4.3 Soil fertility constraints

Farmers also discussed the problems related to soil fertility in Imanyiro subcountry. A list of 12 constraints was associated with soil fertility in the sub-county (Table 23). Using pairwise ranking, farmers prioritized these 12 constraints, with drought as the number 1 constraint as far as soil fertility is concerned. When asked to explain how drought affects soil fertility, farmers pointed out that drought is a serious problem because it affects yields on both fertile and infertile soils. Constraint number 2 was lack of knowledge and skills on proper soil fertility management, while low natural soil fertility was ranked 3rd and soil borne diseases and pests became numbers 4 and 5. The high cost of inorganic fertilizers was ranked number 6, while soil erosion and poor tillage methods tied at number 7.

Figure 12: Resource map of Kavule village in Imanyiro sub-county



DISTANCE	500m	100m	200m	500m	300m	700m	700m
SOILS	Loam Soils	Sandy	Sand/Clay mixture	Sandy	Loam	Loam	
CROPS	BANANAS, MAIZE, COFFEE, GROUND NUTS, ONIONS, CASSAVA, BEANS, SOYA BEAN.	MAIZE COFFEE BANANA B PEAS S. POTATO	RICE YAMS, BANANA, SWEET POTATOES	MAIZE, BEANS, SESAME, SWEET POTATOES PASTURES, NAPIER	COFFEE, CASSAVA, BANANAS, MAIZE, SWEET POTATOES, GROUND NUTS, COTTON, SESAME.	COFFEE, CASSAVA, PASTURES, BANANAS, BEANS, POTATOES.	
TREES AND SHRUBS	F. NATALENSIS, MILICIA E., FICUS SPP, CYPRESS MANGIFERA INDICA ALBIZIA SPP, SENNA SPP.	TERMINALIA RINDUS. CAMARIUM, CASHEW NUT, SENNA SPP.	ACACIA, LANTANA CAMARA.	MARKHAMIA SPP, MAESOBIS E.	TEPHROSIA, MARKHAMIA L., SENNA SPECTABLIS, ALBIZIA SPP, JACK FRUIT, ORANGES, AVOCADO, MIVULE, GUAVA.	MARKHAMIA SPP, MANGOES, JACK FRUIT.	
PROBLEMS	LAND OVER USE	EROSION POTENTIAL PROBLEM OF LAND OVER USE.	EROSION, OVER CROPPING, TOO MUCH INTER-CROPPING.	SEVERE TERMITE DAMAGE, MOLE RATS, LAND OVER USE, FRAGMENTATION.	EROSION, NO TREE COVER DEFORESTATION LAND OVER-USE.		
NON-FARM ACTIVITIES	BRICK BURNING	BRICK BURNING	CHARCOAL BURNING				
LIVESTOCK			EXOTICS LOCALS CROSSES	LOCAL COWS, EXOTICS, CROSSES.			
POTENTIAL SOLUTIONS.	NEED TO FALLOW	EROSION CONTROL FALLOWING MEASURES	NEED		NEED TO CROP ROTATE	PLANTING OF TREES	

Figure 13: Transect of Kavule village

Table 22. Farmers' soil classification, description and land use in Imanyiro sub-county

Soil type	Description	Land management/crops grown
E'lyolubale(bale) (Lubalebale)	Gravely soils which contain murram and small stones. Loose soil, does not stick, dries up quickly. Found on the upper parts of the catena (upland soil). "Hard" soil (difficult to cultivate).	Soybeans, onions, groundnuts, millet, maize and cassava.
E'lyolukusikusi (emyufu)	Red soil in the upper parts of the catena. Dries up quickly. Sticky when wet, cracks when dry.	Many crops, e.g. bananas, coffee, beans, maize, groundnuts and fruit trees, grow well on this soil.
E'lirugavu	Black fertile soil with high organic matter content. Friable, does not crack, high water holding capacity. Found in both upper and lower parts of the catena. Attracts termites.	All crops grow well on this soil, particularly bananas, maize, beans, cassava and coffee.
Omusenho (sand) Omusenhosenho or Lusenhosenho	Sandy soil sometimes used for smearing (plastering) buildings. Found in swampy areas. Sometimes contains small stones (ironstone). Dries and heats up easily.	Crops do not do well on this soil. Those grown here include soybeans, peas, groundnuts and cassava.
E'lyeitosi (Bumba or Lumosi)	Fine grey clay soil found in swampy areas. Sticky, cracks when dry, high water holding capacity. Can be used to make earthen pots.	Rice, cocoyam, sugarcane, millet, maize, sorghum, pumpkins, cabbages and tomatoes.
E'lyekyolera	Mostly shallow soils underlain by rock. Low water-holding capacity. Found in small patches on hillcrests.	This soil does not support crop growth.
E'lyengugo	Saline-sodic (salty) soil found in swampy areas. Livestock and birds lick this soil.	Used for growing roof-thatching grass (Sporobolus spp). Sorghum and wheat may be grown on this soil.
E'lyolunhu	Mostly found in small patches on hilltops. Very infertile.	Unproductive.

Table 23. Pairwise ranking of soil fertility constraints in Imanyiro

Constraints	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Score**	**Rank**
Low natural soil fertility (1)	-	1	1	1	1	6	1	1	1	1	11	1	9	3
Soil erosion (2)		-	3	4	5	6	2	8	2	2	11	2	4	7
Soil-borne diseases (3)			-	3	3	6	3	3	3	3	11	3	8	4
Soil-borne pests (4)				-	4	6	4	4	4	4	11	4	7	5
Land shortage (continous cultivation) (5)					-	6	7	5	9	10	11	5	3	9
Lack of knowledge and skills (6)						-	6	6	6	6	11	6	10	2
High labour demand for soil fertility management (7)							-	7	9	10	11	7	3	9
Lack of soil conservation Materials (8)								-	9	10	11	8	2	11
Poor land tillage methods (9)									-	10	11	9	4	7
High costs of fertilizers (10)										-	11	10	5	6
Drought (11)											-	11	11	1
Negative attitude to farming (12)												-	0	12

4.4 Causes of soil fertility decline and possible solutions

A group of farmers and same facilitators discussed the causes of soil fertility decline in Imanyiro sub-county, indicators of soil fertility decline and possible solutions to these causes (Defoer *et al.*, 2000). First of all, farmers identified 8 indicators (signs) of soil fertility decline (Table 24). Farmers then discussed the causes of soil fertility decline in Imanyiro subcounty (Table 25). Farmers were also asked to suggest possible strategies that they can use to address the problem of soil fertility decline. They suggested a long list (Table 26).

