ADOPTION OF INORGANIC FERTILIZERS FOR CROP PRODUCTION BY LOCAL COMMUNITIES IN SOROTI DISTRICT, UGANDA.

A Thesis

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Master of Science in Environmental

Management and Development.

By:

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OCTOBER, 2012.

DECLARATION A

I, **Eniru Emmanuel Innocent**, solemnly declare that, this thesis was produced as a result of my own committed efforts and to the best of my understanding ,its contents have not been presented for the award of a thesis of a higher degree or any other professional award in this institution or any other institution of higher learning.

Signature .....

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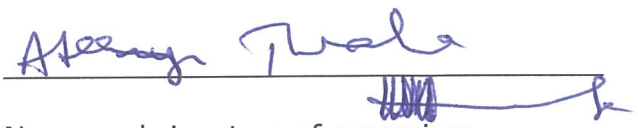
Date 6TH - NOV 2012.

DECLARATION B

"I confirm that the work reported in this thesis was authentically carried out by the candidate under my critical supervision".



Name and signature of supervisor

10.11.2012

Date

APPROVAL SHEET

This thesis entitled "Adoption of inorganic fertilizers for crop production in Soroti district "prepared and submitted by Eniru Emmanuel Innocent in partial fulfillment of the requirements for the degree of Masters of Science in Environmental Management and Development has been examined and approved by the panel on oral examination with a grade of PASSED.

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Name and Sig. of Principal, CHDR

DEDICATION

This thesis is dedicated to my parents Maj. (Rtd) Eniru John Jorem and Mrs. Eniru Agnes Alubo, my brothers and sisters, the family of Mr. and Mrs. Edigu John Henry, my fiancée Aiyo Rebecca, the family of Mr. and Mrs. Oboi John Charles and Mr. Ekotu Stephen.

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ABBREVIATIONS

ANOVA: Analysis of Variance

CAN: Calcium Ammonium Nitrate

CATEP: Christian Action to End Poverty

CBOs: Community Based Organizations

CIDI: Community Integrated Development Initiative

DAP: Diammonium Phosphate

Demo-sites: Demonstration sites

MAAIF: Ministry of Agriculture Animal Industry and Fisheries

MFPED: Ministry of Finance, Planning and Economic Development

MAP: Monoammonium Phosphate

NAADS: National Agricultural Advisory Services

NARO: National Agricultural Research Organization

NGOs: Non-Governmental Organizations

NPK: Nitrogen, Phosphorus, and Potassium

S/C: Sub-County.

SOCADIDO: Soroti Catholic Diocese Development Organization

SODIFA: Soroti District Farmers Association

SSA: Sub-Saharan Africa

SSP: Single Superphosphate

TEMEDO: Temele Development Organization

TSP: Triple superphosphate

UBOS: Uganda Bureau of Statistics.

ABSTRACT

In modern agriculture, inorganic fertilizers are commonly being used to supplement soil nutrients, to promote plant growth, to increase crop productivity and also improve food quality. Fertilizer adoption in Uganda in small holder agriculture is among the lowest in comparison with other Sub-Sahara African countries. This study was carried out to investigate the adoption of inorganic fertilizers for crop production in Soroti district by identifying the common types of inorganic fertilizers used for crop production, finding out the factors affecting the adoption of inorganic fertilizers, and determining the relationship between adoption of inorganic fertilizers and crop yields. The methods used were stratified random sampling, purposive, and snowball sampling. The data collection instruments were the questionnaires and structured interview schedules. The data was analyzed using the Statistical Package for Social Scientists software. Spearman's rank correlation coefficient was used to analyze the correlation between the adoption of inorganic fertilizers and crop yields. ANOVA and t-test were carried out to determine significant mean differences between samples. Results from the study showed that DAP and Urea are the most commonly used inorganic fertilizers in all the sub-counties. The factors affecting adoption of inorganic fertilizers are high cost of purchasing, lack of sensitization, inaccessibility of the inorganic fertilizers, lack of training, cultural or negative attitude, poor storage facilities, and unreliable weather patterns. The ANOVA test indicated that there is no significant mean difference in fertilizer usage among the four sub-counties. However, from the t-test for independent samples, it was observed that there is a statistically significant difference between the means in the views regarding fertilizer usage between the local people in the different sub-counties and agricultural officers from NGOs, CBOs and NAADs coordinators. There is a modest and significant correlation between the adoption of inorganic fertilizers and crop yields. This study recommends frequent sensitization and training sessions, integrated fertilizer-use approach, a comprehensive fertilizer policy, provision of improved seeds or crop varieties, and setting up community demo-sites and carrying Environmental screening.

CHAPTER ONE

THE PROBLEM AND ITS SCOPE

Introduction/Background Information

Commercial inorganic fertilizers are referred to as commercially prepared mixtures of plant nutrients such as nitrates, phosphates and potassium applied to the soil to restore its fertility and increase crop yields (Miller, 1999). It is important to note that the term commercial inorganic fertilizer is synonymously used with inorganic fertilizers, artificial fertilizers or chemical fertilizers.

Hartemink (2003) stated that in the late 1800s and early 1900s, it was assumed that soil fertility in the humid tropics was very high because it supports such abundant vegetation as rain forest. The American soil scientist Hilgard E.W. thought that soils of the humid tropics were rich in humus because of the abundant vegetation supplying together with continuous and rapid rock and soil decomposition were thought to be very high under the prevailing climatic condition hence providing a constant supply of minerals for plant growth. Hartemink further emphasized that the high fertility theory of tropical soils was dispelled when the forests were cut, crops planted and it was discovered that yield levels were low or rapidly declining. It emerged that soil fertility in the tropics is uniformly low and easily lost by cultivation.

Inorganic fertilizers are being used to supplement soil nutrients, to promote plant growth, to increase crop productivity and food quality is now common in modern agriculture. Therefore, crop production and global food security are also now highly dependent on inorganic fertilizers as inputs to agricultural lands (Bolduc, *et al.,* 2010). In Asian and Latin American countries, the dissemination of modern agricultural technology in the form chemical fertilizers and high-yielding varieties has boosted crop yield drastically since the 1960s while agricultural productivity in most Sub-Saharan African countries has been stagnant (Matsumoto, *et al.,* 2010).

The agricultural sector in Sub Saharan Africa has continued to be an essential element for sustainable development, rural poverty reduction and a reliable

source of self food sufficiency for the region. Increasing agricultural productivity in the Sub Saharan Africa especially in Nigeria is an urgent necessity and one of the basic ways of improving agricultural productivity is through introduction and optimal use of improved agricultural technologies like use of inorganic fertilizers (World Bank, 2008; Sunday, *et al.,* 2012).

Annual growth rates in fertilizer use in East Africa was about 10% in the 1960s but had decreased to 0.7% in the 1990s. In Southern Africa annual growth rates in fertilizer use decreased from 10% in the 1970s to 3.4% in the 1990s (Hartemink, 2003). Overall growth rates in sub-Saharan Africa remained behind the developing world since the 1960s although the gap widened in the 1980s and 1990s. Sub-Sarahan Africa (SSA) is one of the poorest regions on Earth, in both living standards and soil fertility. The depleted soil nutrients caused average yields of grain crops to stagnate at around 1 tonne per hectare since the 1960s. However, yields now reach 2.5 t ha^{-1} in south Asia and 4.5 t ha^{-1} in East Asia, where chemical fertilizers have been widely adopted since the green revolution. Fertilizer use across Africa has remained at around 9 kg ha^{-1} of cultivated land over the past 40 years, whereas Asia uses 96 kg ha^{-1} of inorganic fertilizer (Natasha, 2012).

Most of the inorganic fertilizers in Sub-Saharan Africa are used on plantation crops and less on the small scale farms hence integrated nutrient management is being promoted alongside inorganic fertilizers to improve the overall negative nutrient balance and the efficiency of nutrient use (Hartemink, 2003). The agricultural sector in Uganda for the foreseeable future will remain the mainstay and engine of growth for the economy. Over 88% of Uganda's population live in the rural areas and earn their livelihood from agriculture. In 1996/97, the sector contributed 47% of the total GDP and over 94% of exports. Agricultural production is increasingly based on a wider range of purchased or free inputs in terms of seeds, fertilizers, pesticides, machinery, and water that must be combined and used wisely to achieve sustainable production (World Bank, 2007).

A prominent constraint to higher productivity among farmers in the region is soil infertility related mainly to low nutrient status of the soils and continuous cultivation, little or no replenishment of depleted soil nutrients, absence of modern inputs, and very low use of critical inputs including fertilizers and pesticides. The absence of an almost efficient distribution network also affects the low level of input usage (Sunday, *et al.,* 2012).

Problem Statement

Agricultural production in Uganda can be categorized in four major sub-sectors namely crops, livestock, fisheries and forestry. The crops sub-sector is by far the largest in terms of area of coverage and contribution to Gross Domestic Product (GDP) of 76% in 1995 (Mukiibi, 2001). Much of the food production, however, is for direct consumption at household level. Only 35% is sold to the domestic and export markets. Small holder farming, estimated at 2.5 to 3.0 million holdings, predominates, accounting for 94% of all crop production. The typical smallholder farmer cultivates 0.5-2.0 ha per year (Mukiibi, 2001). Achieving sustained higher levels of agricultural production should be done through enabling smallholder farmers to access and make profitable use of high yielding agricultural technologies, such as inorganic fertilizer. The ever increasing human population and the declining crop yields due to lack of adequate soil nutrients are factors for enhancing proper adoption of inorganic fertilizers. Erisman, *et al.* (2008) asserted that almost half the people on planet Earth are fed as a result of synthetic fertilizer use.

According to MAAIF and MFPED (2000), it was reported that fertilizer adoption or use in Uganda particularly in smallholder agriculture was among the lowest in the world in comparison with other Sub-Saharan countries. Inorganic fertilizer supply and use in Uganda remains very low at about one (1) kg/hectare/year, in spite of stagnant or declining productivity on smallholder fields in the recent years and one of the major reasons for this kind of trend in fertilizer use is the wide belief mostly among the policy makers that Ugandan soils are exceptionally fertile (Korugyendo, *et al.*, 2011). Cost is

one of the biggest problems perhaps because of transport expenses, farmers in Africa pay more than twice as much for fertilizer as farmers in Europe and this makes supply often unreliable because of poor distribution systems (Natasha, 2012). In addition, Sunday, *et al.,* (2012) also proved that output of crop, level of education, farm size and price of fertilizer were some of the important factors influencing farmers' use of fertilizer in arable crop production while gender, age and household size were not while in Kenya extension service providers' visit to farmers, proportion of land under maize production, sex of household head, and agricultural training. This study assessed the adoption of inorganic fertilizers for crop production.

Research Objectives

General objective:

The general objective of this study was to assess the adoption of inorganic fertilizers for crop production by the local communities in Uganda.

Specific objectives:

The specific objectives of the study were;

1) To find out the types of inorganic fertilizers commonly used by the local communities for crop production
2) To identify the factors affecting the adoption of inorganic fertilizers
3) To determine the relationship between the adoption of inorganic fertilizers by the local communities and crop yields.

Research questions

This study was guided by the following research questions;

1) What are the types of inorganic fertilizers commonly used for crop production?
2) Which factors affect the adoption of inorganic fertilizers?
3) Is there any significant relationship between adoption of inorganic fertilizers by the local communities and crop yields?

Scope

Geographical scope

The study was conducted in Soroti district located in Eastern Uganda. It was specifically in the sub-counties of Arapai, Kamuda, Gweri and Katine in Soroti County.

Content scope

The study assessed whether the local communities are adopting the use of inorganic fertilizers for crop production. It further find out the common types of inorganic fertilizers used for crop production; identified the factors affecting the use of inorganic fertilizers by the local communities and also determined the relationship between adoption of inorganic fertilizers by the local communities and crop yields.

Significance of the study

The study will help the government to plan for better solutions to increase crop production and reduce food insecurity in the country.

More Non-Governmental Organizations will be persuaded to increase service delivery in terms of agricultural inputs to the district.

The government will be influenced to conduct ample research and introduce high quality inorganic fertilizers at affordable prices to the local communities.

Vital information concerning crop productivity, soils and inorganic fertilizers will be adequately disseminated, hence making them readily available from the National level to the local levels for better provision of agricultural inputs in the region. This will also serve as a reference source for others seeking similar information to suit their needs, especially academicians.

Operational Definitions of Key Terms

For purposes of this study, the following terms are defined to mean the following;

Adoption: it refers to the process of choosing or accepting to follow a course of action or idea.

A crop: refers to a non-animal species or variety that is grown to be harvested as food, livestock fodder, fuel or for any other economic purpose. While the term "crop" most commonly refers to plants, it can also include species from other biological kingdoms, for example, mushrooms, which are in the fungi kingdom (FAO, 2009).

Inorganic fertilizers: These are fertilizers mined from mineral deposits with little processing (for example, lime, potash, or phosphate rock), or industrially manufactured through chemical processes (for example, urea).

Local community: refers to a group of interacting people sharing an environment. In human communities, intent, belief, resources, preferences, needs, risks, and a number of other conditions may be present and common, affecting the identity of the participants and their degree of cohesiveness.

