

**FARMERS' KNOWLEDGE OF AND ATTITUDES TOWARDS THE USE OF
INORGANIC FERTILIZERS FOR IRISH POTATO (*Solanum tuberosum*)
PRODUCTION IN KABALE DISTRICT, UGANDA**

BY

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DECLARATION

I, Rusagura Joseph, hereby declare that this thesis is my original work and has never been presented by any researcher to any institution of higher learning for the award of any other degree.

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APPROVAL

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DEDICATION

This work is dedicated to my beloved wife Mwamikazi Chantal, my daughter Uwase Rachel, my late father Byondo Ngendahayo Elias, my mother Roda Nyirankuyenge, my brothers Mbonigaba Willy and Bizimana Pacifique.

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ABSTRACT

Irish potato (*Solanum tuberosum*) is the fourth most significant food crop in the world after rice, maize and wheat. However, Irish potato production in Uganda is low with an average yield of 3 tonnes ha⁻¹ without fertilizer use. This is ascribed to high soil nutrient mining coupled with low inorganic fertilizer use. In Kabale District, for example, farmers apply low rates (41.5kg-67.2kg/ha) compared to the recommended application rate of 120kg – 215kg/ha. There are a number of reasons for the low inorganic fertilizer use, including farmers' knowledge and attitudes. Therefore, the study assessed the farmers' knowledge and attitudes towards the use of inorganic fertilizer for Irish potato production in Kabale District. The target population comprised 363 farmers randomly selected, and 3 Agricultural officers with 4 suppliers of fertilizers purposively selected providing a sample size of 370 respondents. In testing the instruments, validity was found as 0.91 and reliability was found as 0.81. Validity and reliability coefficients were higher than 0.7, Cronbach Alpha which means that the instruments used were valid and reliable. A cross sectional survey design involving interviews and structured questionnaires was used. The results show that majority of respondents (60.6%) use inorganic fertilizers. NPK is the most commonly used inorganic fertilizer. In terms of quantity, nearly one half (49%) of respondents applied 50kgs/ha while 65.8% reported lack of sufficient technical knowledge in the use of inorganic fertilizer. The results revealed that there is a positive relationship between three knowledge variables and Irish potato yield as shown respectively (0.868, 0.684, 0.890, p-value<0.01). The results also show that farmers' attitudes were significantly positive to the use of inorganic fertilizers (r=0.417, p<0.05). The socio-economic variables examined were found to influence positively both knowledge and attitudes of the farmers in the use of fertilizers. Based on these results, it was concluded that farmers in Kabale used low fertilizer application rates and lacked sufficient knowledge but the attitudes were positive towards the use of inorganic fertilizer application needed to achieve high yields. It is, therefore, recommended that more sensitization and provision of technical services on inorganic fertilizer use be done and that the Government of Uganda should develop a mechanism for improving the accessibility of inorganic fertilizers by the farmers.

TABLE OF CONTENTS

DECLARATION	i
APPROVAL	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
ABSTRACT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xi
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS AND ACRONYMS	xiv
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background	1
1.2 Statement of the problem	6
1.3 General objective	6
1.4 Specific objectives	7
1.5 Research questions.....	7
1.6 Hypotheses	8

1.7 Significance of the Study	8
1.8 Scope.....	8
1.8.1 Geographical scope	8
1.8.2 Content scope.....	9
1.8.3 Time Scope	9
1.9 Limitations	10
1.10 Operational definitions of terms	10
CHAPTER TWO	11
LITERATURE REVIEW	11
2.1 Introduction.....	11
2.2 Inorganic fertilizer use	11
2.3 Role of farmers' knowledge in inorganic fertilizer use	13
2.4 Farmers attitudes towards inorganic fertilizer use	16
2.5 Effect of Socio-economic factors on use of inorganic fertilizers	18
2.6 Summary of literature review	21
2.7 Theoretical framework.....	21
2.8 Conceptual Framework.....	26
CHAPTER THREE	28

RESEARCH METHODOLOGY	28
3.1 Introduction	28
3.2 Research design	28
3.3 Area of the study	28
3.4 Study population	29
3.5 Sampling techniques and sampling size	30
3.6 Instrumentation	31
3.6.1 Questionnaire	31
3.7 Validity and Reliability of research instruments	32
3.7.1 Validity of research instruments	32
3.7.2 Reliability of research instruments	33
3.8 Data collection procedure	33
3.9 Data analysis	34
3.9.1 Analysis of qualitative data	34
3.9.2 Analysis of quantitative data	34
3.10 Ethical consideration	36
CHAPTER FOUR.....	37
PRESENTATION OF RESULTS	37

4.1 Introduction	37
4.2 Background information of the respondents	37
4.3 Extent of Inorganic Fertilizer use in Irish Potato Production in Kabale District.....	42
4.4 Farmers' Knowledge of inorganic Fertilizer use in Irish Potato Production in Kabale District	49
4.4.1 Factor analysis of farmers' knowledge of inorganic fertilizer application	49
4.4.2 Findings about mode of application of inorganic fertilizers, effectiveness of inorganic fertilizer application, amount of inorganic fertilizer application and Irish potato production.....	52
4.5 The Influence of farmers' attitudes towards inorganic fertilizer use for Irish potato production	55
4.5.1 Testing the Influence of farmers' attitudes towards inorganic fertilizer use for Irish potato production	58
4.6 Influence of socio-economic factors that affect knowledge and attitudes of farmers in the use of Inorganic fertilizer for Irish Potato Production in Kabale District.....	59
4.6.1 Effect of Socio-economic Variables on Inorganic fertilizer usage	60
4.6.2 Source of information on inorganic fertilizers.....	62
CHAPTER FIVE	64
DISCUSSION OF FINDINGS	64
5.1 Introduction.....	64

5.2 Extent of Inorganic Fertilizer use in Irish Potato Production in Kabale District.....	64
5.3 Farmers' Knowledge of inorganic Fertilizer use in Irish Potato Production in Kabale District	65
5.4 Influence of farmers' attitudes towards inorganic fertilizer use for Irish potato production..	67
5.5 Influence of socio-economic factors that affect knowledge and attitudes of farmers in the use of Inorganic fertilizer for Irish Potato Production in Kabale District.....	68
CHAPTER SIX	69
SUMMARY OF THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS	69
6.1 Introduction.....	69
6.2 Summary of findings.....	69
6.3 Conclusions.....	70
6.4 Recommendations.....	71
REFERENCES	75
APPENDICES	85
Appendix A: Questionnaire for Irish Potato farmers.....	85
Appendix B: Interview guide for key informants.....	95
Appendix C: Observation Guide for the Researcher/Assistants.....	96
Appendix D: Letter of introduction	97

LIST OF TABLES

Table 3.1: Percentages of households that grow Irish potatoes by Sub County.....	29
Table: 3.2: Summary of Statistical tests and analysis forms used.....	35
Table 4. 1: Percentages of respondents on the duration of education in years attained by Irish potato farmers	41
Table 4. 2: Percentages of farmers regarding their experience in growing Irish potatoes.....	41
Table 4. 3: Percentages of farmers regarding their responses on YES and NO questions	43
Table 4. 4: Percentages of Farmers who responded by type of fertilizer they used	43
Table 4. 5: Quantity of inorganic fertilizer used by farmers per season.....	44
Table 4. 6: Times of applying inorganic fertilizer per season by farmers	44
Table 4. 7: Period of duration in applying inorganic fertilizer by farmers	45
Table 4. 8: Inconveniences farmers met in the use of inorganic fertilizer in Kabale District	45
Table 4. 9: Farmers' responses on the time of applying inorganic fertilizer	46
Table 4. 10: Farmers responses on the level of benefit for applying inorganic fertilizer	47
Table 4. 11: Farmers responses on the quantity of potato yield per hectare by farmers resulting from fertilizers use.	47
Table 4. 12: Percentages of key informants regarding their responses on YES and NO questions	48
Table 4. 13: Factor analysis of Farmers' Knowledge of inorganic Fertilizer application	50
Table 4. 14: Relationship between the knowledge variables and yield of Irish potatoes	52
Table 4. 15: Distribution of farmers' knowledge of inorganic fertilizer usage by farm size	53
Table 4. 16: Determinants of inorganic fertilizer application in Irish Potato production.....	54

Table 4. 17: Results of attitudes of farmers towards inorganic fertilizer use for Irish potato production	56
Table 4. 18: Relationship between farmers' attitudes and inorganic fertilizer usage	58
Table 4. 19: Percentages of influence of socio-economic factors on inorganic fertilizer usage ..	59
Table 4. 20: Multiple regression results for the effect of selected socio-economic variables on inorganic fertilizers	61
Table 4. 21: Distribution of respondents according to information sources	62

LIST OF FIGURES

Figure 2.1: Conceptual Framework showing relationships of variables of knowledge of and attitudes towards inorganic fertilizer use in Irish potato production.....	26
Figure 4. 1: Percentages of respondents by age category	38
Figure 4. 2: Frequencies of respondents by sex	39
Figure 4. 3: Marital status of farmers who responded	39
Figure 4. 4: Percentages of respondents by increasing level of Education Achievement	40
Figure 4. 5: Type of farm owned by farmers	42

LIST OF ABBREVIATIONS AND ACRONYMS

ARI-Uyole:	Agricultural Research Institute of Uyole
CIP:	Centre International de la Pomme de terre/ Potato International Centre
CIS:	Community Information System
DADP:	Delta Agricultural Development Programme
DAIMINA:	Developing Agriculture-input Market in Nigeria
FAO:	Food and Agriculture Organisation (of the United Nations)
FYM:	Farm Yard Manure
IFDC:	International Centre for Soil Fertility and Agricultural Development
KAZARDI:	Kachwekano Zonal Agricultural and Research Development Institute
N.P.K:	Nitrogen-Phosphorus-Potassium
PRA:	Participatory Rural Appraisal
UBOS:	Uganda Bureau of Statistics
USA:	United States of America

CHAPTER ONE

INTRODUCTION

1.1 Background

Irish potato (*Solanum tuberosum*) is the fourth most important food crop in the world after rice, maize and wheat in terms of human consumption (Kandil, Attia, Badawi, Sharief and Abido, 2011). The quantity produced yearly exceeds 300 million metric tons and more than a billion people worldwide consume potato which is rich in carbohydrates, protein, vitamins, dietary fibers, simple sugars and minerals (Centre International de la Pomme de terre/ Potato International Centre 2010). However, its yields have reduced in most parts of the world due to low soil fertility (Shaaban and Kisetu, 2014). This is because Irish potato production requires a reasonable quantity of readily available nitrogen, phosphorus and potassium in the soil (Suh, Meka, Ngome, Neba, Kemngwa, Sonkouat and Njualem, 2015) which is only possible through the use of inorganic fertilizers.

Inorganic fertilizer is one of the critical inputs used in improving smallholder food and agricultural productivity. The importance of fertilizer application to agricultural production was stated by Lawal and Ayoola (2008) to include: improvement of soil structure, positive effect on biotic factors and nutrient supply. This meant a huge amount of money spent annually in the USA by both States and Federal Authorities on fertilizers procurement and distribution to increase agricultural production (Agwu and Anyanwu, 2000). According to Monirul, Akhter, Majid, Alam and Jannatul (2013), variation in the rate of application of inorganic fertilizers could influence the yield of Irish potato and improve soil fertility while combating pests and diseases (Khadem, Galavi, Ramrodi, Mousavi, Roustana and Rezvani-Moghadam, 2010).

In order to achieve high yield, Irish potato requires cool weather, reasonable amount of nitrogen (N), phosphorus (P) and potassium (K) in the soil. Phosphorus is the second most important macro nutrient after nitrogen that plays significant roles in the physiological and biochemical reactions such as photosynthesis and transfer characteristics (Mehrvarz, Chaichi and Alikhani, 2008). Phosphorus fertilizers and manure in the soil increase phosphorus uptake by plants, through favouring production of carbonic acid, the acid that increases solubility of phosphate compounds in calcareous soils. Fertilizer application has important effects on the quality and yield of Irish potatoes (Leytem and Westermann, 2005). Potato is highly responsive to N fertilization and N is usually the most limiting essential nutrient for Irish potatoes growth, especially on sandy soils. Nitrogen supply also plays an important role in the balance between vegetative and reproductive growth for Irish potato (White, Wheatley, Hammond and Zhang, 2007).

Studies conducted by Kanyeka, Kamala and Kasuga (2007) and Al-Dalain (2009) revealed that the potential average potato tuber yield in Tanzania is 25 tonnes ha⁻¹ under optimal agronomic practices. The low level of potato production in Tanzania is associated with low soil fertility and absence of deliberate replenishment of the nutrients to the agricultural soils in the cropping cycle after crop harvest.

In Uganda, Irish potato (*Solanum tuberosum*) is a very important staple food crop grown in places such as Kabale, Mbale, Kisoro and Fort Portal. Irish potatoes grow in soil temperature higher than 45°F (7°C) and lower than 70°F (21°C). At the time of planting, soils should be moist but not excessively wet. In irrigated desert areas, it is common to irrigate prior to planting to add moisture to dry soils. Planting into soils that are excessively cold, hot, wet or dry may increase the potential for seed decay. Within reasonable limits, the early establishment of a crop may increase yield and dry matter potential (Oladele, 2005).

Increased use of inorganic fertilizer in combination with other improved technologies such as good agronomic practices, irrigation, can improve agricultural productivity. Inorganic fertilizer has been used in significant amounts in Irish potato production in various regions like South Africa, Egypt, and Zimbabwe. This was due to the fact that education gives farmers better access to information about the inorganic fertilizers and more knowledge of how much inorganic fertilizer to use. Thus, education is expected to favourably affect inorganic fertilizer decisions. On the other hand, in a situation when nitrogen fertilizer is overused, better knowledge of fertilizer has the effect of neutralizing the tendency of overuse. Kelly *et al.* (2001) found that the most common reason of not using inorganic fertilizer in Rwanda is the lack of knowledge and the next most common is the high fertilizer prices. The interpretation they give to the first reason is that farmers' knowledge of the benefits and of how to use the fertilizers is not strong enough to stimulate use.

The study of Shiferaw, Obare and Muricho (2008) showed that there is a positive and significant difference between membership in a farmers' association and technical efficiency ($P < 0.1$), suggesting that Irish potato farmers who belong to an organization are likely to benefit from better access to inputs and to information on improved farming practices. Being a member in Irish potato farmers' association may lead to sharing of information on farming technologies which tends to influence the production practices of members through peer learning. This could be explained by the fact that Irish potato farmers' associations have the potential to shorten the marketing chain by directly connecting small producers to markets; better coordinate production and marketing activities and facilitate Irish potato farmer access to production inputs at fair prices. Farmers' attitudes determine adoption of improved technology; attitudes are evaluative responses towards the technology, and are formed as Irish potato farmers gain information about it. Adopters tend to hold positive attitudes towards the technology (Chilonda and Van Huylenbroeck, 2001). Adoption

of technology is influenced by socio-economic factors which include age, family size, education, knowledge, source of information, and farmer's attitudes towards the technology (Rogers, 2003). Knowledge influences adoption; farmers who have adequate knowledge of technology use are likely to adopt it (Rogers, 2003). Young farmers are more likely to adopt a new technology because they have had more schooling and are more susceptible to attitude change than old farmers. Education is expected to enhance the decision making and the adoption of agricultural technologies.

In their study on the Assessment of Farmers' Attitude towards the Use of Chemical Fertilizers in Northern Agricultural Zone of Delta State, Nigeria, Okoedo-Okojie and Aphunu (2011) found that responses on perceived attitudes towards fertilizer use shows that respondents have unfavourable attitude towards the technology.

Agriculture in most developing countries such as Uganda is predominantly subsistence, dominated by smallholder farmers. Over 80 percent of the arable land is dominated by these enterprises, and most often the smallholders do not produce enough. Yields in agricultural production are often low, which pose a challenge to both policy makers and agricultural researchers (Lawal and Ayoola, 2008).