Table 24. Indicators of soil fertility decline

1.	Reduced rate of plant growth
2.	Yellowing of crops
3.	Stunted growth of plants
4.	Soil loses moisture quickly
5.	Increased pest incidence
6.	Wilting of plants
7.	Increased weed growth
8.	Weed indicators of soil fertility decline

Table 25. Priority ranking of the causes of soil fertility decline in Imanyiro

1.	Continuous cropping due to land shortage
2.	Poor soil fertility management
3.	Soil erosion
4.	Unsound / unplanned intercropping practices
5.	Poor management of crop residues and other available organic materials
6.	Poor tillage methods
7.	Lack of fallows (land rest) in the rotations
8.	Nutrient mining through crop harvests
9.	Burning of bushes
10.	Lack of soil erosion control materials e.g. vetiver grass planting materials

Table 26. Strategies for coping with the problem of soil fertility decline in Imanyiro

1.	Use of green manures e.g. Mucuna and Canavalia
2.	Use of inorganic fertilizers e.g. urea and DAP
3.	Use of agroforestry trees e.g. Calliandra
4.	Use of fallows (letting land to rest)
5.	Use of compost manure
6.	Mulching
7.	Crop rotations
8.	Terracing
9.	Use of grass strips e.g. vetiver grass to control soil erosion
10.	Proper intercropping
11.	Use of improved tillage equipment e.g. ox-ploughs

From this list, it was clear that many farmers had some ideas on how to cope with soil fertility decline on their land. However, when asked to indicate by raising hands how many were using each of the strategies they had listed, only 7 farmers out of 23 were using some small quantities of inorganic fertilisers, and even fewer were using other methods of which they were aware (Table 27). When farmers were asked why so few of them were using these strategies they gave several socio-economic reasons (Table 28).

Table 27. Farmers using soil fertility improvement methods

Methods	**Number of farmers n = 23**	**Reasons / remarks**
Fallow (Mucuna)	4 (17.4%)	• Improves soil fertility • Long fallow periods suppress weeds
Fallow (Crotalaria)	2 (8.7%)	• Improves soil fertility • Used as vegetable
Farmyard manure	3 (13.0%)	• Enhance crop vigor especially coffee and maize
Crop residues	2 (8.7%)	
Compost	1 (4.4%)	
Mulching	1 (4.4%)	• Used in banana plantations
Fertilizers (inorganic)	7 (30.4%)	• Lack knowledge on fertilizer use
Agroforestry	2 (8.7%)	• Improves soil fertility • Long establishment period provides shade for crops

Table 28. Socio-economic constraints hindering the use of soil fertility improvement methods

Method	Constraint
Mucuna fallows	• Land shortage
Crotalaria	• Land shortage
Farm-yard manure	• Smell • Labour intensive • Needed in large quantities
Compost manure	• Labour intensive • Collecting and applying compost materials is difficult • Lack of knowledge on compost manure making
Mulching	• Shortage of mulching materials
Inorganic fertilizers	• Expensive • Lack of knowledge on use of inorganic fertilizers • Poor quality of maize grown using fertilizers

4.5 Analysis of the soil fertility management among farms

The issue of soil fertility management diversity among farmers in the three villages of Buyemba, Kavule and Magada was raised and discussed. Farmers identified factors that explain the differences in soil fertility management between farms/households as:

1 Use of fertilizers (both organic and inorganic).
2 Use of soil erosion control measures, such as planting grass strips (vetiver grass), terracing and mulching.
3 Use of green manures, such as Mucuna, Canavalia, Crotalaria and Lablab.
4 Leaving land to rest (fallowing).
5 Agroforestry.

Farms/households using 4 or more of these five measures were considered “good” (class I). Those farms using 1-3 measures were considered “average” (class II), while those farms not using any of these measures were considered “poor” (class III). After establishing these criteria for distinguishing soil fertility management between farms/households, farmers analysed all households in the three villages (Table 29). The name of each household head was written on a card; cards were picked one by one; and the household was analysed according to the criteria above. The class agreed on by the farmers was then noted at the back of each card. At the end of this analysis, the number of farms/households falling in each class was as shown in Table 30.

Table 29. Criteria for differentiating soil fertility management between farms

Criteria	Class I Good	Class II Average	Class III Poor
Vetiver grass (*ekisubi*) for soil erosion/grass strips & lablab	X	X	-
Mucuna for soil fertility improvement	X	-	-
Agroforestry	X	-	-
Canavalia	X	X	-
Fertilizer use	X	-	-
Mulching	X	-	-
Terracing	X	-	-
Use farmyard manure	X	-	-
Fallow land	X	X	-
Crotolaria	X		

Table 30. Soil fertility management classification in Buyemba, Kavule and Magada villages in Imanyiro

Village	Households			
	Class I	Class II	Class III	Total
Buyemba	7	19	165	191
Kavule	9	28	94	131
Magada	4	8	235	247
Total	20	55	494	569

Out of a total of 569 households, only 20 (3.5%) fell in class I, 55 (9.7%) in class II and the overwhelming majority (494 or 86.8%) in class III. The vast majority of the farmers in the area were not carrying out any improved soil fertility management practices.

Correlation between soil fertility classification and wealth ranks, gender and decision making in Imanyiro: Wealth ranking, soil fertility classifications, gender and household survey approaches to understanding social dynamics were applied in the Imanyiro community. Rankings obtained during the diagnostic phase of the PLAR process were compared with data from the diagnostic survey for the same households in the three villages.

Out of the 140 households interviewed during the diagnostic survey only 76 respondents corresponded to the soil fertility classification and only 25 respondents were categorised in the wealth ranks obtained during PLAR. The majority of the respondents (73.7%) were in soil fertility class III, while class II and I each had 13%. The wealth ranks were standardised into four categories (wealthy, average, poor and very poor) for correlation with soil fertility classes. Out of the 25 respondents, 28% were wealthy and average, 20% were poor and 24% were very poor. Wealth ranking was correlated with the soil fertility classes (Table 31). Most households (75%) in class I were wealthy while 25% were average. None of the households in class 1 is poor or very poor. The majority of households (67%) in class II were average and very poor

(33%). For soil class III the majority is the very poor (39%), poor (31%), average (23%) while a few are wealthy (8%). The conclusion is that soil fertility management by farmers is related to the resource endowment as determined by the farmers ranking criteria. Therefore poor farmers are generally poor soil fertility managers, they have little contact with extension agents and hence they have insufficient information on modern improved agricultural technologies. Wealthy and average farmers are good soil fertility managers as they have the resources and they are in contact with extension agents.