A local community also includes the local government authority, as well as the local businesses, schools, and cultural activities hence local communities vary in size, composition, structure, and organization.

Crop production: is the process of producing cultivated plants.

CHAPTER TWO

LITERATURE REVIEW

Concepts, Ideas and Related studies.

Concept of adoption

According to Tadesse (2008), there are several definitions of adoption which include;

Adoption is a mental process through which an individual passes from first knowledge of an innovation to the decision to adopt or reject and to confirmation of this decision.

It also refers to the decision to use a new technology, method, practice, and many others by a firm, farmer or consumer.

Furthermore, adoption is not regarded as a permanent behaviour. An individual may decide to discontinue the use of an innovation for a variety of personal, institutional or social reasons one of which could be the availability of an idea or practices that is better in satisfying his or her needs.

However, he further emphasized that adoption does not necessarily follow the suggested stages from awareness to adoption; trial may not always practiced by farmers to adopt new technology. Farmers may adopt the new technology by passing the trial stage. In some cases, particularly with environmental innovations, farmers may hold awareness and knowledge but because of other factors affecting the decision making process, adoption does not occur.

The adoption is a decision-making process, in which an individual goes through a number of mental stages before making a final decision to adopt an innovation. Decision-making process is the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward an innovation, to a decision to adopt or reject, to implementation of new idea, and to confirmation of the decision.

Theoretical perspective

Inorganic fertilizers provide nutrients to plants and an exact measurable amount is fed to the plants. However, fertilizers partially restore plant nutrients lost by erosion, crop harvesting, and leaching. Farmers can use either organic fertilizers from plant and animal materials or commercial inorganic fertilizers produced from various minerals to restore soil fertility (Miller, 1999).

According to Wolman, *et al.* (1987), the dominant influence that inorganic fertilizers are having on agriculture in the world today is inescapable. They account for at least 30% of all agricultural produce of the United States, and probably more of the order of 50% of cereal grain production. Without them, the United States of America (USA) would not be an exporter of agricultural products. Certainly many different advances-including improved varieties and hybrids, expanded irrigation practice, better control of pests and diseases, and improved cultural practices-have contributed to the approximate doubling of wheat and quadrupling of corn yields in the past 30 years. These production increases have come about by reason of the fertilizer input in combination with other factors.

Michael, *et al.* (1997), suggested that increasing fertilizer use can help solve Africa's environmental problems and on the other hand, lack of inorganic fertilizer has greater negative environmental consequences than increasing use of this fertilizer. Current agricultural practices mine soil nutrients, with average removal of more than 24 kg/ha/year of nitrogen (N), phosphorus (P), and potassium (K) and the organic sources are not always sufficient to replace these nutrients hence low crop yields.
They further proposed that in order to feed its growing population, Africa must increase its food production by 4% per year for the next 10 years while increasing the use of chemical fertilizers from an average of 10 kg/ha to 50 kg/ha because organic sources of soil nutrients will not be sufficient. This means that the use of inorganic fertilizers must increase at the rate of 18% per year, which is significantly more than the increases observed in South Asia (13%) and Southeast Asia (9%) from the early 1960s to the late

1980s. Moreover, these increases must be achieved under much more difficult conditions than Asian farmers faced, particularly with respect to soil conditions, water availability, and access to input and output markets. A more realistic target for increases in inorganic fertilizer use is probably 30 kg/ha.

Types of inorganic fertilizers commonly used by local communities for crop production.

Data available on different types of fertilizers consumed such as Di-ammonium Phosphate (DAP), Monoammonium phosphate (MAP), urea, Nitrogen Phosphorous Potassium (NPK) complexes, among others are very patchy across countries making it difficult to determine whether changes have occurred in the types of fertilizers used. In many SSA countries, fertilizer supplies are often provided as "in-kind aid" by bilateral donors for example, Japan or European countries that tend to send NPK complexes. Since the 1980s, however, some countries have begun importing higher analysis fertilizers such as DAP and urea (Kelly and Naseem, 1999).

They also indicated that Urea consumed in 1995 was six times greater than that consumed in 1970. As total nitrogen consumption in the 1990s was only two times what it was in the 1970s, this six-fold increase in urea probably represented a switch from reliance on NPK complexes and lower-analysis nitrogen fertilizers. This led to a dramatic change in the relative importance of countries consuming urea whereby, in 1970 Sudan accounted for almost 90% of SSA's urea consumption, but in 1995 it represented about 15%, with approximately 40% being consumed by Ivory Coast, Nigeria, and Zambia while the remaining 45% was being distributed across other SSA countries.

In Vihiga district-western Kenya, extension workers recommended the use of organic manure and/or triple super phosphate (TSP), calcium phosphate (CAP) or rock phosphate, but not Di-ammonium phosphate (DAP), which is soil acidifying. However, DAP makes up about one half of all the fertilizer used among the twelve (12) types

available according to Ministry of Agriculture in the year 2000. They also proposed that DAP should not be superior to other phosphorus sources on agronomic reasons, since the East African soils are pronounced to have a flush of nitrogen (N) mineralization at the start of the rains, and the small amounts of N supplied in DAP are likely to be leached out of the root zone by the time that high crop demand for N occurs (Waithaka, *et al.,* 2007).

However, farmers' preference for DAP could be due to historic reasons because DAP has been more readily available country-wide than TSP or calcium phosphate. For example, while total fertilizer use increased gradually from 879 tons in 1994 to 2,356 tons in 2000, there was a decline in the use of TSP and rock phosphate, largely because of their unavailability. Recommended application rates by the ministry of agriculture in Vihiga for all crops of are 130 kg per ha. Although 70% of the farmers in Vihiga use fertilizers, the amount used is quite low. It was on average 10.7 kg of fertilizer per ha, which is much lower than the already-low Kenyan aver-age of 46 kg per ha, of which 20–28% goes to food crops.

Korugyendo, *et al.* (2011), emphasized that Urea and Diammonium Phosphate (DAP) are the most commonly sold fertilizers in Uganda; followed by the NPK (Nitrogen, Phosphorous and Potassium) blend at a ratio of 1:1:1. Urea and DAP are used principally on maize, whereby DAP is used as a basal dressing applied shortly after crop emergence and urea as a top-dressing applied three to six weeks later when the maize plants are about knee-height before the maize flowers. Calcium Ammonium Nitrate (CAN) is also another nitrogen fertilizer used on coffee and vegetables more than on maize whereas Potassium (potash) fertilizers are not commonly sold in Uganda.

Factors affecting the adoption of inorganic fertilizers for crop production by the local communities.

According to Chanan (1999), community involvement in local development means that a large proportion of local residents are involved in their own local organizations, networks and initiatives; know what is being planned for their locality by the authorities and have mechanisms for influencing this and for being represented in decision making; are also confident that development budgets are being used to best effect and that the population of the locality as a whole will benefit; cooperate actively with official schemes, invest their own voluntary labour, and adapt their organizations or taking new initiatives of their own to add value; feel ownership of what is achieved by development schemes and therefore preserve and enhance it.

It is important to note that inorganic fertilizers are at the centre of any efforts meant to bring agricultural productivity back to life in western Kenya. This argument places emphasis on the strategies that promote best organic options without integration of inorganic fertilizers are unlikely to succeed under smallholder farming systems in western Kenya because of the low effect of organic fertilizers on the inherently low soil fertility levels (Odendo, *et al.,* 2009).

Baanante and Thompson (1988) observed that the demand for fertilizers is derived from the demand for agricultural products. The factors that affect and determine agricultural production and the demand for fertilizers may be classified as; climatic variables, soil characteristics, economic and social variables. In conjunction with the knowledge and experience of farmers, these factors affect decisions about the use of resources for agricultural production (crops and cropping systems) and the use and management of fertilizers and other variable inputs.

In accordance with the fertilizer Policies, both supply and demand constraints have hindered the emergence of viable fertilizer markets in Sub-Saharan Africa (Melinda, *et*

al., 2011; and Mariam, *et al.,* 2010). Further, whereas nearly all fertilizer is imported, the cost of fertilizer is dependent on transport costs, and landlocked countries like Uganda are particularly disadvantaged with respect to this bulky input. Transport and logistics costs in African have been found to be three to four times higher than they are in the US, explaining the fact that in general, farmers in Sub-Saharan Africa pay at least double the price for fertilizer relative to farmers in Asia and the United States. They continued to suggest that the high seasonality of demand for fertilizer in rain-fed systems and the bulkiness of the product lead to relatively slow stock turnover or sales, considerable storage requirements, and high finance charges, resulting in risk for distributors and dealers. However, on the demand side, high cost, combined with low agronomic efficiency, makes the use of inorganic fertilizers unprofitable for many farmers in Sub-Saharan Africa.

Liberalization of fertilizer markets has been implemented to varying degrees across countries and with very mixed success. The liberalization of Kenya's fertilizer markets is considered to have been most successful (Ariga and Jayne, 2011). After the elimination of fertilizer price and import controls in the early 1990s, national fertilizer consumption doubled by 2007. Survey data collected from 1997 to 2007 by Tegemeo Institute indicated that smallholder fertilizer use per hectare of maize cultivated grew by 34 percent. The distance travelled by farmers to the nearest fertilizer retailer declined dramatically, reflecting increased investment in fertilizer retailing by private dealers. Inflation-adjusted fertilizer marketing margins between Mombasa and inland markets have narrowed, and nutrient-to-grain price ratios at the farm gate have become more favourable.

Melinda, *et al.* (2011), indicated that in contrast to Kenya, Ethiopia continues the state-led, package-based approach today. The Government of Ethiopia liberalized the fertilizer sector after the end of the Derg and by 1996 several private firms were importing fertilizer, and 67 private wholesalers and 2,300 retailers had taken over a significant share of the domestic market. Low use of fertilizer has been partly attributed

to weak or nonexistent crop responses, partially because of variable rainfall, poor soil quality, an absence of irrigation, and a lack of improved crop cultivars (McIntire, *et al.,* 1992).

Studies in Zambia illustrate that, in the more remote areas, where farmers faced nitrogen-maize price ratios that were 20 percent higher than elsewhere, fertilizer use was profitable for only a few farmers. However, fertilizer use was profitable for farmers in the more accessible areas only when its delivery was timely. Subsidized fertilizer under government programs in Zambia has often been distributed late. It is also believed that government programs have also caused private traders to wait and see where subsidized fertilizer is being distributed before deciding where to distribute commercial fertilizer, intensifying the problem of late delivery even for commercial fertilizer (Melinda, *et al.,* 2011).

Researchers assign varying levels of importance to the different causes of Africa's land degradation problems, but most agree that farmers' failure to intensify agricultural production in a manner that maintains soil productivity is a key component (Crawford, *et al.*, 2006; Kaizzi, *et al.,* 2011). Social and economic factors do not favour the use of inorganic fertilizers by smallholder farmers. Poulton, *et al.* (2006) identified four constraints on increased fertilizer use in Africa – supply constraints, knowledge gaps, agro-ecological and other biophysical constraints, and economic challenges related to poorly performing output markets. They further stressed that of all the constraints, the supply constraint was the most binding but also the most easily addressed.

However, Poulton, *et al.* (2006), proposed that the significant determinants of the levels of use of fertilizer in Africa can be identified on the demand side as well. Demand for fertilizer is often weak because the incentive to use fertilizer is undermined by the low level and high variability of crop yields on the one hand and the high level of fertilizer prices relative to crop prices on the other. The demand depressing effects of unfavourable price incentives are aggravated by many other factors, including the lack

of market information about the availability and cost of fertilizer, the inability of many farmers to raise the resources needed to purchase fertilizer and the lack of farmer knowledge on how to go about using fertilizer efficiently.

Farmers in north-eastern Uganda are poor (Anon, 1999) and inputs in sweet potato, such as fertilizers and pesticides, cannot be afforded. In a previous study only farmers in the village Aukot (Soroti District; Sub-county Gweri) were reported to apply pesticides or inorganic fertilizers (Abidin, 2004). Moreover, pesticides and inorganic fertilizers are not always available at the trading centres, or are only accessible for those who own transportation means. To date, the economics of fertilizer use in Uganda is problematic due to both the high cost of the input and the often low prices that farmers receive for their crops. Relevant to explaining low uptake of fertilizer by farmers in Africa is the often long distances between farmers and the nearest fertilizer retailer, weak market infrastructure, and lack of government support (Ariga and Jayne, 2011).

For Uganda's case, relatively inefficient transport systems deliver fertilizer into Uganda from the depots of wholesalers in Kenya or direct from international suppliers through the port of Mombasa and on to rural trading centres in rural areas. The bulky nature of inorganic fertilizer adds to the cost of transport and handling, resulting in high prices for the input when farmers purchase it. While the government of Uganda does not impose explicit taxes on fertilizer, costs are exacerbated by missing public investments that, if in place, would reduce the costs borne by farmers in using fertilizer – these include public infrastructure for transport and marketing, information, and institutions that would facilitate farmer's use of the input (Korugyendo, *et al.,* 2011).