In Uganda, Irish potato is grown for both home consumption and income especially in the highland areas of South Western Uganda (Kabale and Kisoro) and Eastern Uganda (Mbale and Sironko) districts. Although other regions are taking on commercial Irish potato production due to introduction of low land varieties, about 60% of the crop production remains in the East and Southwest of the country (Wang'ombe, 2008). Between 1964 and 1997, Irish Potato production in Uganda was fuelled by the introduction of hybrid Irish potato and related technologies. However,

there has been a marked decline in yield since 1997. Irish potato yield have declined from 1.85 metric tonnes per hectare in the period 1985 – 1989 to the current yield of 1.57 metric tonnes per hectare. Shortage of Irish potato in Uganda results in food insecurity or famine among the poor urban and rural households. Future increase in Irish potato production will heavily depend on yield improvement rather than expansion in area under production (Doward and Chirawa, 2011).

Ugandan government policy objective for Irish sub-sector is to encourage increased production so that self-sufficiency and food security can be achieved. Some of the reasons for the dwindling performance in Irish potato production are associated with the constraints along the Irish potato value chain. Key among the constraints are; poor access to credit, inadequate use of recommended technologies, high cost of inputs, inefficient agricultural extension services among others (Doward and Chirawa, 2011).

The studies by Zelalem, Tekalign and Nigussie (2009); Babaji *et al.* (2009); Namwata, Lwelamira and Mzirai (2010) and Kandil *et al.* (2011) have shown that inorganic fertilizer applications can increase dry matter content, protein content of Irish potato tubers, total and/or marketable tuber yield. Nitrogen fertilization has been reported to increase the average fresh tuber, plant height, leaf number and tuber weight per plant. The purpose of the present study was to determine the role of farmers' knowledge of and attitudes towards inorganic fertilizer use for Irish potato (*Solanum tuberosum*) production in Kabale District in order to meet optimum Irish potato yields.

Kabale District is on the highlands of southwestern Uganda. The district covers an area of 1,827 square kilometres (705 sq mi). The topography is mainly green, with heavily cultivated interlocking hills and spectacular valleys. The altitude ranges between 1,219 metres (3,999 ft) to 2,347 metres (7,700 ft) above sea level which makes it colder than the rest of the country.

Temperatures average about 18 °C (64 °F) during the day and fall to about 10 °C (50 °F) at night. The relative humidity is between 90% and 100% in the morning and decreases to between 42% and 75% in the afternoon, all the year around. These conditions are favourable for the production of Irish potatoes.

1.2 Statement of the problem

Uganda is one of the countries in sub-Saharan Africa with the highest soil nutrient mining and where levels of fertilizer use remain very low nationally at 2 kg per hectare compared to the neighbouring Kenya which uses an average of 32kg per hectare (Ministry of Agriculture, Animal Industries and Fisheries, Uganda, MAAIF, 2010). The majority of Irish potato farmers in Uganda either use little or no inorganic fertilizer (Okoboi and Birungi, 2012). In Kabale, farmers apply between 41.5kg and 67.2kg per hectare of inorganic fertilizer compared to the recommended application rate of 120kg – 215kg/ha (Maiangwa, Ogungbile, Olukosi and Atala, 2007). The reasons for the low utilization rates by Irish-potato farmers in Kabale District are not well known. Yet, proper understanding of farmers' knowledge and attitudes towards inorganic fertilizer use for Irish potato production provides a context-specific entry point for advisory services needed to achieve higher yields and overall economic growth and poverty reduction (Dethier and Effenberger, 2011). This study was therefore designed to assess farmers' knowledge and attitudes towards inorganic fertilizer use in Kabale District in western Uganda.

1.3 General objective

The general objective of this study was to establish farmers' knowledge and attitudes towards use of inorganic fertilizers for Irish potato production in Kabale District, Uganda

1.4 Specific objectives

The specific objectives were to:

1. Assess the extent of inorganic fertilizer usage among Irish potato farmers in Kabale District.
2. Determine the farmers' knowledge of the inorganic fertilizers used in Irish potato production in Kabale District.
3. Determine the farmers' attitudes towards use of inorganic fertilizers for Irish potato production in Kabale District.
4. Determine socio-economic factors that influence knowledge and attitudes of farmers in the use of inorganic fertilizer for Irish potato production in Kabale District.

1.5 Research questions

1. To what extent is inorganic fertilizer used among Irish potato farmers in Kabale District?
2. What is the level of the farmers' knowledge of inorganic fertilizers used for Irish potato production in Kabale District?
3. What are the farmers' attitudes towards the use of inorganic fertilizers in Irish potato production in Kabale District?
4. What are the socio-economic factors influencing farmers' knowledge and attitudes in the use of inorganic fertilizer for Irish potato production in Kabale District?

1.6 Hypotheses

Two hypotheses were developed to test the relationship between three knowledge variables and Irish potato yield; and the second hypothesis was used to test the relationship between farmers' attitudes and inorganic fertilizer use.

1. **H₀₁**: In Kabale, farmers' knowledge on the use of fertilizer in three variables of application mode, effectiveness and amount used has no significant relationship with Irish potato yield per hectare.

2. **H₀₂**: In Kabale, farmers' attitude towards the use of fertilizers has no significant relationship with inorganic fertilizer use.

1.7 Significance of the Study

The results of the study would be helpful in the following ways:

- i. In sensitization of farmers on the relevance of using inorganic fertilizer in increasing Irish potato production.
- ii. Help extension workers in designing the farmer field school as an extension approach to promote fertilizer use in Irish production.
- iii. Inform policy for inorganic fertilizer utilization as a way of increasing crop production and fighting hunger in Uganda and elsewhere in African countries.

1.8 Scope

1.8.1 Geographical scope

The study was carried out among Irish potato farmers in Kabale District. The study was mainly done in Hamurwa and Muko sub-counties. This was because the two sub-counties were and remain

among the sub-counties of Kabale District with higher percentage of Irish Potato production. Other Irish potato producing sub-counties in Kabale District are Bubare, Bufundi, Buhara, Bukinda, Butanda, Ikumba, Kaharo, Kamuganguzi, Kamwezi, Kashambya, Kitumba, Kyanamira, Maziba, Rubaya and Rwamucucu. The Municipality is composed of three divisions: Central Division, Northern Division and Southern Division.

1.8.2 Content scope

The study investigated farmers' knowledge of and attitude towards inorganic fertilizer use for Irish potato (*Solanum tuberosum*) production, Kabale District. It mainly assessed the extent of inorganic fertilizer usage among Irish potato farmers; determined the farmers' knowledge of the inorganic fertilizers used for Irish potato production; determined the farmers' attitudes towards use of inorganic fertilizers for Irish potato production and determined the socio-economic factors influencing farmers' attitudes towards the use of inorganic fertilizer for Irish potato production in Kabale District.

1.8.3 Time Scope

The study covered the period of five years (2010-2015). This was because during the last five years, there had been intensification of Irish potato production in Kabale District and people were sensitized on the production of Irish potato as it gained international market to Rwanda, DRC and South Sudan.

1.9 Limitations

The findings of this study might have been limited by:

- i. Some respondents were concealing vital information for fear of hidden agenda by the researchers. This was solved by assuring them on the confidentiality of the information that they provided.
- ii. Expectations from some respondents for tokens in form of money as they thought that the information required was for commercial purposes. This problem was solved by explaining to the respondents the purpose of the research.
- iii. The time scheduled to carry out this research was not enough due to the process and the distance the researcher had to travel during data collection. To overcome this, the researcher also hired research assistants to assist him in the process of data collection.

1.10 Operational definitions of terms

The following key terms will be operationally defined as follows:

Farmers' attitudes: Is strong predictors of behaviours or the acceptance of ideas (Ajzen, 1991).

Farmers' Knowledge: Is a combination of education and experience and farmers use knowledge to arrive at decisions that influence agricultural management practices (Mangan and Mangan, 1998).

Fertilizer Use: Is to increase the overall performance of cropping systems by providing economically optimum nourishment to the crop while minimizing nutrient losses from the field.

Yield: Is an energy ratio to the ratio between the numbers of seed harvested and seed sown (Evans 1993).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter examines the related literature from previous studies on the different aspects of Irish potato production covering; the extent of inorganic fertilizer usage among Irish potato farmers, farmers' knowledge of the inorganic fertilizers used, farmers' attitudes towards the use of inorganic fertilizers, socio-economic factors influencing farmers' attitudes towards use of inorganic fertilizer in production, theoretical framework and conceptual framework.

2.2 Inorganic fertilizer use

Inorganic fertilizers are used in modern agriculture to correct known plant-nutrient deficiencies; to provide high levels of nutrition, which aid plants in withstanding stress conditions; to maintain optimum soil fertility conditions; and to improve crop quality. Adequate fertilization programmes supply the amounts of plant nutrients needed to sustain maximum net returns (Leonard, 1986). In essence, inorganic fertilizers are used to make certain that soil fertility is not a limiting factor in Irish potato production.

The use of inorganic NP fertilizers improves Irish potato yields. Tolessa, and Friensen (2001) reported that the application of 25% recommended inorganic NP fertilizers + enriched FYM resulted in the highest marginal rate of return indicating that the integrated approach can save up to 75% of commercial fertilizers. Likewise, Bayu, Rethman, Hammes and Alemu (2006) also reported the possibility of saving up to 50% of the recommended NP fertilizers due to amendment with 5-15 tonnes ha⁻¹ of FYM without significantly affecting the optimum possible yield that can be obtained with the application of full dose of inorganic NP fertilizers alone. Joy, Savithri,

Mathew, Thomas and Kurien (2005) reported the possibility of substituting up to 25% inorganic fertilizers with the application of 30 tonnes ha⁻¹ FYM while still maintaining the highest rhizome yield.

Roy, Finck, Blair and Tandon (2006) formulated the following recommendations concerning N-fertilizers and reported that split application is better. They advised to apply about two-thirds of the nitrogen recommendation in the seedbed and the remainder top-dressed shortly after emergence if top dressing is planned for management reasons or to reduce the risk of leaching for crops grown on light sand and shallow soils. Different methods of fertilizer application can be adopted according to soil, weather and cultural practices conditions. For P-fertilizer, they recommended the application of total amount at ploughing or planting using special methods of application such as placement or band spreading. Regarding K-fertilizer, the author recommended split application (in case of soil with potential leaching): a half at planting and another one a bit later. Placement method of application was advised.

Kelly and Murekezi (2000) emphasized the use of inorganic fertilizer. These studies show that little fertilizer is used (five percent of farmers on three percent of total cultivated area) which has very high marginal returns and, if correctly used, would be highly profitable for Irish potato farmers. The increase and more efficient use of inorganic fertilizer is expected to contribute 4% of the 5.3% growth of the agriculture sector. Inorganic fertilizer is among the inputs which contribute to a better Irish potato production.

Kelly and Murekezi (2000), the studies show that less than 10% of farmers in Rwanda have ever used fertilizer. This means that a vast majority of farmers simply do not know how profitable it is to use fertilizer on crops they grow on their own farms. This is fundamentally different from

farmers who have heard about fertilizer, or about its profitability in general terms. That is why there is a vast gap between farmers' total demand for fertilizers and total profitable fertilizer potential. For instance, according to Kelly *et.al.* (2010) the yield estimate of 22,798 tonnes/ha of Irish potato is possible with the correct use of fertilizer. Such a gap could persist for many years in the absence of public efforts to convince farmers about the profitability of fertilizer use. In this scenario, many farmers will miss the opportunities to raise their income through fertilizer use, year after year. Vast amounts of cultivated land will continue to remain unfertilized, despite economic viability of fertilizer use, and this will further aggravate depletion of soil fertility. The research on profitable fertilizer potential is usually based on an economic evaluation of actual fertilizer response on various crops in different agro-climatic regions. Therefore, it is an invaluable aid in developing programs to convince farmers about profitability of fertilizer use in their own agro-climatic environments. Such programs make a decisive impact on farmers' fertilizer use decisions that accelerate the adoption and diffusion processes. This is how sustainable rapid growth in farmers' total demand for fertilizer has to be generated in many countries, especially in the early stages when there is a vast gap between actual fertilizer consumption and profitable potential.

2.3 Role of farmers' knowledge in inorganic fertilizer use

Inorganic fertilizer has been used in significant amounts in Irish potato production in various regions like South Africa, Egypt, and Zimbabwe. This was due to the fact that education gives farmers better access to information about the inorganic fertilizers and more knowledge of how much inorganic fertilizer to use. Thus, education is expected to favourably affect inorganic fertilizer decisions. On the other hand, in a situation when nitrogen fertilizer is overused, better knowledge of fertilizer has the effect of neutralizing the tendency of overuse. Likewise, the effect

of age is not straightforward in the adoption literature (Abdoulaye and Sanders, 2005). It could be that older farmers have more experience in farming and have better access to the technologies than younger farmers.

Similar to other crops, for several years (more than 20 years) Agricultural Research Institute of Uyo (ARI-Uyo) has been engaged in generation of improved agricultural technologies for Irish potatoes farming in southern highlands of Tanzania to enhance productivity. The Research institute has also been working very closely with agricultural extension system and other stakeholders in the area in trying to disseminate these technologies to farmers (Kanyeka *et al.*, 2007). However, despite the efforts done, there is still lack of information on the adoption of the disseminated technologies and factors hindering or promoting their adoption, or information important for more informed decisions and programmes aiming at improving potatoes production in the study area.

It has, however, been recognized that farmers know a lot, and the cardinal principles of participatory processes respect knowledge and skills of farmers since farmers are the most important stakeholders and the role of outsiders is to support them (Conroy, 2005). Exploratory studies based on participatory methods are well suited to getting an understanding of the farmers' technology needs, adoption constraints and prospects for effective technology intervention. Use of participatory rural appraisal (PRA) and participatory situational analysis approaches accord respect to the knowledge and skills of the farmers, recognize that farmers are the most important stakeholders and encourage target communities to freely express themselves, get involved and own the process (Conroy, 2005).

Conroy, *et al.* (2004) noted that although many projects rely solely on conventional government extension services to disseminate information to all farmer typologies, the approach is often not

effective. Matthewrman, Ashley and Morton (1997) describes the sources of failure by conventional information delivery of technology packages as being the common use of 'top down' information flow with heavy reliance on 'progressive farmers' hoping that other farmers-of different objectives, preferences; circumstances and resource endowment - will learn and copy from experiences of these farmers and subsequently adopt the technologies in question.

Kelly *et al.* (2001) found that the most common reason of not using inorganic fertilizer in Rwanda is the lack of knowledge and the next most common is the high fertilizer prices. The interpretation they give to the first reason is that farmers' knowledge of the benefits and of how to use the fertilizers is not strong enough to stimulate use.

Kelly *et al.* (2001) illustrate the concept of capacity to invest when trying to explain the big gap between potential fertilizer demand and fertilizer effective demand in Rwanda. They say that, if farmers do not know about the economic incentives associated with inorganic fertilizer, there is a human capital constraint that needs to be lifted by improving knowledge; if farmers do not purchase inorganic fertilizer because they do not have the financial capital, there is a need to build financial capital through savings and credit programs; if Irish farmers do not purchase fertilizer because they do not have the physical capital to use it properly, the productivity is reduced . The constraint needs to be addressed for agro economic potential to be translated into effective demand. It is, therefore, important that credit constrained farmers be facilitated to access loans at reasonable costs in order to purchase farm inputs such as inorganic fertilizers and pesticides.

The study of Shiferaw, Obare and Muricho(2008) showed that there is a positive and significant difference between membership in a farmers' association and technical efficiency ($P < 0.1$), suggesting that Irish potato farmers who belong to an organization are likely to benefit from better

access to inputs and to information on improved farming practices. Being a member in Irish potato farmers' association may lead to sharing of information on farming technologies which tends to influence the production practices of members through peer learning. This could be explained by the fact that Irish potato farmers' associations have the potential to shorten the marketing chain by directly connecting small producers to markets; better coordinate production and marketing activities and facilitate Irish potato farmer access to production inputs at fair prices.

