

**Evaluating Farmers Investment Decisions
in Soil Fertility Management in
Market Oriented Agriculture in Masindi District**

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Master's Dissertation

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Throughout the work I have acknowledged all sources used in its compilation.

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LIST OF ACRONYMS AND ABBREVIATIONS

AGOA	African Growth Opportunities Act
APEP	Agricultural Productivity Enhancement Programme
ASPS	Agriculture Sector Programme Support (DANIDA)
CMB	Coffee Marketing Board
ERI	Enabling Rural Innovation
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
IDEA	Investment in Developing Export Agriculture
LMB	Lint Marketing Board
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MFPEd	Ministry of Finance Planning and Economic Development
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organisation
NEMA	National Environment Management Authority
NEPAD	New Partnership for African Development
NPK	Nitrogen, Phosphorus, Potassium fertilizers
NRM	National Resistance Movement
NUCAFE	National Union of Coffee Agribusinesses and Farm Enterprises
PEAP	Poverty Eradication Action Plan
PMA	Plan for Modernisation of Agriculture
UBOS	Uganda National Bureau of Statistics

ABSTRACT

This study summarizes the results from a study conducted in Masindi district, Uganda to evaluate soil fertility management practices in market oriented agricultural production. A series of policy and institutional reforms designed to modernize and increase productivity of the economy in general, and more specifically the agricultural sector are being implemented in Uganda. The mission of the Plan for Modernisation of Agriculture (PMA) is poverty eradication through the transformation of the agricultural sector, especially by shifting poor farmers from subsistence to commercial production in order to improve household incomes. The strategy is to encourage households to specialize in what they can produce economically in order to increase the share of what they produce for sale. Expansion of agricultural production into previously forested or fallow land in an effort to commercialize agriculture and help mitigate poverty is growing rapidly. It is envisaged that market oriented agricultural production provides incentives for reinvestment in soil fertility management to sustain increased productivity and available market options. However, there is need to understand whether more market orientation empowers farmers to invest their additional income in soil fertility improvement to sustain production in the long run or priority is given to other livelihood needs like school fees, health care, nutrition, business investments, housing and savings. It is also important to understand what factors influence farmers decisions to re- invest in soil fertility improvements. There are variations across areas, crops, gender, wealth categories, age, level of education and occupation. The study also explored how adoption and use of improved soil fertility management technologies by Ugandan farmers can be enhanced to sustain increased agricultural productivity. Understanding the complex relationship between increased agricultural production and sustainable resource use for economic gains in market oriented agriculture are key issues central to identifying effective strategies that will sustainably transform the livelihoods of rural Ugandans thereby reducing poverty levels.

Table of contents

Chapter 1: Introduction	
Background to the study	1
Statement of the Problem	3
Objectives of the study	5
General Objective	5
Specific objectives	5
Research questions	5
Significance of the study	6
Justification of the study	7
Scope of study	7
Chapter 2: Literature Review	9
Overview of the Agricultural Sector and Commercialization in Uganda	9
Linking farmers to Markets in Uganda	10
Agricultural Production and Soil Nutrient Mining in Africa	12
Land degradation and productivity in Uganda	16
Soil fertility management practices and productivity in Uganda	18
Soil degradation in Masindi district.....	20
Conceptual Framework	21
Chapter 3: Methodology	23
The study area	23
Sample selection	24
Data collection, sources and tools	25
Quality control and ethical considerations	25
Data analysis and presentation	26
Chapter 4 – Data Presentation and Analysis	27
Household characteristics	27
Level of education	27
Age of household head	28
Land tenure and accessibility	29

Changes in Land use	30
Primary occupation	30
Expenditure patterns	31
Access to credit	32
Crop production and marketing	32
Change in crop yields	33
Crop variety, acreage, cropping system	33
Crop management practices	34
Soil fertility management practices	35
Source of soil fertility management information	36
Factors influencing use of soil fertility management practices	37
Appropriate soil fertility management practices	37
Suggestions for soil fertility management	38
Farm investment characteristics	38
Re-investment of revenue/profits	39
Crop marketing	39
Chapter 5: Implications and Significance of Study	40
Factors influencing market oriented farmers' behaviour	40
Level of education	40
Family labour availability	41
Land tenure and accessibility	41
Land size	41
Sources of income	42
Access to credit	42
Soil fertility management practices	42
Strategies for strengthening farmers' capacity	43
Implications of findings and theory, policy, practice	43
Chapter 6: Conclusion and Recommendations	45
Conclusions	45
Overall recommendations	45
Suggestions for further research	46

Bibliography	48
Appendices	50
Household questionnaire	50
Questionnaire for service providers	61

List of tables and graphs

Graph 1: Level of education	29
Graph 2: Household expenditure patterns	32
Table 1: Duration of stay in community	29
Table 2: Land tenure and accessibility	29
Table 3: Land holding	30
Table 4: On farm activities	31
Table 5: Years in crop production	34
Table 6: Fertilizer usage	37
Table 7: Appropriate soil fertility management practice	39

CHAPTER ONE

INTRODUCTION

Background to the study

A series of policy and institutional reforms designed to modernize and increase productivity of the economy in general, more specifically the agriculture sector are being implemented in Uganda. The reforms include a movement towards reliance on a market oriented economy with more private enterprise investment and participation and a reduced role for direct government intervention. The Plan for Modernisation of Agriculture (PMA) in Uganda places emphasis on commercializing agriculture for poverty eradication. This is supported by special programmes like the African Growth Opportunity Act (AGOA) and the New Partnership for African Development (NEPAD) which recognises the fact that agriculture led development is fundamental to cutting hunger, reducing poverty, generating economic growth, reducing burden of food imports and opening the way to expansion of exports. NEPAD offers new opportunities for smallholder producers in developing countries to alleviate poverty by increasing their income opportunities. However, the orientation towards market oriented agricultural production is limited by both biophysical and socio-economic constraints. It is necessary to explore how market oriented agriculture for poverty eradication develops forward and backward linkages (between natural resources management, production and markets). This calls for ecological sustainability of agriculture and finding ways to increase productivity per unit area in a manner that does not compromise the natural resource base.

Soil fertility management is the basis for sustainability in every agricultural farming system. Each farming system has its own unique way of land use and soil fertility management which depends on a combination of factors that include the condition of the natural resource base; land availability; labour and capital resources with respect to their relative price; history of local farming; decision making patterns; farmers knowledge and skills, their motivation, degree of market orientation; relative prices of inputs and agricultural policy. Soil management systems indicate that future agricultural productivity is seriously threatened by soil nutrient depletion (mining without replenishment), (Stoorvogel and Smaling, 1990). There is therefore need for a socio- economic environment conducive for farmers to undertake short and long term investment in soil fertility and soil nutrient management.

Management practices that influence soil fertility include fallowing, application of organic/synthetic fertilizer, green manuring, mulching, burning, soil tillage, soil and water conservation, crop rotation, use of cover crops, animal and tree integration.

A farming systems and livelihood analysis survey conducted by the National Agricultural Research Organisation (NARO) in the lake Albert Crescent Agro ecological Zone (covers Hoima, Masindi and Kibaale districts) revealed that soil fertility in the zone is highly fragile and consequently bound to lose fertility when subjected to continuous cultivation without replenishment, (*NARO Publication 2004*). Declining soil fertility was reported a major constraint in crop production resulting in poor crop yields. The black soils are the most fertile. However, soil fertility for all soil types (black soils, sandy loams) declines within three years of cropping and land is expected to be left under fallow for the same number of years to regain its fertility. However, the cropping phase is usually longer than the fallow period due to increasing population pressure on the land hence the soils do not regain their fertility.

The government of Uganda is increasingly supporting the private sector to carry out business in the agricultural sector. Market liberalization and privatization (trade liberalization and divestiture of public enterprises) has opened up the economy to private investors which in turn has improved the production and marketing efficiency in many sectors of the economy. The manufacturing industries are based on agriculture hence they create forward linkages to the agricultural sector (Uganda Investment Authority, 2000). Various initiatives have been put in place at grass roots like farmers groups/private sector partnerships under the NAADS programme to undertake marketing of various commodities. Rural farmers have a range of market linkages available to them – they sell directly to consumers (informally like home sales to friends or in formal markets), they can also sell to rural market traders who in turn sell to wholesalers in larger towns. Farmers also sell to agro processors directly or through middlemen. Farmers produce enters the local, national and sometimes international market.

Soil fertility investment encompasses all those strategies aimed at increasing productivity, conservation and sustainability of the soil as a natural resource base. Such strategies include adoption of new technologies like use of chemical fertilizers, use of nitrogen fixing legume cover crops, improved fallow. They also include the abandonment of traditional practices like slash and burn.

Statement of the Problem

The government of Uganda has embarked on several programmes to transform agriculture. These include the macro economic reforms of the mid 1980's, export diversification of the 1990's, the Poverty Eradication Action Plan (PEAP) and Plan for Modernisation of Agriculture (PMA) of 2000. The PMA has become the blue print to guide the government of

Uganda's efforts towards agricultural development and transformation from subsistence to commercial agriculture. Efforts have been made by both government and non governmental organisations to link farmers to markets. Farmers have responded positively by intensifying agricultural production to supply the expanding identified markets both internally and externally. However, the move towards market oriented production is not clear on the likely consequences and hidden effects of increased commercial production on the natural resource base. It has been observed that areas with high market access are associated with higher agricultural intensification but followed by declining yields of several crops implying declining soil fertility (Nkonya et al, 2002). Although improved market access may increase efficiency of agricultural marketing, low profitability of outputs may limit farmers' ability to apply adequate inputs to stop the nutrient depletion. It is against this background that this study was conducted to investigate whether market oriented production is profitable enough to encourage farmers to invest in proper land management to replenish soil fertility. Besides this, the study went ahead to establish what factors motivate market oriented farmers to invest in soil fertility management and what are the key economic factors that affect land management decisions in the context of soil fertility management? The findings of the study can therefore be used to explore the problem in detail so as to identify land management options that address increased production in market oriented agriculture vis a vis soil fertility replenishment in Masindi district.