Mwangi (1997) asserted that up to the year 2000 and beyond, the population of SSA was expected to grow at a rate of more than 3% per year, while food production was likely to grow at a rate of 2% or less a year. Closing this gap and increasing food production therefore required intensive agriculture based on modern technologies, including fertilizers. Such changes are particularly crucial because many regions of SSA

are no longer land abundant. Land scarcity is compounded by low soil fertility, resulting from the shortening or elimination of the fallow period without concurrent efforts to increase soil nutrients through fertilizer application or other soil management practices.

The use of chemical fertilizers integrated with sound crop nutrient management practices is the key to increased yields per unit area and the maintenance of these yields in a sustainable manner. The increased yields further reduce the pressure for extension of cultivated areas and thus the encroachment of agriculture into marginal areas and fragile environments, therefore, fertilizer is not only essential but also environmentally beneficial. Careful use of fertilizer based on sound soil and crop-production knowledge can reduce any adverse environmental effects these products may have (Michael and Walter, 1997).

Relationship between adoption of inorganic fertilizers and crop yields

High quantities of inorganic fertilizer, particularly nitrogen (N), have been used to increase world food production. By the year 2020, it is estimated that 70% of plant nutrients will have to come from fertilizer. Generally, large amounts of applied fertilizers are not taken up by crops and thus could cause negative environmental impact if not well handled (Mubarak, *et al.,* 2003). The nutrient content of fertilizers consumed in SSA has remained relatively constant over time. Nitrogen represents the most important nutrient, accounting for about 52% of consumption from year to year. Phosphorus has increased slightly from about 26% to about 30%, and potassium has declined from about 22% to 18% (Kelly and Naseem, 1999).

The field experiments conducted during the wet seasons of 2006 and 2007 at the Agricultural Experimental Farm of the Indian Statistical Institute, Giridih, investigated the effect of planting geometry and nutrient management practices on productivity of two hybrid rice cultivars (a plant or group of plants selected for desirable characteristics that can be maintained by propagation), that is, Pro Agro 6201 rice and "CNRH-3" rice. CNRH-3" rice proved its efficiency in terms of grain yield that was also reflected in yield

attributing characters such as number of productive tillers, number of grains per panicle, length of panicle, panicle weight, test weight and harvest index. Higher rice grain yield were registered from the cultivars grown in 20 cm × 20 cm planting geometry. Rice cultivars grown with the application of inorganic fertilizers alone produced maximum grain yield and also recorded higher values of ancillary characters (Ranjita, *et al.,* 2011).

In Burundi, Common bean (Phaseolus *vulgaris*) a major staple food had its outputs declining for decades, yet demand for the crop in East Africa has greatly increased. This study was conducted in Burundi to assess the determinants of quantity produced and marketed by smallholder farmers. Limitations to the production and supply of beans to markets include lack of productive assets, lack of improved varieties and inadequate use of fertilisers. The results indicated that with regard to these limitations indicated that a unit increase in the value of productive assets is likely to lead to about 10 percent increase in production of beans; while changing to improved bean varieties may increase production by 22%. It was also noted that a kilogram increase in fertiliser use is likely to raise bean quantities produced by about 10% thus increasing its production and marketing with the potential of raising incomes of the farming households (Birachi, 2011).

Minde (2005) emphasized the following gaps in fertilizer utilization as; lack of concrete and related evidence on adoption rates and fertilizers types in the Region, knowledge of response to different types of fertilizers is not documented, limited Knowledge of the structure conduct and performance in the fertilizer market particularly with regard to private sector participation, there is no regionally accepted business code of conduct, regulations, procedures, policies, among others, and further more the existence of a big gap in the regional knowledge on the constraints affecting fertilizer use. He equally identified the following as the key issues in increased use of fertilizers; Identifying underlying causes of weak access to fertilizers by farmers, relative prices (input-output

relationship), improved crop responses to fertilizers, better transactions costs, Credit markets, and the creation of an enabling policy environment.

However, Food and Agricultural Organization (FAO) reports on fertilizer use intensity among Nigerian farmers reveal an increasing fertilizer use rate from 1970 to 1993. The intensity however dropped from 11.8Kg/ha in 1995 to 8.90Kg/ha, 9.0Kg/ha and later increased to 13.0Kg/ha in 1996, 2003 and 2009 respectively. The reports further reveal that the fertilizer use rate among farmers in Nigeria was far below the 200 kg/ha recommended by FAO for the sub Sahara African countries. In the whole of Sub-Saharan Africa, it is estimated that 40 percent of fertilizer is used on maize, implying that the average dose is only about 17 kg/ha of nutrients compared to the developing country's average of 100 and the industrialized country's average of 270 kg/ha on the same crop (Mariam, *et al.,* 2010). In comparison with other traditional farmers' crop varieties, maize is has proved to be a heavy consumer of fertilizer, hence it is the leading fertilizer demand crop in industrialized countries among major cereals, and the second most heavily fertilized crop on a global scale, after potatoes (Melinda, 2011).

Crop production and yield per unit area are low and declining because of low soil fertility and low levels of fertilizer application (Kaizzi, *et al.,* 2011). Declining soil fertility and land degradation in Uganda have negatively affected the land on which the poor smallholder farmers depend, putting at risk their food security and the sustainability of their natural resources base. Reversal of soil degradation will require policy interventions to enable the majority smallholder farmers to purchase and increase their use of chemical fertilizers. Application of inorganic fertilizers is an effective means to reverse soil nutrient depletion and improve land productivity and has been credited for much of the sustained increases in per capita food production in Asia and Latin America (Bumb, 2009).

Currently, the economics of fertilizer use in Uganda is problematic due to both the high cost of the input and the often low prices that farmers receive for their crops. Our interest here is on fertilizer. Relevant to explaining low uptake of fertilizer by farmers in Africa is the often long distances between farmers and the nearest fertilizer retailer, weak market infrastructure, and lack of government support (Ariga and Jayne, 2011). This is certainly the case in Uganda. Relatively inefficient transport systems deliver fertilizer into Uganda from the depots of wholesalers in Kenya or direct from international suppliers through the port of Mombasa and on to rural trading centres in rural areas. The bulky nature of inorganic fertilizer adds to the cost of transport and handling, resulting in high prices for the input when farmers purchase it. While the government of Uganda does not impose explicit taxes on fertilizer, costs are exacerbated by missing public investments that, if in place, would reduce the costs borne by farmers in using fertilizer and these include public infrastructure for transport and marketing, information, and institutions that would facilitate farmers' use of the input.

A study demand of fertilizer among farmers in Benin Republic and Malawi discovered that in Benin Republic the education of household head, size of farm plot, household head expenditure, farm size, maize plot, rice plot, and number of cattle owned had significant effect on fertilizer demand. In Malawi, they made conclusions that household size, education of household head, ethnicity, price of maize, farm size, number of pigs owned, household head expenditure, club membership, and vegetable plot affect fertilizer demand (Sunday, *et al.,* 2012)

It is also noted that, large scale and widespread inorganic fertilizer trials are no longer conducted. Instead of advocating the use of inorganic fertilizers, studies in the late 1980s and early 1990s focused on new arguments to justify the use of inorganic fertilizers. This was found when nutrient balances were re-introduced as a research tool because of reported widespread soil fertility decline and nutrient mining particularly for sub-Saharan Africa (Hartemink, 2003).

However, when Malawi faced a major food crisis in 2005, Bingu wa Mutharika who was the President by then, was facing re-election, hence he had to reintroduce subsidies for fertilizers and improved seeds in a bid to solicit for votes by addressing the problem of low crop productivity which was leading to hunger. In the next few years, that policy reaped strong agricultural gains, which came to be known as the Malawi miracle. As fertilizer use in Malawi almost doubled between 2005 and 2009, maize yields greatly increased from around 1 t ha^{-1} in 2005 to almost 3 t ha^{-1} in 2009–10, according to government figures. The agricultural subsidy programme cost the Malawian government $461.4 million over five years, and comprised 13.5% of the national budget in 2009 (Natasha, 2012). Therefore it is generally found that crop yield increases with the use of inorganic fertilizers.

CHAPTER THREE

MATERIALS AND METHODS

Introduction

In this chapter, the methods of the study are presented and discussed. It concentrates on the research design, the sample population and the sampling techniques for data collection, the research ethics to be considered, the instruments and measures employed for collecting data, and the techniques utilized for analyzing the data.

Description of the study area

Soroti District is located in the Eastern region of Uganda. Soroti District is bordered by Amuria District to the north, Katakwi District to the east, Serere District to the south, and Kaberamaido District to the west. It is located at Latitudes 01°42′54″N and Longitudes 33°36′40″E. Soroti district is situated approximately 320kms north east of Kampala city and approximately 112 kilometers (70 miles) by road, northwest of the city of Mbale. It covers an area of 2,257km^2 of land and 406km^2 of water.

Rainfall and temperature: Soroti District receives a mean annual rainfall of about 1350 mm. Peak rainfall is experienced from April to June and August to November. In other words it receives a bi-modal type of rainfall. The temperatures recorded are; mean annual maximum temperature of around 31.3°C and a mean minimum of around 18°C.

Soils: The soils are mainly of the ferrallitic type (sandy sediments and sandy loams). They are well drained and friable. Bottom lands contain widespread deposits of alluvium. Most of the areas in the district are underlain by rocks of the basement complex pre-cambrian age which include; granites, mignalites, gneiss, schists and quartzites.

Economic activities: Agriculture is the main economic activity in the district. The produce is consumed locally and some is sold in the urban areas, particularly in Soroti Town.

Population: The national census of 2002 estimated the district population at approximately 193,300 of whom 51.2% were female and 48.8% were male. It is estimated that in 2010, the population of Soroti District was approximately 241,200. The two predominant ethnic groups in the district are the Iteso and the Kumam. The main languages spoken in the district are; Ateso, Kumam and Swahili.

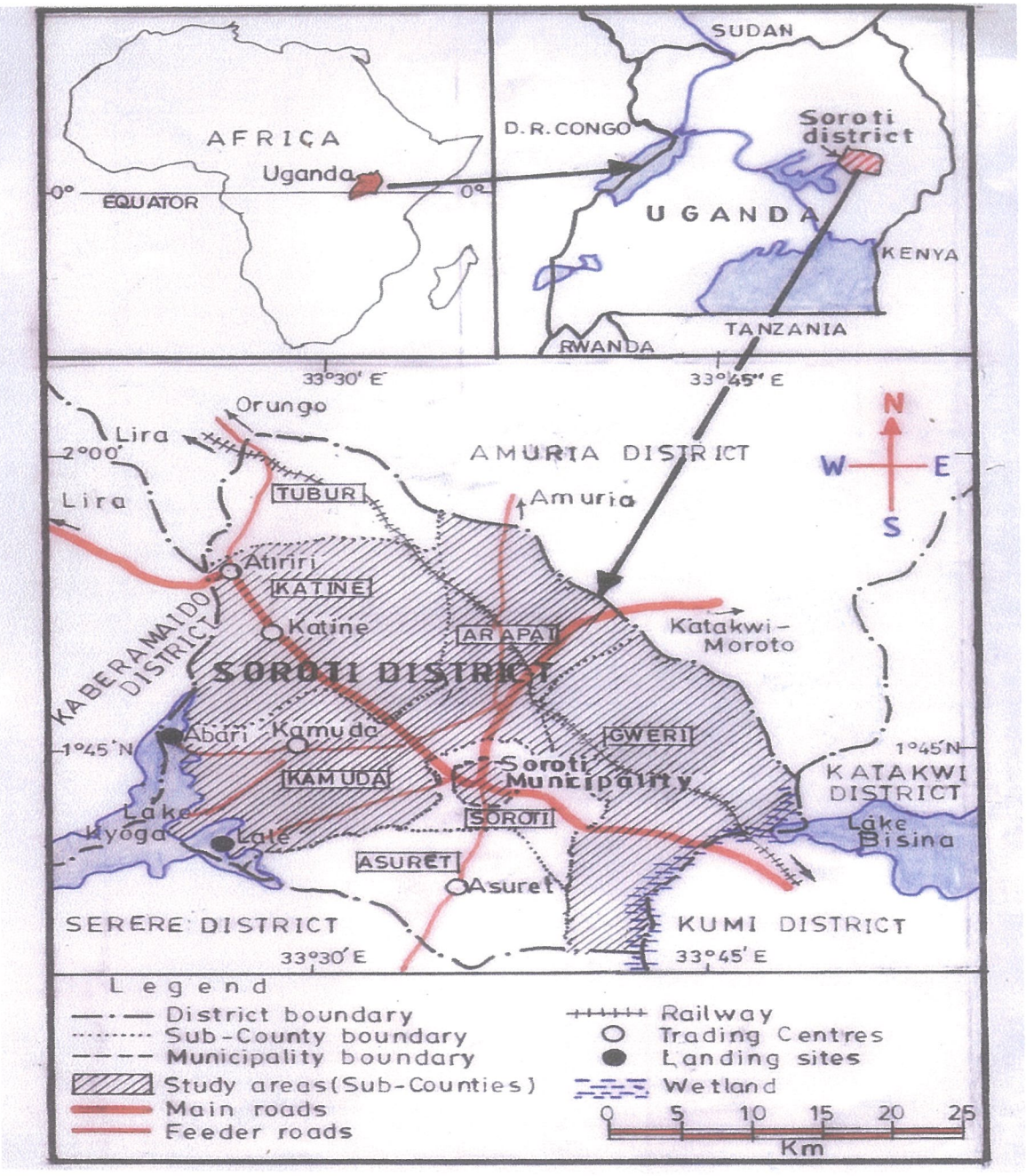

Figure 1: Map of Soroti District showing the study areas

Research design

This study involved the descriptive designs. Therefore, both qualitative and quantitative data collection methods were used for obtaining data from the local community and agricultural related officers.