2.4 Farmers attitudes towards inorganic fertilizer use

The importance of inorganic fertilizer application to agricultural production are stated by Lawal and Ayoola (2008) to include improvement of soil structure, positive effect on biotic factors and nutrient supply. This informed that not a huge amount of money was spent by Irish potato farmers on inorganic fertilizer purchase to increase Irish potato production. This may probably be attributed to a number of factors including lack of knowledge, social and economic factors such as status, attitudes and costs of technology as well as factors relating to the technology. Pre-conditions for the adoption and efficient use of inorganic fertilizers by Irish potato farmers are that the inorganic fertilizer has to be technically and environmentally sound, socially desirable, economically affordable and sustainable (Mundi and Ezenwa, 2006). If Irish potato farmers are convinced of the value of using inorganic fertilizer, they will adopt. Sometimes, the Irish potato farmers' attitude towards the use of inorganic fertilizer may play a decisive role. Farmers' attitude are more likely to correspond with their behaviour and in most cases, attitudes influence a broad range of behaviours. Indeed, an individual's reaction to any stimulus in any situation depends on the perception and personality of the individual (Pffnner and Presthus, 1997).

The financial liquidity constraint is often cited as an important determinant of fertilizer use (Abdoulaye and Sanders, 2005). As the rural credit market is not well developed in this region under the study, in times of difficulty, Irish potato farmers usually use their social networks or informal ways to attain money for inorganic fertilizer. Irish potato farmers with economic incapacity decide not to use inorganic fertilizer in Irish potato production.

The production and marketing of Irish potato in the highland zones of plateau state has become an integral part of the rural economy, both at the rainy and dry seasons as it is cultivated as a rain-fed and dry season crop (Okunade and Ibrahim, 2011). The attitude of farmers towards the adoption of inorganic fertilizer is influenced by their expectation of economic benefits. Therefore, Irish potato farmers who adopted a particular production method do so in anticipation of economic benefits.

Asiabaka, Morse and Kenyon (2001) noted that, if Irish potato farmers do not adopt a new technology, it is because they do not understand well the technology, it is not compatible with existing practice or because they have perceived the technology to be too complicated or too risky and not because they are ignorant.

In spite of the advantages of inorganic fertilizers in boosting production and efforts towards making inorganic fertilizers available to farmers, DADP (2007) reported that, there is a crisis situation of declining domestic agricultural use and demand for inorganic fertilizers. Many Irish potato farmers have either not adopted the fertilizer technology or are not fully abreast of the importance. Sometimes the farmers' attitude towards such innovation may play a decisive role.

Farmers' attitudes determine adoption of improved technology; attitudes are evaluative responses towards the technology, and are formed as Irish potato farmers gain information about it. Adopters tend to hold positive attitudes towards the technology (Chilonda and Van Huylenbroeck, 2001).

In their study on the Assessment of Farmers' Attitude towards the Use of Chemical Fertilizers in Northern Agricultural Zone of Delta State, Nigeria, Okoedo-Okojie and Aphunu (2011) found that responses on perceived attitudes towards fertilizer use shows that respondents have unfavourable attitude towards the technology. Respondents disagreed with statements such as: fertilizer is necessary for crops to do well (M= 2.25) fertilizers double the yield of crops (M= 1.95) once and fertilizer does not impair the quality of produce (M= 1.85). The aggregate mean of attitude towards fertilizer use was 80 percent, indicating that generally, the attitude of Irish potato farmers towards inorganic fertilizer use was unfavourable. Attitude, like knowledge and skill, determine the use of new innovations. Farmers' attitudes are more likely to correspond with their behaviours.

2.5 Effect of Socio-economic factors on use of inorganic fertilizers

Factors militating against sufficient crop production can be social, political, scientific and technological including the use of fertilizer. This study discusses socio-economic factors influencing farmers' use of inorganic fertilizers in Irish potato production. Broadly, factors that influence farmer efficiency may be summarized into agent and structural (Van Passel *et al.*, 2006). Agent factors are those associated with the farm manager such as education level, age and social capital. Structural factors are either on-farm for instance farm location, farm type, farm size, fertility and drainage or off-farm such as policy, infrastructure, upstream and downstream relations. Brazdik (2006) groups these factors into three broad categories: farm-specific variables (intensity of inputs like labour, fertilizers and seeds; farm size; organizational structure such as

tenure; crop variety), economic factors (markets, transport and prices of inputs), and environmental factors (wet-dry period, village). Most studies have examined the influence of farm-specific and economic factors on farm efficiency.

Salimonu (2007) potentially emphasized that increased cultivation on less productive lands is a major cause of declining yield among Irish potato farmers. To reverse the declining yield trends, intensification through the use of inorganic fertilizers and other land augmenting technologies is very essential. Fertilizer, generally refer to chemically synthesized plant nutrient compounds which are usually applied to the soil to supplement fertility.). The demand and use of fertilizer has a close interaction on the supply factors. In Nigeria, there is a significant unsatisfied demand for fertilizer, only about one-third of the demand is being satisfied (Singh, 2003). Inadequate supply of fertilizer has led farmers to rely heavily on organic waste as an alternative source of plant nutrients.

Past studies have documented some factors affecting application of inorganic farming practices among Irish potato farmers. Akpan and Aya (2009) identified education and extension services among the important determinants of fertilizer demand decision in Kenya. Olayide, Arega and Ikpi (2009) established that the intensity of fertilizer use increases with the family labour and physical access to fertilizer. Also, Amanze, Eze and Eze (2010) proved that output of crop, level of education, farm size and price of fertilizers were important factors influencing farmers' use of fertilizer in arable crop production.

Adoption of technology is influenced by socio-economic factors which include age, family size, education, knowledge, source of information, and farmer's attitudes towards the technology (Rogers, 2003).

Knowledge influences adoption; farmers who have adequate knowledge of technology use are likely to adopt it (Rogers, 2003). Young farmers are more likely to adopt a new technology because they have had more schooling and are more susceptible to attitude change than old farmers. Education is expected to enhance the decision making and the adoption of agricultural technologies. Family size plays a role on labour provision.

Adoption of new varieties requires more labour inputs. It is assumed that large families provide the labour required for improved Irish potato production practices. Sources of information, including extension, enhance the adoption of technology (Abebeaw and Belay, 2001). Knowledge influences adoption; farmers who have adequate knowledge of technology use are likely to adopt it (Rogers, 2003).

In the existing literature, the analysis of the decisions on fertilizer use has mainly considered the factors lying within the public domain, for instance, prices and marketing, fertilizer provision and distribution, research and credit and on agro-climatic conditions and characteristics of the farm or the farmer such as education, age, experience and farm resources (Abdoulaye and Sanders, 2005). Earlier works on fertilizer use by economists focus on fertilizer adoption and assume that farmers make adoption decisions based on utility maximization. However, social scientists, especially anthropologists and sociologists, have argued that farmers' subjective assessments of agricultural technologies are also important in influencing their use (Ifejika, Akinbile, Ifejika and Oladeji, 2008).

Finally, Franzel (1999) argued that higher income farmers may be less risk averse, have more access to information, have longer-term planning horizon, and have greater capacity to mobilize resources and hence increased likelihood of adopting new technologies. Being a male or married

by a household head were significantly positively associated with adoption of improved technologies.

2.6 Summary of literature review

The literature review summarized previous works on farmers' knowledge and attitudes towards inorganic fertilizer use in Irish potato production. They showed that most of farmers have low knowledge of inorganic fertilizer usage in Irish potato production; most of farmers have negative attitudes towards the use of inorganic fertilizer especially illiterate and aged farmers. In addition, socio-economic factors such as level of education, price of fertilizer, farm size and age of farmers influence the use of inorganic fertilizers in Irish potato production.

Gaps of literature existed on knowledge and attitudes towards inorganic fertilizer use but through cross referencing using hard and soft libraries tried to get the information recorded herein. Soft libraries like AGORA and TEEAL helped the researcher later to find the required information on knowledge and attitudes. It shows the need for use of a variety of reference materials also like journals, encyclopedia, book reviews and government documents.

2.7 Theoretical framework

This research focused on farmers' knowledge of and attitudes towards inorganic fertilizer use in Irish potato production. The study was built on two correlated theories: the Theory of Planned Behaviour and the Theory of Reasoned Action. These theories explain the decision to adopt or not to adopt inorganic fertilizers in Irish potato production with respect to a variety of socio-economic factors as well as comparing the knowledge and attitudes of Irish potato farmers.

In order to gain a better understanding of the decision of Irish potato farmers to adopt inorganic fertilizers, it was first perceived as a human behavioural issue. A model from the social psychology literature named the theory of planned behaviour (TPB) was applied. The theory of planned behavior is “designed to predict and explain human behavior in specific contexts” (Ajzen, 1991). It had its origin in the theory of reasoned action (Ajzen and Fishbein, 1985). According to the TPB, the intention was based on three main constructs, namely attitudes, subjective norm (SN) and perceived behavioural control (PBC). Intention to perform the behaviour was regarded as the most important immediate determinant of that action (Ajzen and Fishbein, 2005). Therefore, knowledge of Irish potato farmers had on inorganic fertilizer use drove the intention to use Inorganic fertilizer in Irish potato production. However, due to social and economic factors such as prices, experience of Irish potato farmers, level of education, which were the control factors, farmers would adopt the use of inorganic fertilizers in Irish potato production.

According to Ajzen and Fishbein (1980), the behaviour of an individual is basically determined by two factors; one is the individual’s nature and the other reflects perceived social and behaviour economic pressure. The individual factor is the individual’s positive or negative evaluation of performing the behaviour. Since it deals with personal feelings, this factor is termed the “attitude towards the behaviour” (Ajzen and Fishbein 1980). The other factor is the individual’s perception of social and economic pressure put on him/her to perform or not perform the behaviour. Since it deals with perceived prescription, this factor is termed the “subjective norm” (Ajzen and Fishbein, 1973).

Generally, Irish potato farmers intend to use inorganic fertilizers when they both have a favourable evaluation of the behaviour and they believe that a significant number of other people wish they would do it. Considering these arguments, Ajzen and Fishbein developed the Theory of Reasoned

Action (TRA) in 1980. This theory assumes that people are normally quite rational, in that they make systematic use of available information, consider the implications of their actions, and thus behave in a sensible manner. TRA argues that behaviour is best predicted by a person's intentions which are in turn affected by his/her attitude and perceived social pressure. Thus the TRA provided a theoretical framework for examining the influence of attitudes and goals on volitional behaviours (Willock *et al.* 1999). The TPB states that a person's behaviour results from his/her goals and intentions, attitudes, perceived behavioural control and social norms (Bergevotte *et al.* 2004).

Attitude is determined by the beliefs that are salient or important to a person. Attitudes are formed by what an individual perceives to be true about the attitude-object. The beliefs underlying an individual's social pressure are termed normative beliefs and represent the perception of the preferences of 'a significant number of others' about whether one should perform the behaviour (Chetsumon, 2005).

The theory on farmer decision-making in relation to the uptake of inorganic fertilizer technologies and examines the variables which commonly explain adoption. The study set out by briefly exploring some general theories that can help explain the application and adaptation of innovative agricultural technologies. . Recently, researchers have started to pay more attention to the internal decision-making process and look beyond the mere characteristics of the innovation and the household to include psychological and motivational factors in technology uptake. Knowledge, attitude and practice studies looking at the uptake of innovations have been carried out since the 1980s; however, these surveys have rarely been applied to f adoption, especially in sub-Saharan Africa (Ajayi, 2007). The theories reviewed here led to the development of an analytical framework, which emphasized the role of knowledge, attitudes and perceptions in the decision-making process of technology adoption. Using this analytical framework as a reference point, the

literature was reviewed on the uptake of fertilizer use practices in sub-Saharan Africa to better understand the variables that most commonly explain technology adoption. Application of the framework in adoption studies and design of Agriculture technology interventions are hoped to help in ensuring sustainability.

There is a broad range of the literature with regard to theories about decision-making processes. Rogers (1995) described how innovations are adopted over time in his 'diffusion of innovations' theory. Diffusion refers to the process by which innovations are spread among the members of a social system over time. An innovation can be an idea or concept, technical information or an actual practice that is perceived as new by the individual. Rogers (1995) identified five characteristics that determine the rate of adoption of the innovation: the relative advantage, compatibility, complexity, trialability and observability. The decision to adopt an innovation is a mental process consisting of five stages: knowledge, persuasion, decision, implementation and confirmation. Rogers (1995) suggested that the innovativeness of an individual determines when the individual adopts the innovation and recognized five successive adopter categories: innovators, early adopters, early majority, late majority and laggards. The adoption process is also affected by the so-called receiver variables, such as personality characteristics, social characteristics and the perceived need for the innovation.

The diffusion of innovations theory has guided many studies that try to understand the uptake of new agricultural technologies and it has been applied in the development of farmer decision-making models in the tropics (Mercer, 2004; Edwards-Jones, 2006; Pannell *et al.*, 2006, Reed, 2007). There has been a shift in thinking away from looking at adoption as the delivery of an external, typically science-based innovation with farmers as potential end users towards a more complex learning process involving a wide range of actors (Röling and Jiggins, 1998). Röling

(1992) describes the emergence of knowledge systems thinking, in which an articulated set of factors, networks and organizations are expected or managed to work synergistically to support knowledge processes. Röling and Jiggins (1998) describe three types of knowledge systems: transfer of technology, farm management development and the ecological knowledge system. The most common and conventional knowledge system is the transfer of technology, which views desirable farming practice as using science-based component technologies, farmer learning as the adoption of external innovations and facilitation as the delivery of these innovations.

Farm management development operates within strategic rationality and aims to support the practices of the farmer as an entrepreneur engaged in an economic enterprise focusing on the farm as a whole. The main purpose of the ecological knowledge system is to help land users to become experts at managing complex ecosystems in a sustainable manner. It assumes that farmers are experts on their own farm and take decisions based on knowledgeable interference from observation and analysis through social learning (Röling and Jiggins, 1998)

2.8 Conceptual Framework

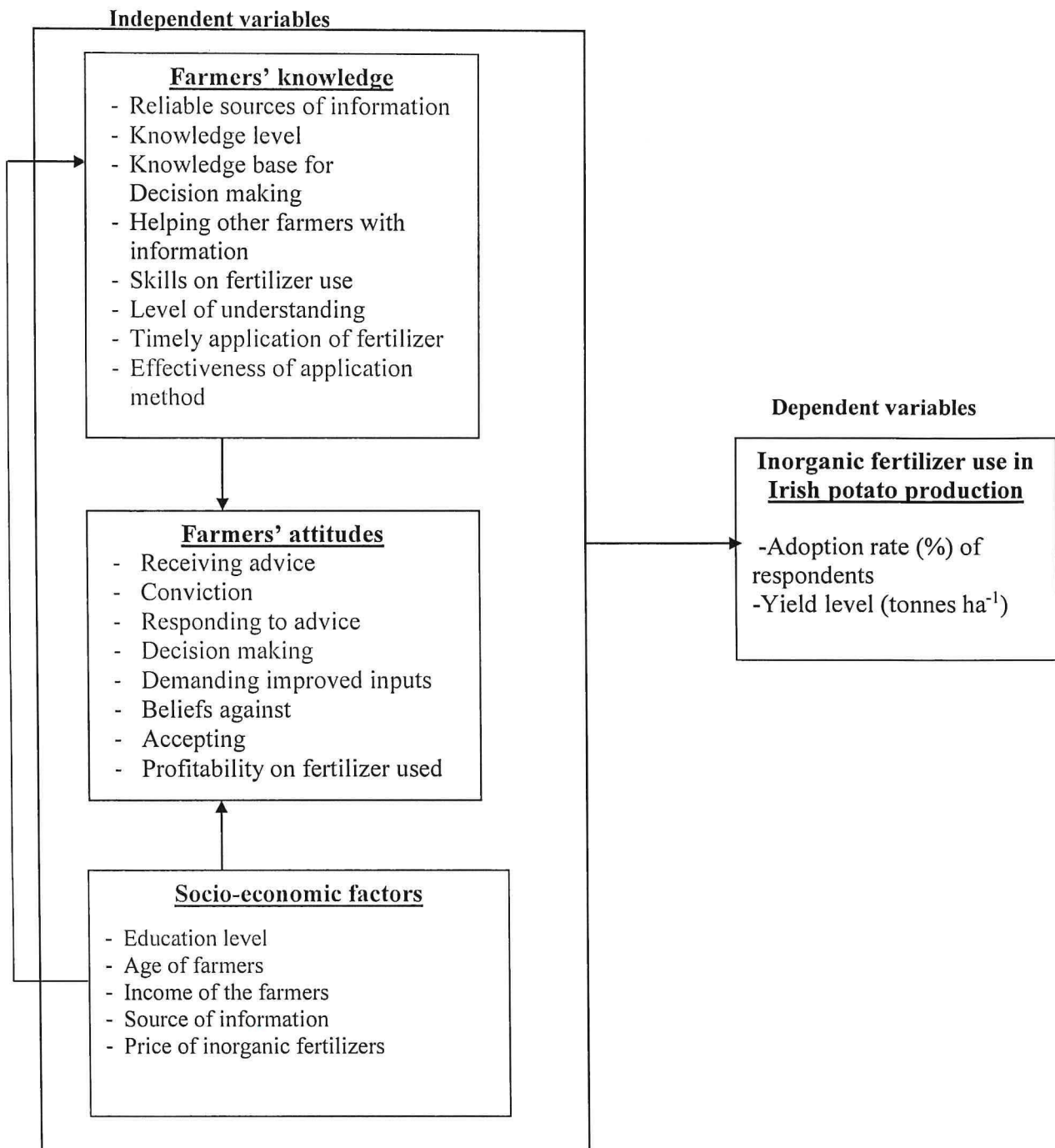


Figure1: Conceptual framework showing relationships of variables of knowledge and attitudes towards inorganic fertilizer use in Irish potato Production.