Objectives of the study

General Objective

The general objective of conducting the study was to investigate the extent to which market oriented production stimulates and promotes investment in improved soil fertility management practices for sustainable production in Masindi district.

Specific objectives

1. To assess quantitative and qualitative factors that influence market oriented farmers behaviour and decisions to invest in soil fertility management practices in Masindi district.
2. To identify the most important factors that affect use and adoption of soil fertility management practices/ new technologies in market oriented production in Masindi district,
3. To identify improved soil fertility management practices/technologies that respond to market oriented production in Masindi district,
4. To identify strategies for strengthening farmers' capacity to adopt improved soil fertility management options for sustainable market oriented agricultural production in Masindi district.

Research questions

While many land use and soil fertility management technologies have been developed and promoted by researchers over the years, the natural resource base continues to be degraded as exhibited by declining productivity levels. There remains a gap to understand the factors that

influence decision making, choices and options available to men and women in land use management in market oriented production. The research specifically attempted to answer the following questions:

1. Do farmers adopt new practices/ improved approaches to ensure sustainability of high production in market oriented production?
2. What is the investment behaviour of market oriented farmers in Masindi district?
3. What soil fertility management practices/technologies respond to market oriented production?
4. What can be done to strengthen farmers' capacity to take advantage of market opportunities to manage their land in a more sustainable manner, minimizing nutrient depletion?

Significance of the study

Inappropriate land use and poor soil fertility management practices increase loss of productivity which in turn affects farmers' food security and income levels. If yields above subsistence production levels are expected to meet demands of identified market opportunities, there is need to intensify soil fertility management on the arable lands to spare the natural resource base from degradation and exhaustion. Understanding the relationship between market oriented agriculture and soil fertility management will highlight critical points necessary to identify technology options that respond to market oriented production while at the same time maintain high soil fertility levels for sustainable production.

Justification of the study

Increasing production for the market is associated with negative consequences like severe ecological degradation and economic marginalization, (Nkonya et al, 2002). Gradual soil fertility decline is a menace to rural communities in terms of income and food security. If farmers continue to produce for the market and export /lose nutrients in quantities higher than they can afford at a higher production level than the natural options can accommodate, they have to compensate for nutrient loss either through harvesting nutrients, recycling, mineralization, biological nitrogen fixation or phosphate mobilization. If they do not do so, nutrient depletion; soil degradation and yield decline will be unavoidable. There remains a gap between re-orientation towards market oriented agricultural production whilst keeping ecological degradation within bounds. The research findings will help identify soil fertility management options that address nutrient depletion and environmental degradation at large in market oriented production. Findings from this study will help researchers design technology packages that can assist farmers adopt improved nutrient management practices in market oriented production. Information collected from study can help policy makers and development practitioners design and incorporate soil fertility management packages that encourage farmers adopt improved nutrient management practices in market orientation production as one way to achieve the necessary productivity increase now and in the future. The study also explored the potential and capacity of local institutions to spearhead soil fertility management initiatives.

Scope of Study

The study was conducted in Masindi district in mid western Uganda. It focused on farmers involved in market oriented production and examined their soil fertility management

practices in the last five years (2001-2006). The study was based on five selected crops namely sunflower, maize, sorghum, sugar cane and tobacco that farmers produce given identified market opportunities/market outlets within the district. The study investigated the market led hypothesis that better access to market opportunities provides incentives for adoption and re-investment in soil fertility management. The market led hypothesis is a key research strategy in many national and international research organizations but there remains unanswered questions that need to be investigated further to test this hypothesis. Market oriented production given better access to market opportunities should ideally provide incentives for adoption and re investment in soil fertility management practices/technologies.

CHAPTER TWO

LITERATURE REVIEW

Overview of the Agricultural Sector and Commercialization in Uganda

Approximately 83% of labour is employed in the agricultural sector which accounts for 13% of Uganda's GDP and 85% of export earnings. The sector provides most of the raw materials to the mainly agro-based industrial sector comprising coffee hulling, cotton ginning, tea processing, sugar production, textile mills, soap industries, edible oil industries, cigarette manufacturing, grain milling, meat processing, dairy and leather products manufacturing (MFPED, 2003). The rural economy supports 85% of Ugandans who are largely dependent on agriculture. Ninety six percent (96%) of the poor are rural and vulnerable to food insecurity while two thirds (2/3rds) of rural households produce food mainly for their own consumption (2020 Vision network for East Africa; Country Note for Uganda 1998). Uganda's farming system is based on small holders with relatively small farm sizes averaging 3.0 ha but ranging from 1 ha to 5 ha. This obviously has a bearing on agricultural production and marketing. In many, subsistence production still dominates. Production aspects form an important part of marketing. There has to be a minimum quantity and quality of supply to attract buyers.

The government of Uganda has embarked on a Plan for Modernisation of Agriculture (PMA) in order to grow the predominantly rural economy out of poverty and to improve the welfare of the majority of the population. Under this programme, the focus is on increased and sustainable food production by improving agricultural techniques and practices, optimal use of land and water resources, increasing production of high value commodities and products and gradually moving towards commercial agriculture in collaboration with the private sector.

The macro economic reforms which began in the early 1980's and intensified under the National Resistance Movement (NRM) administration resulted in the removal of the marketing monopoly of the statutory marketing parastatals like the Coffee Marketing Board(CMB), Lint Marketing Board (LMB) and Produce Marketing Board(PMB). The markets for agricultural produce including export crops were liberalized by removing the monopoly of these marketing boards and freeing producer prices from government control. Export tax and other market distortions were also removed to provide incentives to producers and other market participants. The government has formed public organizations aimed at providing public marketing and production services. These organizations provide market and production information in order to help farmers and traders make cautious decisions. Consequently, the necessary conducive and enabling environment has been created for active private sector participation in agricultural production, processing and marketing.

Linking farmers to Markets in Uganda

The government of Uganda is increasingly supporting the private sector to carry out business in the agricultural sector. Various initiatives have been put in place at grassroots like farmers groups/private sector partnerships under the NAADS programme in the marketing of sorghum, rice, maize and sunflower,(Improving Rural Lives, a quarterly PMA Bulletin). The PMA is addressing rural farmers' needs to access profitable markets to enable them move beyond subsistence to commercial farming thereby improve their quality of life. A number of market linkages are available to rural farmers; they sell directly to consumers (informally e.g. home sales to friends or in formal markets), they can also sell to rural market traders who in turn sell to wholesalers in larger towns, farmers also sell to agro-processors directly or through

middlemen. Some farmers are involved in contracted farming by buyers. Farmers produce enters the local, national and sometimes international markets.

Successful farmers' groups- private sector partnerships are being implemented under the NAADS programme in the marketing of *Epuripur* sorghum, rice, maize and sunflower. The Agricultural Sector Programme Support (ASPS) under its farmers' organizations component is supporting District Farmers Associations while the Uganda Cooperative Alliance is promoting cooperatives. According to the ministry of Tourism, Trade and Industry, 52% (or 2280) of all registered and functional cooperatives are engaged solely in agricultural marketing. Districts are also promoting marketing associations. Under the Agricultural Productivity Enhancement Project(APEP), some 700 farmers groups with 15 -30 members have been organized and trained in marketing coffee, cotton, sunflower and other crops. APEP is a USAID funded activity that aims to expand rural economic opportunities and increase household income in the agricultural sector by increasing food and cash crop productivity and marketing. The programme builds on sector successes with added emphasis on creating economies of scale that catalyze transformation of agriculture from low input/output subsistence farming to commercially competitive agriculture. The National Union of Coffee Agribusiness and Farm Enterprises (NUCAFE) has organized 102 coffee farmers associations in all coffee growing districts and over 100,000 farming families with over 300,000 industrial coffee farmers have been mobilized to enhance their capacity in adding value, improving quality and marketing coffee. The investment in Developing Export Agriculture (IDEA) projects promotes increase in the production and sale of high and low value crops while the Agricultural Productivity Enhancement Project (APEP) is expanding rural economic opportunities in the agricultural sector by increasing food and cash crop productivity and marketing. The project involves

lower production in partnership with the largest processor Mukwano. About 20,000 small producers are participating with yields going up significantly and farm gate revenue increasing. Farmers adapt where benefits are visible and meaningful. In some cases, productive partnerships are organized between small farmers and the private commercial sector supported by stakeholders (public entities and NGO's).

Agricultural Production and Soil Nutrient Mining in Africa

About two thirds of Africans depend on Agriculture for their livelihoods. The fate of agricultural production therefore directly affects economic growth, social improvement and trade in Africa. As the regions population continues to grow rapidly, outpacing the growth rate in other parts of the world, its agricultural land is becoming increasingly degraded (Julio et al, Oct 2000). Farmers are intensifying land use to meet food needs without proper management practices and external inputs. The resulting depletion of nutrients from soils has caused crop production to stagnate or decline in many African countries. In some cases, notably in the East African highlands, the rate of depletion is so high that even drastic measures such as doubling application of fertilizer or manure or halving erosion losses, would not be enough to offset nutrient deficits. Unless African governments supported by the international community, take the lead in confronting the problems of nutrient depletion, deteriorating agricultural productivity will seriously undermine the foundations of sustainable economic growth in Africa.