Table 31. Linkages between resource endowment and soil fertility classes in Imanyiro

Soil fertility class	Wealth category			
	Wealthy	Average	Poor	Very poor
Class I	75 %	25 %	0 %	0 %
Class II	0 %	67 %	0 %	33 %
Class III	8 %	23 %	31 %	39 %

Most households (88%) were male headed. In half of the households (52%), men were the decision makers; in 21% of the households women were the decision makers and probably these were mainly female headed households; 27% of households reported that men and women share the responsibility of decision-making. For soil fertility classification 1, in most households (70%) decision making was shared between the male and female, while in 20% of households men were the decision makers and only 10% of women were the decision makers. This is not the case for class II farmers, where the majority (44%) of men are the decision-makers, followed by sharing between men and women (33%) and women (22%). For class III farmers, men are the main decision-makers (56%) followed by women (24%) and both men and women (20%).

5.0 AGROFORESTRY

5.1 The role of trees in agriculture in Imanyiro

Farmers in Imanyiro grow both indigenous and exotic tree species. They identified the six most common species on farmland (Table 32) as *Albizia, Ficus mucusu, Sepium ellipticum, Canarium swcheinfurthi, Roystorea regia and F.natalensis. Albizia* is used for timber and building poles. *Ficus mucusu* is mainly used for soil fertility improvement whereas *Canarium swcheinfurthi* is a fruit that generates some income. The farmers also indicated 12 other tree species that they normally plant on their land, for timber, fuelwood, fruits, shade, windbreaks, medicine and soil fertility improvement (Table 33). Most of these trees were planted around the homestead, few on cropland and some on farm boundaries.

Table 32. The most common tree species on farmland in Imanyiro

Local name	Scientific name	Main purpose	Other uses
Musita	*Albizia coriaria*	Timber Building poles Shade	Fire wood Medicinal (mosquito repellent)
Mukunyu	*Ficus mucusu*	Soil fertility Shade Windbreak	Fuel wood Improves microclimate
Omudasa	*Sepium ellipticum*	Fuelwood Windbreak	-
Musafu	*Canarium swcheinfurthi*	Fruits eaten Fruits sold Incense ('lubaani')	Shade, soil fertility, timber Windbreak
Nsansa	*Roystorea regia* (royal palm)	Ornamental Windbreak	-
Omugaire	*Ficus natalensis*	Bark cloth Fodder Shade	Firewood, marking boundaries

Table 33. Tree species planted by farmers in Imanyiro

Local/common name	Scientific name	Purpose/uses	Where planted (Niche)	Source of seeds/seedling
Umbrella tree	*Terminalia spp.*	Shade, ornamental	Homestead	
Musizi	*Maesopsis eminii*	Timber, shade for coffee and cocoa, fuelwood, windbreak	Coffee plantation and homestead	Kyebando during seminar
Calliandra	*Calliandra calothyrsus*	Hedgerow, intercropping/soil improvement	Crop land	CIAT
Jack fruit	*Artocarpus heterophyllus*	Fruits, timber, shade and fuelwood	Homestead (as shade), crop land	Local
Neem tree	*Azadiracha indica* (neem tree)	Medicine, shade	Homestead	Purchased from UNFA
Mango	*Mangifera indica*	Fruits, fuelwood	Homestead	Purchased from the market
Avocado	*Persea americana*	Fruits, soil improvement		
Mapera (Guava)	*Psidium guajava*	Fruits, sale for income	Homestead	
Kabakajangala	*Aleurites mollucana*	Shade, vanish extracted from seed kernels	Homestead	
Cypress (Christmas tree)	*Cupressus lusitanica*	Timber, hedge, windbreak, medicinal (treats measles) anti mosquito	Homestead	German NGO at Imanyiro sub-county headquarters
Pine	*Pinus spp.*	Timber improves microclimate	Homestead and crop land	
Nsambya (lusambya)	*Markhamia lutea*	Poles, fuelwood, boundary planting	Boundary and homestead	

Farmers also identified seven trees that affect soil and crop productivity (Table 34). *Ficus mucusu, F. natalensis and Calliandra calothyrsus* are useful for soil fertility improvement as the leaf litter increases soil organic matter. *Maesopsis eminii* and *Albizia coriaria* provide shade for coffee trees, whereas *Markhamia lutea* is a prolific coloniser and competes for moisture with crops.

Table 34. Effects of trees on soil productivity and crop production

Local / common name	**Scientific name**	**Positive effects**	**Negative effects**
Nsambya (lusambya)	*Markhamia lutea*	-	Moisture competition, prolific coloniser
Mango	*Mangifera indica*	-	Shades crops
Musizi	*Maesopsis eminii*	Shade for coffee, cocoa, improves soil productivity through leaf litter	-
Mukunyu	*Ficus mucusu*	Leaf litter improves soil productivity, open crowned and does not shade crops, deep roots capture moisture for crops, fallen fruits improve soil moisture supply and provide manure. Good for intercropping with bananas.	-
Musita	*Albizia coriaria*	Shade for coffee and cocoa, leaf decompose quickly	No tap roots and blown by wind which damages crops
Omugaire	*Ficus natalensis*	Litter fall is good mulch and improves soil fertility	Crop damage (blown by wind)
Calliandra	*Calliandra calothyrsus*	Leaves are good mulch, improves soil fertility and provides fodder for livestock	Unpruned trees shade crops

Farmers ranked agroforestry problems in Imanyiro (Table 35). Lack of knowledge was the most important problem followed by lack of planting materials/seeds. Poverty, pests and diseases and laziness were also indicated as important problems.

Table 35. Pairwise ranking of agroforestry problems in Imanyiro

Problem	1	2	3	4	5	Score	Rank
Lack of knowledge (1)	-	1	1	1	1	4	1
Laziness / negligence (2)		-	3	4	2	1	3
Lack of planting material (3)			-	3	3	3	2
Pests and diseases (4)				-	5	1	3
Poverty (5)					-	1	3

5.2 Gender and trees

Women farmers mentioned a wider range of uses for trees than did the men (Table 36). Women indicated a wider range of useful tree products. Most products are used for cultural, traditional and medicinal purposes as well as for household goods and handicrafts. Women also use a wide range of tree species for basic family health care.

Table 36. Gender use of trees

Women	Men	Both men and women
• Fuel wood • Making mats • Extracting dyes for mats • Medicine • Skin lotion • Making clothing for cultural / traditional purposes • Pan cleaners • Soap • Rubber/glue	• Timber • Building poles • Charcoal • Boat building • Tool handles • Furniture • Making ropes/fibre	• Improving soil fertility • Fodder • Shade • Support for creeping plants • Ornamental/decoration

Tree species planted by men and women varied depending on their use. Both men and women plant fruit trees and species that improve soil fertility. However, men plant trees for timber and poles whereas women plant medicinal trees (Table 37).