Figure 1 shows the conceptual framework for Irish potato production and that inorganic fertilizer use depends on the knowledge of and attitudes of farmers toward the use of fertilizers. Knowledge variables affecting farmers' attitudes towards the use of inorganic fertilizer for Irish production. Also socio-economic factors affect both knowledge and attitudes of farmers in the use of inorganic fertilizers. Fertilizers can be directly applied into the soil to increase on the soil nutrients thus enhancing the growth of potatoes hereby increasing the total output per hectare. Inorganic fertilizer use directly depends on knowledge in that when farmers are ignorant about the importance of fertilizers, then there might be limited or no application of these fertilizers. In addition, if farmers are aware of the availability and importance of inorganic fertilizers, application and usage might be high. Furthermore, attitude of farmers greatly affects the use of inorganic fertilizers. Adopters tend to hold positive attitudes towards the technology (Chilonda and Van Huylenbroeck, 2001). Adoption of technology is influenced by socio-economic factors which include age, family size, education, knowledge, source of information, and farmer's attitudes towards the technology (Rogers, 2003). Most times when people have negative attitude either due to lack of knowledge about the importance or due to bad experiences and wrong application of the fertilizers which limit the use of inorganic fertilizers (Kelly *et al.* 2001). In addition, some farmers prefer to use organic fertilizer rather than inorganic thus such farmers already have poor attitudes towards inorganic fertilizer use hence limiting the application of inorganic fertilizers. However, socio-economic factors such level of education, age of farmers, prices of fertilizers, income of the farmers and source of information among others influence knowledge of and attitudes towards the use of inorganic fertilizers by Irish potato farmers. Testing of relationships identified were done using Hypotheses reported on pages 52 and 58.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlights the research design, area of study, population and sampling, instrumentation, data collection procedure, data analysis and ethical consideration.

3.2 Research design

A descriptive cross-sectional survey design was used to capture specific data on farmers' knowledge, attitudes at a particular point in time. It was conducted in two phases: first through a reconnaissance visit to collect qualitative information on status of Irish potato production in Kabale, inorganic fertilizer use and support services. The second phase was the questionnaire survey to collect quantitative information on farmers' socio-economic characteristics, knowledge and attitudes towards inorganic fertilizer use.

3.3 Area of the study

The study was conducted in Kabale District on the highlands of southwestern Uganda. The district covers an area of 1,827 square kilometres (705 sq mi). The topography is mainly green, with heavily cultivated interlocking hills and spectacular valleys. The altitude ranges between 1,219 metres (3,999 ft) to 2,347 metres (7,700 ft) above sea level which makes it colder than the rest of the country. Temperatures average about 18 °C (64 °F) during the day and fall to about 10 °C (50 °F) at night. The relative humidity is between 90% and 100% in the morning and decreases to between 42% and 75% in the afternoon, all the year around. These conditions are favourable for the production of Irish potatoes. Farmers in Hamurwa and Muko sub-counties can grow Irish potatoes four seasons a year. According to UBOS (2011), Butanda sub-county occupies the first position in the production of Irish potatoes with 61.9% of the households producing Irish potatoes.

Hamurwa sub-county occupies the second position with 61.3% followed by Ikumba sub-county (57.2%) and Muko sub-county (51.4%) respectively. The district's population was estimated at about 498,300. Kabale District was selected for the study due because of its high potential as one of the Uganda's Irish potato basket.

Table 3.1: Percentages of households that grow Irish potatoes by Sub County

Sub county	Total Number of households	% of households growing Irish potatoes
Bubare	8,286	32
Bufundi	4,527	31
Buhara	4,580	18.5
Bukinda	3,950	28.3
Butanda	3,386	61.9
Central division	1,412	5.7
Northern division	1,446	2
Southern division	1,734	7.1
Hamurwa	4,257	61.3
Ikumba	6,551	57.2
Kaharo	3,381	18.4
Kamuganguzi	4,326	27.5
Kamwezi	4,582	4.3
Kashambya	4,167	34.9
Kitumba	3,248	15.9
Kyanamira	4,289	25.8
Maziba	3,810	9.2
Muko	7,683	51.4
Rubaya	4,911	35.3
Rwamucucu	4,245	45.5

Source: Uganda Bureau of Statistics (2011)

3.4 Study population

The study population was comprised all households which grow Irish potato in Hamurwa and Muko Sub-counties. The Community Information System summary results (2009) showed that the households of Muko sub-county were 7,683 and Hamurwa sub-county had 4,257 households,

(see Table 3.1). Available data showed that 51.4% (3,949) of households in Muko Sub-county and 61.3% (2,610) households in Hamurwa sub-county grew Irish Potatoes. Therefore, the study population comprised 6,559 households growing Irish potato in Muko and Hamurwa sub-counties in Kabale District.

3.5 Sampling techniques and sampling size

The research used a sample size of 363 household heads or one of their members growing Irish potato determined by the following formula for determining the sample size (Krejcie & Morgan, 1970).

$$S = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)}$$

S = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (95%) = (3.841).

N = the population size.

P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (0.05).

Therefore, the application of the formula is as follows:

$$S = \frac{3.841 \times 6,682 \times 0.50(1-0.50)}{(0.05)^2(6,682-1) + 3.841 \times 0.50(1-0.50)}$$

$$S = \frac{6416.3905}{17.66275}$$

$$S = 363$$

In addition, seven (07) key informants including four (04) input dealers, two (02) field agricultural extension workers and one (01) District Agricultural Officer were selected because they had

relevant information about Irish potato production and inorganic fertilizer use in the District. Therefore, a total of 370 people participated in the study including key informants.

3.6 Instrumentation

3.6.1 Questionnaire

The researcher first prepared questionnaire and interview guide for respondents. They were approved by the supervisor and then after a pilot test was done to establish the validity and reliability of the study. The study employed the questionnaire to collect quantitative data from Irish potato farmers. The researcher developed close-ended questions using “yes” and “no” questions and Likert scaling. The Likert scale requested the respondent to respond to a number of statements by indicating their agreement using a five-point Likert scale of 1=Strongly Disagreed(SD), 2=Disagreed(D), 3= Not decided(N), 4=Agreed(A) and 5=Strongly Agreed(SA).

The questionnaire was composed of five sections. The first section was on the extent of use of inorganic fertilizer by farmers in Irish potato production, the second section was about farmers’ knowledge on the use of inorganic fertilizer in Irish potato production, the third section was about the farmers’ attitudes towards inorganic fertilizer use in Irish potato production and the fourth section was about socio-economic factors influencing the use of inorganic fertilizer for Irish potato production in Kabale District and fifth section described the demographic characteristics of respondents.

3.6.2 Interview guide

The interviews were used to collect information from key informants Irish potato farmers. These were suppliers of inorganic fertilizers, agricultural extension officers, and the District agricultural officer. This helped to get in-depth information on knowledge and attitudes of farmers towards inorganic fertilizer use and other socio-economic factors influencing the use of inorganic fertilizers

in Irish potato production in Kabale District. The key informants were approached because they are in position of much knowledge of inorganic fertilizer use in Irish potato production in Kabale District.

3.6.3 Observation guide

Observation is a method of data collection which involves observing something without changing it or any variables involved (Price, 2006). Under this method, using an observation guide, the researcher used senses of seeing of what was on ground using a non-verbal approach. The researcher used an observation checklist of items to assess farmer's knowledge of and attitudes towards the use of inorganic fertilizer for Irish potato production in Kabale District, Uganda.

3.7 Validity and Reliability of research instruments

3.7.1 Validity of research instruments

Validity refers to how well a test measures what it is purported to measure (Amin, 2005). A validity test was carried out prior to the administration of the research instruments. This was done in order to find out whether the questions are capable of capturing the intended data (Amin, 2005). Research Supervisors reviewed the questions to see whether they are capable of capturing the intended response. A Content Validity Index (CVI) was calculated in order to establish the validity of the research instrument and the researcher used the following formula to establish validity of the research instruments as seen below.

$$\text{Content Validity Index (CVI)} = \frac{\text{Relevant items by all judges as suitable}}{\text{Total number of items judged}}$$
$$\text{CVI}=0.9$$

CVI was 0.9 which was greater than 0.7 as recommended by Amin, (2005). Then, the questionnaire was considered valid for data collection.

3.7.2 Reliability of research instruments

Reliability is the degree to which an assessment tool produces stable and consistent results (Mugenda & Mugenda, 1999). Also, Reliability was ensured through pre-testing the questionnaires on different categories of the study population. Cronbach's Alpha Coefficient was used to assess the internal consistency and a minimum of alpha 0.7 was taken as acceptable measure for it (Amin, 2005). George and Mallery (2003) provide the following rule of thumb in judging the reliability of a test: "> .90: Excellent, \geq .80: Good, \geq .70: Acceptable, \geq .60: questionable, \geq .50: poor, and < .50: Unacceptable". The alpha value of 0.81 generated was interpreted as a good measure according to the rule provided by George and Mallery (2003).

3.8 Data collection procedure

The researcher got an introductory letter from Kyambogo University and one from National Council of Science and Technology to introduce him to the authority of Kabale District who turn introduced him to the authorities of Hamurwa and Muko sub-counties. The researcher contacted sub-county chiefs in Hamurwa and Muko sub-counties and explained to them the purpose of this study and sought for the necessary assistance. The famers who responded to the research questionnaires came from households which grow Irish potatoes. Therefore, the researcher targeted one individual who was involved in Irish potato production from each household. The researcher introduced himself to the respondents, had meetings with them and also explained the purpose of the study in order to build mutual relationship with them. He made some visits to Irish potato farmers, he gave questionnaires. The researcher asked permission from the respondents to go ahead and get information from them. After getting information from questionnaires, interviews, and observations, the data was properly recorded and stored. The questionnaires were

administered to farmers who were literate and they were filled by themselves. In case of farmers who were illiterate, the researcher proceeded with administration of the questionnaire. The administration of questionnaires took between 30 minutes to an hour in order to reach the necessary information. Also the research use interview guide to collect information from key informants.

3.9 Data analysis

The data was analysed through qualitative and quantitative procedures as described on this page and in Table 3.2. The results generated are reported in Chapter four and discussed in Chapter five.

3.9.1 Analysis of qualitative data

The researcher reviewed all the responses from the interviews and the questionnaires to make sure that all information was put together to meet the objectives of the study. The process was through open coding according to variables which were identified in the conceptual framework. From the answers to the research questions, it was possible to fix meaning of the responses to uphold the objectives. Frequencies were used to generate percentages which described the responses according to the objectives.

3.9.2 Analysis of quantitative data

Inferential statistics were computed using factor analysis and multiple regression to allow testing of relationships between knowledge variables and aspect of fertilizer use namely application mode, effectiveness of application, amount of inorganic fertilizers and ways of accessing inorganic fertilizers. Pearson correlation was used to establish relationships between knowledge variables and yield; relationships between farmers' attitudes and inorganic fertilizers use. Computations of correlation coefficients were done using the SPSS computer software version 16.0. Two

hypotheses were developed to test the relationships of variables. Data from the questionnaires were coded and entered into software for analysis and generation of quantitative data for both descriptive and inferential statistics namely: frequencies, percentages and correlation from factor analysis, multiple regression and Pearson correlation.

Table: 3.2: Summary of Statistical tests and analysis forms used

Objectives	Hypotheses	Independent Variable	Dependent Variable	Relationship	Statistical Test/Analysis Form
Farmers' knowledge of inorganic fertilizer used in Irish potato production	In Kabale, farmers' knowledge on the use of fertilizer in three variables of application mode, effectiveness and amount used has no significant relationship with Irish potato yield per hectare.	-Method of application -Time of application -Rate of application	Quantity of Inorganic fertilizer use	The quantity of inorganic fertilizer used depends on farmers knowledge on Method of application ,Time of application and rate of application	Factor analysis and correlation
Farmers' attitudes towards use of inorganic fertilizer in Irish potato production	In Kabale, farmers' attitude towards the use of fertilizers has no significant relationship with inorganic fertilizer use	Level of accepting	Level of inorganic fertilizer use	The level of conviction of farmers is related to the level of inorganic fertilizer use	Correlation

3.10 Ethical consideration

In order to maintain confidentiality and anonymity of interviewees the names of the participants were not disclosed. To assure confidentiality of official documents obtained for this study was by not disclosing names of people. Once permission to start the research was granted, the researcher began by scheduling questionnaires and interviews sessions and observations among respondents. At the beginning of each interview, the researcher explained the purpose of the study, asked for consent to conduct the interview and explained their rights as participants to partake in the interview. Considering that the subjects of the research who were the main source of information were important, therefore, ethical issues were observed during field work.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.1 Introduction

The study examined the influence of farmers' knowledge of and attitudes towards the use of inorganic fertilizer for Irish potato (*solanum tuberosum*) production in Kabale District, Uganda. This chapter presents and discusses the findings of the study. The chapter also presents the analysis and interpretation of results. The presentations are done according to the specific objectives and hypotheses as follows: extent of fertilizer usage; farmers' knowledge of fertilizers; farmers' attitudes towards fertilizer use; and influence of socio-economic factors.

4.2 Background information of the respondents

Respondents were asked about their age, gender, marital status, and education level, duration of education and growing Irish potato and type of farm owned by Irish Potato farmers. This information was required to ensure that the sample that participated in the study had similar distribution of the respondents by characteristics to that of the population it was drawn from. This determined the accuracy and representativeness of information drawn from the sample to the population. Findings regarding their age, gender, marital status, education level, duration of education and growing Irish potato, and type of farm owned by Irish Potato farmers are presented in the subsequent tables and charts.