This has policy implications in the sense that if nutrient depletion and land degradation continue at current rates, one has to wonder how farmers in African countries will be able to produce enough food for ever larger populations in the next century. To avoid possible crises, national governments and donors should address the threat of nutrient depletion and land

radation through policies and programs that promote increased productivity of land resources conservation of the resource base. Significant policy changes will be required to establish an environment that makes agricultural inputs easily available, that encourages farmers to use these inputs easily available, that encourages farmers to use these inputs more efficiently and that improves local extension services and farmer support. Structural adjustments, market development, trade and price policies, credit systems, infrastructure improvement, and institutional support services should be re-evaluated and assessed for their impact on the resource base and the sustainable expansion of agricultural production and productivity.

Many countries and regions need to integrate natural resource management with economic and sector policies. More economic and environmental impact analyses at the country level are needed to help set priorities for agricultural land issues, to assess the costs and benefits of policy decisions, and to expedite identification of the type of investments that will be required to prevent land degradation and increase production, prevention of nutrient mining through sound economic policies, research, information dissemination and human resource development should be actively promoted in Africa.

The economic development of Africa, more than any other region, depends on development of the agricultural and agro industry sectors which are fundamentally affected by productivity of land resources. Agriculture accounts for more than 25% of the GDP of most African countries, and is the main source of income and employment for at least 65% of Africa's population of 750 million (International Centre for Soil Fertility and Agricultural Centre, 1999). Therefore, agricultural development is vital to Africa's economic growth, food security and poverty reduction. Crop production can be increased through two ways; through higher production per unit of land, or by increasing the area cultivated. Expansion of cultivated land is the most

commonly used system in Africa. Traditionally, farmers have cleared land, grown a few crops then moved on to clear more land, leaving the land to fallow to regain fertility. However, population pressure now forces farmers to grow crop after crop, 'mining' or depleting the soil of nutrients while giving nothing back. With little access to fertilizers, the farmers are forced to bring less fertile soils on marginal land into production, at the expense of Africa's wildlife and forests. The declining fertility of soils due to soil nutrient mining is a major cause of decreased crop yields and per capita food production in Africa and in the mid to long term, a key source of land degradation and environmental damage. Crop uptake is an important loss of nutrients, which are exported from farmers' fields for human and animal consumption. Soil nutrient mining, the result of over exploitation of agricultural land is in fact consumption of a key component of the soil's natural capital. Continued nutrient mining of soils would mean a future of even increased poverty, food insecurity, environmental damage, social and political instability. African countries today face not only the challenge of increasing agricultural production with scarce overall resources but must raise productivity in a way that conserves the natural resource base and prevents further degradation that has characterized African soils for generations.

Based on nutrient mining estimated by country, total annual mining of nutrients (NPK) is about 800,000t for humid central Africa; 3.0 million t for the humid and sub humid West Africa; 600, 000t for the Mediterranean and arid North Africa; 1.5 million t for the sub humid and Mountain East Africa; 1.7 million t in the Sudano Sahel; and 1.4 million t in sub humid and semi arid Southern Africa (Henao et,el 1999). Total nutrient mining in the sub Saharan region may be about 8 million tons of NPK per year. The evidence leaves no doubt that the very resources on which African farmers and their families depend for welfare and survival are being undermined

soil degradation caused by nutrient mining and associated factors such as deforestation, use of marginal lands, and poor agricultural practices. About 50,000ha of forest and 60,000 ha of savanna's grassland are lost to agriculture yearly. Intensification of agriculture with low fertilizer use and the clearing of forest lands are the main causes of nutrient mining and land degradation in tropical forests and savannas that are characteristic of the humid and sub humid regions that predominate in Cameroon, Ghana, Nigeria, Gabon, Congo, Sudan, and parts of Uganda. Most of these soils are fragile and low in plant nutrients. The nutrient recycling mechanisms that sustain soil fertility are insufficient to support increased production without fertilizers. Land is being degraded, and soil fertility is declining to levels unsuitable to sustain economic production.

Population growth and migration associated with drought, food shortages and land degradation have accelerated degradation of agricultural land. The influence of nutrient mining on land's capacity to sustain population and production has long term impacts besides loss of soil fertility and the consequent exodus of farmers. About 33% of the sub Saharan population is malnourished compared with about 6% in N. Africa and 15% in Asia. Most of the malnourished are in East Africa, where nutrient mining rates are high. Malnutrition rates in these regions are from 10% to 50% (Henao et al, 1999). The nutritional level as measured in Kilo calories per person per day is lower than the basic level of 2500Kilo calories. Crop cereals provide more than 60% of these calories in the semi arid and sub humid areas, while animal products provide 5% to 30%. Roots, tubers and plantation crops provide most of the calories in some regions. Low yields in nutrient mined areas seem to contribute to poverty and malnutrition.

Land degradation and productivity in Uganda

Land degradation is a serious problem that contributes to the low and declining agricultural productivity and to food insecurity (NEMA 2001) in Uganda. Evidence of land degradation in Uganda is widespread. The major forms of land degradation in Uganda are soil erosion, soil fertility mining, soil compaction, water logging, and surface crusting (Zake et al. 1987). Soil erosion and soil fertility mining are believed to be the most important causes of land degradation. Soil mining in Uganda is occurring at among the highest rates in Sub Saharan Africa, with an estimated average annual rate of total nutrient depletion of 70 kgs of nitrogen (N), phosphorus (P); and potassium (K) per hectare in the 1980's (Stoorvogel and Smaling, 1990). Wortmann and Kaizzi(1998) estimated even higher rates of soil nutrient depletion for several farming systems in central and eastern Uganda in the mid 1990's.

Most communities in rural Uganda perceive that crop productivity is declining, and that food insecurity and land degradation have increased since the early 1990's (Pender et al. 2001b). This perception is supported by agricultural statistics, which show that per capita food production in Uganda is declining. Farmers' yields are typically less than one third of the yields obtained on research stations, and yields of major crops have been stagnant or declining for most farmers since the early 1990's (Deininger and Okidi 2001). This trend is putting at stake the food security of the rural and urban poor (NEMA 2001; UBOS 2002c).

There is a high rate of soil nutrient depletion in Uganda attributed to the limited and declining use of fallow, low use of organic or inorganic sources of soil nutrients, and other poor fertility management practices. For example, fewer than 10% of small holder farmers in Uganda use inorganic fertilizer, one of the most likely technologies to improve soil fertility (Pender et al.2001b). It has been estimated that smallholder farmers in Uganda apply an average of only 1

kg of soil nutrients per hectare (NARO and FAO 1999). This rate is among the lowest fertilizer application rates in Sub Saharan Africa, where the total average fertilizer application is 13 kgs of NPK nutrients per hectare (Heisey and Mwangi 1996), and is well below that in other developing regions of the world.

The land degradation problem affects all three elements of the critical triangle of development goals, namely, agricultural growth, poverty reduction and sustainable resource management (Vosti and Readon 1997). The major challenge for the government and its development partners is to identify policies to effectively address land degradation, low agricultural productivity, and poverty in a sustainable and equitable way. Finding and implementing policies to help farmers break out of the cycle of land degradation, declining productivity and poverty is an urgent need in Uganda, as is the case in many other developing countries. The government of Uganda has responded to this challenge by designing the Plan for Modernisation of Agriculture (PMA) which is one of the strategies of the PEAP (MAAIF and MFPED ,2000). The goal of the PMA is to transform the largely subsistence agriculture in Uganda into commercially oriented farming, to contribute to governments efforts to alleviate poverty, and to address the land degradation problem in the country (MAAIF and MFPED, 2000). This and other strategies call for clear policy guidance, which can only be developed when policy makers and their development partners are equipped with well researched information. A major goal of this study is to provide empirical information that will help policy makers, development practitioners, and other stakeholders to formulate policies and strategies for sustainable land management, increased agricultural productivity, and reduced poverty in Uganda.

Soil fertility management practices and productivity in Uganda

A study conducted by Nkonya, Pender, et al (2004) reveals that there is more soil nutrient depletion in areas of better market access and among more commercialized farmers, raising questions about the assumptions of the PMA and many policy makers that increasing commercialization and investment in roads will solve the land degradation problem in Uganda. We find that, even though education increases household income, it is associated with more soil erosion, especially in highland areas. Rather than suggesting a shift in paradigm, these results suggest that further research is needed to better understand the causes of such tradeoffs and to find ways to avoid or ameliorate them. Twenty five (25 %) of land is considered 'very good'. However, continued unregulated expansion of low input/low output production in lieu of productivity improvements pushes farmers onto marginal land or sensitive ecosystems where yields are lower and environmental degradation occurs. More private investment is needed to increase this low land and labour productivity, especially in commodities where there is competitive advantage and because food security is a concern for the expanding population.

Increased production of commodities for providing food and income depends on sustaining and managing the soil and water resources that support these production systems. Sustaining soil productivity, often referred to as soil fertility, embodies all aspects of managing soil related to maintenance and improvement of fertility, reducing erosion, and managing and conserving water in a manner that will promote sustainable production (*Responding to Research Challenges for Modernisation of Agriculture; NARO Medium Term Plan 2001-2005*). This is achieved through improved land use management and use of a systems orientation towards optimizing management of inputs (such as legume seed for green manures or inorganic fertilizer), information related to technologies and husbandry practices, and labour. Given the

range of solutions for different socio-economic and biophysical conditions, a participatory approach is needed to identify options suitable for specific locations. Soil productivity decline has been highlighted by stakeholders as a major constraint throughout the country and has been caused due to the following degradation processes:

- i. nutrient mining (removal without replenishing),
- ii. water losses by run off and evaporation;
- iii. loss of soil by 'in situ' destruction or removal of crop residues and land cover;
- iv. accelerated loss of soil organic matter due to continuous cultivation, removal of residues, and erosion, and
- v. restricted rotting caused by soil compaction, often linked to soil texture and tillage practices.

