FACTORS AFFECTING FARMERS' ADOPTION OF AGRICULTURAL TECHNOLOGIES IN UGANDA: A CASE STUDY OF BANANA PRODUCTION IN MUKONO DISTRICT

BY

GODFREY KAYONGO KIBIRIGE
REG. NO. 09/MMSPPM/20/008

A DISSERTATION SUBMITTED TO THE HIGHER DEGREES DEPARTMENT IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS DEGREE IN MANAGEMENT STUDIES (PROJECT PLANNING AND MANAGEMENT) OF UGANDA MANAGEMENT INSTITUTE

2012

DECLARATION

I, Godfrey Kayongo Kibirige, declare that this is my original work and has never been presented for a degree in this or any other university or institution of higher learning.

Signed:.....

GODFREY KAYONGO KIBIRIGE

Date:.....14/3/2012

APPROVAL

This thesis has been submitted for examination with our approval as Institute supervisors.

Signed:.....

MR. ANACLET NAMANYA

Date:....14/03/2012.....

Signed:.....

DR. SYLVESTER KUGONZA

Date:.....14/03/2012.....

DEDICATION

To my wife Immaculate Kibirige and children, Annet Nakito, Lilian Nakabuye, Monica Nakakande, Ruth Nagayi and Julia Nabunya, for their encouragement throughout the course.

ACKNOWLEDGEMENT

I attribute the successful completion of this study to the support of various individuals and institutions whose contribution I would like to acknowledge. Firstly, I must give special thanks to the Director General of NARO, Dr. T.D. Kyetere, the Director NaCRRI, Dr. J.A. Ogwang, the Head COREC, Dr. A. Kangire for granting me permission to pursue this study. I greatly appreciate the financial support rendered to me which enabled me to successfully complete my study.

I am greatly indebted to my supervisors, Mr. Anaclet Namanya, consultant, Department of General Management, UMI and Dr. Sylvester Kugonza, Senior consultant, School of Public Administration, UMI who have tirelessly guided me through this academic research. Without them, the study would have not materialized. I am grateful that they took their time to make corrections, constructive comments and suggestions.

I must thank all the staff of the Higher Degree Department at UMI especially Dr. B. Basheka, Dr. D. Onen, Dr. Karyeija, Dr. M. Barifaijo, Mr. Kiwanuka and Mrs. P. Oluka who provided the academic back-up that guided me through this research. I am extremely grateful to Dr. David Onen of UMI for his willingness to act as my co-promoter. I am especially grateful for his interest in the work, critical and valuable comments which helped me to improve on this research. In spite of my agricultural background, he tirelessly guided me through the concepts of social science. His rich experience in social science research provided me great insights into my work. Thank you David, especially for the detailed statistical analysis that covers the entire

study. A word of thanks to Edgar Kirya of UMI for his invaluable input in assisting me with the initial statistical analysis.

My sincere thanks also go to Dr. A. Kangire, Head COREC, for his great support throughout my study at UMI both at post graduate and masters programme. I greatly appreciate his role both as the Head of Coffee Research Centre and academic mentor. I am also thankful to Dr. P. Musoli of COREC for the financial support which enabled me to successfully complete data collection and analysis.

I would like to extend my sincere thanks to Dr. G.J. Hakiza of COREC for providing guidance during the proposal of the research and the insightful comments and suggestions made on the draft report.

Special thanks to Dr. C. Sekyewa of Uganda Martyrs University Nkozi for providing guidance during the proposal of the research and constructive comments and suggestions made on the draft report.

I would like to thank my colleagues at the Coffee Research Centre for the moral, material and academic support which they provided during my study period. I cannot forget the tireless effort of my friend Summy Olal for taking personal keen interest and guidance in this work. Special thanks to Hassan Lubulwa who willingly and ably typed the manuscript. A word of thanks to Edward Mutema, Margret Duku, Margret Nanyonjo, Dorah Najjemba and Viola Kigonya for the material support rendered to me to reach this professional milestone. Please accept my sincere thanks.