Research population

In this study, the target population was the local farmers and agricultural experts/employees from the various organizations such as National Agricultural Advisory Services (NAADS) which is the leading government agency concerned with agriculture in the entire district and Country at large but mandated by the Ministry of Agriculture, Animal Industry and Fisheries. However, other NAADS activities are done concurrently with the support from other Non-Governmental Organizations (NGO's) and Community Based Organizations (CBO's). The NGO's included CIDI, SODIFA, SOCADIDO and World Vision (W V), Sunshine Agro-products Limited. The, CBO's included; TEMEDO and CATEP. These categories of respondents were considered because it was believed that they had up to date and reliable information on the aspects considered in the study.

Sample size

According to Amin (2005), the target or parent population is the population to which the researcher ultimately wants to generalize the results. It may not be easily accessible to the researcher. On the other hand, a sampled or accessible population refers to one from which the sample is actually drawn. The target population from the different sub-counties was divided into strata namely; the local farmers, NAADS coordinators, then the NGO's & CBO's. In using stratified random sampling, I determined the extent to which each stratum in the population was represented in the sample and ensured the coverage of all the target population in the representative sample.

Stratification of the sample size categories

The target population of the different local farmers and organizations in the four sub-counties were subjected to stratification in order to get the representative sample that was included and used as a target population and sample size. In this case, 43 farmers were considered from Arapai Sub-county, 39 from Kamuda sub-county, 32 from Gweri sub-county and 27 from Katine. In addition, 10 employees from the various agricultural-related organizations working in each sub-county will be considered totalling to 30 employees.

Table 1: Categorization of the Representative Target Population

Name of Sub-counties, government Agency, NGO's & CBO's	**Number of respondents**
Arapai sub-county	43
Kamuda sub-county	38
Gweri sub-county	32
Katine sub-county	27
NAADS representatives	12
NGO's & CBO's	20
Total	**172**

Therefore, stratification sampling function= $^{n}/_{N}$ OR: **n/N.**

Whereby: n= Sample N= Population size

$$\frac{172}{}$$

1.425 = 120.

Sloven's formula was also used to support and guide the sampling process for clarity as indicated below:

$$n = \frac{N}{1+Na^2}$$

Whereby; **n**= sample size, **N**= target population, and **α**= confidence level at 0.05

$$n = \frac{172}{1+172x0.0025} = 120$$

$$= \frac{120}{172} = 0.7$$

Arapai = 0.7 X 43 = 30

Kamuda = 0.7 X 39 = 27

Gweri = 0.7 X 32 = 22

Katine = 0.7 X 27 = 19

NAADS = 0.7 X 12 = 08

NGO's & CBO's =0.7×20 = 14

Therefore; 30 + 27 + 22 + 19+8+14 = **120 total number of respondents.**

Sampling Procedure

Purposive sampling

In this non random sampling method, best judgement was used to select and pick the respondents that met the purpose of the study at its best. Only those that had been considered relevant to the study were included, meaning that the respondents were chosen based on their experience and knowledge about the study. Respondents were also picked from the different categories to ensure effective representation. It therefore implies that, the local farmers from four sub-counties, NAADS coordinators from district, alongside NGO's and CBO's representatives were selected.

Snowball or network sampling

In addition, the snowball method was also used in stages; therefore in the first stage, a few respondents were identified who qualify to be in the sample. In the subsequent samples, the identified respondents acted as informers to help in the identification of other possible respondents to be included in the sample. This method helped because most of the respondents using inorganic fertilizers were not known. It also involved winning the confidence of the respondents which in turn helped when requesting them to invite their colleagues to be part of this study and referring me to their colleagues.

Stratified random sampling

In this random sampling method, the population was divided into mutually exclusive and non-overlapping groups or strata and a simple random sample was obtained from the strata. A random was taken from the strata. The main aim of stratifying the target population was because there were several parameters or characteristics such as the education level, gender, age, experience in agriculture that were represented in the sample, among others.

Furthermore, the sample was then categorized into proportionate samples; therefore, different numbers of respondents were obtained from each stratum.

Research Instruments

Questionnaires:

A questionnaire is a set of related questions designed for soliciting responses from respondents regarding a particular topic. A self-administered questionnaire was used whereby the respondents were required to read the questions and later on filled in the answers by themselves.

A letter of transmittal also known as the cover letter was acquired from the university administration to accompany the questionnaire. It contained an adequate

brief about the research, which was intended to explain the objectives of the research in order to eliminate too much doubt from the respondents.

However, it is important to note that some of the respondents could not read and write. Therefore, I administered the questionnaires an option which involved deciding to use the questionnaire to interview the respondents. More to this, it was very applicable in cases whereby the subjects did not have the ability to easily interpret the questions probably because of their education level, hence I had to read the items or questions and the categories to the subjects and while I was writing down their responses.

Formal or Structured interviews:

An interview is an oral questionnaire where the investigator or researcher gathers data through direct verbal interaction with respondent. In addition, as a research technique, the interview is used as a conversation carried out with the definite purpose of obtaining certain information by means of spoken word (Amin, 2005).

The researcher designed a set of predetermined and logically related questions contained in an **interview schedule**. In the course of the interview, I was recording the responses from the interviewees or respondents as soon as possible. In case the interviewee misinterpreted any question, I could follow up with a clarification while at the same time evaluating the sincerity and insight of the respondent. These formal interviews were useful mainly for comparative purposes.

Document review:

This method involved delivering information by carefully studying written documents, or visual information from sources best known as documents. These were in form of newspapers, speeches, advertisements, textbooks, pictures, and others. In the course of the research, some documents were gathered regarding local community adoption of inorganic fertilizers for crop production especially from the key informants, that is the NAADS coordinators, agricultural officers from NGO's and CBO's. This gave more

insights from the employees based on their daily practical field encounters with the local farmers.

Validity of the Instrument

Validity refers to the ability to produce findings that are in agreement with theoretical or conceptual values, in other words, to produce results and to measure what is supposed to be measured. Validity also means that it is true that the instrument measures what it is supposed to measure and that the data collected should accurately represent the respondent's opinions based on experience and knowledge.

Therefore, the Content Validity Index (CVI) will be used to test for validity.

Formula: **CVI** = $\frac{\text{Number of items declared valid}}{\text{Total number of items.}}$

Therefore; CVI = $\frac{111}{120}$ = 0.9

For the instrument to be accepted, the average index should be 0.7 or above (Amin, 2005). Hence the instrument has been accepted because it has an average index of 0.9 as its Content Validity Index.

Data analysis

After the collection of the raw data using the data collection instruments explained above, it was then systematically organized in a manner that facilitated statistical analysis.

For qualitative analysis, descriptive statistics was used to describe, organize and summarize the data inform of frequency distribution tables, and percentages.

The data collected was analyzed using the Statistical Package for Social Scientists (SPSS) software, Spearman's rank correlation coefficient test was carried out to determine the correlation between adoption of inorganic fertilizers and the crop yields. One-way Analysis of Variance (ANOVA) was also carried out to determine any

significant differences between the means from the five categories or samples of respondents at a selected probability level in the study of (α = 5% or 0.05).

Ethical consideration

In order to guarantee the Ethical standards of research, the following considerations were observed to avoid underachievement of the desired goals;

Confidentiality; this is needed because respondents can be suspicious, as to what can happen after the study has been completed. Therefore, the respondents/participants were assured of confidentiality in all the information or contributions they provided. This was done by further re-assuring them that the information provided was to be used for addressing the issues of this study, academic purposes but not any other unintended motives.

Respect of opinions or views; it was important to observe and further respect all the opinions from the participants. This created a sense of belonging to the participants by showing how much they are important in the society hence permitting for a smooth flow and avoiding sabotage from them.

Limitations to the study

This research study may not produce effective results due to a number of reasons that often threatened the internal validity of research. The following were identified as limitations to the research;

- **Attrition or experimental mortality:** Some respondents dropped out in a systematic way hence only more motivated and creative respondents were left in the study. Mostly, it was the less motivated (those who required money before filling in the questionnaires). Therefore, not all questionnaires were returned or collected implying much as I tried to convince them that the study was for academic purposes only and not for my profit making or business.

- **Instrumentation:** The instruments used for data collection appeared too difficult or too easy for some respondents based on their education levels. Another problem also arose because the research assistants were not consistent in observing, measuring, scoring or assessing the characteristics of the study despite the prior and consistent induction.
- **History:** The study conducted was taking too long beyond the available time of the respondents given the fact that it was cultivation, weeding and harvesting time for some crops. Some of the respondents got much involved in their own activities that influenced their participation in the study negatively thus affecting the quality of the research study.
- **Maturation:** During the course of the study, some of the respondents became more intellectually enlightened or motivated hence they were able to influence the participation or decisions of other prospecting respondents. In addition, some of the questions seemed too technical for them.

CHAPTER FOUR

Presentation, Analysis and Interpretation of Data

Introduction

This Chapter presents the analysis of data obtained from the questionnaires and interview schedules used to find out the common types of inorganic fertilizers from the four sub-counties, to identify the factors affecting the adoption of inorganic fertilizers and also to determine the relationship between the adoption of inorganic fertilizers and crop yields. The analysis and interpretation of the data is descriptive, qualitative and quantitative.

Demographic characteristics of the respondents

This section presents the distribution of respondents by age, gender, marital status, and education level as reflected in table one below.

Table 2: Demographic characteristics of the respondents from the four sub-counties of Gweri, Arapai, Kamuda and Katine (n=90).

Age of respondents	**Frequency**	**Percentage (%)**
24-33	21	23
34-43	18	20
44-53	29	32
54-63	14	16
64-73	08	09
Gender	**Frequency**	**Percentage (%)**
Male	69	77
Female	21	23
Marital status	**Frequency**	**Percentage (%)**
Single	10	11
Married	79	88
Divorced	1	01

Education level	Frequency	Percentage (%)
Primary	24	27
O-level	40	44
A-level	03	03
Tertiary	23	26

The above table indicates that respondents between the age categories of 44-53 are the highest users of inorganic fertilizers with a frequency of 29 and percentage of 32% while the second group is the respondents between 24-33 with 21 (23%). In addition the third group is the 34-43 with 18 (20%), and they are closely followed by those between 54-63 with 14 (16%), whereas the category 64-73 are the least in terms of using inorganic fertilizers with a frequency of 8 (9%).

However, the male headed households have the males influencing most of the family decisions including the adoption of inorganic fertilizers hence they account for a frequency of 69 and percentage of 77%, as compared to the female headed households with 21 (23%).

The respondents who are married are the highest users of inorganic fertilizers with a frequency of 79 and percentage of 88%, while those who are single as their marital status are 10 (11%), and only one respondent was divorced accounting for 1 (1%).

In terms of education level or rather qualification, it was noted that those who stopped in Ordinary level (O-level) were the most serious respondents as well as farmers in that they accounted for a frequency of 40 and percentage of 44% as far as adoption of inorganic fertilizers is concerned, and they are closely followed by those who acquired primary education only who had 24 (27%). In addition, the respondents who acquired tertiary education were 23 (26%) whereas the least category was Advanced level (A-level) with 3 (3%).

Types of inorganic fertilizers commonly used by the local communities

These inorganic fertilizers are on the vertical axis on the first column in correspondence to the horizontal axis indicating the different sub-counties in the second, third, fourth and fifth columns whereas the categories of NGO's & CBO's and NAADS coordinators are in the sixth and seventh columns respectively.

Table 3: Types of inorganic fertilizers commonly used in the communities.

Types of inorganic fertilizers	Use by the local communities and agricultural officials						Frequency	Percentage (%)
	Arapai	Kamuda	Gweri	Katine	NGO's and CBO's	NAADS coordinators		
DAP	20	5	7	8	10	5	55	27.5
Urea	20	18	13	11	10	5	77	38.5
MAP	4	2	0	0	0	0	06	3
SSP	4	9	3	0	4	4	24	12
CAN	9	3	4	1	3	1	21	10.5
NPK	3	0	2	0	2	4	11	5.5
SA	0	1	0	0	1	0	2	1
TSP	0	0	0	0	2	1	3	1.5
MOP	0	0	0	0	1	0	1	0.5
Total	60	38	29	20	33	20	**200**	**100**

Legend:

DAP= Diammonium Phosphate

MAP= Monoammonium Phosphate

SSP = Single Super Phosphate
CAN= Calcium Ammonium Nitrate
NPK= Nitrogen, Phshorous, and Potassium
SA = Sulphate of ammonia
TSP = Triple superphosphate
MOP= Murate of Potash

Table 3 above indicates the frequency distribution whereby Arapai S/C (sub-county) has the highest rates while Katine S/C has the lowest adoption rates of inorganic fertilizers. However, the most used fertilizers in Arapai S/C are DAP and Urea, whereas NPK is the least preferred. In comparison with Kamuda S/C, Urea is the highest followed by SSP while the least used is SA. Gweri S/C has Urea as the most used inorganic fertilizer as Urea, followed by DAP and least used is NPK. For the case of Katine S/C, Urea is still the most preferred, followed by DAP whereas CAN is the least used.