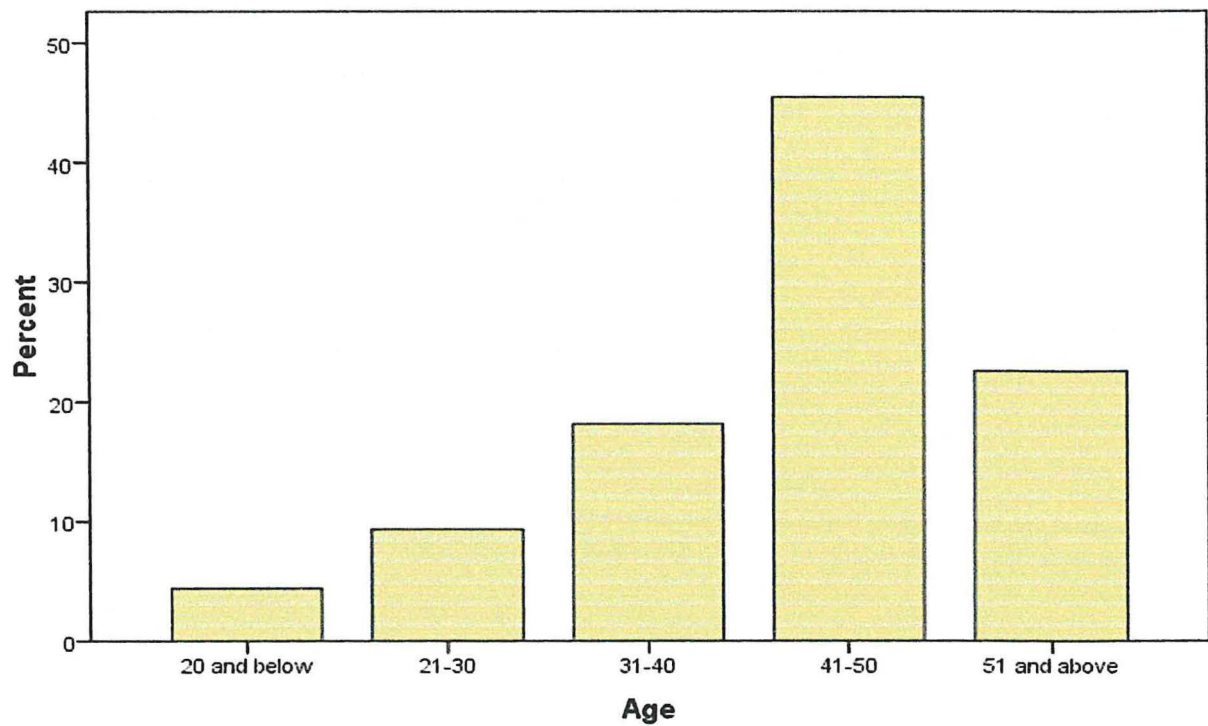


Figure 4. 1: Percentages of respondents by age category

Figure 4.1 shows that 165 (45.5%) of respondents were aged between 41-50 years, 82 (22.6%) of respondents were aged of 51 years and above, 66 (18.2%) of respondents were aged between 31-40 years, 34 (9.4%) of respondents were aged between 21-30 years and 16 (4.4%) of respondents were aged of 20 years and below. The study findings showed that most of Irish potato farmers in Kabale District are people with a long experience in farming, like more than 20 years.

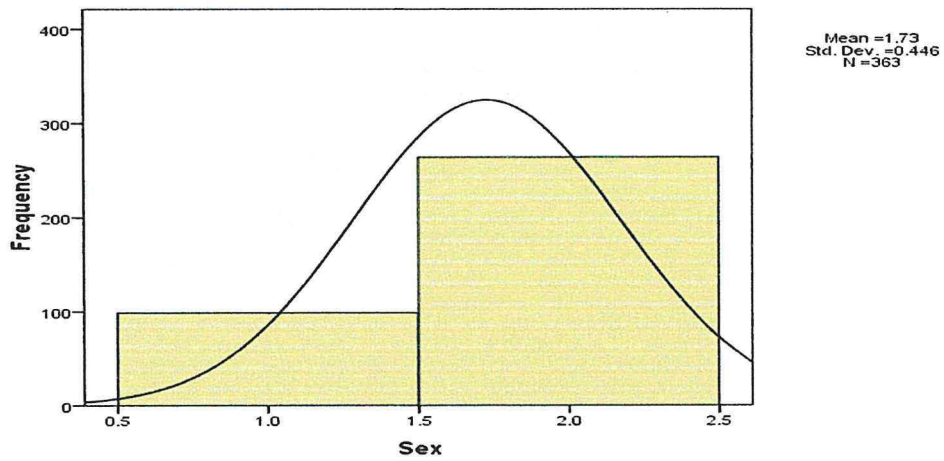


Figure 4. 2: Frequencies of respondents by sex

Figure 4.2 shows that 264 (72.7%) of respondents were males while 99 (27.3%) of respondents were females. This implies that males are more involved in Irish potato production in Kabale District.

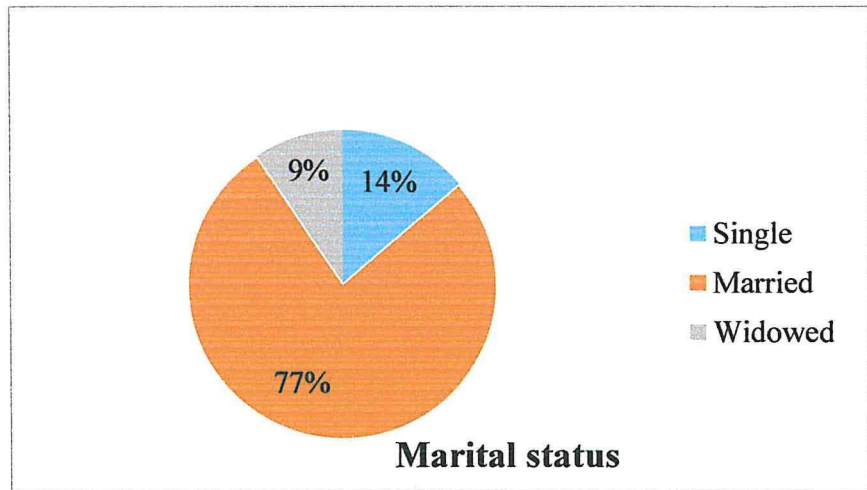
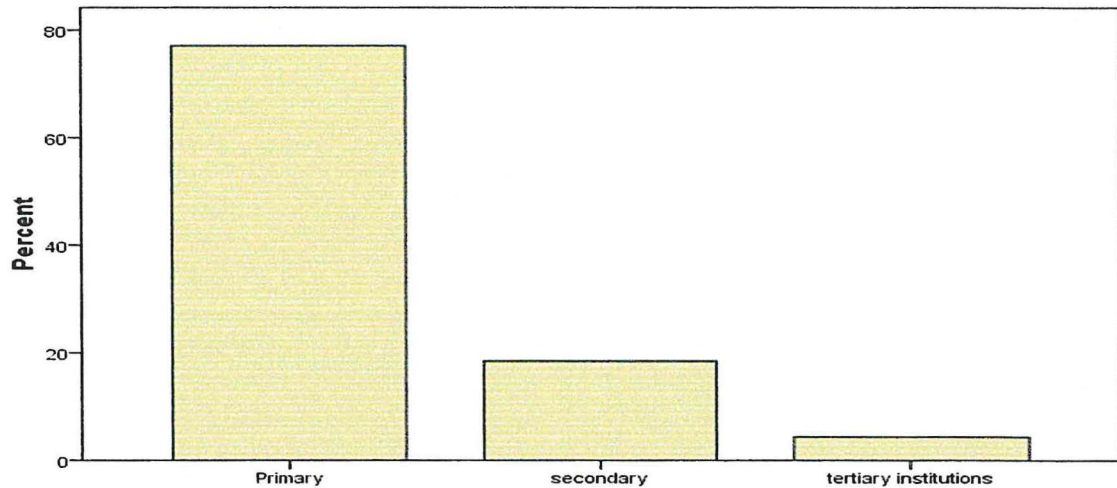


Figure 4. 3: Marital status of farmers who responded

Figure 4.3 shows that 279 (77%) of respondents were married, 50 (14%) of respondents were single while 34 (9%) of respondents were widowed. This implies that most of Irish potato farmers in Kabale District are married people.



Increasing level of education

Figure 4. 4: Percentages of respondents by increasing level of Education Achievement

Figure 4.4 shows that 280 (77.1%) of respondents had primary education, 67 (18.5%) of respondents had secondary education and 16 (4.4%) of respondents had tertiary education. The implication is that most Irish potato farmers in Kabale District had low level of education as most of them did not go beyond primary education.

Table 4. 1: Percentages of respondents on the duration of education in years attained by Irish potato farmers

n=363

Duration in years	Primary schooling		Secondary schooling		Tertiary Institutions		Non formal training		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
1-2 years	0	0	7	2	16	4.4	0	0	23	6.3
3-4 years	49	13.5	35	10	0	0	0	0	84	23.1
>4 years	231	64	25	7	0	0	0	0	256	70.5
Total	280	77.5	67	19	16	4.4	0	0	363	100

Source: Primary Data, 2016

The findings in Table 4.1 shows that 231 (64%) of respondents who had primary education spent more than 4 years in primary education, 49 (13.5%) of respondents spent between 3-4 years in primary education, 35 (10%) of respondents spent 3-4 years in secondary education, 25 (7%) of respondents spent more than 4 years in secondary education, 7 (2%) spent 1-2 years in secondary education and 16 (4.4%) of respondents spent 1-2 years in tertiary institutions.

Table 4. 2: Percentages of farmers regarding their experience in growing Irish potatoes

n=363

Time taken growing Irish potatoes in years	Frequency	Percentage
1-5 years	117	32.2
6-10 years	43	11.8
11-15 years	53	14.6
16-20 years	32	8.8
More than 20	118	32.5
Total	363	100

Source: Primary Data, June 2016

Table 4.2 shows that experience in growing potatoes starting from the highest to the lowest thus 118 (32.5%) of respondents had more than 20 years in growing Irish potato, 117 (32.2%) of respondents had between 1-5 years in growing Irish potato, 53 (14.6%) of respondents had between

11-15 years in growing Irish potato, 43 (11.8%) of respondents had 6-10 years in growing Irish potato and 32 (8.8%) of respondents had 16-20 years in growing Irish potato.

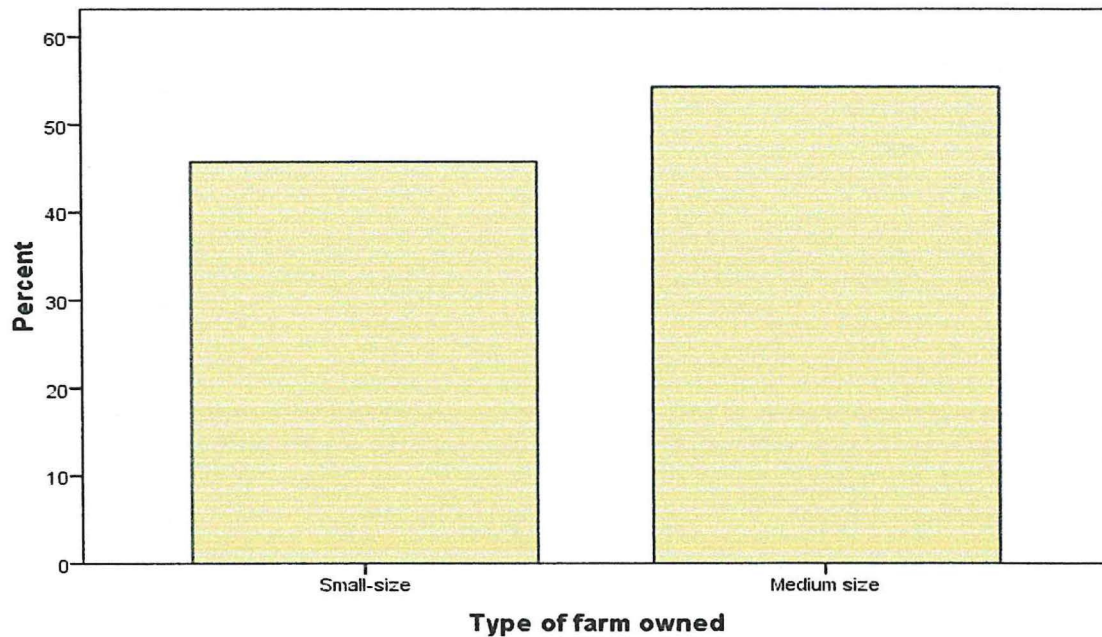


Figure 4. 5: Type of farm owned by farmers

The results in Figure 4.5 shows that 197 (54.3%) of respondents own medium size farms (0.6-1ha) while 166 (46.7%) of respondents own small size farms (0.1-0.5ha). This implies that most Irish potato farmers in Kabale District own medium size farms (0.6-1ha) and small size of farms (0.1-0.5ha) which explain the amount of Inorganic fertilizers applied in Irish potato production.

4.3 Extent of Inorganic Fertilizer use in Irish Potato Production in Kabale District

This section is about the extent of inorganic fertilizer use in Irish potato production. It is in relation to the first research objective which is “to assess the extent of inorganic fertilizer usage among Irish potato farmers in Kabale District”. In order to answer the above objective, respondents were asked some questions.

Table 4. 3: Percentages of farmers regarding their responses on YES and NO questions

n=363

Items	Responses					
	YES		NO		TOTAL	
	Freq.	%	Freq.	%	Freq.	%
Do you use inorganic fertilizer?	220	60.6	143	39.4	363	100
Do you know how to apply inorganic fertilizer?	200	55.1	163	44.9	363	100
Would you like other farmers to use the same fertilizer?	278	76.6	85	23.4	363	100
Has the government played a big role in extending such fertilizer to farmers?	95	26.2	268	73.8	363	100

Source: Primary Data

Table 4.3 shows that 220 (60.6%) of respondents use inorganic fertilizer, 200 (55.1%) know how to apply inorganic fertilizer, 278 (76.6%) of respondents would like other farmers to use inorganic fertilizer, and 268 (73.8%) of respondents affirmed that the government did not play a big role in extending inorganic fertilizer to them.

In the perspective of inorganic fertilizer use, respondents were asked about the type of inorganic fertilizer used, the quantity used, the times inorganic fertilizer is used per season, and the duration of applying inorganic fertilizer. The findings in relation to these questions are presented in Tables 4.4, 4.5, 4.6 and 4.7

Table 4. 4: Percentages of Farmers who responded by type of fertilizer they used

n=363

Type of inorganic fertilizer	Frequency	Percentage
NPK	215	59.2
Urea	3	0.8
DAP	2	0.6
Other	0	0
Do not use	143	39.4
Total	363	363

Source: Primary Data

The Table 4.4 shows that NPK was affirmed to be used by 215 (59.2%), Urea was affirmed to be used by 3 (0.8%), DAP was affirmed to be used 2 (0.6%), and 143(39.4%) do not use.

Table 4. 5: Quantity of inorganic fertilizer used by farmers per season

n=363

Quantity used	Frequency	Percentage
50kgs and below	178	49.0
51-100kgs	10	2.7
101-150kgs	12	3.3
151-200kgs	14	3.8
200kgs and above	132	36.3
Do not use	17	4.7
Total	363	100

Source: Primary Data

Table 4.5 shows that 178 (49.0%) of respondents use 50kgs and below of inorganic fertilizer in Irish potato production, 132 (36.3%) of respondents use 200kgs and above, 14(3.8%) of respondents use between 151-200kgs, 12 (3.3%) of respondents use between 101-150kgs, 10 (2.7%) respondents use between 51-100kgs and 17(4.7%) of respondents do not use. The average quantity of inorganic fertilizer used by many Irish potato farmers in Kabale District was 50kgs and below which is equal to (49.0%). This is explained by the size of farms they own and low income. Farmers with little land use little inorganic fertilizer and farmers with low income buy inorganic fertilizer they can afford.

Table 4. 6: Times of applying inorganic fertilizer per season by farmers

n=363

Times	Frequency	Percentage
Once	279	76.8
Twice	50	13.8
Three times	17	4.7
Do not use	17	4.7
Total	363	100

Source: Primary Data

Table 4.6 shows that 279 (76.8%) of respondents use inorganic fertilizer once per season. Only 50 (13.8%) of respondents use inorganic fertilizer twice per season and 17 (4.7%) of respondents use inorganic fertilizer three times per season. This implies that most of Irish potato farmers in Kabale District use inorganic fertilizers once per season. The study findings contrast with the study of Roy, Finck, Blair and Tandon (2006) which formulated the following recommendations concerning N-fertilizers and reported that split application is better. The application of inorganic fertilizer once in Irish potato production in Kabale District may be due to lack of enough financial capacity to buy inorganic fertilizer or little knowledge on applying inorganic fertilizers.