I would like to extend my sincere thanks to the research team in the four sub-counties of Mukono where the study was carried out. I offer my gratitude to all the interviewers for their diligence in carrying out the survey. Special thanks to the Agricultural Officers in the four sub-counties who headed the research team. Mr. Mugerwa, Mr. Wari, Mr. Walabyeki and Mr. Ssali, thank you for the support and mostly in locating the respondents. Sincere gratitude goes to banana farmers who sacrificed their time to answer all the questions, all Research Assistant for taking their time to interview farmers, without their cooperation it would have been impossible to carry out the study. Special thanks to key informants, Mr. Kasirye, Mr. Walabyeki, Mr. Wari, Mr. Mwanga, Mr. Mugerwa, Mr. Ssali and others for offering all the valuable information and your time.

Lastly but not least, I would like to express my sincere gratitude to my wife Immaculate Kibirige, our children, Annet Nakito, Lilian Nakabuye, Monica Nakakande, Ruth Nagayi and Julia Nabunya. I thank you for the constant encouragement most of the time during my long period of training at UMI.

Finally, if it were not for the abundant grace of God, this work would never have been accomplished.

TABLE OF CONTENTS

DECLARATION i
APPROVAL ii
DEDICATION iii
ACKNOWLEDGEMENTS iv
TABLE OF CONTENTS vii
LIST OF TABLES x
LIST OF FIGURES xii
ACRONYMS xiii
ABSTRACT xiv

CHAPTER ONE: INTRODUCTION 1
1.1 Introduction 1
1.2 Background to the study 2
1.3 Problem statement 6
1.4 Purpose of the study 7
1.5 Objective of the study 8
1.6 Hypotheses of the study 8
1.7 Conceptual framework 9
1.8 Significance of the study 11
1.9 Justification of the study 12
1.10 Scope of the study 13

CHAPTER TWO: LITERATURE REVIEW 15
2.1 Introduction 15
2.2 Theoretical review 15
2.3 Determinants of adoption 23
2.3.1 Economic factors 23
2.3.2 Farmers' characteristics 27
2.3.3 Institutional factors 32
2.3.4 Summary of literature 37

CHAPTER THREE: METHODOLOGY **39**
3.1 Introduction 39
3.2 Research design 39
3.3 Area of study 40
3.4 Study population 41
3.5 Sample size and selection 41
3.6 Sampling techniques and procedures 42
3.7 Data collection methods 43
3.8 Data collection instruments 44
3.9 Data quality control (validity and reliability) 46
3.10 Procedure of data collection 49
3.11 Problems encountered in Data Collecton 50
3.12 Data management and analysis 51
3.13 Management of variables 52

CHAPTER FOUR: PRESENTATION AND INTERPRETATION OF RESULTS **53**
4.0 Introduction 53
4.1 Response rate 54
4.2 Demographic characteristics of respondents 56
4.3 General farming characteristics 60
4.4. Economic factors affecting farmer's adoption of recommended agricultural Technologies 66
4.5 Farmers' characteristics affecting farmer's adoption of recommended Agricultural Technologies 83
4.6 Institutional factor affecting farmer's adoption of recommended Agricultural Technologies 92
4.7 Adoption of Banana recommended production 107

CHAPTER FIVE: SUMMARY, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS **122**
5.1 Introduction 122

5.2 Summary of findings.....122
5.3 Discussion of findings.....123
5.4 Conclusions.....130
5.5 Recommendations.....132
5.6 Area for further research.....134

REFERENCES.....135

APPENDIX I: SURVEY QUESTIONNAIRE.....i
APPENDIX II: INTERVIEW GUIDE.....i
APPENDIX III: DETERMINING SAMPLE SIZE.....i
APPENDIX IV: INTRODUCTORY LETTER.....i
APPENDIX V: TEST SCORES FOR RELIABILITY.....i
APPENDIX VI: MAP OF MUKONO DISTRICT.....i
APPENDIX VII: RESPONDENTS SELECTION.....i

LIST OF TABLES

Table 1: Study population selection procedure....42

Table 2: Reliability determination....48

Table 4.1.1: Summary of study response rate....55

Table 4.2.1: Respondents by gender distribution....57

Table 4.2.2: Respondents by age distribution....58

Table 4.2.3: Respondents by marital status....59

Table 4.2.4: Level of education of the respondents....60

Table 4.3.1: Farm size of the respondents....61

Table 4.3.2: Farming experience of the respondents....62

Table 4.3.3: Types of crops grown....63

Table 4.3.4: Banana acreage....64

Table 4.3.6: Category of livestock....66

Table 4.4.3.1: Farmers reasons for not borrowing funds from banks/lending institutions....74