In many parts of the country, farmers traditionally maintained soil fertility through fallowing; and research findings have indicated that with good soil conservation practices, a three year cropping cycle followed by a three- year planted grass fallow maintains soil properties at an acceptable level. However, due to land pressure and costs associated with opening new fields, fallowing periods have been considerably shortened or are no longer practiced. Current agriculture is characterized by minimal use of inputs and limited land resource management practices. Farmers generally use small quantities of organic amendments mainly on perennial crops like bananas while annual crop systems are characterized by nutrient mining. Uganda has one of the lowest inorganic fertilizer use rates in the world estimated at 1 kg/ha/year. Since the fertilizer use is low the fertilizer industry is not yet developed and current fertilizer prices are high. Fertilizer supplies are limited and beyond the reach of most small holders. Use of farm yard manure is also limited in many farming systems. Although some soil and water structures were put in place, particularly in mountainous areas, during the colonial era, many have not been

maintained. Most farmers do not manage soils well to prevent erosion; and harness available water to mitigate drought spells; or to optimize production in cultivated valley bottoms.

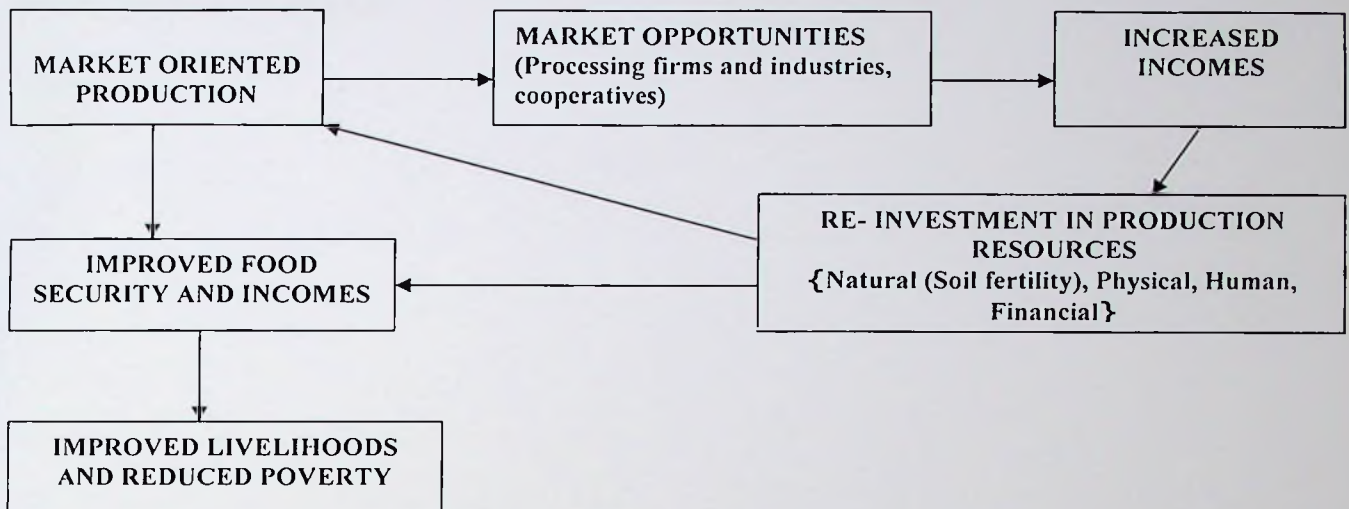
It is therefore necessary to promote in a participatory way a range of options (including indigenous ones) and to empower farmers to achieve sustainable land use based on management decisions which are profitable and low risk in the short term but sympathetically fit into their existing farming systems.

Soil degradation in Masindi District

A farming systems and livelihood analysis survey conducted by the National Agricultural Research Organisation in the lake Albert Crescent Zone (covers Hoima, Kibaale and Masindi districts) in 2003 reveals that farmers are aware that the soils are being degraded. Farmers cited indicators of soil degradation like stunted crops, poor/declining crop yields, change in soil texture and color. They attributed soil degradation to socio-economic factors and the breakdown of extension services, de-forestation, bush burning, continuous cropping, poor soil conservation/management practices and overgrazing. The study also revealed that declining soil fertility is one of the causes of poverty in the district because it reduces farmers' yields thereby affecting household income and food security. Smallholder farmers usually respond to a decrease in crop yield per unit area of production through area expansion but this is not sustainable given the increase in population growth. A study conducted by Wortmann and Kaizzi in 1998 also reveals that the percentage of land affected by land degradation ranges from 90% in Kabale district to 20% in Masindi district.

Conceptual framework

The conceptual framework in this study was derived from the market led hypothesis (a key research strategy in many national and international research organisations) that market oriented production given better access to market opportunities provides an incentive for adoption and reinvestment in soil fertility management practices and technologies.



Source: Researcher 2007

The framework explains whether production for an identified market opportunity improves farmers' income which in turn is re-invested in the production resources (this study put a lot of emphasis on soil fertility as a basic production resource base). The framework further tries to explore what importance is given to re-investment in the resources [human-labour; capital - equipment; and natural resources base- soils] used in market oriented production or is channeled to other socio- economic aspects and welfare.

The framework also explores if market availability is a driving force to invest in soil fertility management to offset increased production to sustain the markets in the long run.

It is envisaged within the PMA framework that market oriented production will improve rural households' incomes and consequently reduce poverty levels. In this framework, market oriented production to satisfy identified market opportunities will promote re-investment in production resources especially the basic production resource(soil fertility) and offset increased production for both food and income security thereby improve farmers livelihoods and reduce poverty levels in the long run.

CHAPTER THREE

METHODOLOGY

This chapter discusses the data sources, data collection tools, study area, sample selection, method of data analysis, quality control and ethical considerations.

The study area

The study was conducted in Masindi district located in the northern most part of the western region of Uganda. The district is comprised of four counties and fourteen sub counties. It has a total area of 9326sq. km out of which 8087sq km is land area, 2843sq km is wildlife protected area, 1031sq km is under forest reserve and 814.4sq km is under water. The total arable land is 430,649ha out of which 60,000ha is under cultivation. The district has a population growth of 2.4 per annum, average household size of 6.9 persons and average household land holding is 2.5 acres. 94.5% of the population is rural based while 5.5% is urban based. The key economic activity is subsistence farming that accounts for 66.7%. The district receives an average annual rainfall of 1200 mm and has two rain seasons. The soils are widely varied and can be classified into 17 mapping units. They include vertisols which consist of black clays, sandy alluvials and Kaiseo beds which are occasionally lateralized. (National Agricultural Research Organisation Publication: Farming Systems and Livelihood Analysis in the Lake Albert Crescent Zone, May 2003).

The district has one large scale agro processing industry (Kinyara Sugar Works Limited) that serves as a market for sugar cane out growers. Other organisations linking farmers to markets

include Mukwano group of companies, Afrokai Limited, Masindi District Farmers Association (MADFA), British American Tobacco (B.A.T.U Ltd) and Continental Tobacco Ltd.

Sample selection

The study focused on farmers involved in market oriented production at commercial and semi commercial levels for the last five years (2001 – 2006). The study was based on five selected crops namely sunflower, maize, sorghum, sugar cane and tobacco. The aspect of ‘market linked production’ was a basis of choice of crops in the study. This is where farmers are involved in agricultural production to supply identified market opportunities/market outlets within the district. A total of twenty households were randomly selected for each of the five crops in question. (sorghum, sugarcane, sunflower, tobacco and maize). Maize is the only crop among the five that is grown for both cash and food crop and at the same time on purely commercial, semi commercial and subsistence levels. It was on this basis that maize was selected so as to compare soil fertility management practices in production of purely commercial crops and semi commercial crops.

The study was conducted in Masindi districts in Bujenje, Kibanda and Buruli counties. Four sub counties (Miirya, Kigumba, Pakanyi and Bwijanga) were purposively selected from the three counties due to the fact that market oriented production is more concentrated there compared to other sub counties in the district.

The study also categorized nature of market orientation basing on type of crop produced (for example traditional cash crops like tobacco and sugar cane; new or high value crops like sunflower, sorghum and maize). Random sampling was used to select households for inclusion in the study. At least twenty (20) farmers were selected from each crop category and level of

market orientation as defined by the PMA. A total of one hundred household heads involved in production of tobacco, sugarcane, sunflower, sorghum and maize on commercial basis in the period 2001 -2006 were interviewed. A number of service providers involved in extension service delivery of the crops in the study were also interviewed to collect information regarding production and soil fertility management aspects of these crops in question to satisfy the identified market opportunities.

Data collection sources and tools

The study was descriptive in nature and collected both qualitative and quantitative data from primary and secondary sources. An open ended questionnaire was administered at household level to collect primary data from the selected farmers while another was used to collect data from officers/service providers from key organizations involved in mobilizing farmers for market oriented production. Secondary data was collected from the relevant offices (District Production Department, Masindi District Farmers Association, Kinyara Sugar Cane Growers Limited, British American Tobacco Uganda Ltd.).

Quality control and ethical considerations

To ensure quality of data collected, enumerators who participated in data collection were trained for one day on how to administer the questionnaire. This was followed by a one day pre-testing exercise of the data collection tool in Bulindi LC I (this is outside the study sample area) after which corrections were made to ensure only relevant data was collected. Prior interviewing the respondents, enumerators would introduce themselves, tell respondents where they have

come from and the purpose of the interview. Having made all these clear, they would then seek permission of the respondents to allow them be interviewed or not.

Data analysis and presentation

A statistical package known as SPSS was used to analyse quantitative data to get descriptive statistics. The findings of the study are presented in form of percentages, tables and graphs to explain the variables spelt in each objective and hypothesis.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

This chapter gives a presentation of data analysis and interpretation of empirical data.