Table 4. 7: Period of duration in applying inorganic fertilizer by farmers

n=363		
Period	Frequency	Percentage
0-5 years	296	81.5
6-10 years	50	13.8
Do not use	17	4.7
Total	363	100

Source: Primary Data, June 2016

The results in Table 4.7 shows that the majority of respondents 296 (81.5%) applied inorganic fertilizer between 0-5 years and 50 (13.8%) of respondents applied inorganic fertilizer between 6-10 years while 17 (4.7%) of respondents did not use inorganic fertilizer. This implies that the application of inorganic fertilizer in Irish production in Kabale District is not for a long time.

Table 4. 8: Inconveniences farmers met in the use of inorganic fertilizer in Kabale District

n=363		
Inconveniences	Frequency	Percentage
Financial constraints	91	25.1
Lack of Information	16	4.4
Lack of technical knowledge	239	65.8
Others	17	4.7
Total	363	100

Source: Primary Data

Table 4.8 shows that the inconveniences in the use of inorganic fertilizer are inadequate technical knowledge 239 (65.8%) of respondents, financial constraints 91 (25.1%) of respondents and lack of information 16 (4.4%) of respondents, and others factors are those associated with the farm manager such as education level, age, farm location, farm type, farm size. In the line of the study findings, the study of Kelly *et al.* (2001) confirmed that the most common reason for not using inorganic fertilizer in Rwanda is the lack of knowledge and the next most common is the high fertilizer prices. Also, the study findings are supported by Shiferaw, Obare and Muricho (2008) who found that there is a positive and significant difference between membership in a farmers' association and technical efficiency ($P < 0.1$), suggesting that Irish potato farmers who belong to an organization are likely to benefit from better access to inputs and to information on improved farming practices. This implies that Irish potato farmers in Kabale District mostly face technical knowledge and financial challenges in the use of inorganic fertilizers.

Table 4. 9: Farmers' responses on the time of applying inorganic fertilizer

n=363

Responses	Frequency	Percentage
Before planting	247	68
During planting	116	32
Total	363	100

Source: Primary Data

The results in Table 4.9 shows that 247 (68.0%) of respondents use inorganic before planting and 116 (32.0%) of respondents use inorganic fertilizer during planting. This implies that more of Irish potato farmers in Kabale District use inorganic fertilizer before than during planting.

Table 4. 10: Farmers responses on the level of benefit for applying inorganic fertilizer

n=363

Responses	Frequency	Percentage
Very high	83	22.9
High	280	77.1
Total	363	100

Source: Primary Data

The findings in Table 4.10 shows that 280 (77.1%) of respondents declared that the level of benefits for applying inorganic fertilizer is high and 83 (22.9%) of respondents declared that the level of benefit for applying inorganic fertilizer is very high. The study findings concur with the results of Tolesaa and Friesen (2001) who reported that the application of 25% recommended inorganic NP fertilizers + enriched FYM resulted in the highest marginal rate of return indicating that the integrated approach can enable to save up to 75% of commercial fertilizers. This implies that the use of inorganic fertilizer in Irish potato production in Kabale District has a significant relevance.

Table 4. 11: Farmers responses on the quantity of potato yield per hectare by farmers resulting from fertilizers use.

Level	Production(Tonne/ha)	Production (Tonne/acre)
Farmers field with fertilizers	7-10	2.8-4
Farmers field without fertilizers	3-6	1.2-2.4

Table 4.11 shows that farmers field yield with fertilizer is 7-10tonnes/ha while without fertilizer is 3-6tonnes/ha. And also shows that farmers field yield with fertilizer per acre is 2.8-4tonnes/acre while without fertilizer is 1.2-2.4tonnes/ha.

According to Kachwekano Zonal Agricultural and Research Development Institute (KAZARDI), Irish potato is grown by more than 300,000 smallholder households producing a total of 800,000 tones on 112,000 hectares in Uganda.

Table 4. 12: Percentages of key informants regarding their responses on YES and NO questions

n=7

Items	Responses					
	YES		NO		TOTAL	
	Freq.	%	Freq.	%	Freq.	%
Do Irish potato farmers usually use inorganic fertilizer?	6	85.7	1	14.3	7	100
Do Irish potato farmers have enough knowledge of inorganic fertilizer use	3	42.9	4	57.1	7	100
Do Irish potato farmers like to use inorganic fertilizers	7	100.0	0	0	7	100

Source: Primary Data

Table 4.12 shows that 6 (85.7%) of respondents said that Irish potato farmers usually use inorganic fertilizer, 1(14.3%) of respondent said that Irish potato farmers usually do not use inorganic fertilizer, also 3(42.9%) of respondents said that farmers have enough knowledge of inorganic fertilizer use, 4(57.1%) of respondents said that farmers do not have enough knowledge of inorganic fertilizer use, 7 (100%) of respondents said that Irish potato farmers like to use inorganic fertilizers. The key informants were the inorganic fertilizer suppliers (04), agricultural extension workers (02) and Agricultural District Officer (01).

4.4 Farmers' Knowledge of inorganic Fertilizer use in Irish Potato Production in Kabale District

4.4.1 Factor analysis of farmers' knowledge of inorganic fertilizer application

Farmers' knowledge was looked at in terms of mode of application of inorganic fertilizers, effectiveness of inorganic fertilizer application, amount of inorganic fertilizer application and sources of information regarding inorganic fertilizers.

Table 4. 13: Factor analysis of Farmers' Knowledge of inorganic Fertilizer application

	Mode of application of inorganic fertilizers	Effectiveness of inorganic fertilizer use	Amount of Inorganic fertilizer application	Ways of accessing inorganic fertilizer information
Inorganic fertilizer				
Are applied once in a season	.824			
Inorganic fertilizers are applied twice in a season	.853			
applied Thrice in a season	0.921			
Inorganic fertilizer usage depends on the soil type		.781		
Inorganic fertilizer usage depends on the weather conditions		.902		
Inorganic fertilizer usage depends on the time of application		.795		
Inorganic fertilizer usage depends on the Quantity used		.869		
Inorganic fertilizer usage depends on the method of application		.798		
The amount of Inorganic fertilizer application depends on the type of soil		.773		
The amount of Inorganic fertilizer application depends on the type of soil			.773	
The amount of Inorganic fertilizer application depends on soil structure			.651	
The amount of Inorganic fertilizer application depends on Quality of fertilizer			.803	
The amount of Inorganic fertilizer application depends on Size of land			.891	
The amount of Inorganic fertilizer application depends on the level of farmers knowledge			.720	
The amount of Inorganic fertilizer application depends on the level of income			.912	
Information about inorganic fertilizers can be got from extension workers				.987
Information about inorganic fertilizers can be got from the Radio				.843
Information about inorganic fertilizers can be got from newspapers				.726
Information about inorganic fertilizers can be got from Farmers' field school				.685
Information about inorganic fertilizers can be got from Seminars				.685
Eigen value	4.602	4.023	3.612	3.212
Variance %	26.824	18.921	15.806	13.423
Cumulative variance %	26.824	45.745	61.551	74.974

Source: Primary Data 2016

An initial analysis was done to obtain eigen values of each component in the data set. In the Table 4.13, shows four components and eigen values over kaiser's criterion of (4.602, 4.023, 3.612 and 3.212) and in combination explained 74.974% of the variance. Factor analysis seeks to resolve a large set of measured variables. This technique allows the researcher to group variables into factors (based on correlation between variable and factor).The Table further shows the factor loadings after rotation which corresponds to the four components or factors which include mode of application of inorganic fertilizers, effectiveness of inorganic fertilizer application, amount of inorganic fertilizer application and sources of information regarding inorganic fertilizers. Each cluster of the factor loadings shows that there is an attribute that measures farmers' knowledge. In order to exploit the above objective, the researcher wanted to know respondents' understanding of inorganic fertilizer use for Irish potato production. A category of key informants gave points of views on inorganic fertilizer use in Irish potato production and these were the positive point of view; "that inorganic fertilizer use in Irish potato production is a strategy to increase soil nutrients and soil fertility in order to increase yields and Irish potato production", thus referring inorganic fertilizers as minerals used to improve soil fertility in order to increase Irish potato production. The other point of view was that, "inorganic fertilizer use in Irish potato production is a way to reduce yields and Irish potato production". Further, a section of key informants think that inorganic fertilizer use in Irish potato production is harmful to human beings.

4.4.2 Findings about mode of application of inorganic fertilizers, effectiveness of inorganic fertilizer application, amount of inorganic fertilizer application and Irish potato production

The study sought to establish the relationship between mode of application of inorganic fertilizers, effectiveness of inorganic fertilizer application, amount of inorganic fertilizer application and Irish potato production. The study looked at the relationship between variables which were categorical in nature (mode of application of inorganic fertilizers, effectiveness of inorganic fertilizer application, amount of inorganic fertilizer application and Irish potato yield) thus analysis of the association through computation of the Pearson correlation was done and thereafter, a comparison of probability values using correlational tables to find out the interval nature of the data and the need to test the nature and direction of the relationship was done.

Table 4. 14: Relationship between the knowledge variables and yield of Irish potatoes

n=363

		Mode of inorganic fertilizer application	Effectiveness of inorganic fertilizer usage	Amount of inorganic fertilizer application	Irish potato yield
Mode of inorganic fertilizer application	Pearson Correlation	1	.780(**)	.939(**)	.868(**)
	Sig. (2-tailed)		.000	.000*	.000*
	N	363	363	363	363
Effectiveness of inorganic fertilizer usage	Pearson Correlation	.780(**)	1	.857(**)	.684(**)
	Sig. (2-tailed)	.000		.000	.000*
	N	363	363	363	363
Amount of inorganic fertilizer application	Pearson Correlation	.939(**)	.857(**)	1	.890(**)
	Sig. (2-tailed)	.000	.000		.000*
	N	363	363	363	363
Irish potato yield	Pearson Correlation	.868(**)	.684(**)	.890(**)	1
	Sig. (2-tailed)	.000	.000	.000	
	N	363	363	363	363

** Correlation is significant at the 0.01 level (2-tailed)

Source: Primary Data 2016

The relationship between mode of application of inorganic fertilizers and Irish potato yield

From the correlation Table 4.14, there is a positive relationship between mode of application of inorganic fertilizers and Irish potato yield. ($r=.868^{**}$, $p\text{-value}<0.01$)

The relationship between effectiveness of application of inorganic fertilizers and Irish potato yield

From the correlation Table 4.14, there is a positive relationship between effectiveness of application of inorganic fertilizers and Irish potato yield. ($r=.684^{**}$, $p\text{-value}<0.01$)

The relationship between amount of inorganic fertilizers and Irish potato yield

From the correlation Table 4.14, there is a positive relationship between amount of inorganic fertilizers and Irish potato yield. ($r=.890^{**}$, $p\text{-value}<0.01$)

Table 4. 15: Distribution of farmers' knowledge of inorganic fertilizer usage by farm size

Size of Farm owned by Farmer	Knowledge level (% correct answered)	Overall	Marginal	Small	Medium	Large
Low (<60%)		20.16	22.64	10.71	6.25	8.88
Moderate (60-80%)		40.31	37.74	53.57	43.75	34.11
High (>80%)		39.53	39.62	35.71	50.00	57.01
Total		100.00	100.00	100.00	100.00	100.00

Source: Primary Data 2016

The distribution of farmers' knowledge of inorganic fertilizer application in the Table 4.15 indicated that, overall, nearly half of the respondents (40.31%) had a moderate level of knowledge, 39.53% had a high level of knowledge and 20.16% had a low level of knowledge. More than half the farmers of large farms (57.01%) had a high level of knowledge about inorganic fertilizer use in Irish potato production, as did half of the farmers of medium-sized farms (50%) and nearly half the farmers of marginal farms (39.62%). More than half of the farmers of small farms (53.57%)

had a moderate level of knowledge about inorganic fertilizer usage. Interestingly, farmers of larger farms were more knowledgeable about inorganic fertilizer usage than farmers on smaller farms.

Table 4. 16: Determinants of inorganic fertilizer application in Irish Potato production

n=363

Parameters	Frequency (n=)	Percent
Timing of inorganic fertilizer application		
Once	298	82.1
Twice	48	13.2
Thrice	17	4.7
Factors influencing effectiveness of fertilizer usage		
Type of soil	82	22.59
Weather conditions	12	3.31
Time used	28	7.71
Quantity used	49	13.50
Method of application	119	32.78
Quality of inorganic fertilizer	73	20.11
Factors influencing amount of fertilizer usage		
Type of soil	24	6.61
Soil structure	39	10.74
Quality of fertilizer	57	15.70
Size of land	41	11.29
Level of farmer's knowledge	109	30.03
Level of income	93	25.62

Source: Primary Data

The Table 4.16 revealed that the majority 298 (82.1%) of respondents apply inorganic fertilizers in Irish potato production once per season, 48 (13.2%) of respondents apply inorganic fertilizers in Irish production twice per season and 17 (4.7%) of respondents apply inorganic fertilizers in Irish potato production three times per season. The application of inorganic fertilizers in Irish potato production once per season may be explained by the economic capacity of Irish potato farmers, low knowledge on the application of Irish potato and inaccessibility to inorganic fertilizers.

Results further revealed that factors influencing the effectiveness of inorganic fertilizer use in Irish potato production include but not limited to the quantity of inorganic fertilizers used represented by 49 (13.50%) of the total respondents, the time of fertilizer application 28 (7.71%) of the respondents, the type soil 82 (22.59%) of the respondents, weather conditions 12 (3.31%) of the respondents, the quality of inorganic fertilizers 73 (20.11%) of the respondents and method of inorganic fertilizer application represented by 119 (32.78%) of the total 363 respondents targeted for the study.

Regarding factors influencing the amount of inorganic fertilizer application in Irish potato production, findings revealed the following key factors; quality of inorganic fertilizers 57 (15.70%) of respondents, level of income 93 (25.62%) of respondents, soil structure 39 (10.74%) of respondents, type of soil 24 (6.61%) of respondents, size of land 41 (11.29%) of respondents and level of farmers' knowledge 109 (30.03%) of respondents. In line with the study findings, Lawal and Ayoola (2008) found that the use of inorganic fertilizer improves soil structure, and has positive effect on biotic factors and nutrient supply. This shows the importance of applying inorganic fertilizer in Irish potato production.

4.5 The Influence of farmers' attitudes towards inorganic fertilizer use for Irish potato production

The fourth objective of the study was to examine the Influence of farmers' attitudes towards inorganic fertilizer use for Irish potato production. The respondents were requested to respond to a number of statements regarding farmers' attitudes in Kabale District by indicating their agreement using a five-point Likert scale of 1=Strongly Disagreed(SD), 2=Disagreed(D), 3= Not decided(N), 4=Agreed(A) and 5=Strongly Agreed(SA) as shown in Table 4.17. The responses are summarized in the Table 4.17.