Table 37. Tree species planted by men or women

Tree species	Men	Women
Ficus natalensis	11	8
Persea Americana	5	8
Artocarpus heterophyllus	5	5
Mangifera indica	6	7
Carica papaya	3	3
Maesopsis eminii	8	2
Psidium guajava	3	6
Albizia coriaria	2	1
Markhamia lutea	5	0
Citrus sineusis	4	1
Milicia excelsa	1	0
Cuppressus lusitanica	5	2
Pinus spp.	3	0
Aleurites mollucana	1	0
Azadirachta indica	4	2

In many cases, women and men use the same species for the same purposes. This category includes all the fruit and soil fertility improvement species and some of the timber and pole species. But, as shown above, men tend to plant timber and pole species whereas women plant fruits and medicinal species.

5.3 Wealth categories of farmers who plant trees

Farmers identified factors affecting their attitude towards tree planting in Imanyiro Sub-county as:

- Availability of tree seedlings and tree products.
- Market for tree and tree products.
- Land availability.
- Availability of capital for investment.
- Awareness.
- Investment strategies.

The farmers used these factors and classified themselves into four main categories as follows:

- The very poor - who work for daily bread (today's bread group).
- The poor to whom daily bread is not an issue and can afford to buy soap (able to buy soap group).
- Wealthy - who earn a living off-farm (working class and traders group).
- The very wealthy - who fall under no.3 and have cars.

Table 38. Factors affecting farmers' attitudes towards tree planting in Imanyiro

Factors	Group 1	Group 2	Group 3	Group 4
Availability of tree seedlings and tree products	• Small farmers without enough land to cover all their wood needs; • collect tree seedlings from neighbours' farms.	• Farmers with enough land to cover their wood requirements. • Some collect part of firewood off-farm.	• Enough land and trees on farm to cover all wood requirements. • Parts of their farm still remain uncleared.	• Surplus trees on-farm. • Sell trees to pit sawers and brick and charcoal burners, reducing tree cover.
Market for trees and tree products	• Deficit of trees and tree products on farm, so marketing options not an issue for these farmers.	• Quantity of fruits produced for market is too small, mainly sold locally at low prices. • Pole and timber trees mainly used on the farm.	• Some specialised farmers produce on commercial basis, but at times the low quantity produced does not warrant hiring of motor transport to the market.	• Produce large quantities for the market when involved in tree production.
Land availability	• Land too scarce to plant trees. • plant trees mainly for use on the farm (e.g. fruit trees).	• Land scarce but enough for subsistence. • No fallow plots or fallow for only a short period of time (e.g. 1-2 seasons). • Many farm suffer decreasing soil fertility. • Plant trees for maintaining soil fertility. • Plant fruit trees.	• Enough land to fallow, but rarely plant trees for maintaining soil fertility. • Can afford to use fertilisers.	• Can afford to have plantations and interested in growing trees commercially for the market, e.g. *Eucalyptus* plantations for timber and poles.
Labour availability	• Often lack labour due to high dependency ratio, sickness, and work off-farm or as casuals.	• Enough labour within household except for peak periods. • Lack money to hire additional labour.	• No labour constraints. • Additional labour hired when necessary.	• No labour constraints. • Rely much on hired labour.
Availability of capital for investment	• Chronic lack of capital to meet even basic needs.	• Small savings kept for emergency but not for investment. • No formal credit facilities, the property possessed is not valuable enough. • Small amounts of money lent among friends.	• Possess enough valuable property, therefore have credit access from formal banking and credit institutions.	• All basic needs are met and surplus capital for investments exists. • Get all necessary credit facilities to develop their business.

Table 38. (continued)

Factors	Group 1	Group 2	Group 3	Group 4
Awareness	• Lack information about tree planting. • Not aware of importance of trees. • Have other problems than caring about trees.	• Have heard about campaigns for tree planting over radio, newspapers etc, and have been inspired to plant trees.	• Have heard about campaigns for tree planting. • Are aware of the importance and potential of trees for the farming system, the environment and commercial value.	• Have heard about campaigns for tree planting and have been inspired to plant trees.
Investment strategies	• No investment strategies made, live from day to day. • If investment strategies are mentioned, they are short-term e.g. one crop season.	• Short to mid-term investment plans. • Not willing to invest money and time in trees, but can grow more trees if no extra work required.	• Mid to long-term investment plans. • Some willing to invest time and money in tree growing mostly for commercial purposes. • Would like to invest in fruit trees and willing to buy grafted seedlings.	• Work on long term investment scale. • Willing to invest in trees for commercial purposes.
Summary	• Neither able nor prepared to invest in trees. • Have other things to care about than tree planting. • Tree planting does not solve their most important and immediate problems.	• Plant trees for fruit and soil fertility improvement. • Interested in trying agroforestry and new tree species. • Low risk takers, e.g. farmer must have first seen species or technologies perform elsewhere. • Due to labour constraint, only interested in new technologies that demand little additional labour input.	• Ready to take risks and invest in new technologies. • If tree planting is profitable, they will provide the necessary labour.	• Can be high-risk takers and invest in new technologies if commercial prospects are promising enough. • Can adopt new technologies without problems. • If tree planting is profitable they will provide necessary labour.

6.0 LIVESTOCK PRODUCTION

6.1 Major livestock species and reasons for their importance in Imanyiro

Farmers in Imanyiro sub-county reported that they keep a wide range of livestock on their farms. Priority ranking was done using pairwise ranking (Table 39).

Table 39. Pairwise ranking of the relative importance of livestock Imanyiro

Livestock type	C	G	S	PI	CL	CE	T	D	R	PE	Score	Rank
Cattle (C)	-	G	C	C	C	C	C	C	C	C	8	1
Goats (G)		-	G	G	CL	G	G	G	G	G	8	1
Sheep (S)			-	S	CL	S	T	D	R	PE	2	7
Pigs (P)				-	CL	PI	PI	D	R	PE	2	7
Local chicken (CL)					-	CL	CL	CL	CL	CL	8	1
Exotic chicken (CE)						-	T	D	R	PE	0	10
Turkeys (T)							-	D	R	PE	2	7
Ducks (D)								-	R	PE	4	6
Rabbits (R)									-	R	6	4
Pigeons (PE)										-	5	5

The farmers discussed reasons for keeping the various types of livestock:

- Local chicken: home consumption of eggs and meat, income through sale of eggs and chicken, manure, require low capital input, time keeping because they crow, pleasure, financial security and dowry.