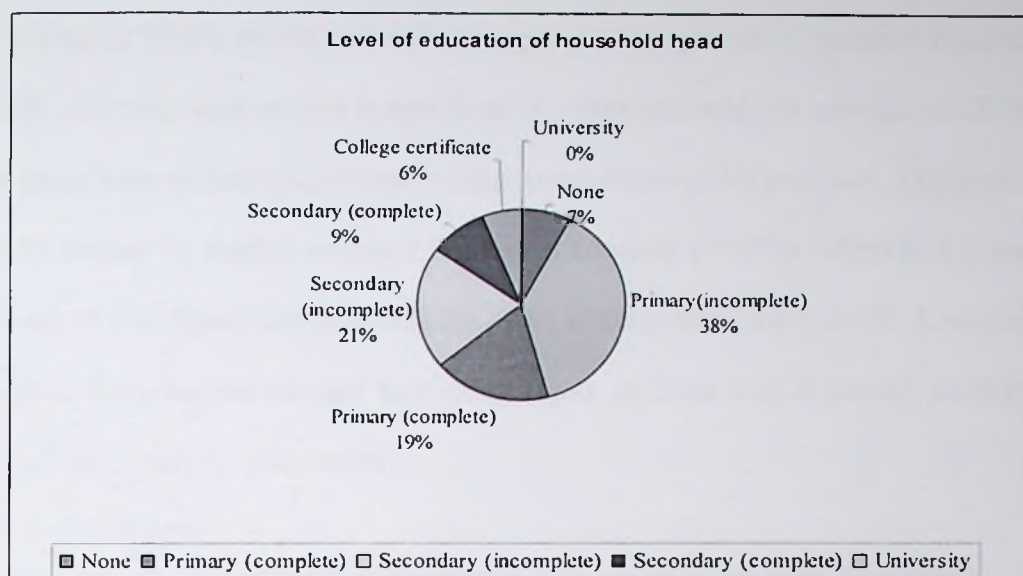
Household characteristics

Ninety six point nine percent (96.9%) of the respondents were males and 3.1% females. This arises from the fact that women culturally do not own land and they must seek consent of their husbands to engage in commercial farming on their own. Women therefore work hand in hand with their husbands in market oriented agriculture. Majority of the respondents (91.8%) are married while 2.1% are single and 6.2% are widowed.

Level of education of household head

Majority of the respondents did not complete primary level education as indicated by 38.1% while 20.6% did not complete secondary education. At least 9.2% completed secondary level while 6.2% have a college certificate. There was no case of university graduates. Findings indicate that 7.3% did not attain any level of formal education. Education level of household head is an important aspect in the sense that it affects farmers' levels of knowledge and skills regarding production. This in turn influences their decisions on use and adoption of a given soil fertility management technology as well as other management aspects.

Graph 1: Level of education of household head



Research data 2007

Age of household head, duration of stay in the community and family size

Findings revealed that 98% of the respondents had stayed in their communities for a period ranging from 3-71 years and 26 years on average. The average age of the household heads ranged from 20 to 89 with an average of 44 years. The average number of members in a household was two female and two male children, two male and two female adults. Family size, age and composition have implications on labour supply regarding agricultural production and adoption of technologies.

Table 1: Duration of stay in the community, age of household head, and family size

	N	Min	Max	Mean	Std. Deviation
Duration of stay in community	95	3	71	26.88	17.210
Age of household head	97	20	89	44.95	15.105
Adult females	97	0	7	1.52	1.072
Adult males	97	0	10	1.85	1.583
Female children	97	0	6	1.81	1.495
Male children	97	0	6	1.97	1.591

Research data 2007

Land tenure and accessibility

A total of 97.9% of the respondents reported they owned or operated land in the period 2001-2006. The total land owned ranges from 0 – 600acres with an average of 38.26acres. The most common form of land acquisition is inheritance followed by purchase. The type of rights on land solely owned by market oriented farmers is freehold (59.8%) followed by leasehold that accounts for 16.5%. Hired land accounts for 4.1% while public land is 3.1%. It was reported that farmers have both cultivation and harvesting rights on land that is owned jointly with other members of the family or community.

Table 2: Land accessibility

	Did you own or operate land in 2001-2006?		
		Yes	Total
Tobacco	Count	18	20
	% of total	18.6%	20%
Sorghum	Count	11	11
	% of total	11.3%	11.3%
Sunflower	Count	.24	24
	% of total	24.7%	24.7%
Sugar cane	Count	.21	21
	% of total	21.6%	21.6%
Maize	Count	21	21
	% of total	21.6	21.6%
Total count			
Total Percentage		97.9%	100%

Research data 2007

Table 3: Total land holding

	N	Min	Max	Mean	Std Deviation
Total land (acres)	97	.0	600	38.269	96.8170
Hired	97	.0	13	1.112	2.236
Borrowed	97	.0	22	.74	2.72
Sharecropped	97	.0	30	.309	3.04
Owned	97	.0	580.8	29.633	79.9
Jointly owned with others	97	.0	400	7.464	42.5

Research data 2007

Changes in land use from 2001 – 2006

A total of 53% of the respondents reported an increase in size of cultivated land in the period 2001 – 2006 while 14.4% reported a decrease in size of cultivated land. 32% reported the size of cultivated land remained constant. The most important reasons given for an increase in size of cultivated land were commercialization/production for the market(17.5%), expansion of crop acreage 8.2%), realization of profits that were re-invested(5.2%), increased demand for food by household due to an increase in family/household size(4.1%). Reasons for a decrease in size of cultivated land were lack of money to hire more land (6.2%), limited labour/manpower (2.1%), and company promoting sunflower production pulled out of Sub County (1.0%), Ill health (1.0%) and drought (1.0%).

Household head's primary occupation

The primary occupation of 96.9% of respondents is farming and salaried employment accounts for 3% only. The major income generating on farm activity is crop production dominated by maize (96.9%), cassava (77.3%), beans (72.2%), groundnuts (36.1%) and sweet potatoes (23.7%) among other crops. Livestock production is less dominant as exhibited by cattle (15.5%), poultry (7.2%) and goats (4.1%).

The main off farm activity carried out by respondents is small scale retail businesses that account for 36%. This is followed by tractor/oxen hire services accounting for 10.5%. Active participation in local politics is also regarded as a secondary occupation and it accounted for 5.8%.

Table 4: On farm activities

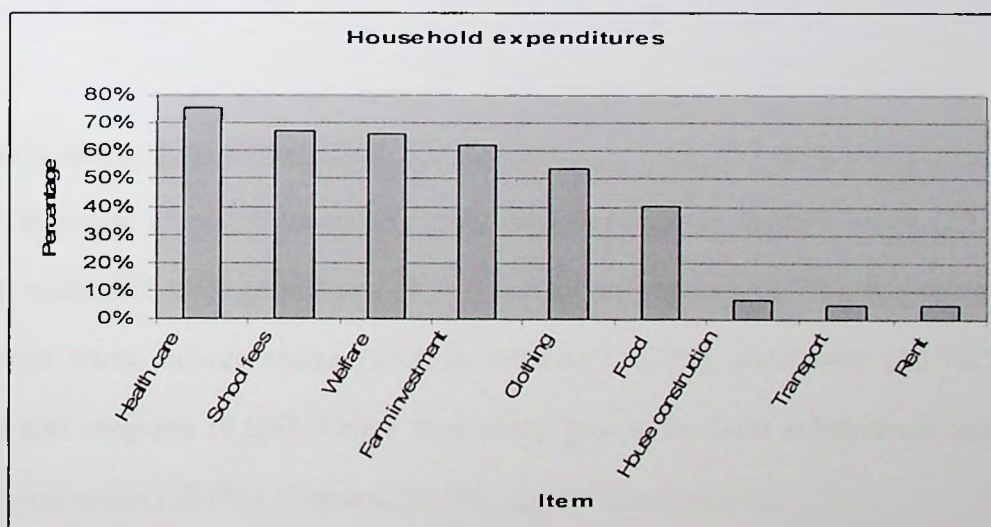
Activity	Count	Percent of responses	Percent of cases
Tobacco production	21	4.8	21.6
Maize production	94	21.6	96.9
Cassava production	75	17.2	77.3
Bean production	70	16.1	72.2
Sweet potato production	23	5.3	23.7
Sunflower production	31	7.1	32.0
Sorghum production	17	3.9	17.5
Sugar cane production	22	5.0	22.7
Cattle production	15	3.4	15.5
Groundnut production	35	8.0	36.1
Others	33	7.7	7.5
	436	100.0	449.5

Research data 2007

Household expenditure patterns

The major household expenditure goes to health care (75.3%) followed by school fees (67%), welfare (66%), farm investment (61%), clothing (53.6%) and food (40.2%). Other important expenditure items are house construction (7.2%), transport (5.2%) and rent (5.2%) as shown in graph 2.

Graph 2: Household expenditures



Research data 2007

Access to credit

A total of 49.5% of the respondents reported having taken credit during the period 2001-2006 while 49.5% did not. The major sources of credit are NGO's (18.6%), micro finance institutions (11.3%), commercial banks (10.3%), friends (5.2%), co- operative society (2.1%) and women credit savings groups (1.0%). 63% of those who use credit reported they are not allowed to borrow as much as they want from these sources due to the fact that the amount borrowed depends on one's level of savings with credit facility. Besides this, loans are given in kind (services and material inputs like chemicals and fertilizers) and this depends on one's crop acreage. 86.6% reported that they have never defaulted to pay back a loan while 10.3% have ever defaulted because of low price for their crop produce. This was however handled by the source of credit extending the grace period to another season to enable farmers pay back.

Fear of high interest rates, property confiscation and imprisonment was the major reason for not taking credit by 49.5% of the respondents. Another reason given by respondents is that they don't require credit due to lack of business skills to use it and lack of knowledge on where to invest it lucratively.