Table 4.4.4.1: Benefits from recommended banana technologies....76

Table 4.4.5.1: Household labour availability for banana activities and other enterprises....78

Table 4.4.6.1: Hired labour required for banana activities....80

Table 4.4.8.1: Correlation analysis on the economic factors that affect farmers' adoption of Agricultural technologies....82

Table 4.5.1: Farmer characteristics....84

Table 4.5.6.1: Independent Samples Test....88

Table 4.5.6.2: Statistics on mean adoption rate by age groups....89

Table 4.5.6.3: Anova....89

Table 4.5.6.4: Statistics on mean adoption rate by level of education.....90

Table 4.5.6.5: Anova.....90

Table 4.6.1.1: Access to agricultural information.....93

Table 4.6.2.1 Usefulness of agricultural information and time of adoption.....96

Table 4.6.3.1: Personnel giving agricultural advice to farmers.....98

Table 4.6.4.1: Membership to farmer organization, usefulness and number of meetings in a year 101

Table 4.6.5.1: Form of technology presentation and combination use of technology.....103

Table 4.6.7.1: Pearson correlation analysis.....106

Table 4.7.1.1: Types of banana varieties planted by farmers.....108

Table 4.7.2.1: Summary of the reason for not planting improved banana varieties.....110

Table 4.7.3.1: Comparison of improved banana varieties with selected characteristics.....112

Table 4.7.5.1: Banana management practices followed.....115

Table 4.7.6.1: Maintenance of soil fertility in banana plantations.....117

Table 4.7.7.1: Control of pests and diseases.....119

Table 4.7.8.1: Level of participation in technology generation and evaluation.....121

LIST OF FIGURES

Figure 1: Conceptual framework 9

Figure 2: Categories of adopters 20

Figure 3: Livestock ownership 65

Figure 4: Source of planting materials 113

LIST OF ACRONYMS

CIMMYT	International Maize and Wheat Improvement Centre
COREC	Coffee Research Centre
FFS	Farmer Field Schools
FHIA	Foundation Honduran Internationalo Agricola
GDP	Gross Domestic Product
IDRC	International Development Research Centre
IPM	Integrated Pest Management
MDG	Millennium Development Goals
MoFPED	Ministry of Finance, Planning and Economic Development
NaCRRI	National Crop Resources Research Institute
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organization
NGO	Non-governmental Organization
SPSS	Statistical Packages for Social Scientists
UNBRP	Uganda National Banana Research Programme

ABSTRACT

This study examined factors affecting farmers' adoption of improved agricultural technologies in Uganda with specific reference to banana production in Mukono District. This was in light of the fact that since 1989, a number of banana production technologies had been developed by NARO researchers at Kawanda and disseminated to farmers for adoption. Despite the availability of the technologies, the rate of adoption was still very low and banana production had continued to decline. Across sectional survey design was used. Data were collected from four sub-counties using a structured questionnaire. A total of 251 respondents were interviewed in the four sub-counties. Face to face interview with key informants in the four sub-counties were also carried out. The results showed that the most important factors associated with adoption of agricultural technologies in banana production were; Institutional ($p = .000$), gender ($p = 0.002$) and economic factors ($p = 0.020$). However, Age ($p = 0.26$) and education ($P = 0.198$) were not significant factors. From the study therefore, it was concluded that, research-extension contact with the farmer was inadequate. Available evidence indicated that there was no gender balance during technology dissemination and the biological and chemical technologies were expensive. The following recommendations were made; Participatory research should be encouraged, researchers, extensionist and farmers should work together irrespective of gender and government should enforce formation of farmer cooperative societies which should be mandated to purchase agricultural inputs directly from source and supply them to farmers on credit and at a relatively fair price. The number of extension agents per sub-county should be increased from one to at least three and formation of farmer field schools should be encouraged.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