In addition, DAP and Urea are the most used inorganic fertilizers at 27.5% and 38.5% respectively. SSP is at 12%, CAN at 10.5%, while the least used are NPK at 5.5%, MAP 3%, TSP 1.5%, SA 1% and lastly MOP 0.5%.

Figure 2: A farmer shows his preference for DAP.

Figure 3: The crop varieties the farmer applies DAP and Urea.

Figure 2 shows a farmer in Arapai S/C and Amoru village displaying what was left from a full sack applying his favourite inorganic DAP while Figure 3 shows the crops, citrus and groundnuts that the farmer prefers to apply DAP and Urea to increase crop yields.

In reference to the agricultural officers in the NGO's & CBO's, they also stated that DAP and Urea are the most preferred by most of the local communities in the four sub-counties, followed by SSP, CAN, NPK and TSP, while the least preferred is SA and MOP.

In accordance, the NAADS coordinators equally commended DAP and Urea as the most preferred while SSP and NPK were stated as the third preferred in order of priority, however, CAN and TSP are the least preferred by the local communities.

It has been noted that DAP and Urea are the most commonly used fertilizers in all the sub-counties as noted by the figures above which is also in agreement with the findings of Korugyendo, *et al.* (2011), who emphasized that Urea and Diammonium Phosphate (DAP) are the most commonly sold fertilizers in Uganda. On the same note, the findings also disagreed with the latter's results which indicated that NPK (Nitrogen, Phosphorous and Potassium) blend at a ratio of 17:17:17 as the third, because my findings instead noted SSP as the third most preferred.

Table 4: Inorganic fertilizers combinations preferred in the four sub-counties

Inorganic fertilizers combinations	**Arapai**	**Kamuda**	**Katine**	**Gweri**	**NGO's and CBO's**	**NAADS coordin-Ators**	**Frequency**	**Percenatge (%)**
DAP and Urea	20	17	10	11	10	2	70	53
DAP and CAN	11	2	3	9	2	0	27	20.3
MAP and CAN	5	4	2	2	1	0	14	10
DAP and MAP	6	1	1	0	4	0	12	9
SSP and CAN	0	1	0	0	0	0	1	0.8
SSP and Urea	1	1	0	0	0	1	3	2.3
SSP and DAP	1	0	0	0	1	0	2	1.5
DAP and NPK	0	0	0	0	0	1	1	0.8

Urea and NPK	1	0	0	0	0	0	1	0.8
CAN and Urea	0	1	0	1	0	0	2	1.5

DAP and Urea inorganic fertilizer combination is the most used at 53%, followed by DAP and CAN at 20.3% and DAP and MAP at 10%. The least used combinations are SSP and CAN, DAP and NPK, and finally Urea and NPK. Urea and DAP are mostly used on cereals like maize, whereby DAP is used as a basal dressing applied shortly after crop emergence and urea as a top-dressing applied three to six weeks later when the maize plants are about knee-height before the maize flowers. Calcium Ammonium Nitrate (CAN) is also another nitrogen fertilizer used vegetables cabbages, tomatoes, egg plants more than on maize.

In addition, DAP, Urea, CAN and SSP fertilizers are commonly applied on citrus or oranges crops.

Figure 4: Longe-10 maize variety planted without applying any inorganic fertilizer.

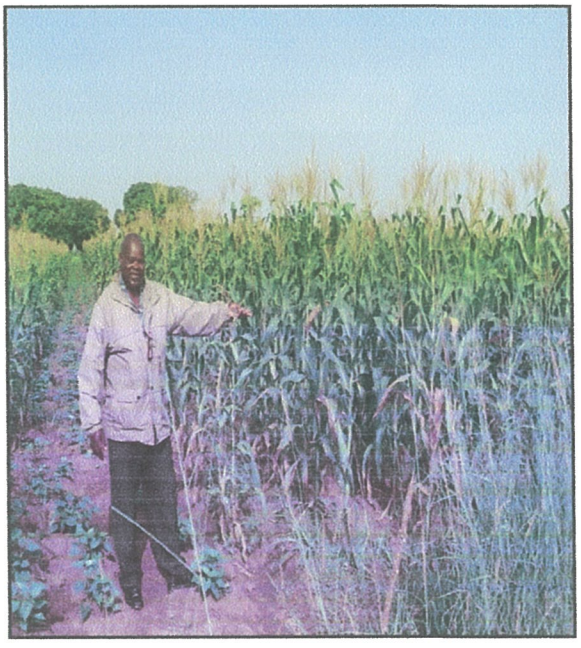

Figure 5: Longe-10 maize variety planted with DAP and Urea in organic fertilizers.

In the figures 4 and 5, the NAADS coordinator of Katine S/C Mr. Odieny James explaining how Hybrid Longe-10 Maize variety was used for experimental purposes at one of the respondent's garden. The maize seeds were of the same type and planted under the same conditions of the soils that is, texture, structure, and inherent fertility before manipulation. In figure 4, the maize seeds were planted without application of any inorganic fertilizers and this implies that it acted as a control experiment while in figure 5, DAP was applied at planting and urea as top dress after growing to knee level.

The maize seeds were planted on the 20th April, 2012. The maize leaves in figure 4 appeared light yellow in colour which is an indicator of nitrogen deficiency whereas the leaves in figure 4 are dark green indicating proper nutrient provision for the plants. Both the images were taken on the 27th July, 2012. The boundary between the two parts of the crop fields or experimental fields is separated by beans planted in columns.

Table 5: ANOVA to determine the mean difference in the inorganic fertilizer usage among the sub-counties.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	147.125	3	49.042	1.305	0.300
Within Groups	751.500	20	37.575		
Total	898.625	23			

From Table 5 above, the ANOVA test results that there is no significant mean difference in the fertilizer usage among the four sub-counties ($F=1.305$, $df=3$, at $p= 0.05$). This therefore implies that in all the four sub-counties, the adoption of inorganic fertilizers is similar.

Table 6: Descriptive results for the mean inorganic fertilizer usage among the different sub-counties.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	6	4.83	4.622	1.887	-.02	9.68	0	13
2	6	10.00	8.025	3.276	1.58	18.42	3	20
3	6	6.33	6.377	2.603	-.36	13.03	1	18
4	6	3.33	4.885	1.994	-1.79	8.46	0	11
Total	24	6.13	6.251	1.276	3.49	8.76	0	20

From Table 6, Arapai S/C has the highest adoption rates with a mean of 10, followed by Kamuda S/C with a mean of 6.33, then Gweri S/C with a mean of 4.83 and finally Katine S/C with a mean of 3.33. The high adoption rates in Arapai and Kamuda S/C is attributed to more sensitization and limited cultural barriers as compared to the other sub-counties.

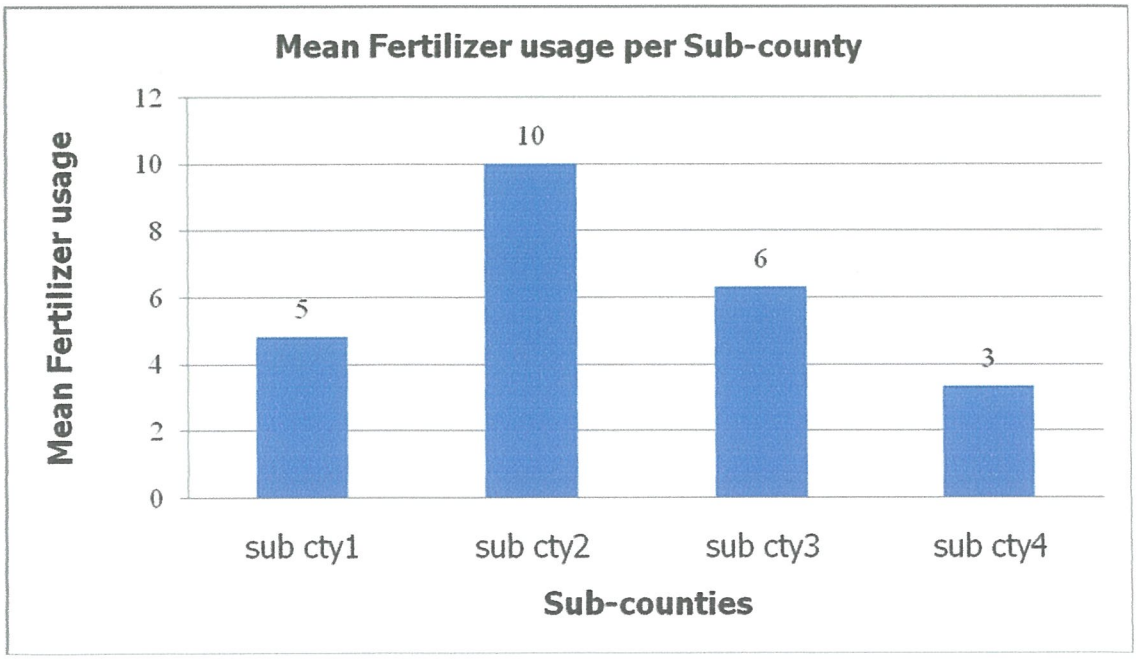

Figure 6: Shows the mean usage of inorganic fertilizers per sub-county (Sub cty).

Legend

Sub cty (sub county) 1= Gweri

2= Arapai

3= Kamuda

4= Katine.

From the means plot in Figure 6 above, it is clear that Arapai sub-county has the highest inorganic fertilizer adoption rate followed by Kamuda S/C, then Gweri S/C while Katine S/C has the lowest adoption rate.

Factors affecting the adoption of inorganic fertilizers in Soroti district.

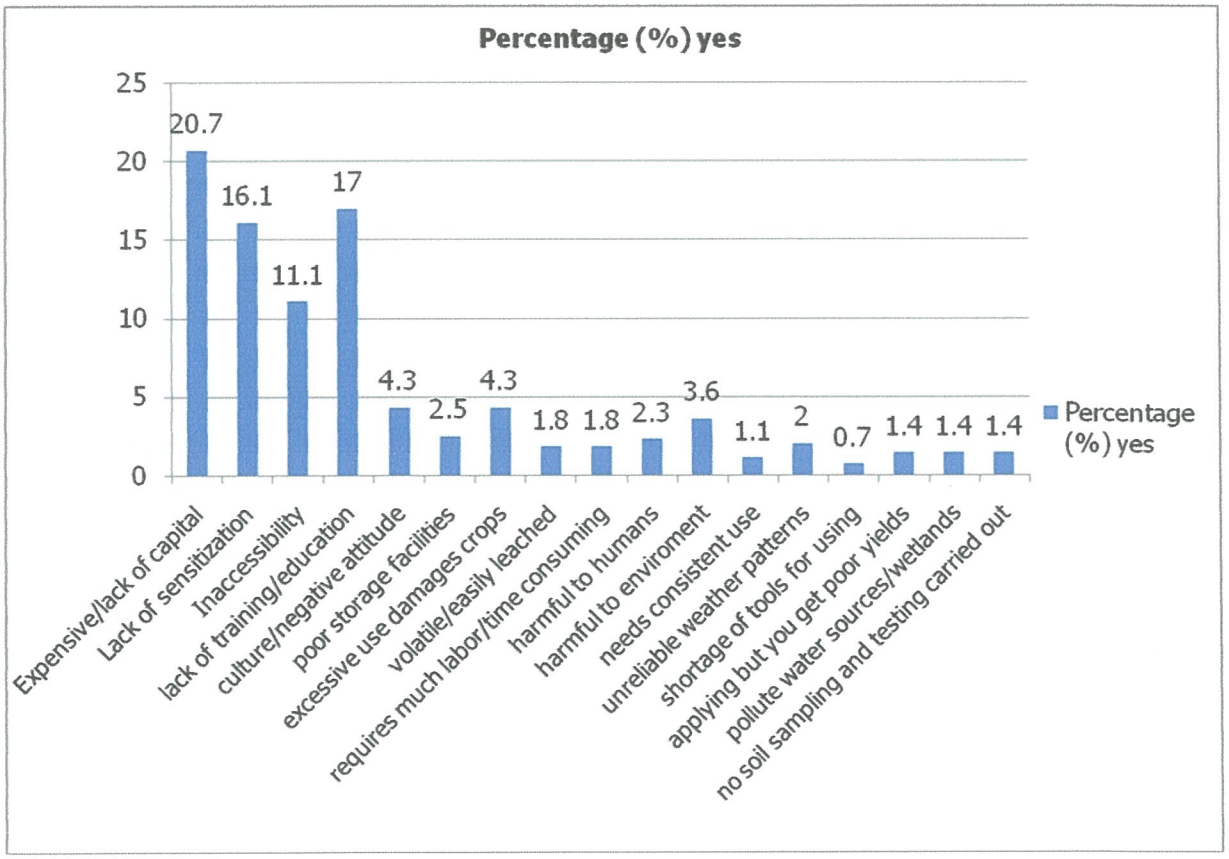

Figure 7: showing the factors or problems affecting adoption of inorganic fertilizers.