Crop production and marketing 2001 – 2006

The major crops produced on purely subsistence level include beans (29.2%), Cassava (24.6%), maize (23.1%), groundnuts (9.7%) and sweet potatoes (8.7%). Major crops grown on commercial basis include maize (23.8%), tobacco (18.3%), sunflower (16.7%), sugar cane (16.7%) and sorghum (9.5%). Crops commonly grown for both subsistence and commercial purposes are maize (30.6%), Cassava (23.1%), groundnuts (10.5%).

Table 5: Years in crop production by category:

Category of production	Minimum	Maximum	Mean	SD
Purely subsistence	2	50	13.93	13.006
Market oriented	1	40	6.53	6.284
Both subsistence and market oriented	2	50	10.19	9.624

Research data 2007

Change in crop yields

A total of 42.3% of the respondents reported a positive change in crop yields while 56.7% reported a negative change in crop yields in the period 2001 – 2006. Positive change in crop yields was reported on a range of crops that include sorghum, groundnuts, and sugarcane among others. Reasons attributed to the positive change include improved management practices (38.3%), good/fertile soils (19.2%), good weather conditions (17.8%), fertilizer application (12.3%) and use of improved varieties (6.8%). A negative change in crop yields has been observed on quite many crops that include maize, groundnuts, cassava, beans, sweet potatoes and bananas. Reasons for a decline in crop yields include drought (35.9%), declining soil fertility/soil exhaustion (23.9%), crop diseases (9.8%), crop pests (8.7%), and poor seed varieties (2.2%).

Crop variety, source, average acreage, cropping system, average yield, quantity sold, unit price and where sold

The major crop varieties are improved and are mostly supplied by companies involved in buying farmers produce. These include Mukwano group of companies, Kinyara sugar works limited, British American Tobacco Uganda Limited, Continental Tobacco Ltd., Masindi District Framers Association in collaboration with FICA seed company, AFROKAI and Nile Breweries Limited. A small percentage of the respondents get seed from other farmers while the improved

varieties of maize are sourced from seed stockists/farm supply shops many of which are agents of seed companies. All the crops considered in the study are grown as a monocrop/pure stand. The average acreage per season is 1.2 acres for tobacco, 1.5 acres for sorghum, 2.2 acres for sunflower, 12 acres for sugar cane and 12 acres for maize.

The average yield per season per acre is 609kgs for tobacco, 981kgs for sorghum, 1569kg for sunflower, 6581kgs for sugar cane and 1732kgs for maize. 100% of total production for tobacco, sorghum, sugarcane, and sunflower is sold off. 85.7% of the maize is sold off while 12.5% is retained for home consumption/household food security.

The average unit price per kg in Ugandan shillings is 1977.5 for tobacco, 300 for sorghum, 347 for sunflower, 31.60 for sugar cane and 232 for maize.

Crop management practices

Findings of the study indicated that 69% of the respondents commonly use the slash and burn method to during bush clearing while 24.8% use slash only. At least 4.1% use caterpillar that incorporates the trash and this is a common practice in sugar cane production. The first and second ploughing is done by tractor and caterpillar drawn implements for tobacco and sugar canes respectively. Harrowing is done by a wheel tractor for sugar cane. Oxen drawn implements are used by sorghum, sunflower and maize farmers. Planting is usually manual using a hand hoe for all the crops. Weed management is done manually with a hand hoe or hand picking and there was no case of use of chemicals/herbicides was reported across all crops. Pesticides are commonly used in tobacco production and include orthene(60%), Laneti (20%) and ambush(%). Rouging is practiced to a small extent in sugar cane and maize as a way of controlling spread of smut disease.

harvesting in all crops is done manually using simple tools like knives and pangas.

Soil management practices

Early ploughing is a common practice across all crops (98.8%). 20.6% of respondents used using practice before market orientation while 18.6% introduced it after market orientation and 51.5% have been using it both before and after market orientation.

Crop residues are incorporated by 26.8% of the respondents (13.4% before, 8.2% after, 1.1% both before and after market orientation). 72.2% reported they did not incorporate crop residues.

Total fertilizer usage by type is 73.2% urea, 69.6% DAP, 19.6% NPK, and 7.1% TSP (table 6). The highest amount of fertilizer usage is in sugarcane (37.5%) followed by 28.6 in tobacco and maize (21.4%). It is 10.7% for sunflower and 1.8% for sorghum.

Table 6: Fertilizer usage by type

	UREA	DAP	NPK	TSP
tobacco	25%	1.8%	17.9%	0%
sorghum	0%	1.8%	0%	0%
sunflower	1.8%	10.7%	0%	0%
sugar cane	32.1%	35.7%	0%	7.1%
maize	14.3%	19.6%	1.8%	0%
	73.2%	69.6%	19.6%	7.1%

Research data 2007

Crop rotation is practiced by 82.5% of the respondents while 16.5% do not. There is a great variation in the crop rotation sequence but it is mostly tobacco, maize and groundnuts that always come first in the sequence with cassava as the last crop. The reason why tobacco is grown as a first crop first is that it is a heavy feeder and an income generating crop. Maize is grown as a first crop in the rotation because it is also a heavy feeder, priority and dual purpose crop (grown for both cash and food security).

Fallowing is practiced by 46.6% (9.3% before and 16.5% after market orientation while 18.6% practiced it before and after market orientation). 52.6% of the responses indicated they do not practice fallowing. Reasons for not fallowing include limited farmland/size (89.2%), while others hire land (5.4%) and therefore want to maximize returns from it. 5.4% reported that they are not interested in the practice. The average fallow period ranges from 2-10 growing seasons (1-5 years) with an average of two seasons (one year). Fallow land is left bushy/idle as reported by 25.8% and 13.4% use it to graze livestock. Some respondents reported that the fallow period has become shorter due to limited land (4.1%), high demand for crops (3.1%), commercialization (3.1%) and increasing population (1.0%). Some respondents reported that the fallow period has become longer due to high rate of soil fertility decline and a need to replenish it (5.2%) as well as to break down disease/pest cycles (1.0%).

Source of soil fertility management information

A total of 88.6% of respondents reported that they get information on soil fertility management from extension workers while 13.4% get it from radio and 4.7% from other farmers. A number of soil fertility management practices are known but not used and there are reasons for this phenomenon. These include the monetary costs involved, labour requirements and time needed to prepare and apply the treatments. Some respondents attributed non usage of these practices to lack of skills and knowledge while others reported that soils are still fertile enough to sustain crop productivity.

Factors motivating/influencing use of a soil fertility management practice

The most important factor that influences/motivates use of a given soil fertility management practice is the expected yield/output gain as reported by 50% of the responses. This is followed by plant vigor and quality of produce that accounted for 10.6% and 4.8% of the responses respectively. Intervention by buyer/company is also an important factor and it accounted for 3.9% of the responses while possession of necessary skills and knowledge accounted for 4.8% of the responses. Crop variety and affordability of a fertility management practice are equally important and accounted for 2.9% of the responses each.

Appropriate soil fertility management practice in market oriented agriculture

A greatest percentage of the respondents (48.8%) indicated that use of chemical /inorganic fertilizers is the best option for soil fertility management in market oriented agriculture. This is due to the fact that it easy to apply and comes in a ready to apply form. Besides this, fertilizers increase yields tremendously. Crop rotation is another option for soil fertility management (26.8%) because it is easy to follow, manage and it also helps control pests and diseases. Fallowing was also recommended by 21.6 % of the respondents because it replenishes soil fertility the natural way, does not involve any labour and monetary costs. Incorporating crop residues is a cheap method and practically possible across all socio-economic categories of farmers. Use of organic manure was also cited as a cheap and appropriate technology in market oriented agriculture.

Table 7: Appropriate soil fertility management practice/technology and reasons for choice

SFM	Percent of cases reporting	Reasons for choice of SFM
Chemical/inorganic fertilizers	48.8	Easy to use (15%), Easy to access (8.2%), improves yields tremendously (5.2%), quick results (3.1%), gives direct benefits (4.1%), and comes in ready form (2.1%)
Crop rotation	26.8	Easy to follow and manage (15.5%), break disease/pest cycle (4.1%), maximizes yields (4.1%).
Fallowing	21.6	Replenishes fertility the natural way (3.1%), does not require labour to practice (8.2%), easy to manage (5.2%), no costs involved (1.0%).
Incorporating crop residues	12.4	It is cheap(4.1%), easy to apply(3.1%), applicable across all levels of farmers(%), retains organic matter
Manure	7.2	It is cheap (4.1%), improves soil fertility (2.1%), controls disease (1.0%)

Research data 2007

What should be done to enable farmers manage soil fertility in a sustainable manner

A majority of the responses indicate that farmers need to be trained and sensitized on soil fertility management aspects (71.1%). Other suggestions include promotion of use of chemical fertilizers (7.5%) that must be availed at a subsidized cost (7.4%) or provided on loan (5.6%). There is also need for demonstrations on soil fertility management on farm.(3.7%) while improving market dynamics is also necessary to enable farmers manage soil fertility in a sustainable way.

Farm investments characteristics

The major farm investment items reported include hiring labour, tractor or oxen (31.1%), purchasing livestock (14.1%), purchasing farm inputs like fertilizers and seeds (25.4%), buying farm tools and equipment (9.9%), hiring land (7.7%) and construction of a storage facility

(4.2%). Other investment items mentioned were purchase of a grinding mill, a transport facility like motor cycle or bicycle to ease mobility and supervision of farm activities.