In Uganda, the use of improved agricultural technologies has been stressed by the National Agricultural Research Organization as the key drive to increased agricultural production that will lead to a reduction in hunger and poverty. Despite the effort made by the Ministry of Agriculture and forestry through the National Agricultural Advisory Service to disseminate the technologies to farmers, the adoption rate of the technologies has remained low. This study examines factors affecting farmers' adoption of agricultural technologies in Uganda with specific reference to banana production in Mukono district. In this study the independent variables were factors affecting adoption of banana production technologies with emphasis on economic factors, farmers' characteristics and institutional factors. The dependent variable was the adoption of agricultural technologies based on acquisition and use of the recommended banana production technologies. The intervening variables were government policies likely to affect the use of agricultural technologies. The extraneous variables were the variables which the researcher could not control. This chapter addresses the background of the study, the problem statement, purpose of the study, objectives of the study, hypotheses, conceptual framework, significance of the study, justification of the study, scope of the study and operational definitions are highlighted.

1.2. Background to the study

The use of improved agricultural technologies has remained the major strategy used by governments globally to increase agricultural productivity and promote food and livelihood security (Nguthi, 2007). However, the contribution of improved technology to agricultural production can only be realized when the technology is widely used. Adoption itself results from a series of individual decision to begin using the technology. These decisions are the result of a comparison between the benefits of the improved technology against the conventional practice. Understanding of how the factors affect this choice is essential for both the generators (researchers) and disseminators (extension agents/educators).

In Indonesia, where rice is the major staple food, integrated pest management practices were adopted by farmers to increase rice yields while reducing on production costs (Soejitno, 1999). As for Malaysia, which is the largest world supplier of oil palm and kernel oil, farmers adopted the use of recommended fertilizer application rates and other agronomic practices on oil palm that increased yields and incomes of farmers (Basiron, 1995). Similarly in South Asia where cotton is the major cash crop and wheat is the major food crop, farmers adopted new integrated agricultural technologies such as zero tillage, integrated nutrient management, improved hybrid varieties, irrigation management that also led to increased yields and incomes (Mayee *et al.*, 2008).

In Africa, agriculture contributes around 25% of Gross Domestic Products, employs 70% of the population and is a livelihood for more than 65% of the population. It is therefore the main source of income, employment, food, foreign exchange and it also supplies raw materials for domestic industries (Mutamba *et al.*, 2009). Agriculture has therefore, continued to be a fundamental instrument for sustainable development, poverty reduction and enhance food security in developing countries. It is a vital development tool for achieving the Millennium Development Goals (MDG), one of which is to ensure that people suffering from extreme poverty and hunger are reduced by 50% by the year 2015 (World Bank, 2008). In Africa, agriculture is a strong option for spurring growth, overcoming poverty and enhancing food security. Agricultural productivity growth is also vital for stimulating growth in other sectors of the economy. However, agricultural productivity in Africa has continued to decline over the last decades and poverty levels have increased (Olwande, Sikei & Mathenga, 2009).

Currently, agricultural productivity growth in Africa lags behind that of other regions in the world and is well below that is required to achieve food security and poverty goals. Increasing agricultural productivity in Africa is an urgent necessity and one of the fundamental ways of improving agricultural productivity is through introduction and use of improved agricultural technologies (Olwande *et al.*, 2009). Africa is no longer viewed as a land-abundant region where food crop supply could be increased by expansion of land under agriculture due to its rapid population growth (Ariga et *al.*, 2008). Large areas in Africa are increasingly becoming marginal for agriculture and arable land has become

scarce in many African countries. This calls for intensification of land use through adoption and use of improved agricultural technologies such as fertilizer/manure application, integrated pest management, timely planting, weed control, pruning/desuckering, use of improved varieties, soil and water management and proper post harvest handling methods for achieving food security (Olwande *et al.*, 2009).

In Uganda, approximately 80% of the country's population live in the rural areas and earn their livelihood from agriculture (MoFPED, 2007/2008). The sector contributes 32% GDP and 85% of the total export earnings (NARO, 2008/09). Uganda's key agricultural products can be divided into cash crops, food crops, livestock, fishing and horticultural produce. The food crops make the largest component of the agricultural sector followed by forestry and then fishing (MoFPED 2007/08). Among the food crops of particular importance to Uganda is banana. Globally banana is the fourth most important food crop after rice, wheat and maize (Rutherford, 2005).