- Goats: generation of income, spiritual (used in rituals), meat, milk for home consumption, medicine for measles, skins, manure and for pleasure.

- Cattle: provision of milk, income, meat, cow dung which is used for manure and smearing on houses and baskets, hides, ghee, and urine used as a pesticide.

- Small livestock: Rabbits for meat, income, fur for treatment of fire burns, and to exchange for bigger animals such as goats. Pigeons for sacrifice, pleasure, meat for home consumption, income, manure and exchange for bigger animals. Food and income were the two reasons for keeping ducks. Pigs for food, income, treatment for diseases, sacrifice and provision of cooking fat. Sheep for meat, milk used to cure certain diseases, sacrifice, manure and skins for making drums, shoes and for sitting on. Turkeys are kept for meat, income and security (to scare off people and animals).

The major reasons for keeping various types of livestock were ranked using preference ranking. The most important reason for keeping livestock is to provide income, followed by milk, then meat and eggs, manure, prestige and lastly hides and skins; however, responses varied (Table 40).

Table 40. Preference ranking of the important reasons for keeping livestock in Imanyiro

Uses	Respondents					Score	Rank
	A	B	C	D	E		
Income	7	7	7	7	7	35	1
Meat	5	5	6	2	3	21	3
Eggs	4	4	3	5	5	21	3
Milk	6	6	4	4	4	24	2
Hides/skins	3	1	1	1	2	8	7
Manure	2	3	5	3	6	19	5
Prestige	1	2	2	6	1	12	6

7 = most important, 1 = least important

Farmers also discussed inputs and outputs livestock production. Main inputs were drugs, capital, knowledge, labour, time, and infrastructure, e.g. stalls and animal houses. Main outputs are food, income, manure and use in cultural practices.

Farmers indicated that the most demanding livestock were pigs due to their vulnerability to bad weather, high feeding expenses, religious attachment, sometimes develops the vice of eating its offspring, and they also transmit jiggers.

6.2 Livestock management systems

Farmers reported that management of livestock varies with number and type of livestock, financial and other resources available, skill of the farmer and available labour. Each management system has advantages and disadvantages. These issues were discussed with farmers for the three livestock types ranked as top priority.

Chickens are mainly managed under one of two systems: housed at night and allowed to scavenge during the day, or left to roam during the night and day (free range). The birds that are not housed at night tend to gather around the house, under or in trees. Disadvantages associated with night housing are the tedious exercise of cleaning the chicken house everyday, easy spread of disease when numbers increase, increase in populations of fleas and susceptibility to predation. Disadvantages of free range were identified as susceptibility to predation, risk of theft at night, birds easily get lost, eggs laid in bushes and not recovered, and keeping track of the number of birds.

There is one major goat management system, whereby animals are tethered during the day and housed or kept on verandahs at night. Disadvantages associated with this system are the labor required for tying and untying the animals, expenses for buying new ropes as they break frequently, and drugs. The system is not viable when goat numbers increase.

Three major cattle management systems were identified as tethering, free range grazing on compounds / unused land, and communal grazing where many owners graze their animals together. Tethering as in goat management was reported to be labor intensive and costly. Under the free range system with cattle grazing on unused land, major disadvantages identified were the possibility of animals destroying neighbours' crops, getting lost and increased vulnerability to diseases. Communal grazing is associated with the disadvantages of animal inadequate feed,

increased vulnerability to diseases, animals destroying crops and all farmers herding in the group beeing accountable, animals walking long distances, trampling on soil, and not gaining weight.

6.3 Constraints to livestock production

General constraints to livestock production in Imanyiro were discussed and the farmers ranked them using preference ranking. These were shortage of land, inadequate knowledge and skills on livestock production, malicious acts (neighbours become jealous and harm the animals), lack of markets, lack of capital and laziness (Table 41).

Table 41. Preference ranking of constraints to livestock production in Imanyiro

Constraint	**Respondents**					**Score**	**Ranking**
	A	**B**	**C**	**D**	**E**		
Limited land	6	5	6	6	6	29	1
Lack of capital	1	3	1	3	5	13	5
Laziness	2	1	4	4	2	13	6
Lack of knowledge and skills	4	4	3	5	4	20	2
Lack of markets	5	2	2	2	3	14	4
Malice	3	6	5	1	1	16	3

6 = most important constraint, 1 = least important

6.4 Livestock diseases and control methods

Principal livestock diseases in the area and periods of occurrence were discussed with farmers (Table 42).

Table 42. Livestock disease epidemics in Imanyiro

Disease	**Animal**	**Year /Period**
Trypanosomiasis (*Kipumpuli*)	Cattle	1969
Listeria	Cattle	1994
Newcastle disease	Ducks and chicken	1994
Nagana	Cattle	1969
Swine fever	Pigs	1997

6.4.1 Poultry diseases

Major poultry diseases in the area are Newcastle disease (NCD), chicken pox, coccidiosis and mange. Farmers identified periods when coccidiosis and NCD were rampant; however they could not do the same for other diseases (Figure 14).

Cattle & goat diseases	Pink eye		Diarrhoea Foot rot Pox			Pink eye			Diarrhoea Foot rot Pox			
Poultry diseases		Coccidiosis NCD					Coccidiosis NCD					
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**

Months of the year

Figure 14: Disease incidence calendar for chicken, goats and cattle

6.4.2 Goat Diseases

Major goat diseases in the area are "Kawaali"(seasonal occurrence as in cattle), diarrhoea, worms, orf and listeria (Figure 14).

6.4.3 Cattle diseases

The major cattle diseases in the area are Kawaali, dietary diarrhoea, pink eye, nagana, foot and mouth disease (Ebisoli) and east coast fever (ECF) (Figure 14).

6.4.4 Disease control strategies

Farmers do the following to control diseases:

- Consult veterinary personnel; this is expensive.
- Slaughter or sell the sick animals.
- Vaccinate.
- Use indigenous knowledge (IK) (Table 43).

Table 43. Indigenous knowledge (IK) used by farmers to treat livestock diseases

Livestock species	Disease	ITK applied
Chicken	NCD	Boil a mixture of mululuza, kampanga (Lantana camara) and eyibombo, then add ash, sieve and give to the birds. Residue is dried and added to feeds.
Cattle and goats	Kawaali	Boil a mixture of endaye, mululuza and eyibombo eyiganda and give to animals (small quantities of marijuana can be added).
Cattle	Worms	Boil ejirigiti and add rock salts then give to the animal.
Cattle	ECF	• Apply nandere (plant) • Burn the lymph nodes • Squeeze enkejje (fish) and give the fluid to the animal

6.5. Livestock feeds

The feeds given to livestock and their sources were also identified (Table 44). Vegetative and non-vegetative feeds were discussed separately.