Re-investment of revenue/profit

A total of 96.9% of the respondents reported reinvesting their revenue /profits as follows; tobacco (20.6%), sunflower (11.3%), sugar cane (19.6%) and maize (20.6%). 95.7% of the responses indicate that farmers invested in a new business or enterprise. The most common enterprises are purchase of livestock, investment in a retail shop/business and construction of a commercial building. The major reason given for investment in a new business/enterprise is to diversify sources of household income (77.8%).

Crop marketing

The major form of marketing in place is contracted farming and it accounts for 95% of tobacco, 100% for sorghum, sunflower and sugarcane. Findings further revealed that 52.4% for maize is produced on contract basis while 47% is for the open market. The key buyers of crop produce are processors – Kinyara Sugar works Limited for sugar, British American Tobacco-Uganda for Tobacco, Mukwano group of companies for sunflower and Nile breweries limited for sorghum. Some farmers are contracted by FICA seed Company to produce maize foundation seeds. Maize not grown on contractual basis is sold to AGROVET feed processors based in Masindi town and other produce buyers from within and outside Masindi district.

The major actors involved in marketing are farmers, extension workers and agents of the organisations involved in contracted production of the crops in question. The commodity price is usually determined by buyers in all cases.

CHAPTER FIVE

IMPLICATIONS AND SIGNIFICANCE OF STUDY

This chapter discusses implications of findings from the study for theory, policy and practice. It goes further to discuss possible policy and other suggestions and recommendations.

Factors influencing market oriented farmers behaviour and decisions to adopt and invest in soil fertility management practices

Farm level decisions concerning the use and adoption of soil fertility management technologies are governed by socio-economic and institutional factors. The study revealed that a greatest percentage of market oriented farmers in Masindi district do not invest in soil fertility management. The proceeds realised from sale of crop produce are either used to solve other important household needs or are invested in other enterprises rather than the initial crop enterprise. A number of factors are responsible for this phenomenon and are explained here below.

Level of education

The study revealed that the highest level of education attained by household heads (majority of whom are male headed) is a college certificate (6.2%) and majority (38.1%) did not complete primary level. This greatly affects farmers' levels of knowledge and skills regarding decisions to invest in soil fertility management. School was reported as one source of information for soil fertility management information.

Family labour availability

The average number of members in a household and their age has serious implications on labour supply. Available supply of family labour influences the type of soil fertility management practices/technology a household will use and adopt. Family size will determine family spending patterns. Given a good number of school going age especially in secondary and higher institutions, priority is given to school dues at the expense of farm investment at large.

Land tenure and accessibility

The form of land ownership is an important factor that affects farm investment patterns. Where farmers hire or borrow or own land jointly affects decisions to invest in long term soil fertility management practices. Such form of land ownership always guarantees cultivation and harvesting rights only. In the event that the land is hired, farmers will always want to maximize returns from the land in the shortest time possible at expense of replenishing its fertility.

Land size

Findings from the study further revealed that majority of farmers involved in market oriented agriculture in Masindi district own big chunks of land ranging from 0-600acres with an average of 38.26acres. A big proportion of cultivated land with averagely high fertility is a disincentive to investment in soil fertility management. Farmers will always open up new pieces of land the moment they start realizing declining soil fertility without necessarily taking any efforts to replenish it. The size of land explains why such farmers are involved in contracted farming by large agro based processing companies that put a lot of emphasis on increased production.

Sources of income

The study revealed that farmers have limited opportunities to earn off farm income. The majority of farmers in the study area are peasant farmers (96.9%) who derive their main income from crop production. They have limited sources/opportunities of off farm income which they can partition to solve household needs and offset investment in agriculture. Given such a scenario and a growing enthusiasm towards market orientation, there is need to diversify income opportunities to alleviate poverty at household level to off set investment in agricultural production and eradicate poverty as envisaged by the PMA.

Access to credit

Farmers reported that they have access to credit but findings reveal that the credit schemes are insufficient, reason why a few of them take credit. This is attributed to the fact that farmers still lack the capacity and skills to utilize it in a profitable way. People still have high fears of paying interest and look at credit institutions as a means of impoverishing them. Farmers think the grace period does not favour them to invest credit money in crop farming given the long gestation periods.

Improved soil fertility management practices that respond to market oriented production

Findings from the study indicate that a soil fertility management technology suitable for adoption in market oriented agriculture revolves around accessibility, cost, form in which it is availed, labour and time required for its application as well as knowledge and skills. Majority of the market oriented farmers contend that use of chemical fertilizer is the best option for soil fertility management in market oriented agriculture. Some farmers recommend fallowing but

how sustainable is it given the growing population size that puts pressure on the available limited arable lands. Besides, the move towards market orientation/commercialization is growing so following on its own cannot suffice as a soil fertility management practice.

A soil fertility management technology /practice in market oriented agriculture must strengthen biological processes to optimize nutrient cycling, minimize external improvements and maximize their use and efficiency. It must also fit within the socio economic and agro-ecological conditions of the farmer.

Strategies for strengthening farmers' capacity to adopt improved soil fertility management options for sustainable market oriented agricultural production in Masindi district

The study revealed that there is a skill/knowledge gap regarding soil fertility management in market oriented agriculture. Farmers need to be trained and sensitized on soil fertility management aspects. This calls for strengthening the extension service whether public and private. Soil fertility management should be given equal importance just like the value attached to expected yield output to meet the market demand and capacity of processing plants. Emphasis should also be put on utilizing locally available knowledge, materials and best practices. Improving market dynamics is also necessary to facilitate farmers increase their profit margins and this will consequently enable them invest in soil fertility in a sustainable way.

Implications of findings for theory/policy/practice

Findings from the study reveal that improved access to markets by smallholder farmers does not provide incentives that accelerate adoption of improved technologies and investment in soil fertility management. Better access to market opportunities should ideally provide incentives

for re-investment in the natural resource base (soil fertility in this context) alongside solving other livelihood needs like school fees, health care, welfare, business investments, housing as well as savings accumulation.

Commercialization of agriculture is a government strategy to eradicate poverty at household level and mission for the PMA. However, there is concern that specialized market oriented agricultural production can have adverse effects on the natural resource base since there is a tendency of expansion and utilization of arable land to increase production in favour of socio-economic gains. This poses a risk of depleting the natural fertility reserves (given utilization without replenishment) hence unsustainable development in the long run. Policy issues should therefore advocate for integration of soil fertility management into the market oriented farming agenda of the PMA so as to ensure sustainability of the available land. Such issues should be implemented by both farmers and all those actors involved in promoting market oriented agriculture. The policies should address the likely hidden effects of increased commercial production on the natural resource base. Research policies should strengthen efforts to improve soil management.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

This chapter highlights possible policy or other suggestions and recommendations. Basing on the findings of the study discussed in the previous chapter, the following conclusions are drawn. Many farmers have responded positively to the government call for producing for the market. The effect of market oriented agriculture on the natural resource base is not certain. Specialization as opposed to diversification dominates market oriented agriculture.

Increased incomes realised from commercialization increases household expenditures on items like school fees, health care, construction of permanent houses (for commercial or residential purposes) at the expense of investing in the natural resource base (soil fertility and land management in this case). Soils are being exploited without consideration to replenishing its fertility. This poses a threat to sustainable production now and in the future.

Overall Recommendations

In light of the above conclusion, the following recommendations have been suggested. Re-orienting agriculture to market oriented production should be done alongside principles and practices of integrated soil fertility management for sustaining and enhancing agricultural productivity.

Farmer education is important in raising the likelihood of using most of the soil fertility management practices. Education is indispensable to reducing soil nutrient depletion.

Research and extension should develop and promote soil fertility management packages that address nutrient depletion, enhance soil organic matter restoration and nutrient use efficiency while ensuring profitability.

Policy makers should design, incorporate and address soil fertility policies that encourage farmers to invest in soil fertility management (farming as a business in totality). Enabling national policies and infrastructure that will correct market and institutional constraints to improving soil productivity should be promoted. These should be backed by supportive government action.

Policies should advocate for a socio-economic environment that is conducive for farmers to invest in farming for instance widening the income generation opportunities. They should not emphasize market orientation without exploring the means through which it can be achieved in an effort to alleviate poverty.

Dissemination of appropriate technologies for the restoration and maintenance of soil fertility and intensification of agriculture through an integrated approach using organic and mineral fertilizers, erosion control, land and water management to enhance food security and income should be promoted.

Suggestions for further research

Research should advocate for developing soil fertility management packages in a participatory manner that links scientific understanding of agricultural processes with farmers' insights. These should lay emphasis on local knowledge and focus on capacity building of farmers to innovate to help them develop more sustainable soil fertility management systems.

Research should also try to explore a variety of options in place that are adaptable to specific farmers needs and locations to stimulate them adopt soil fertility management practices and technologies.

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APPENDICES

Appendix 1 – Household questionnaire

EVALUATING FARMERS INVESTMENT DECISIONS ON SOIL FERTILITY MANAGEMENT IN MARKET ORIENTED AGRICULTURE IN MASINDI DISTRICT

SECTION 1: PERSONAL DATA

1.1 District	1.2 County	1.3
Sub county.....	1.4 Parish.....	
1.5 Village/L.C.....		
1.6 Name of Household head.....		
1.7 Respondents (i).....		
(ii).....		
1.8 Duration of stay in the community (Years).....		

SECTION 2: HOUSEHOLD CHARACTERISTICS

- 2.1 Sex of household head
- 2.2 Age of household head
- 2.3 Marital status
- 2.4 Level of education of household head.....
1. None 2.Primary incomplete 3.Completed primary 4. Secondary incomplete
5. Completed secondary 6.College certificate 7. University 8.Other (Specify)
- 2.5 How many people usually live in your household? (Adults and Children by age)

Category	Number, Age
1. Adults (female)	
2. Adults (male)	
3. Children (Female)	
4 Children (Male)	

SECTION 3: LAND TENURE AND ACCESSIBILITY

- 3.1 Did you own/operate land anywhere in the period 2001 - 2006? (Yes=1 No=2)
- 3.2 If yes to 3.1 above, what is your total land holding (in acres) including hired, borrowed, sharecropped and owned.....