Table 4. 17: Results of attitudes of farmers towards inorganic fertilizer use for Irish potato production

ITEMS	M	SD	D	NS	A	SA
Inorganic fertilizers are cheaply priced	3.2	52	47	73	159	32
		14.30%	12.90%	20.10%	43.80%	8.80%
Irish potato farmers commonly use urea	3.23	35	60	79	165	24
		9.60%	16.50%	21.80%	45.50%	6.60%
Most of the farmers like to use broadcasting methods of fertilizers application	3.55	28	37	74	156	68
		7.70%	10.20%	20.40%	43.00%	18.70%
The rate of fertilizer application among Irish potato farmers is high	3.23	44	53	74	159	33
		12.10%	14.60%	20.40%	43.80%	9.10%
Inorganic fertilizers are highly nutritious	3.26	33	60	74	172	24
		9.10%	16.50%	20.40%	47.40%	6.60%
Inorganic fertilizer application enable Irish potatoes to grow well	3.26	29	58	96	148	32
		8.00%	16.00%	26.40%	40.80%	8.80%
Inorganic fertilizer application increases the level of production	3.34	37	37	81	180	28
		10.20%	10.20%	22.30%	49.60%	7.70%
Inorganic fertilizer are easily accessed by Irish potato farmers	3.28	43	37	90	161	32
		11.80%	10.20%	24.80%	44.40%	8.80%
Inorganic fertilizer application required skills labor	3.27	44	37	91	160	31
		12.10%	10.20%	25.10%	44.10%	8.50%
N.P.K is less used by Irish potato farmers	3.22	55	38	75	163	32
		15.20%	10.50%	20.70%	44.90%	8.80%
Most of these inorganic fertilizers are poisonous to human being	3.19	49	46	78	166	24
		13.50%	12.70%	21.5	45.70%	6.60%
Some inorganic fertilizers retard plant growth	3.35	44	38	76	157	48
		12.10%	10.50%	20.90%	43.30%	13.20%
Excessive application of inorganic fertilizers can damage the soil	3.23	44	53	74	159	33
		12.10%	14.60%	20.40%	43.80%	9.10%
Inorganic fertilizers are used by only large scale Irish potato farmers	3.2	48	50	69	172	24
		13.20%	13.80%	19.00%	47.40%	6.60%
Inorganic fertilizer application requires technical skills	3.26	29	58	96	148	32
		8.00%	16.00%	26.40%	40.80%	8.80%
Inorganic fertilizer improve soil fertility	3.2	53	38	80	168	24
		14.60%	10.50%	22.00%	46.30%	6.60%
Inorganic fertilizers increases the production of Irish potatoes	3.17	56	39	86	150	32
		15.40%	10.70%	23.70%	41.30%	8.80%
Inorganic fertilizers reduces the quality of Irish potatoes	3.19	57	33	82	165	26
		15.70%	9.10%	22.60%	45.50%	7.20%
Inorganic fertilizers increases the growth rate of Irish potatoes	3.24	45	41	80	166	26
		12.40%	11.30%	22.00%	45.70%	7.20%
Some inorganic fertilizers encourage weed development	3.08	69	37	77	165	11
		19.00%	10.20%	21.20%	45.20%	3.00%
AVERAGE MEAN	3.25					

Source: Primary Data 2016

To analyze the findings in Table 4.17, farmers who strongly disagreed and those who disagreed were combined into one category of “who opposed the items”. In addition, farmers who strongly agreed and those who agreed were combined into another category of those “who concurred with the items”. Another category was that of those farmers who neither agreed nor disagreed, “the undecided with the items”. Thus, the three categories of farmers were compared. Interpretation was then drawn from the comparisons of the three categories as shown in the following paragraph. The study findings in the table above show that farmers’ attitude is moderately positive (aggregate mean=3.25). A comparison on these items shows that the percentage of farmers that opposed ranged from 17.9% to 29.2%, while the percentage of those that were not sure ranged from 19.0% to 25.1% and the percentage of those who concurred ranged from 48.2% to 57.3%. From these comparisons, it can be seen that the range of percentages of those that concurred and those that were not sure are on average lower compared to those who disagreed. The study findings concur with Pfiffner and Prethus (1997) who stated that farmers’ attitude are more likely to correspond with their behavior and in most cases, attitudes influence a broad range of behaviors. Indeed, an individual’s reaction to any stimulus in any situation depends on the perception and personality of the individual. Also, Abdoulaye and Sanders (2005) argued that the financial liquidity constraint is often cited as an important determinant of fertilizer use. This explained that socio-economic conditions of farmers influence the application of inorganic fertilizer in Irish potato production in Kabale District.

4.5.1 Testing the Influence of farmers’ attitudes towards inorganic fertilizer use for Irish potato production

In order to determine the Influence of farmers’ attitudes towards inorganic fertilizer use for Irish potato production, correlation and regression analysis were conducted. Pearson correlation coefficient (r) was used to determine the strength of the relationship between farmers’ attitudes on inorganic fertilizer use for Irish potato production. The coefficient of determination was used to determine the effect of farmers’ attitudes towards inorganic fertilizer use for Irish potato production. The significance of the coefficient (p) was used to test the objective by comparing p to the critical significance level at 0.05. This procedure was applied in testing the other objectives and thus, a lengthy introduction is not repeated in the subsequent sections of the testing.

Table 4. 18: Relationship between farmers’ attitudes and inorganic fertilizer usage

n=363

		Farmers’ attitude	Inorganic fertilizer usage
Farmers’ attitude	Pearson Correlation	1	.417(*)
	Sig. (2-tailed)		.025
	N	363	363
Inorganic fertilizer usage	Pearson Correlation	.417(*)	1
	Sig. (2-tailed)	.025	
	N	363	363

Source: Primary Data 2016

H₀₁: There is no significant relationship between farmers’ attitudes and inorganic fertilizer use for Irish potato production

According to the results in Table 4.18, farmers’ attitudes and inorganic fertilizer use were found to have a significant positive relationship ($r=0.417$, $p<0.05$). Thus, the hypothesis that stated that farmers’ attitudes would have a significant influence on inorganic fertilizer use for Irish potato

production in Kabale District. This means that farmers' attitude has a positive effect on inorganic fertilizer use for Irish potato production in Kabale District. This practically implies that inorganic fertilizer use for Irish potato production improves with positive farmers' attitudes.

4.6 Influence of socio-economic factors that affect knowledge and attitudes of farmers in the use of Inorganic fertilizer for Irish Potato Production in Kabale District

Data for the study were collected through structured interview schedule containing several sections, each comprising multiple statements with different units of measurement. To obtain a quantitative measure of the respondents on the socio-economic factors affecting the use of inorganic fertilizers on Irish Potato Production, a list of possible factors was compiled and made available, and respondents were asked to rate the factors.

Table 4. 19: Percentages of influence of socio-economic factors on inorganic fertilizer usage

n=363			
Characteristics	Category	Frequency (n= 363)	Percentage
Accessibility to Inorganic fertilizers	Yes	260	71.6
	No	103	28.4
Rating of Price of inorganic fertilizers	Very expensive	26	7.20
	Expensive	320	88.20
	Worth	16	4.40
	Cheap	00	0.00
	Very cheap	00	0.00
Price of inorganic fertilizers	2000-2500	184	50.7
	2500-3000	156	43.0
	3000-3500	01	0.30
	3500-4000	01	0.30
	More than 4000	17	4.70
Perception on the price	High	312	86.00
	Accessible	48	13.20

Source: Primary Data 2016

The results in Table 4.19 shows that 320 (88.2%) of respondents affirmed that the price of inorganic fertilizer is expensive, 26 (7.2%) of respondents said that the price is very expensive and only 16 (4.4%) of respondents said that the price of inorganic fertilizer is worth. This indicates that

the price of inorganic fertilizer in Kabale District is expensive which influence its use in Irish potato production.

Results also suggest that 184 (50.7%) of respondents supported that 1kg of inorganic fertilizer is between 2000-2500Ush and 156 (43.0%) of respondents affirmed that 1kg of inorganic fertilizer is between 2500-3000Ush. This implies that 1kg of inorganic fertilizer varies from 2000-3000Ush in Kabale District. Therefore, the Table 4.27 showed that 312 (86.0%) of respondents declared that the price of inorganic fertilizer is high while only 48 (13.2%) of respondents declared that the price of inorganic fertilizer is accessible. This explains the low level of application of inorganic fertilizer in Irish potato production in Kabale District.

Furthermore, 260 (71.6%) of respondents supported that it is easy to access to inorganic fertilizers, and 103 (28.6) affirmed that it is hard to access inorganic fertilizers. This implies that the accessibility of inorganic fertilizer by Irish potato farmers is not a great hindrance to the application of inorganic fertilizer in Irish potato production in Kabale District

4.6.1 Effect of Socio-economic Variables on Inorganic fertilizer usage

Multiple regression analysis was used to predict the effect of selected socio-economic variables (independent variables) on inorganic fertilizer usage in Irish production in Kabale District. The selected predictors were; rating of price of inorganic fertilizers, X_1 (very expensive, expensive, worth, cheap and very cheap), price of inorganic fertilizers, X_2 (2,000-2,500, 2500-3000, 3000-3500, 3500-4000 and more than 4000 Ugandan shillings), price perception, X_3 (High, Accessible and low) and then accessibility to inorganic fertilizers, X_4 (yes and no). The data were fitted and tried in four functional forms of linear, exponential, semi-log and double-log. Output of double-

log was chosen, since, it gave the best result in terms of signs, magnitudes, and significant parameter estimates.

Table 4. 20: Multiple regression results for the effect of selected socio-economic variables on inorganic fertilizers

Variable	Regression coefficient	t-value	Sig
Constant	11.578	0.715	0.423
X ₁	3.795	0.307	0.000
X ₂	-0.391	-0.567	0.001
X ₃	0.461	0.307	0.002
X ₄	0.578	0.239	0.037

R² = .85. F-value = 12.356, 5% level of significance

Source: Primary Data 2016

The results in Table 4.20 shows that out of the four socio-economic variables considered as independent variables, three were found to positively influence the farmer's use of inorganic fertilizers in the study area and these were: rating of price of inorganic fertilizers X₁; price perception X₃; and, then accessibility to inorganic fertilizers, X₄. The estimated co-efficient of X₂ (price of inorganic fertilizers) was negatively correlated with the usage of inorganic fertilizers by farmers. The negative relationship implies that an increase in this variable (price of inorganic fertilizers) will decrease farmers' usage of inorganic fertilizers and ultimately impact on the production of Irish potatoes in Kabale District.

The output of the regression analysis showed an R² of 0.85. This implies that about 85% of the variation in the inorganic fertilizer usage by respondents was accounted for by joint actions of the four independent variables. The high value of R² observed is an indication that the explanatory

socioeconomic variables were sufficient to explain the variations in fertilizer use in Irish potato production, while the remaining 15% was as a result of non-inclusion of some other explanatory variables, errors in estimation, as well as other factors outside the study. This implies that the indicators considered were relevant socio-economic variables that influenced inorganic fertilizer use in the area. The overall result was found to be statistically significant, as F-static value of 12.356 was significant at a 5% level of significance. Also the Durbin-Watson value of 1.728 which lies within the bench mark of 2.0 indicated an absence of autocorrelation among the factors considered.

4.6.2 Source of information on inorganic fertilizers

The researcher further analyzed particular sources of information regarding inorganic fertilizers to farmers in Kabale District and how relevant or significant they are in regard to the use and application of inorganic fertilizers in Irish potatoes in Kabale District.

Table 4. 21: Distribution of respondents according to information sources

Information source	Frequency	Percentage
Radio	20	5.51
Television	05	1.39
Extension agents	62	17.08
Fellow farmers	98	26.99
Farmers' organization	79	21.76
Fertilizer marketers	41	11.29
Text messages	58	15.98
Total	363	100

Source: Primary Data 2016

The results in Table 4.21 revealed that 20 (5.51%) of respondents learned of application of inorganic fertilizer through radio, 5 (1.39%) of respondents learned of application of inorganic fertilizer through television, 62 (17.08%) of respondents learned of application of inorganic fertilizer through extension agents, 98 (26.99) of respondents learned of application of inorganic fertilizer through fellow farmers, 79 (21.76) of respondents learned of application of inorganic fertilizer through farmers' organization, 41 (11.29) of respondents learned of application of inorganic fertilizer through fertilizer marketers and 58(15.98) of respondents learned of application of inorganic fertilizer through text messages. Nenna (2011) observed that extension services bear great potential for improving the productivity of natural resources, promoting the right attitude among natural resource managers. The service is recognized as an essential mechanism for information delivery and advice as input, into modern resource management. It could also be deduced from the Table 4.21 that fellow farmers (26.99%) played a very important role in the dissemination of useful and practical information to the audience on the application of inorganic fertilizers to improve production and productivity of Irish Potatoes in Kabale District.

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.1 Introduction

This chapter discusses the findings in relation to the objectives set by the researcher.

5.2 Extent of Inorganic Fertilizer use in Irish Potato Production in Kabale District

The finding in Table 4.6 revealed that 279 (76.8%) of respondents use inorganic fertilizer once per season. Only 50 (13.8%) of respondents use inorganic fertilizer twice per season and 17 (4.7%) of respondents use inorganic fertilizer three times per season. This implies that most of Irish potato farmers in Kabale District use inorganic fertilizers once per season. The study findings contrast with the study of Roy, Finck, Blair and Tandon (2006) which formulated the following recommendations concerning N-fertilizers and reported that split application is better. The application of inorganic fertilizer once in Irish potato production in Kabale District may be due to lack of enough financial capacity to buy inorganic fertilizer or little knowledge on applying inorganic fertilizers.

Findings also revealed that more males in the age of 41-50 years used more inorganic fertilizers compared to their female counterparts. The reason for this gender and age variability in inorganic fertilizer use was attributed to the ability of men to understand the relevance of using inorganic fertilizer in increasing the yields of Irish potatoes.

In terms of inorganic fertilizer use, 55.1% knew how to apply inorganic fertilizers; close to 66% of the respondents reported to have had technical challenges in inorganic fertilizer use. This was because according to the farmers, Government did little to improve inorganic fertilizer

accessibility and technical training in the use of fertilizers. This was evidenced by 73.8% of respondents affirming that the government did not play a big role in extending inorganic fertilizers. This finding agrees with (Hausman, 2008) who reported that Government interventions are not costless, and there are many cases where it is better to live with market failures than to call on government to fix the problem. The challenge therefore lies in formulating the right kind of government interventions that can provide a correctional response in the input markets.

Also education level of the respondent influenced use and application of inorganic fertilizers. Farmers that attained at least formal education used fertilizer in production compared to the ones that did not acquire any formal education. This was because formal education improved farmer's knowledge and understanding of inorganic fertilizer relevance in increasing Irish potato yields. This compares very well with a report by Kelly *et al.* (2001) that low level of knowledge as a result of inadequate education negatively affects the use of inorganic fertilizers in production.

5.3 Farmers' Knowledge of inorganic Fertilizer use in Irish Potato Production in Kabale District

Findings in Table 4.15 showed that overall, nearly half of the respondents (40.31%) had moderate level of knowledge, 39.53% had a high level of knowledge and 20.16% had a low level of knowledge. More than half the farmers of large farms (57.01%) had a high level of knowledge about inorganic fertilizer use in Irish potato production. The high level of knowledge among the large farmers is because they are profit oriented so try to maximize output through using the available technological innovations like application of inorganic fertilizer that boosts Irish potato productivity. This agrees with Earlier, Mundi and Ezenwa, (2006) reported that for a farmer to adopt and use inorganic fertilizer, she/he must be technically and socially sound. This agrees with

the finding of this study. Accordingly, Asiabaka, Morse and Kenyon (2001) noted that, if Irish potato farmers are to adopt a new technology like inorganic fertilizers, then they have to understand well the technology. A similar study in Nigeria showed that farmer's knowledge and skills determines the use of new innovations (Okoedo-Okojie and Aphunu, 2011)

The study further looked at the relationship between farmers' knowledge (mode of application of inorganic fertilizers, effectiveness of inorganic fertilizer application, amount of inorganic fertilizer application and Irish potato yield) and the findings were as follows:

Table 4.14 shows that there is a positive relationship between mode of application of inorganic fertilizers and Irish potato yield ($r=.868$, $p\text{-value}<0.01$). From the correlation in a Table 4.14 showed that, there is a positive relationship between effectiveness of application of inorganic fertilizers and Irish potato yield ($r=.684^{**}$, $p\text{-value}<0.01$). From the correlation in Table 4.14 showed that, there is a positive relationship between amount of inorganic fertilizers and Irish potato yield. ($r=.890$, $p\text{-value}<0.01$).

Furthermore factor analysis was done with the main objective of finding out the underlying common factors influencing farmers' knowledge of inorganic fertilizer application in this study. The principal component factoring method with variance rotation was used for factor extraction. Using the factor analysis it was found out that the study variables have developed a factor solution. This factor model has a strong statistical support and the Kaiser- Maya-Olkin (KMO) test of sampling adequacy concurs that the sample taken to process the factor analysis is statistically significant.