Table 44. Non-vegetative livestock feeds in Imanyiro

Feed	Livestock	Source(s)
Maize bran	Chicken Goats Cattle	• Milled from on-farm maize • Purchased
Maize	Chicken	• On-farm • Purchased
Millet (ground)	Chicken	• on-farm
Termites	Chicken	• On-farm
Kitchen wastes	Chicken Goats	• On-farm
Water	All livestock	• Springs
Cassava dried and ground	Chicken	• On-farm
Ground Mukene (fish meal)	Chicken	• Purchased
Banana peels	Cattle Goats	• Households • Hotels/restaurants (given free)
Sweet potato vines	Cattle Goats	• On-farm
Cassava peels	Cattle	• Households • Hotels/restaurants (given free)
Banana stems	Cattle	• On-farm
Rock salt	Cattle	• Purchased
Jack fruit	Cattle	• On-farm

The farmers indicted that the cost of feeds had remained relatively steady for the past five years. Half a kg (1 mug) of ground Mukene costs Uganda Shillings (Ug.Shs.) 100 and has remained so for a number of years and 1kg of maize bran costs Ug.Shs.100 if purchased at the milling machine. This last increased in 1997 from Ug.Shs.50 to the current 100. Farmers were unsure of the amounts of the different feeds that they give to the animals and could not even give estimates.

Pastures (forage and/or fodder), mainly for goats and cattle, include ficus leaves from on-farm or neighbours' farms, banana leaves from on-farm, elephant grass from on-farm or purchased from neighbours, maize stover from on-farm, potato vines from on-farm, Makendone eye from their or neighbours' farms, Lablab and Mucuna from on-farm.

The main feeds given to goats and cattle were ranked by farmers using matrix ranking and four criteria (Table 45). Natural pasture ranked highest followed by elephant grass, peels, banana leaves, banana stems and finally maize bran. A livestock feed availability calendar is shown in Figure 15 and corresponds with availability of rainfall.

Table 45. Matrix ranking of major cattle and goat feeds

Feeds	Availability	Stomach fill	Increase in Milk yield	Preference by animals	Score	Rank
Elephant Grass	2	2	3	3	10	2
Maize bran	1	1	1	2	5	6
Peels (banana, potato & cassava)	2	2	2	3	9	3
Banana leaves	2	1	1	3	7	4
Bush pasture	3	3	3	3	12	1
Banana stems	2	2	2	1	7	5

3 = Very high, 2 = Medium, 1 = Low

Farmers also discussed problems encountered in livestock feeding, listed below (not in order of priority):

- lack of capital
- lack of pasture during the dry season and during periods
- lack of knowledge and skills
- lack of exchange visits to other knowledgeable farmers
- shortage of land.

Farmers try to overcome these problems using the following coping strategies: in the dry season when pasture is scarce, goats are taken to graze in wetlands, use of crop residues such as sweet potato vines and peels is increased, while drought-resistant elephant grass also is increasingly used.

Figure 15: Livestock feed availability calendar

Farmers mentioned that milk production depends on the amount and quality of feed given to the animals and therefore decreases in the dry season. Manure and urine production also to follows the same trend.

The farmers discussed uses of animal manure and urine:

- Dung smeared on baskets for a neat finish.
- Urine as a pesticide for ants on bananas (mixed with cow dung and red pepper, then poured on the banana plant).
- Urine against termites (mixed with ash *Vernonia spp* (omululuza), red pepper and then applied into the termite hill). This mixture also a fungicide for tomatoes and coffee.
- Urine as manure.
- Cow dung for house construction (making smooth walls).
- Dung and urine as manure and in some instances dung is used in liquid form to stimulate plant growth (manure is heaped and dried for 2-3 weeks depending on the temperature and applied in strips in gardens).
- Cow dung and urine to improve soil pH (i.e. correct salty "lunyu" condition in soil).
- Dung for construction of grain drying pavements in homesteads.
- Cow dung to chase mosquitoes (dried and burnt).
- Dung is used as medicine for pregnant woman in softening the hipbones.
- Dung is also used as medicine for children to treat external scalp infections.

- Dung is used to repel vermin from food crops (when smeared on maize cobs and banana bunches monkeys will not eat them).

6.6 Consumption of livestock products in the household

The frequency of consumption of livestock products among the farmers was analysed using pairwise ranking (Table 46).

Table 46. Pairwise ranking of the frequency of home consumption of livestock products

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Score**	**Rank**
Chicken meat (1)	-	1	3	1	1	6	7	1	4	4
Goat meat (2)		-	3	2	5	6	7	2	2	6
Cattle meat (3)			-	3	5	6	7	3	4	4
Goat's milk (4)				-	5	6	7	8	0	8
Cow's milk (5)					-	5	7	5	6	2
Egg (6)						-	7	6	6	2
Fish (7)							-	7	7	1
Ghee (8)								-	1	7

The exercise showed that the most frequently consumed products in the households are fish followed by eggs and cow's milk. Farmers gave the following reasons for frequently consuming fish: it is cheap, available, culturally accepted, convenient (it does not attract uninvited visitors as chicken do, and so some farmers sell hens and buy fish instead), soft flesh and cooks fast and easy to chew by the young, sick and elderly, and works as medicine.

Sources of this fish were lakes, markets, hawkers and privately owned fish ponds. However, fish ponds in the area are few (attributed to lack of knowledge and skills), lack of capital and security, and the perceptions of farmers that fish from ponds is tasteless.

6.7 Livestock ownership

The three major types of livestock: chicken, goats and cattle - were owned by men, women and children.

6.8 Trends in livestock numbers

Changes that have occurred over the years in numbers of livestock were discussed (Table 47).

Table 47. Trends in livestock numbers and reasons for these trends

Livestock	Trend	Reasons
Chicken	Decreasing	• Increased disease incidence • Women culturally did not eat chicken but now have increased consumption
Goats	Decreasing	• Increased land shortage due to gazetting of forest areas
Cattle	Increasing	• New technical know how and skills • Decreased diseases/organisms, e.g. tsetse flies • Absence of taxes on cattle • Decrease in cattle thieves • Both men and women now own cattle (in the past mainly owned by men) • Increased attractiveness in owning cattle, it has become an investment as well as a status symbol

6.9 Major constraints encountered in the livestock enterprises

Considering particularly the three major livestock enterprises (chicken, goats and cattle), farmers listed and ranked constraints using pairwise ranking. Constraints in order of importance emerged as: shortage of land, limited knowledge and skills, diseases, lack of markets and capital, labour shortage and laziness, and malice (Table 48).