- 3.2.1 Hired land.....
- 3.2.2 Borrowed land size.....
- 3.2.3 Sharecropped land size.....
- 3.2.4 Land owned.....
- 3.2.5 Land jointly owned by the community or others.....

3.3 What type of rights do you have on the land that you solely own?

- 1. Leasehold rights
- 2. Free hold rights
- 3. Public land
- 4. Other (specify)

3.4 How did you acquire the land you solely own?

- 1. Inheritance
- 2. Purchase
- 3. Gift
- 4. Other (specify)

3.5 What type of rights do you have on the land that you jointly own with the community (or other persons)?

- 1. Have both cultivation and harvesting rights
- 2. Have grazing rights only
- 3. Squatting rights only
- 4. Other (specify)

3.6 Changes in land use (proportion of total land area in acres under the following):

Land use	2001	2006	Reasons for change (increase or decrease)
3.6.1 Cultivated land			
3.6.2 Grazing area			
3.6.3 Fallow			
3.6.4. Natural forest/woodland			
3.6.5 Planted woodlots			
3.6.6 Settlements(Homestead)			
3.6.7 Wastelands			
3.6.8 Other			

SECTION 4: HOUSEHOLD INCOME /EXPENDITURE PATTERNS AND ACCESS TO CREDIT

4.1 What is the household head's primary occupation?

4.2 What are the major income generating activities that your household undertakes?

4.2.1 On farm activities	
Activity	Rank
4.2.2 Off farm activities	

4.3 What are the five major important household expenditure items? (rank and give reasons for each rank)

Expenditure item	Rank	Reason(s)

4.4 Within the period 2001-2006, have you taken credit?

4.5 If yes to Qn 4.4 above, please state the type of credit facility/source of credit and their interest rates (1.Commercial banks; 2.Microfinance institution; 3.Co-operative society;

4.Friends/relatives/neighbors; 5.NGO,s-name them; 6.Revolving fund; 7.Women credit and savings groups).

4.6 Are you allowed to borrow as much as you want from these sources?

If no, why?

4.7 Have you ever defaulted to pay back a loan?

4.7.1 If yes, why?.....

.....

4.7.2 How did you deal with the credit institution?.....

4.7.3 If no, why? (1.Lack of credit facilities 2.Do not require them 3. Have never heard of credit facilities 4.Lack of Collateral 5.Other...specify)

SECTION 5: CROP PRODUCTION AND MARKETING (FROM 2001 – 2006)

5.1 How many years have you been involved in agricultural production?

1. Purely subsistence production..... List crops

2. Market oriented/commercial production..... List crops.....

3. Both subsistence and market oriented (semi commercial)...List crops.....

5. Has there been a change in crop yields in the past five years (positive or negative)?

6. Mention crops where the change has been observed

7. What factors are responsible for this change – positive or negative?

SECTION 6: CROP PRODUCTION COSTS

[illegible]

Soil fertility management practice or technology	Unit e.g. bags of mulch, manure, size of bund	Estimated cost per unit e.g. bag of mulch, one bund

¹ Term used to include insecticides, fungicides, and herbicides. Specify by category.

SECTION 7: SOIL FERTILITY MANAGEMENT PRACTICES

7.1 Land preparation and other routine practices

Activity	Method commonly used
Bush clearing	
<u>Land preparation:</u>	
First ploughing	
Second ploughing	
Harrowing	
Planting	
Weed management	
Pest management	
Disease management	
Harvesting	

7.2 Soil fertility management practices (what crops, whether used before or after market oriented agriculture and probe for frequency of use)

Practice	Crops	Before
After		
Early ploughing		
Fallowing		
Fallow strips		
Improved fallow (specify species planted)		
Mulching		
Composting		
Incorporating crop residues		
Use of organic fertilizers (specify type/form)		
Zero tillage		
Soil bunds - fanya juu and fanya chini		
Bio mass transfer		
Cover crops (Specify species used)		
Inorganic fertilizers (specify type)		

7.3 Crop rotation patterns

7.3.1 Is there any common sequence of crop rotation that you usually follow in your cropping system?

7.3.2 What are the crops in sequence?

7.3.3 What is the order of the sequence?

7.3.4 What are the reasons for this sequence?

7.4 Do you practice fallowing? 1. Yes 2. No

7.4.1 If no, why

7.4.2 If yes to 7. 4, what is the average fallow period?

7.4.3 How is the fallow period utilized?

7.4.4 Has there been a change in the average fallow period before and after introduction of market oriented production i.e. is it longer or shorter than it used to be; (If yes, give reasons for the change

7.5 What is your source of information on soil fertility management (specify what aspects of soil fertility management).

Soil fertility management aspect	Source of information

7.5.1 Probe for any soil fertility management practices known but are not used and why?

Soil fertility management practice/technology	Reasons why not used

7.5.2 What factors motivate/influence use of a soil fertility management practice?

7.5.3 What range of soil fertility management practices and technologies do you think are appropriate for farmers in market oriented agriculture?

Appropriate soil fertility management practice/technology	Reasons for choice

7.5.4 What do you think can be done to enable farmers manage soil fertility in market oriented agriculture to enable them improve productivity levels in a sustainable manner to satisfy the identified market linkages?

SECTION 8: FARM INVESTMENT CHARACTERISTICS

8.1 Farm investment characteristics (ranked in order of priority)

Investment item	Proportion of income invested	Rank

8.1.2 What factors influence decisions of the investment behaviour given above?

Investment behaviour	Factors that influence decisions of investment

8.2 Farm - Investment patterns (at least for the last three years)

8.2.1 Do you re- invest your revenue/profits (or the initial capital) back into the same crop or a new business option?

Crop	Year	Average income realised	Proportion re invested
	2004A		
	2004B		
	2005A		
	2005B		
	2006A		
	2006B		

8.2.3 If you invested in a new business/enterprise, what was it?

8.2.4 Why did you invest in a new business/enterprise?

SECTION 9: MARKETING ORGANIZATION/MARKET LINKAGES:

9.1 What is the marketing system in place/ describe the type of market linkage you are involved in.

9.2 Who are the key buyers of produce?

9.3 Who are the main actors involved in the marketing process?

9.4 Who determines the price?

9.5 What is the distance to point of sale /market in kms

9.6 What is the main source of marketing information?

9.7 Crop prices

Crop	Year and season	Prices			
		Farm gate		Off farm	
	2004A	Minimum	Maximum	Minimum	Maximum
	2004B				
	2005A				
	2005B				
	2006A				
	2006B				

Thank you for your cooperation

Appendix II - Questionnaire for Service Providers

EVALUATING FARMERS INVESTMENT DECISIONS ON SOIL FERTILITY MANAGEMENT IN MARKET ORIENTED AGRICULTURE IN MASINDI DISTRICT

Name of respondent:

Position:

1.1 Name of organisation:

1.2 Please give a brief description/mandate of your organisation:

.....
.....
.....
.....
.....
.....

1.3 What are the major crops promoted by the organisation in question?

1.3.1 Food security.....

1.3.2 Cash/ Commercial purposes.....

1.4 List other collaborating organisations/institutions in promoting the crop in question and their roles:

Organisation/institution	Roles

1.5 How long has the organisation been involved in production of the crop in question (in Masindi district)?.....

1.6 What services are offered by this organisation to farmers?(Consider all aspects like extension and training and in what specific areas)

1.6.1 Land preparation – (1) tractor hire (2) Oxen (3) Manual labour (4) other (specify)

.....
1.6.2 Agronomic practices.....
.....
.....

1.6.3 Distribution of improved seed/planting material (specify type).....

.....

- 1.6.4 Harvesting.....
.....
- 1.6.5 Post harvest handling.....
.....
- 1.6.7. Storage/bulking facilities.....
.....
- 1.6.8 Credit/loan facilities(Please indicate whether it is in form of cash or kind, interest rates charged, form of pay back).....
.....
.....
- 1.7 What range of soil fertility management practices and technologies promoted by your organisation in production of the crop in question?
- 1.7.1 Fallowing (What is the fallow period, indicate whether it is improved fallow and plant species grown).....
.....
- 1.7.2 Mulching.....
- 1.7.3 Incorporating crop residues.....
- 1.7.4 Zero tillage.....
- 1.7.5 Soil bunds (fanya juu and fanya chini).....
.....
- 1.7.6 Biomass transfer.....
.....
- 1.7.7 Crop rotation;
Is there a common sequence recommended by your organisation?
If so what is the sequence of the crops?.....
.....
- What are the reasons for this sequence.....
.....
- 1.7.8 Use of organic fertilizers (specify form for example composted manure)
.....
.....
- 1.7.9 Use of Inorganic fertilizers (specify type, frequency of application and quantities per cropping cycle per acre).....
.....
.....
- 1.7.10 Others.....
.....

.....
1.8 What factors influence the choice of soil fertility management practices promoted by your organisation?.....
.....
.....
.....
.....

1.8.1 What range of soil fertility management practices/technologies do you think are appropriate for farmers in market oriented agriculture?.....
.....
.....

1.8.2 What reasons do you give for your choice in (1.8.1) above?
.....
.....
.....

1.8.3 What factors influence farmers behaviour regarding investment in and adoption of soil fertility management technologies?.....
.....
.....

1.8.4 What do you think can be done to enable farmers manage soil fertility in market oriented agriculture for sustainable production in the long run?.....
.....
.....
.....

1.9 What is the marketing system of the crop enterprise in question (main actors involved in the marketing system, key buyers of the crop produce?.....
.....
.....

Thank you for your cooperation