Data analysis and interpretation of the questionnaire responses from the farmers and key informants in Kabale District revealed the existence of a well-established/defined structure between all the study variables.

5.4 Influence of farmers' attitudes towards inorganic fertilizer use for Irish potato production

According to the results in Table 4.18, farmers' attitudes and inorganic fertilizer use were found to have a significant positive relationship ($r=0.417$, $p<0.05$). Thus, the hypothesis that stated that farmers' attitudes would have a significant influence on inorganic fertilizer use for Irish potato production in Kabale District. This means that farmers' attitude has a positive effect on inorganic fertilizer use for Irish potato production in Kabale District. This practically implies that inorganic fertilizer use for Irish potato production improves with positive farmers' attitudes. In fact, farmers' attitude was moderately positive (aggregate mean=3.25). Accordingly, regression analysis further showed that farmers' attitudes significantly affects inorganic fertilizer use for Irish potato production in Kabale District ($r = .241$). The moderate attitude was because of average formal (primary school) education that the majority of the respondents had attained.). Also according to Shook & Bratianu (2010) state that one forms one's attitude based on one's beliefs in the possible outcomes. The more favorable the possibility is, the stronger the intention to do the behavior will be, and vice versa: the less favorable the outcome possibility is, the weaker the intention to do the behavior will be.

5.5 Influence of socio-economic factors that affect knowledge and attitudes of farmers in the use of Inorganic fertilizer for Irish Potato Production in Kabale District

Multiple regression analysis was used to predict the effect of selected socioeconomic variables on inorganic fertilizer usage in Irish production. Out of the four socio-economic variables considered as independent variables, price of inorganic fertilizers, price perception and then accessibility to inorganic fertilizers were found to positively influence the farmer's use of inorganic fertilizers in the study area. However, the estimated co-efficient of price of inorganic fertilizers was negatively correlated with the usage of inorganic fertilizers by farmers. The negative relationship implies that an increase in the price of inorganic fertilizers will decrease farmers' usage of the fertilizer and ultimately impact on the production of Irish potatoes in Kabale District. This agrees with Akpan *et al.* (2012) that identified education, extension services, rainfall pattern and soil textures as important determinants of fertilizer demand decision in Kenya. Olayide *et al.* (2009) in Nigeria, established that the intensity of fertilizer use increases with the family labour and physical access to fertilizer. Also in Nigeria, Amanze *et al.* (2010) proved that output of crop, level of education, farm size and price of fertilizers were important factors influencing farmers' use of fertilizer in arable crop production.

CHAPTER SIX

SUMMARY OF THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the conclusions and recommendations based on the objectives of the study. Suggested areas of further research are also identified.

6.2 Summary of findings

The first research question sought to find out the extent of inorganic fertilizer used among Irish potato farmers in Kabale District. The findings revealed that farmers in Kabale District use low inorganic fertilizer application rates with majority using average of 50kg/ha. The study found NPK being the commonly used fertilizer and a number of the respondents had technical issues related the use of inorganic fertilizer.

The second research question sought to find out farmers' knowledge of inorganic fertilizers used for Irish potato production in Kabale District. The findings revealed 55% of the farmers knew how to apply inorganic fertilizers. However, close to 66% of the farmers had general technical challenges in fertilizer handling, use and storage.

The third research question sought to find out the farmers' attitudes towards use of inorganic fertilizers. The results showed that farmers' attitude was moderate towards the use of inorganic fertilizers in Irish potato production. Farmers perceived fertilizers to improve the yields of Irish potatoes.

The fourth research question sought to find out socio-economic factors influencing farmers' attitudes towards the use of inorganic fertilizer in Irish potato production. The results showed that

three quarters of the respondents reported high prices and inaccessibility of inorganic fertilizers as major factors affecting their ability to utilize fertilizers.

6.3 Conclusions

Objective: 1 Assess the extent of inorganic fertilizer usage among Irish potato farmers in Kabale District

(i) Farmers use 50kgs and below of inorganic fertilizer in Irish potato production .This is explained by the size of the farms they own and their level of income. Farmers with small farms use little inorganic fertilizer as compared to farmers with large farms. In addition farmers with low income levels use less inorganic fertilizers than farmers with high levels of income.

(ii) Majority of the farmers in Kabale District use inorganic fertilizers once per season. This may be due to lack of enough financial capacity to buy inorganic fertilizer and little knowledge on how to apply them.

Objective 2: Determine farmers knowledge of inorganic fertilizers used in Irish potato production in Kabale District

(iii) The findings show that farmers with large farms were more knowledgeable about inorganic fertilizer usage than farmers with small farms. This is because farmers with large farms grow Irish potatoes mainly for commercial purposes as compared to small scale farmers who mainly grow Irish potatoes for home consumption.

Objective 3: Determine farmers' attitudes towards use of inorganic fertilizer for Irish potato production in Kabale District

(iv) With regard to farmers' attitudes towards inorganic fertilizer use in Irish potato production, findings show that farmers' attitudes and inorganic fertilizer use were found to have a positive significance at ($p < 0.05$). This means that farmers' attitudes have a positive effect on inorganic fertilizer use for Irish potato production in Kabale District. This implied that inorganic fertilizer use for Irish potato production improves with positive farmers attitudes.

Objective 4: Determine socio-economic factors that influence knowledge and attitudes of farmers in the use of inorganic fertilizer for Irish potato production in Kabale District

(v) The findings show that the price of inorganic fertilizer in Kabale District is expensive and this influences its use in Irish potato production. As the price of inorganic fertilizers increases, their usage decreases. Also the findings show that socio-economic variables considered as independent variables were found to positively influence the farmers' use of inorganic fertilizers in the study area except price of inorganic fertilizers.

6.4 Recommendations

Based on the conclusions from the study, the following recommendations were suggested for improving knowledge, attitudes and usage of inorganic fertilizers by Irish potato farmers in Kabale District and elsewhere in Uganda.

To extension practitioners

(i) Extension workers should train and sensitize households on the usage, applicability, effectiveness, timing and the amount of inorganic fertilizer to use especially in Irish potato

production. Farmers need to be adequately and continuously trained and equipped with practices and application of inorganic fertilizers such as NPK, Urea, DAP and others.

(ii) Ensure that farmers are given frequent flow of information through radios and farmer groups as well as reminding farmers on things like quantity and quality of inorganic fertilizer use, mode of inorganic fertilizer application per season and also update their knowledge. This would ensure that farmers get to acknowledge the benefits and importance in the use of inorganic fertilizers in Irish potato production.

(iii) It is recommended that farmers should be given skill-based training on the principles of inorganic fertilizer use; be conveyed the right information from other developed countries about methods of application of inorganic fertilizer; assisted in building groups for cooperation and sharing knowledge; be shown the comparable benefits from reducing undesirable attitudes; and be shown that good prices are a sound outcome from the good practice of inorganic fertilizer application.

To government policy makers

The study found out that there was a slightly lower percentage of farmers using and applying inorganic fertilizers compared to the Irish potato producers. According to farmers and stakeholders, there is less government involvement providing extension services regarding inorganic fertilizers to the farmers. Based on this finding, the researcher recommends the following among others that:

(i) Government agencies like extension should step up to their responsibilities in ensuring effective and practical information dissemination and delivery to end users.

(ii) Uganda government should support an effective marketing and distribution system to connect inorganic farmers and check the activities of middlemen, to enable the farmers, still remain in agricultural production.

(iii) Setting up smallholder credit scheme, especially for purchase of farm technologies could be an important step towards accelerating farm technology adoption such as inorganic fertilizer. Because the smallholders may not be able to acquire credit from the mainstream financial sector due to the risky nature of their business, the government could step in either as a guarantor or as a direct provider of the funds through, say microfinance institutions. An alternative approach could be to mobilize the smallholders to form organizations through which to pool resources and obtain additional funding from either the government or financial institutions. Whichever approach is chosen, the funds should be of low interest rates and easily accessible.

(iv). Finally, government should ensure sustained access to education, support the policy on agricultural inputs, and accessibility to credit facilities from financial institutions. The drive to improve inorganic fertilizer market performance in Uganda requires a holistic approach that will strengthen both the private and public sectors. The private sector in Uganda has proven itself versatile but it also is quite sensitive to public sector action. To increase efficiency in procurement and distribution of fertilizer, the government should continue to increase expenditure on infrastructure development, agricultural research, quality control, agricultural extension services, and the promotion of regional trade.

To Researchers

Despite lots of written researches about concept of inorganic fertilizer application, there is still need to for further research to:

(i) Develop a well-defined concept about it which should demonstrate the core elements of inorganic fertilizer application in agricultural development highlighting the objective /purpose of application, the stages of application, the intensity of application and the modes of application.

(ii) Evaluate whether a subsidy on inorganic fertilizer would significantly increase farmers' use of fertilizer, while at the same time strengthening private agricultural input market actors. On the market side, there should be a deliberate drive to improve information flow between suppliers, government, and the final consumers.

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APPENDICES

Farmers' Knowledge and Attitudes towards Inorganic Fertilizer Use for Irish Potato (*Solanum tuberosum*) Production in Kabale District, Uganda

Appendix A: Questionnaire for Irish Potato farmers

Introduction

Irish potato is a crop which is relevant for increasing income to the farmers. This study is conducted by Kyambogo student. The questionnaire is given to you based on your experience for growing Irish potato. This questionnaire is only intended to help me undertake my research and will not be used for another purpose. Your responses will be treated with utmost confidentiality. Thank you for taking your time and responding to questionnaire.

SECTION A: EXTENT OF INROGANIC FARTILISER USE IN IRISH POTATOPRODUCTION

- Do you use inorganic fertilizers?

- Yes

- No

2. If yes, which fertilizer do you use?

- NPK

- Urea

- DAP

- Others, specify.....

3. What quantity of inorganic fertilizer do you use per season?

- a) 50kgs and below
- b) 51-100kgs
- c) 101-150kgs
- d) 151-200kgs
- e) 200kgs and above
- f) Do not use

4. How many times do you use the fertilizer per season?

- a) Once
- b) Twice
- c) Three times
- d) Others, specify.....

6. For how long have you been applying inorganic fertilizers?

- a) 0-5 years
- b) 6-10 years
- c) 11-15 years
- d) Above 15 years

7. Do you know how to apply inorganic fertilizers?

- Yes
- No

8. When do you apply fertilizers?

- a) Before plating

b) During planting

c) After planting

9. What level of benefit have you got for applying fertilizers?

a) Very high

b) High

c) Low

10. How were you inconvenienced during the use of inorganic fertilizers?

a) Financial

b) Information

c) Technical

11. Would you like other farmers to use the same fertilizer?

Yes

No

12. Has the government played a big role in extending such fertilizers to farmers?

Yes

No

**SECTION B: FARMERS' KNOWLEDGE OF INORGANIC FERTILIZER USE IN
IRISH POTATO PRODUCTION**

Answer the following questions.

1. What is your understanding of inorganic fertilizer use for Irish potato production?

.....
.....

2. Give the names of inorganic fertilizers used in Irish potato production in your community.

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

3. Give reasons for using inorganic fertilizers for Irish potato production.

.....
.....

4. Give reasons why some farmers do not used inorganic fertilizers in Irish potato production.

.....
.....

5. State the methods used in applying inorganic fertilizers for Irish potato production

.....
.....

6. Outline the qualities of good inorganic fertilizer used in Irish potato production

.....
.....

7. How many times is inorganic fertilizer applied in Irish potato production season?

.....
.....

8. Outline the factors that influence the effectiveness of inorganic fertilizer use in Irish potato production

.....
.....

9. State factors that influence the amount of inorganic fertilizer to apply in Irish potato production

.....
.....

10. Enumerate good fertilizer storage practices applied for Irish potato production

.....
.....

11. Give the ways through which you access information about inorganic fertilizer

.....
.....

12. What quantity of inorganic fertilizer can be you used per season for Irish potato production?

.....

13. When can inorganic fertilizer be applied by Irish potato farmers per season?

.....

14. List other things do you think that Irish potato farmers should know

.....
.....

**SECTION C: FARMERS' ATTITUDES TOWARDS INORGANIC FERTILIZER USE
FOR IRISH POTATO PRODUCTION**

13. Indicate the extent to which you agree with the following statements. Use the following scale (1-very low; 5-very high)

S/N	Statement	1	2	3	4	5
1	Inorganic fertilizers are cheaply priced					
2	Irish potato farmers commonly use urea					
3	Most of the farmers like to use broadcasting method of fertilizer application					
4	The rate of fertilizer application among Irish potato farmers is high					
5	Inorganic fertilizers are highly nutritious					
6	Inorganic fertilizer application enable Irish potatoes to grow well					
7	Inorganic fertilizer application increases the level of production					
8	Inorganic fertilizers are easily accessed by Irish potato farmers					
9	Inorganic fertilizer application required skills labour					
10	N.P.K is less used by Irish potato farmers					
11	Most of these inorganic fertilizers are poisonous to human being					

12	Some inorganic fertilizers retard plant growth					
13	Excessive application of inorganic fertilizers can damage the soil					
14	Inorganic fertilizers are used by only large scale Irish potato farmers					
15	Inorganic fertilizer application requires technical skills					
16	Inorganic fertilizer improve soil fertility					
17	Inorganic fertilizers increases the production of Irish potatoes					
18	Inorganic fertilizer reduce the quality of Irish potatoes					
19	Inorganic fertilizer increases the growth rate of Irish potatoes					
20	Some inorganic fertilizers encourage weed development					

**SECTION D: SOCIO-ECONOMIC FACTORS INFLUENCING THE USE OF
INORGANIC FERTILISER FOR IRISH POTATO PRODUCTION**

14. How is the price of inorganic fertilizer?

- Very expensive
- Expensive
- Worth
- Cheap
- Very cheap
- Others, specify.....

15. a) How much is a Kg of inorganic fertilizer?

.....

b) How do you find that price?

High

Accessible

Low

16. Do Irish potato farmers have easy access to inorganic fertilizers?

Yes

No

SECTION E: BIO DATA OF RESPONDENTS

Tick in the appropriate box

17. What is your age?

a) 20 and below

d) 41-50

b) 21-30

e) 51 and above

c) 31-40

18. Sex

• Female

• Male

19. Marital Status

a) Single

d) Widowed

b) Married

e) Divorced

c) Separated

20. Highest level of Education attained

(a) No formal Education

b) Secondary

(c) Primary

d) University

(e) Tertiary Institution

f) Non-formal training

21. Indicate duration at each level in years or months or days

- a) Time taken growing Irish potatoes.....
- b) Primary schooling.....
- c) Secondary schooling.....
- d) University education.....
- e) Tertiary Institution.....
- f) Non-formal training.....

22. What is the type of farm do you own?

- a) Small-size
- b) Medium size
- c) Big

Appendix B: Interview guide for key informants

- Position.....
- Years of experience:
- Do Irish Potato farmers usually use inorganic fertilizer?
- What is the quantity of inorganic fertilizers used in Irish Potato production per season?
- How do Irish Potato farmers apply inorganic fertilizers?
- Do Irish Potato farmers have enough knowledge of inorganic fertilizer usage?
- Which category of Irish Potato farmers does normally use inorganic fertilizer?
- Do Irish Potato farmers like to use inorganic fertilizers?
- What are the factors influencing the adoption of inorganic fertilizers in Irish Potato production?

Appendix D: Letter of introduction



FACULTY OF VOCATIONAL STUDIES
DEPARTMENT OF AGRICULTURE

Date: 1st of Feb 2016

TO WHOM IT MAY CONCERN


RE: INTRODUCTORY LETTER

This is to introduce Mr/Ms. Busabwa JOSEPH
who is a student in this Department, offering B.Agricultural Extension and
Education course.

It is a requirement of the course, that the student does research, and writes a report on a topic of educational and/or scientific interest. For this reason therefore, I would like to request you to avail the necessary assistance he/she may require to complete this assignment.

The student is given no special funding for this activity. Your patriotic consideration while offering this assistance will therefore be appreciated.

Yours faithfully


Mutebeke Robert (PhD)
HEAD OF DEPARTMENT