Table 48. Pairwise ranking of major livestock production constraints in Imanyiro sub-county

	L	KS	M	MKT	CAP	LA	DI	LS	Score	Rank
Land shortage (L)	-	L	L	L	L	L	L	L	7	1
Knowledge, skills (KS)		-	KS	KS	KS	KS	KS	KS	6	2
Malice (M)			-	MKT	CAP	LA	DI	LS	0	8
Market (MKT)				-	MKT	LA	DI	MKT	3	4
Capital (CAP)					-	CAP	DI	CAP	3	4
Laziness (LA)						-	DI	LS	2	6
Diseases (DI)							-	DI	5	3
Labor shortage (LS)								-	2	6

Possible solutions to these problems were also discussed with the farmers and their suggestions were as follows:

1. Land shortage: strategies to increase land productivity per unit area, and hiring land from neighbours.

2. Lack of knowledge and skills: training by technicians, farmer exchange visits, farming groups, and on-farm research.

3. Diseases: vaccinations, training of farmers to carry out simple treatments, appropriate feeding of animals, increased awareness of disease symptoms, and construction of proper housing for livestock.

4. Markets: decreased distances to markets, increase in prices for livestock products, and formation of farmer associations to handle marketing.

5. Lack of capital: formation of farmer group credit schemes, knowledge to plan strategies to solve and accumulate money in groups or as individuals.

6. Labor shortage: making friends who can assist at critical times, formation of farmer groups, hiring labor, and proper administration in the household and of laborers

6.10 Marketing

Farmers identified the products they sell and the ones consumed in households as:

Sold	Consumed by household
Animals	Meat
Meat	Milk
Hides and skin	Blood
Milk	Skin
Ghee	Ghee
Eggs	Eggs

It was observed that much of the nutritious products were sold with very little or none left for home consumption. This was due to lack of knowledge on importance of a balanced diet, cultural and religious influence, shortage of cash and selfishness of the beneficiaries. Market sites were livestock dealers, neighbours and weekly markets. The major problems that were associated with marketing are low prices, limited market avenues, high taxes and market dues and lack of transport.

7.0 RESEARCH AND DEVELOPMENT STRATEGIES

Based on the analysis of the information provided by the farmers, potential research, development and policy strategies were suggested by farmers themselves (see sections 7.1 and 7.2). Harmonizing these suggestions with those from researchers in a mutually agreed plan of action constituted the next step and is described in a forthcoming publication on the planning and experimentation phase of this project.

7.1 Development and policy strategies

7.1.1 Provision of inputs and access to credit

Farmers complained of lack of and the high price of inputs mainly seeds, fertilisers and agricultural chemicals. Provision of inputs is therefore an important issue that needs to be addressed to facilitate improved agricultural production in Imanyiro; activities are needed to foster increased competition among suppliers and farmer capacity for decentralised seed production.

Lack of credit is also a problem in Imanyiro and lack of cash is a limiting factor to increased agricultural production. Credit is an important factor in agriculture and some agricultural technologies and recommendations require significant cash investment for farmers. Farmers asked to be facilitated with an efficient yet economic credit program; NGOs need to be approached and possibilities investigated for developing or strengthening community saving schemes.

7.1.2 Post-harvest utilization and marketing

Marketing of agricultural produce was identified as a major constraint to increased agricultural production in Imanyiro. Farmers complained of lack of markets as well as the low prices offered for farm produce. They proposed that the government should provide the necessary infrastructure and good marketing strategies, although market-led initiatives are more likely to succeed and capacity of local entrepreneurs might need developing.

In addition, food stores and post-harvest handling of farm produce are important constraints. Farmers reported that they need storage facilities for maintaining the value and quality of farm produce.

Controlling pests and diseases in stored agricultural products also is important to Imanyiro; a farmer field school would appear to be warranted.

7.1.3 Training and information dissemination

Lack of knowledge in modern agriculture was identified as a major constraint. Farmers need training in technical skills and demonstrations. Ikulwe District Farmers Institute (DFI) will serve as the main training centre. Apart from agriculture, the farmers reported that they need training in human health and nutrition.

Farmers reported that they lack information on markets and appropriate agricultural technologies. Important sources of information include field days, demonstrations, farmer exchange visits, radio, television, newspapers, newsletters, pamphlets. These and other forms of mass media need strengthening.

7.1.4 Extension services

Agricultural extension agents should put more effort in training and disseminating technologies to farmers in the area. There is need to improve the flow of knowledge and information dissemination among the various stakeholders (farmers, extension, research, NGOs and policy makers). Research – extension – farmer linkage can be strengthened through field days, shows,

on-farm trials and demonstrations, farmer exchange visits, etc. Organization of the public sector extension system is about to be substantially modernized; NGOs and farmers themselves also have important roles here.

7.2 Research strategies

7.2.1 Socio-economics

Socio-economic research is needed to determine strategies that provide incentives for farmers to improve land productivity. These include research in marketing, credit, input, gender, role of farmer groups, labour utilisation to improve efficiency and on-farm research.

7.2.2 Crop production

Research should be conducted on the major crops in the area. Introduction of high value crops (e.g. passion fruit, ginger) was cited as important in improving agricultural productivity. Research in controlling difficult pests, e.g. termites and diseases, should also be conducted in the area.

7.2.3 Soil and water conservation

Farmers identified various causes of soil fertility decline and suggested possible solutions, some of which may require research. The main causes of soil fertility decline were continous cropping, poor soil fertility management, soil erosion, unplanned intercropping practises, poor management of crop residues and organic materials, poor tillage methods, lack of fallows, nutrient mining through crop harvests, burning of bushes and lack of soil erosion control materials.

Possible solutions identified by farmers to these constraints include use of green manure, fertilizers, agroforestry practices, fallows, compost, mulching, crop rotations, intercropping, soil conservation (terracing and grass strips), and improved tillage techniques.

Soil fertility has declined in east and central Uganda due to intensive land use that includes continous cultivation, nutrient extraction through crop harvest, and inadequate nutrient replacement. Nutrient balances were reported to be negative for all crops, except for N and P in the banana-based system which benefit from added organic manures and mulches (Wortmann and Kaizzi, 1998). The main means of managing soil fertility in Imanyiro is through recycling of nutrients in green manure, agroforestry, fallowing and soil conservation, with occasional application of small amounts of inorganic fertilizers. These inputs are generally insufficient to maintain land productivity and crop yields. Furthermore, 4% of the farmers use all these practises, 10% use one to three of these measures and 86% do not carry out any improved soil fertility management practices.