According to Figure 7 above, the factors affecting adoption of inorganic fertilizers are indicated on the horizontal axis while the percentages representing their severity in terms of frequency are on the vertical axis. Therefore, it has been noted that the four most severe factors or problems affecting the adoption of inorganic fertilizers are; High costs of purchasing at, followed by lack of training, lack of sensitization, and lastly the fertilizers are not readily available, cultural or negative attitude (illusion that soils are naturally fertile), poor storage facilities, and excessive use damages crops (scotching effect on crops). In addition, the inorganic fertilizers are easily leached because they are volatile, labour intensive and time consuming, harmful to humans, harmful to environment and soils due to excessive use, needs consistent use for better results, unreliable weather patterns (either less rainfall or too much sunshine), shortage of tools for using, applying but you get poor yields, pollute water sources and wetlands, and no soil sampling and testing always carried out.

It is important to note that these problems are not the same in all the sub-counties in terms of the severity as indicated by the results in terms of frequency in Figure 7 and Table 5 above. However, it was also observed that the problem of the fertilizers not being readily available actually limits the adoption of inorganic fertilizers in that there are only two prominent selling enterprises as indicated below.

Table 7: Cost of inorganic fertilizers from the major suppliers in Soroti District.

Suppliers	Cost (Ug. shs) per type of fertilizer				
	DAP	**Urea**	**MAP**	**SSP**	**NPK**
SODIFA	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.
ACHILA ENTERPRISES	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.	3,000/= per Kg **OR:** 150,000/= per 50kg full sack.

Table 7 clearly shows the two most common suppliers of inorganic fertilizers and other agricultural inputs to the entire Teso sub-region from Soroti town namely; SODIFA and Achila enterprises. This therefore implies that these fertilizers are not readily available and very expensive for the local people to afford for application on larger pieces of agricultural land.

Despite the highest adoption rates in Arapai S/C, the most severe obstacles which still hinder consistent use of inorganic fertilizers, and they include; high costs of purchasing and managing inorganic fertilizers due to the high poverty levels, the inorganic fertilizers are not readily available or inaccessible, limited sensitization, lack of training for farmers to acquire skills and knowledge regarding proper use hence most of the

farmers tend to poorly apply the inorganic fertilizers to the soils leading to scotching effect on the crops thus poor yields.

However, in Kamuda S/C the most limiting factors to the adoption of inorganic fertilizers is the high cost of purchasing coupled with the high poverty rates, lack of skills and knowledge due to very limited training opportunities, inaccessibility of the fertilizers and the high cultural attitudes prompting the local people to have a constant fear of the fertilizers spoiling their soils alongside political sabotage by opposition farmers.

In Gweri S/C, most of the local people indicated that the inorganic fertilizers are very expensive for them to purchase, not easily accessible, there is also very limited sensitization and training which have made most farmers have poor fertilizer application on their soils thus damaging their crops. The farmers are equally confused about the best storage facilities.

The situation in Katine S/C is also similar to the other sub-counties but to the local people the most pressing problems in order of priority are the high cost of purchasing the fertilizers, inaccessibility of the fertilizers and lack of training.

The agricultural officers from the NGO's and CBO's together with the NAADS coordinators also noted that the inorganic fertilizers are very expensive, not readily available and further require technical skills and knowledge for proper application and get the best results, there is also an illusion by most farmers that their soils are naturally fertile and do not need any form of inorganic fertilizer to improve on their fertility and this is in relation to their cultures thus fear of soil degradation. However, they are urging the farmers to embark on carrying soil testing before applying these fertilizers in order to determine the nutrient deficiencies in the soils.

This is in relation to Teame (2011) findings, which indicated that economic agents especially farmers, reject and adopt a new technology at its early stage. However, as time goes on, learning skills and experiences enable them to become willing and open to accept and practice the technology at the grass roots level. This implies that when

the solutions to constraints are effective, there will be more adoption rates of the inorganic fertilizers.

The findings above are also related to Mwangi's (1996) findings regarding low use of fertilizer which was partly attributed to weak or non-existent crop responses, partially because of variable rainfall, poor soil quality, an absence of irrigation, and a lack of improved crop cultivars which also correspond to some of the constraints above. He further stated that demand factors, economics of fertilizer use, availability, price policies and credit, supply factors, pricing environment and distribution costs, privatization of supply, and infrastructural development are the major limiting factors to inorganic fertilizer adoption in Sub-Saharan Africa.

Table 8: Comparison of views regarding Inorganic fertilizer adoption between local farmers and the agricultural officers from (NGOs, CBOs) and the NAADs coordinators.

Independent Samples Test

		t-test for Equality of Means						
							95% Confidence Interval of the Difference	
		t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Fertilizer	Equal variance assumed.	2.215	12	0.047	17.75	8.015	0.287	35.213
	Equal variance not assumed.	1.928	5.478	0.107	17.75	9.207	-5.309	40.809

From Table 8 above, the results indicated that there is a statistically significant difference between the means in the views regarding fertilizer usage between the local

people in the different sub-counties and agricultural officers from NGOs, CBOs and NAADs coordinators (t=2.215, at p= 0.05).

This analysis implies that the problems hindering the adoption of inorganic fertilizers cited by the local farmers from the four sub-counties are different from those noted by the agricultural officers from the NGO's, CBO's and NAADS coordinators.

The relationship between the factors affecting adoption of inorganic fertilizers and the crop yields

Table 9: Crop varieties preferred for inorganic fertilizers application in the different Sub-counties.

Crop types	Sub-counties				Frequency	Percentage (%)
	Arapai	Gweri	Kamuda	Katine		
Maize	24	7	15	13	59	27
Groundnuts	12	4	16	5	37	17
Citrus	13	10	8	5	36	16.5
Beans	11	8	8	6	33	15
Soya beans	1	2	1	3	7	3.2
Sorghum	2	2	2	0	6	2.7
Finger millet	3	1	0	2	6	2.7
Tomatoes	3	3	0	0	6	2.7
Cotton	0	0	6	0	6	2.7
Green grams	5	0	0	0	5	2.3
Egg plants	1	3	0	0	4	2
Simsim	0	0	4	0	4	2
Rice	0	2	1	0	3	1.4
Water melon	0	3	0	0	3	1.4
Sukuma wiki	2	0	0	0	2	1

(Brassica oleracea)						
Onions	0	1	0	0	1	0.4
Total					**218**	**100**

The Table 9 shows that the most preferred crop variety by the local communities for the application of inorganic fertilizers is maize at 27%, followed by groundnuts at 17%, citrus (oranges) at 16.5%, and beans at 15% while the least preferred is onions at 0.4%.

The findings in the table above are in relation to Melinda, *et al.* (2011) who observed that in all Sub-Saharan Africa, about 40 percent of fertilizer is used on maize, implying that the average dose is only about 17 kg/ha of nutrients compared to the developing country average of 100 and the industrialized country average of 270 kg/ha on the same crop. On the contrary, they further noted that it is incorrect to conclude that modern maize depends on fertilizer, but in reality modern improved maize varieties actually produce high yields compared to the traditional farmer's varieties. Thus, it was concluded that maize is a heavy consumer of fertilizer, leading fertilizer demand in industrialized countries among major cereals, and the second most heavily fertilized crop on a global scale, after potatoes. NARO (2012) also proved that maize is the leading staple food in Uganda and the East African region because many farmers grow the crop every year on the same piece of land which depletes the soils' fertility.

Table 10: Results for Spearman's rank correlation coefficient to determine the relationship between factors affecting adoption of inorganic fertilizers and crop yields. (n=17)

Correlations

		crop yield	factors affecting inorganic fertilizer adoption
Spearman's rank correlation	crop yield	1.000	0.610
	factors affecting inorganic fertilizer adoption	0.610	1.000

From Table 10 above, the results indicate that there is a modest and significant correlation between the adoption of inorganic fertilizers and crop yields (r_s=0.610, at P= 0.05). This could be attributed to getting of high crop yields after application of inorganic fertilizers as indicated in Table 11 below but also due to the factors affecting the adoption of the inorganic fertilizers earlier on stated in Figure 7 above that reduce crop production hence low crop yields.

Table 11: Crop yields due to use of inorganic fertilizers.

Crop yields	Frequency	Percentage (%)
High	104	96.3
Low	4	3.7
Total	**108**	**100.0**

From Table 11 above, 104 (96.3%) out of the interviewed respondents ascertained that the use of inorganic fertilizers gives them high crop yields whereas 4 (3.7%) stated that they get low yields due to the use of inorganic fertilizers.

This is in agreement with the findings of Birachi, *et al.* (2011) which also observed finding solutions to the factors affecting the adoption of inorganic fertilizers could actually encourage a majority of the farmers to use these fertilizers to increase their

crop yields. However, he also suggested that increasing the incentives like improved beans varieties and inorganic fertilizers would further increase crop yields by 22% in Burundi.

The factors influencing the adoption of inorganic fertilizers are in agreement with Teame (2011), who stated that at the early stages of introduction of a new technology, only few farmers get information about the potential economic benefits of the technology and hence the adoption speed is slow. However, even if farmers get enough information about the potential economic benefits of the technology at an early stage, most farmers fear the possible risks associated with the new technology and hence do not opt to adopt at a faster rate. In addition, it has also been noted that in subsequent periods, the potential adopters acquire more information about the benefits of the technology and the degree of riskiness associated with it which might either hinder or increase on the adoption rate of inorganic fertilizers.

CHAPTER FIVE

Summary of findings, conclusions and Recommendations

Introduction

This chapter presents the summary of the findings, conclusions, recommendations and also areas for further research based on this study. The conclusions are derived from the results of the study and therefore suggested recommendations are meant for ensuring the improved reliable approaches to the adoption of inorganic fertilizers which will also act as areas for further research and /or other researches.

Summary of findings

The study clearly indicated the following findings;

The respondents between the ages of 44-53 are the greatest users of inorganic fertilizers at 32%, while those between 64-73 are the least users at 9%. The males are the most dominant users at a rate of 77%, and also the married respondents at 88%. Meanwhile, those who have studied up to O-level are also the majority users at 44% as compared to those who completed A-level at 3%.

DAP and Urea are the most used inorganic fertilizers at 27.5% and 38.5% respectively. SSP is at 12%, CAN at 10.5%, while the least used are NPK at 5.5%, MAP 3%, TSP 1.5%, SA 1% and lastly MOP 0.5%.

It was found that there is no significant mean difference in the fertilizer usage among all the four sub-counties ($F=1.305$, $df=3$, at $p= 0.05$).

In addition, it was observed that there is a statistically significant difference between the means in the views regarding fertilizer usage between the local people in the four sub-counties and agricultural officers from NGOs, CBOs and NAADs coordinators ($t=2.215$, at $p= 0.05$).

There is a modest and significant correlation between the adoption of inorganic fertilizers and the crop yields ($r_s=0.610$, at $p= 0.05$).

Conclusions

The following conclusions have been noted regarding the study;

The most commonly used types of inorganic fertilizers used in all the four sub-counties of Arapai, Katine, Kamuda and Gweri are DAP and Urea. This is as well a general idea from the agricultural officers from the NGO's and CBO's, and the NAADS coordinators. This is because of their easy accessibility by the local farmers and good crop yields after their application based on experience which influences other farmers.

The most noted factors affecting inorganic fertilizers use which either determine their adoption or affect the crop yields are; High cost of purchasing (poverty or lack of capital), lack of sensitization (ignorance), inaccessibility (difficult to get) the inorganic fertilizers, lack of training (lack of knowledge and skills), cultural or negative attitude(illusion that soils are naturally fertile), poor storage facilities ,excessive use damages crops (scotching effect on crops). The inorganic fertilizers are easily leached because they are volatile, labour intensive and time consuming, harmful to humans, harmful to environment and soils due to excessive use, needs consistent use for better results, unreliable weather patterns (either less rainfall or too much sunshine), shortage of tools for using, applying but you get poor yields, pollute water sources and wetlands, and no soil sampling and testing always carried out.

It was clearly proved that it is not only the crop yields that influence the adoption of inorganic fertilizers but also the factors affecting the adoption of these fertilizers given the fact that there is a modest and significant correlation between the adoption of inorganic fertilizers and crop yields. Therefore, increased inorganic fertilizer use would benefit the environment by reducing the pressure to convert forests and other fragile lands to agricultural uses and, by increasing biomass production, help increase the organic matter content of African soils because organic material supplies and helps retain soil nutrients (Michael, *et al.,* 1997).

Recommendations

In a bid to foster high crop production in the rural areas, it is very imperative for the government to construct a fertilizer factory in Uganda and subsidize the cost of purchasing the inorganic fertilizers by the local farmers. However, the inorganic fertilizers must also be made readily available for easy access by the local people.

Frequent sensitization and training sessions must equally be increased to promote proper use of inorganic fertilizers thus avoiding illusions that the soils are still naturally fertile and the fear of farmers to apply fertilizers because of fear of soil degradation. More research should also be conducted by the experts and also government should fund more research-oriented projects or programs to be conducted within and outside Uganda on the best type of fertilizers to match the different crop varieties.

Inorganic fertilizer use must be combined with other agronomic management practices. For efficient nutrient utilization, inorganic fertilizer must be combined with organic fertilizers, water harvesting, and controlling soil erosion in site-specific integrated soil fertility management strategies. These complementary activities help insure that maximum benefits are derived from each component practice.

A comprehensive fertilizer policy that should contain well stipulated regulatory, standards and quality control must be enacted by the government through its legislative arm or parliament in order to facilitate frequent proper soil tests to be carried out by the qualified and approved agricultural officers at each sub-county before any application of inorganic fertilizers to the crops or the soils. This will avoid the errors of poor application and handling of inorganic fertilizers.

Since most of the agricultural officers commend that improved seeds or crop varieties are a pre-requisite for boosting crop yields albeit application of inorganic fertilizers, it implies therefore that improved seeds and crop varieties should be used together with the indigenous varieties in order to promote conservation and

sustainability. It will also entail providing better storage facilities and advising the local farmers accordingly on how to store the inorganic fertilizers.

Community demonstration sites should be set-up to ensure proper exhibitions to provide experiments regarding the effectiveness of inorganic fertilizers in improving soil fertility henceforth boosting crop yields and all these will ultimately require an increase in the number of agricultural officers at all levels to be relatively proportional to that of the smallholder farmers.

Therefore at all costs, Environmental screening, monitoring, evaluation and coordination should be a priority to the agricultural ministry through considering a multi-sectoral and multi-disciplinary approach whereby all expatriates from various fields of profession should be consulted and further included to give their inputs regarding inorganic fertilizer's use for increasing crop yields, and perhaps their implications to humans and the environment.

Areas for further research

More research should be conducted regarding the following;

The weak market information systems and poor rural network distribution channels of the inorganic fertilizers that are prevalent in Uganda. Perhaps a solution will be got that can enhance the easy availability of the fertilizers to the local farmers.

The most appropriate approaches that can enable integrated use of both the inorganic and organic fertilizers in order to facilitate further development in the country because since time memorial, agriculture has remained the backbone of Uganda's economy.

Development of an affordable, reliable and routine mechanism that will enable the establishment of the soil nutrient deficiencies henceforth encouraging farmers to frequently conduct soil tests before fertilizer application.

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APPENDICES:

Appendix I: Transmittal Letter

KAMPALA INTERNATIONAL UNIVERSITY
EXPLORING THE HEIGHTS

Ggaba Road - Kansanga
P.O. Box 20000, Kampala, Uganda
Tel: +256 - 414 - 266813 / +256 - 772 - 322563
Fax: +256 - 414 - 501 974
E-mail: admin@kiu.ac.ug
Website: www.kiu.ac.ug

OFFICE OF THE HEAD OF DEPARTMENT, ECONOMICS AND MANAGEMENT SCIENCES
COLLEGE OF HIGHER DEGREES AND RESEARCH (CHDR)

Date: 11, July, 2012

RE: REQUEST FOR ENIRU EMMANUEL INNOCENT MEM/12484/111/DU TO CONDUCT RESEARCH IN YOUR ORGANIZATION

The above mentioned is a bonafide student of Kampala International University pursuing Masters of Science in Environment Management.

He is currently conducting a research entitled" **The Adoption of Inorganic Fertilizers for Crop Production by the Local Communities in Soroti County, Soroti District."**

Your organization has been identified as a valuable source of information pertaining to his research project. The purpose of this letter is to request you to avail him with the pertinent information he may need.

Any information shared with him from your organization shall be treated with utmost confidentiality.

Any assistance rendered to him will be highly appreciated.

Yours truly,

for
Mr. Malinga Ramadhan
Head of Department,
Economics and Management Sciences,(CHDR)

NOTED BY:
Dr. Sofia Sol T. Gaite
Principal-CHDR

KAMPALA INTERNATIONAL UNIVERSITY PRINCIPAL CHDR P.O BOX 20000, KAMPALA

Appendix II: Transmittal Letter from Soroti District.

Tel: 04544 61004
Fax: 04544 61030

Our Ref: CR/164/4
Your Ref:

THE REPUBLIC OF UGANDA

Office of the
Chief Administrative Officer
Soroti District Local Government
P.O. Box 61
Soroti - Uganda

Date: 16th July, 2012

To Whom It May Concern

Permission for Eniru Emmanuel Innocent MEM/12484/111/DU to conduct Research

This is to inform you that the above named student has come seeking for permission to conduct his research entitled "***The Adoption of Inorganic Fertilizers for Crop Production by the Local communities in Soroti district'.***

I have no objection in granting him permission to carry out the said research.

Please grant him all the necessary assistance he may require.

For: Chief Administrative Officer
Soroti District Local Government
P. O. Box 61, Soroti - Uganda

Akiror Jane
For: CHIEF ADMINISTRATIVE OFFICER/SOROTI

Cc The District Chairperson
Production Coordinator, Soroti District.

Corr sectheads71

Appendix III: Questionnaire for the local communities.

Kampala International University

College of Higher Degrees and Research

Masters of Science in Environmental Management and Development programme.

Dear Sir/Madam,

Greetings!

I am a post graduate candidate for the award of Masters of Science in Environment Management of Kampala International University and currently pursuing a research entitled **THE ADOPTION OF INORGANIC FERTILIZERS FOR CROP PRODUCTION BY THE LOCAL COMMUNITIES IN SOROTI COUNTY, SOROTI DISTRICT.** In relation to this study, I kindly request you to be part of this study by answering my questionnaires. Rest assured that the information you provide will be accorded the utmost confidentiality and will be used for academic purposes only. Please respond to all the items in the questionnaire and do not leave any item unanswered.

Furthermore, I and my research assistants humbly request for the questionnaire within four (4) days from the date of you receive it.

Yours faithfully,

.....

Eniru Emmanuel Innocent

In signing this document, am giving my consent to be part of the research study of **Eniru Emmanuel Innocent** that will focus on the adoption of inorganic fertilizers for crop production by the local communities in Soroti District.

I shall be rest assured of privacy, anonymity, and confidentiality and that I will be given the option to refuse participation and the right to withdraw my participation anytime.

I have been informed that the research is voluntary and that results will be given to me if I ask for it.

Initials_____

Date _____

Face Sheet: Profile of the Respondents A

1. Age _____

2. Gender *(please tick)* **a).** Male ____ **b).** Female _____

3. Marital Status.

(a). Married _____ **(b).** Single_____ **(c).** Divorced_____

*Any other, please specify*_____

4. Highest Educational Qualification

(a) Primary_____ **(b)** O-Level_____ **(c)** A-Level_____ **(d) Tertiary**_____

Other Qualifications, *please specify* _____

Types of inorganic fertilizers that are commonly used by the local communities

5. What are the common types of inorganic fertilizers used for crop production in this community?

A) Diammonium sulphate (DAP) ☐ **(B).** Calcium Ammonium Nitrate (CAN) ☐

(C). Urea ☐ **(D).** Monoammonium phosphate (MAP) ☐

Any other, please specify.....

.....

6. Why do you apply inorganic fertilizers in your crop fields?

(A) Improve soil fertility ☐ **(B).** Need for high crop yields ☐

(C). Low crop yields ☐ **(D).** Influence by other farmers ☐

Any other, please specify.....

.....

7. Which inorganic fertilizer provides the highest crop yields after its application?

A). Diammonium sulphate (DAP) ☐ **(B).** Calcium Ammonium Nitrate (CAN) ☐

(C). Urea ☐ **(D).** Monoammonium phosphate (MAP) ☐

Any other, please specify.....

.....

8. In your own opinion, why does it offer the highest crop yields?.....

.....

9. What are some of the inorganic fertilizers that have to be used alone?

A). Diammonium sulphate (DAP) ☐ **(B).** Calcium Ammonium Nitrate (CAN) ☐

(C). Urea ☐ **D).** Monoammonium phosphate (MAP) ☐

Any other, please specify.....

.....

10. Which ones are recommended to be used in a combination to produce better results?

A). DAP & CAN ☐ **(B).** DAP & MAP ☐ **(C).** MAP & CAN ☐

(D). Urea & DAP ☐

Please specify any other combinations.....

.....

11. Does it imply that some of these fertilizers are applied to all types of crops?

Yes ☐ No. ☐

If yes, please name them.....

.....

12. What are some of the fertilizers that are applied to specific types of crop?

.....

.....

13. How long do the crops take to grow to maturity due to application of inorganic fertilizers?.....

.....

14. Do you usually apply inorganic fertilizers to crop fields or garden?

Yes ☐ No ☐

Give reasons for your answer.....

.....

Factors affecting use or adoption of inorganic fertilizers for crop production

15. Which problems do you normally face regarding use of inorganic fertilizers or its management?

.....

.....

16. How do you store your inorganic fertilizers?

A. Plastic buckets ☐ **B.** Metallic buckets ☐ **C.** Jerricans ☐

Any other storage facility, please specify.....

.....

17. In your own view, do you think the land tenure systems in this community are part of the major limiting factors? Yes ☐ No ☐

Please give reasons to support your answer.....

.....

18. What quantity of land have you allocated for crop production using inorganic fertilizers?

.....

Give reasons for your answer.....

.....

.....

19. If it is less than 1 acre, which obstacles are preventing you from allocating larger areas of land for crop production using inorganic fertilizers?

.....

.....

20. What is the most severe problem affecting the use of inorganic fertilizers in this community?.....

.....

In relation to the above problems, state the measures that have been put in place to facilitate proper use of inorganic fertilizers for crop production.

.....

.....

21. What other measures do you suggest to be put in place to ensure proper use of inorganic fertilizers?

.....

.....

22. Do you think inorganic fertilizers provide the best solution to increasing crop productivity? Yes ☐ No ☐

Give reasons to support your answer.....

.....

.....

23. What are the other better solutions for increasing crop productivity in this community?

.....

.....

24. In your own opinion, what is the best measure according to those you have listed in question **23** and **24** above?.....

.....

Please give reasons to support your answer.....

.....

25. Why do the above problems still exist?

.....

.....

Relationship between adoption of inorganic fertilizer and crop yields

26. What are the major problems affecting the use of inorganic fertilizers?

.....

.....

27. Which crops types do you advise the farmers to apply inorganic fertilizers for their production?

A). Maize ☐ **(B).** Beans ☐ **(C).** Groundnuts ☐

(D). Oranges/citrus ☐

Any other, please specify .....

.....

28. What are the crop yields after inorganic fertilizer application?

High ☐ Low ☐

Give reasons for your answer

.....

.....

29. How often do you advise farmers to apply inorganic fertilizers in their gardens?

.....

.....

30. How long does it take for the soils to produce high crop yields due to inorganic fertilizer application?

A). 4 months ☐ **(B).** 8 months ☐ **(C).** 1 year ☐

(D). 2 years ☐

Any other period, please specify.....

.....

31. During which period do you advise people to apply inorganic fertilizers to their crop fields?

A). Start of the growing season ☐ **(B).** Mid-way the growing season ☐

(C). After the first harvest ☐ **(D).** Start and mid-way the season ☐

Any other, period please specify.....

.....

32. Why do you advise the farmers to apply the inorganic fertilizer at the period you have indicated in **question 32** above?

.....

.....

33. What are the correct quantities or measurements you consider for the application of the inorganic fertilizers in your or their crop fields?

(A). 125kg/ha of single superphosphate **(SSP)** ☐

(B). 250kg /ha of Sulphate of ammonia **(SA)** ☐

(C). 125kg/ha diammonium sulphate **(DAP)** ☐

(D). 125kg/ha of Monoamonium Phospahte **(MAP)** ☐

Any others please indicate.....

.....

34. In your own opinion, what solutions do you think will improve on the use of inorganic fertilizers and also crop yields?

.....

.....

.....

Thank you for your cooperation.

Appendix IV: Questionnaire for NGO's and CBO's

Kampala International University

College of Higher Degrees and Research

Masters of Science in Environmental Management and Development programme.

Dear Sir/Madam,

Greetings!

I am a post graduate candidate for the award of Masters of Science in Environment Management of Kampala International University and currently pursuing a research entitled **THE ADOPTION OF INORGANIC FERTILIZERS FOR CROP PRODUCTION BY THE LOCAL COMMUNITIES IN SOROTI COUNTY, SOROTI DISTRICT.** In relation to this study, I kindly request you to be part of this study by answering my questionnaires. Rest assured that the information you provide will be accorded the utmost confidentiality and will be used for academic purposes only. Please respond to all the items in the questionnaire and do not leave any item unanswered.

Furthermore, I and my research assistants humbly request for the questionnaire within four (4) days from the date of you receive it.

Yours faithfully,

.....

Eniru Emmanuel Innocent

In signing this document, am giving my consent to be part of the research study of **Eniru Emmanuel Innocent** that will focus on the adoption of inorganic fertilizers for crop production by the local communities in Soroti District.