Numerous legume cover crops and green manures have been evaluated in Uganda. A few species have been recommended as “best-bet” options (Wortmann *et al*., 1998). However, there is need to identify niches for these green manures in space and time and to demonstrate immediate benefit such as substantial increase of food crops, fodder and wood products and cash to the farmers. These benefits must be conveyed to extension groups and farmers to promote adoption and widespread dissemination.

The possibility of supplying adequate quantities of nutrients by adding only organic materials is decreasing as population densities increase and the supply of organic material decline. The use of chemical fertilizers in combination with organic materials (integrated nutrient management) is recommended for farmers who cannot afford to rely on mineral fertilizers alone. This approach combines the short-term benefits of inorganic fertilisers with the long-term value of organic fertilisers. Therefore, applying fertilisers should be a complementary practice to improving soil organic matter and soil water availability.

Managed tree fallows substantially improve soil conditions and raise crop yields. They show much promise as a sustainable system, provided that the short-term loss of crop production during the fallow period is acceptable to farmers and is more than compensated by the subsequent increase in yields (Young, 1997). Research is needed to investigate fallow species that are suitable for the different soil and farmer socio-economic conditions in Imanyiro. As the main constraint to fallowing is that sufficient land must be available, systems of improved fallows like relay intercropping may offer opportunities on smaller farms.

Composting is a useful technique for farmers who do not have livestock but have access to large amounts of biomass. It is best suited to home gardens using agricultural and domestic waste, residues and ashes. The principal constraint is the amount of labour required to produce good compost. Farmers in Imanyiro need training in methods of preparing good compost with subsequent monitoring of their acceptability.

Mulches can play an important role in maintanance of soil organic matter, erosion control, increasing water infiltration, enhancing soil water availability, suppressing weeds and promoting soil biological activity. The main constraints to mulching are the limited quantities of mulching materials, and the cost and availability of labour for collecting, transporting and applying the mulch. Thus evaluation of mulches should be focussed on high value crops close to sources of suitable mulching material.

Crop rotations in well defined sequences need to be investigated in Imanyiro. Proper crop rotations will result in improved soil fertility, efficient utilization of soil moisture, control of weeds and reduce pest and disease problems.

Intercropping systems generally benefit from increased total productivity per unit area especially when legumes are associated with grain crops. There are also lower risks of crop failure due to pests and diseases. Intercropping of grain and forage legumes with grain crops needs to be investigated in Imanyiro.

Soil and water conservation structures and biological soil conservation measures need to be introduced in Imanyiro. The aim should be to introduce simple, cheap and effective conservation measures that can be carried out by farmers (Thomas, 1997). The primary objective is to achieve good land management that involves controlling soil and water losses and maintaining soil fertility and structure at a reasonable cost. The emphasis should be increased and sustained agricultural production with minimum soil loss and damage to the environment. This goal can be achieved by such principles as:

- Conserving and protecting land from degradation.
- Maintaining and improving soil fertility and productivity through good land husbandry including the use of organic manures, fertilisers and appropriate tillage systems.

- Improving the cover of perennial crops, grasses and plant residues to reduce damage from rainfall and runoff.
- Incorporating trees in the farming systems to increase production and conserve the soil.
- Increasing awareness of the importance of soil and water conservation.
- Investigate appropriate tillage practices for long-term maintanance of soil fertility.

Tillage is any physical manipulation of the soil aimed at improving soil conditions affecting crop production. Good tillage is the foundation of successful crop production and contributes to long-term maintanance of soil fertility. Therefore, there is need to investigate and recommend appropriate tillage practices in Imanyiro.

7.2.4 Agroforestry

Appropriate and well managed agroforestry systems have the potential to control runoff and erosion, maintain soil organic matter and physicl properties and promote nutrient cycling and efficient nutrient use (Young, 1997). On the other hand, returns tend to be slow in coming. There is need to assess acceptability of agroforestry practises in the local physical environment and for a range of socio-economic conditions in Imanyiro.

7.2.5 Livestock production

Problems identified during assessment of the constraints and opportunities for improving livestock productivity were inadequate feed resources, reduced fallow periods, poor animal health, labour shortages, lack of inputs and market opportunities. Mixed crop-livestock farming systems generally provide an opportunity for sustainable increases in agriculture productivity. Mixed farming systems in Imanyiro can be improved by developing high yielding forages and legumes, improving the quality of crop residues as livestock feeds, increasing animal resistance to diseases and parasites, improving the productivity of indigenous livestock, establishing effective input and support services (e.g. veterinary services), establishing infrastructure (roads, processing and marketing facilities), strengthening government institutions, and developing supportive fiscal, incentive and trade policies for smallholder farming (Powell and Williams, 1995).

There is need to increase feed productivity and quality, and diet supplementation techniques, to overcome seasonal nutritional constraints. Farmers need to be encouraged to change from livestock management based on grazing to intensive stall feeding which requires improved feed harvesting and storage.

The integration of grain and forage legumes and browse trees can serve an important role in sustaining the productivity of crops and livestock. Forage legumes can improve animal feed, suppress weed growth, accelerate nutrient cycling and improve soil moisture conservation. Legume trees control soil erosion, enhance soil productivity, and provide food, fodder and wood.

Provision of veterinary services and research on indigenous technical knowledge (ITK) for animal health is required to improve livestock health and productivity.

More intensive integrated crop and livestock farming systems are labour demanding. There is need to identify availability of farm household labour and competing activities, and determine efficient ways of utilising labour.

Lack of capital, inputs and market opportunities are important areas that should form part of socio-economic considerations in improving livestock productivity.

7.3 Next steps

The diagnostic phase consisted of analysis of landuse systems, crop and livestock production, socioeconomic conditions, farmers' information and communication networks, and different soil fertility strategies. Farmers classified households in distinct classes with similar soil fertility management strategies. This formed a basis for selecting "test" farmers who will become the core group of farmers for the PLAR process. The "test farmers" analysed their soil fertility management practices using resource flow maps (RFMs) of their farms. The diagnostic phase will be followed by a planning, experimentation and evaluation phase. During the planning phase, farmers will identify "best-bet" integrated nutrient management options for the different categories of farmers. Subsequently, farmers will plan and make arrangements for implementation of experiments for the next year. The planning, experimentation and evaluation phase reports will contain details of the proposed experiments and the results of the first year of the PLAR process.

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9.0 APPENDIX

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