I shall be rest assured of privacy, anonymity, and confidentiality and that I will be given the option to refuse participation and the right to withdraw my participation anytime.

I have been informed that the research is voluntary and that results will be given to me if I ask for it.

Initials_____

Date _____

Types of inorganic fertilizers that are commonly used by the local communities

1. What are the common types of inorganic fertilizers used for crop production in this community?

A). Diammonium sulphate (DAP) ☐ **(B).** Calcium Ammonium Nitrate (CAN) ☐

(C) Urea ☐ **(D).** Monoammonium phosphate (MAP) ☐

Any other, please specify.....

.....

2. Why do people apply inorganic fertilizers in their crop fields?

(A). Improve soil fertility ☐ **(B).** Need for high crop yields ☐

(C). Low crop yields ☐ **(D).** Influence by other farmers ☐

Any other, please specify.....

.....

3. Which inorganic fertilizer provides the highest crop yields after its application?

A). Diammonium sulphate (DAP) ☐ **(B).** Calcium Ammonium Nitrate (CAN) ☐

(C). Urea ☐ **D).** Monoammonium phosphate (MAP) ☐

Any other, please specify.....

.....

4. In your own opinion, why does it offer the highest crop yields?.....

.....

.....

5. What are some of the inorganic fertilizers that have to be used alone?

A). Diammonium sulphate (DAP) ☐ **(B).** Calcium Ammonium Nitrate (CAN) ☐

(C). Urea ☐ **D).** Monoammonium phosphate (MAP) ☐

Any other, please specify.....

.....

6. Which ones are recommended to be used in a combination to produce better results?

A). DAP & CAN ☐ **(B).** DAP & MAP ☐ **(C).** MAP & CAN ☐

(D). Urea & DAP ☐

Please specify any other combinations.....

.....

7. Does it imply that some of these fertilizers are applied to all types of crops?

Yes ☐ No. ☐

If yes, please name them.....

.....

8. What are some of the fertilizers that are applied to specific types of crop?

.....

.....

9. How long do the crops take to grow to maturity due to application of inorganic fertilizers?

.....

.....

10. Do you usually apply inorganic fertilizers to crop fields or garden?

Yes ☐ No ☐

Give reasons for your answer.....

Factors affecting inorganic fertilizer use for crop production

11. Mention the problems you normally face regarding use of inorganic fertilizers?

.....

.....

.....

12. How do you store your inorganic fertilizers?

A. Plastic buckets ☐ **B.** Metallic buckets ☐ **C.** Jerricans ☐

Any other storage facility, please specify.....

.....

13. In your own view, do you think the land tenure systems in this community are part of the major limiting factors? Yes ☐ No ☐

Please give reasons to support your answer.....

.....

14. What quantity of land have the farmers allocated for crop production using inorganic fertilizers? .....

Give reasons for your answer.....

.....

.....

15. If it is less than 1 acre, which obstacles are preventing the local communities from allocating larger areas of land for crop production using inorganic fertilizers?

.....

.....

16. What is the most severe problem affecting the use of inorganic fertilizers in this community?.....

.....

17. In relation to the above problems, state the measures that have been put in place to facilitate proper use of inorganic fertilizers for crop production

.....

.....

18. What other measures do you suggest to be put in place to ensure proper use of inorganic fertilizers?

.....

.....

19. Do you think inorganic fertilizers provide the best solution to increasing crop productivity?

Yes ☐ No ☐

Give reasons to support your answer above.....

.....

.....

20. What are the other better solutions for increasing crop productivity in this community?

.....

.....

21. In your own opinion, what is the best measure according to those you have listed in question **19** and **20** above?.....

.....

Please give reasons to support your answer.....

.....

22. Why do the above problems still exist?

.....

.....

.....

Relationship between adoption of inorganic fertilizer and crop yields

23. What are the major problems affecting the use of inorganic fertilizers?

.....

.....

24. Which crops types do you advise the farmers to apply inorganic fertilizers for their production?

A). Maize ☐ **(B).** Beans ☐ **(C).** Groundnuts ☐

(D). Oranges/citrus ☐

Any other, please specify.....

.....

25. What are the crop yields after inorganic fertilizer application?

High ☐ Low ☐

.....

.....

26. How often do you advise farmers to apply inorganic fertilizers in their gardens?

.....

.....

27. How long does it take for the soils to produce high crop yields due to inorganic fertilizer application?

A). 4 months ☐ **(B).** 8 months ☐ **(C).** 1 year ☐

(D). 2 years ☐

Any other period, please specify.....

.....

28. During which period do you advise people to apply inorganic fertilizers to their crop fields?

A). Start of the growing season ☐ **(B).** Mid-way the growing season ☐

(C). After the first harvest ☐ **(D).** Start and mid-way the season ☐

Any other, period please specify.....

.....

29. Why do you advise the farmers to apply the inorganic fertilizer at the period you have indicated in **question 28** above?

.....

.....

30. What are the correct quantities or measurements you consider for the application of the inorganic fertilizers in your or their crop fields?

(A). 125kg/ha of single superphosphate **(SSP)** ☐

(B). 250kg /ha of Sulphate of ammonia **(SA)** ☐

(C). 125kg/ha diammonium sulphate **(DAP)** ☐

(D). 125kg/ha of Monoamonium Phospahte **(MAP)** ☐

Any others please indicate.....

.....

.....

31. In your own opinion, what solutions do you think will improve on the use of inorganic fertilizers and also crop yields?

.....

.....

Thank you for your cooperation.

Appendix V: Interview schedule for NAADS coordinators.

Kampala International University

College of Higher Degrees and Research

Masters of Science in Environmental Management and Development programme.

Dear Sir/Madam,

Greetings!

I am a post graduate candidate for the award of Masters of Science in Environment Management of Kampala International University and currently pursuing a research entitled **THE ADOPTION OF INORGANIC FERTILIZERS FOR CROP PRODUCTION BY THE LOCAL COMMUNITIES IN SOROTI COUNTY, SOROTI DISTRICT.** In relation to this study, I kindly request you to be part of this study by answering the questions in my interview schedule. Rest assured that the information you provide will be accorded the utmost confidentiality and will be used for academic purposes only. Please respond to all the items in the interview schedule and do not leave any item unanswered.

Yours faithfully,

.....

Eniru Emmanuel Innocent

In signing this document, am giving my consent to be part of the research study of **Eniru Emmanuel Innocent** that will focus on the adoption of inorganic fertilizers for crop production by the local communities in Soroti District.

I shall be rest assured of privacy, anonymity, and confidentiality and that I will be given the option to refuse participation and the right to withdraw my participation anytime.

I have been informed that the research is voluntary and that results will be given to me if I ask for it.

Initials_____

Date _____

Types of inorganic fertilizers that are commonly used by the local communities

1. What are the common types of inorganic fertilizers used for crop production in this community?.....
.....
2. Why do you advise the farmers to apply inorganic fertilizers in your crop fields?

.....
.....
3. Which inorganic fertilizer provides the highest crop yields after its application?
.....
.....
4. In your own opinion, why does it offer the highest crop yields?
.....
.....
5. What are some of the inorganic fertilizers that have to be used alone?
.....
.....
6. Which ones are recommended to be used in a combination to produce better results?
.....
.....
7. Does it imply that some of these fertilizers are applied to all types of crops ?

Yes ☐ No ☐

If yes, please name them.....
.....
8. What are some of the fertilizers that are applied to specific types of crop?

.....
.....
9. How long do the crops take to grow to maturity due to application of inorganic fertilizers?
.....
.....

Factors affecting inorganic fertilizer use for crop production

10. Which problems do you normally face regarding inorganic fertilizer management/use?

.....

.....

11. What storage facilities do you advise farmers to use for inorganic fertilizers?

A. Plastic buckets ☐ **B.** Metallic buckets ☐ **C.** Jerricans ☐

Any other storage facility, please specify.....

.....

12. In your own view, do you think the land tenure systems in this community are part of the major limiting factors? Yes ☐ No ☐

Please give reasons to support your answer.....

.....

13. What quantity of land have most of the farmers allocated for crop production using inorganic fertilizers? .....

Give reasons for your answer.....

.....

14. If it is less than 1 acre, which obstacles are preventing the farmers from allocating larger areas of land for crop production using inorganic fertilizers?

.....

.....

15. What is the most severe problem affecting the use of inorganic fertilizers in this community?.....

.....

16. In relation to the above problems, state the measures that have been put in place to facilitate proper use of inorganic fertilizers for crop production.

.....

.....

17. What other measures do you suggest to be put in place to ensure proper use of inorganic fertilizers?

.....

.....

18. Do you think inorganic fertilizers provide the best solution to increasing crop productivity?

Yes ☐ No ☐

Give reasons to support your answer.....

.....

19. What are the other better solutions for increasing crop productivity in this community?

.....

.....

20. In your own opinion, what is the best measure according to those you have listed in question **18** and **19** above? .....

.....

Please give reasons to support your answer.....

.....

21. Why do the above problems still exist? .....

.....

.....

Relationship between adoption of inorganic fertilizer and crop yields

22. What are the major problems affecting the use of inorganic fertilizers?

.....

.....

23. Which crop types do you advise the farmers to apply inorganic fertilizers for their production?

A). Maize ☐ **(B).** Beans ☐ **(C).** Groundnuts ☐

(D). Oranges/citrus ☐

Any other, please specify .....

.....

24. What are the crop yields after inorganic fertilizer application?

.....

.....

25. How often do you advise farmers to apply inorganic fertilizers in their gardens?

.....

.....

26. How long does it take for the soils to produce high crop yields due to inorganic fertilizer application?

A). 4 months ☐ **(B).** 8 months ☐ **(C).** 1 year ☐

(D). 2 years ☐

Any other period, please specify.....

.....

27. During which period do you advise people to apply inorganic fertilizers to their crop fields?

A). Start of the growing season ☐ **(B).** Mid-way the growing season ☐

(C). After the first harvest ☐ **(D).** Start and mid-way the season ☐

Any other, period please specify.....

.....

28. Why do you advise the farmers to apply the inorganic fertilizer at the period you have indicated in **question 27** above?

.....

.....

29. What are the correct quantities or measurements you consider for the application of the inorganic fertilizers in your or their crop fields?

(A). 125kg/ha of single superphosphate **(SSP)** ☐

(B). 250kg /ha of Sulphate of ammonia **(SA)** ☐

(C). 125kg/ha diammonium sulphate **(DAP)** ☐

(D). 125kg/ha of Monoamonium Phospahte **(MAP)** ☐

Any others please indicate.....

.....

.....

30. In your own opinion, what solutions do you think will improve on the use of inorganic fertilizers and also crop yields?

.....

.....

.....

Thank you for your cooperation.

Appendix VI: Researcher's curriculum vitae

Eniru Emmanuel Innocent
C/o KiBO Foundation
P.O BOX 32087, Kampala.
Tel: (+256)773021533 / 702021533
Date of Birth: 22nd-10-1985
Email: eniruemma@gmail.com

CAREER OBJECTIVE

To excel as an exceptional and dynamic environmental steward and academician in any international academic institution and environmental organizations.

SKILLS PROFILE

- Dynamic team leader
- Outstanding oral and written communication skills
- Tremendous computer skills in Microsoft packages
- Excellent interpersonal and conflict resolution skills
- Coordinate multiple assignments with minimum supervision in a busy environment.

EDUCATIONAL BACKGROUND

Award	**Year**
Masters of Science in Environment Management (Kampala International University, Kampala)	**Ongoing**
Bachelors of Science Degree in Environmental Management (Kampala International University, Kampala)	**2009**
Certificate in ICT & Leadership skills (KiBO Foundation, Kampala)	**2009**
Certificate in Agro forestry systems and practices, fuel wood conservation Technologies, Tree nursery establishments and management, Participatory Rural	**2008**

Appraisal.
(Kabale District Local Government)

Uganda Advanced Certificate of Education **2004**
(Ngora High School, Kumi)

WORK EXPERIENCE

Teaching Assistant, Kampala International University, Kampala. **Ongoing**
I conduct lectures, set exams, supervise and mark exams of students, and also undertake other tasks as assigned by my Superiors at work.

Supervisor, Paxland Motel, Soroti. **2007**
I monitored and coordinated the various departments and updated the books of account.

Polling Assistant, Electoral Commission, Arapai polling station, Soroti. **2006**
I ensured the election process was conducted efficiently.

VOLUNTEER EXPERIENCE / ACCOMPLISHMENTS

Board of Governors member, Soroti Youth Development Organization (SYDO). **Ongoing**
I take part in making insightful decisions for the organization and assist in research studies.

Chairman, Youth Inspired To Make a Change (YIMAC) KiBO Foundation. **2009**
I fostered a spirit of determination, teamwork, honesty, integrity and endurance among individuals.

Volunteer, Beijing Restaurant. **2009**
I coordinated activities of the employees and supplemented in ensuring a clean and healthy environment.

Secretary for Environment, Teso Students' Development Association. **2009**
Kampala International University.
I updated students on the various measures of enhancing environmental quality.

REFEREES

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   Senior Associate
   KiBO Foundation
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