Uganda is the leading banana producer in Africa and ranks second to India in terms of global production (Rutherford, 2005). Banana is the major staple food in the central and southern parts of Uganda (Bagamba *et al.*, 2003). Over 7 million people in Uganda including 70% of the farmers rely on the crop as a staple food with estimated annual consumption per capita of 400kg, the highest in the world (Rutherford, 2005). The crop which is cultivated primarily by resource poor rural farming communities provides a vital source of income for purchase of other foods, household necessities, children education

and medical care. In terms of revenue, banana is the second most important cash crop after coffee providing 22% of national agricultural revenue (Rutherford, 2005). Banana peelings and pseudo stems are also fed to livestock such as goats and cattle (Nankinga, 1994).

Despite its importance, banana productivity in the traditional banana growing areas (central region) has steadily declined (Tushemereirwe *et al.*, 2003). This decline threatens food security and cash income of the people. The decline is mainly attributed to loss in soil fertility, pests and diseases that include banana weevil, nematodes, fusarium wilt, banana bacterial blight, black sigatoka, leaf spot and banana leaf streak virus and poor field management practices. These have been identified as major constraints to productivity as well as post harvest handling problems, socio-economic constraints and low genetic diversity as other contributing factors (Gold *et al.*, 1993) and have therefore been targeted by researchers with new technologies. Despite the new technologies generated by research agencies and efforts by extension workers to disseminate the technologies to farmers, decline in banana production still persists, yet banana is the most preferred staple food in many regions and commands a relatively high price in urban markets.

In Mukono District, the agricultural department in 2003 re-affirmed a decline in banana production in the district. This was probably due to high incidence of banana weevils,

panama wilt disease, root nematodes, decline in soil fertility and the emerging banana bacterial wilt disease (Mukono District Environment Profile, 2003).

In February 2004, a stakeholder's workshop was held in Mukono district for promotion of banana production, commercialization and utilization of technologies. In that workshop the District Agricultural Officer informed the participants that the workshop on banana production was very timely especially for Mukono district which was experiencing a decline in banana production due to declining soil fertility, pest and diseases attack especially banana bacterial wilt, banana weevils and root nematodes (UNBRP, 2004). This presupposes that there have been no successful efforts in ensuring and maintaining a steady production of banana despite the availability of various technologies generated by the Uganda National Banana Research Programme at Kawanda. This study therefore, intends to find out factors that have contributed to poor farmers' adoption of agricultural technologies such that alternatives for improved production can be sought.

1.3. Problem of Statement

Banana is one of the crops that have received increased research attention in Uganda since 1989 after the establishment of the Uganda National Banana Research Programme at Kawanda Agricultural Research Institute (UNBRP). The programme was established with the principal objective of generating and disseminating appropriate environmentally friendly technologies and knowledge in order to improve banana productivity and

utilization. Since 1989, a number of banana production technologies have been developed by UNBRP that would lead to improved banana productivity. Key technologies include improved soil/water management to control soil erosion, the use of organic/inorganic fertilizers and related cultural treatments to improve plant vigour, pest and disease management, post harvest handling, intercropping, weed control and use of tissue culture banana plantlets.

Although these technologies were perceived to have the potential to help reverse the declining banana productivity trends observed by Tushemereirwe *et al.*, (2003), and promote food and livelihood security in banana farming households, the rate of adoption and use of these technologies by farmers in Mukono has been low, leading to continuous decline in production. Because of this decline, farmers in the traditional banana growing areas of central Uganda including Mukono District are facing frequent food shortage crises (UNBRP, 2003). It is feared that if this trend persists, displacement of bananas in the farming system poses a serious threat to food security and general welfare of the people in the affected area, Mukono inclusive. It is for this reason that a study was undertaken to identify the various factors at play in determining the adoption of the technologies developed and disseminated by UNBRP and come up with appropriate recommendations that may help to influence adoption of the technologies.

1.4 Purpose of the study

The purpose of this study was to examine the factors affecting farmers' adoption of agricultural technologies in Uganda with specific reference to banana production in Mukono district.

1.5. Specific objectives of the study

The study was guided by the following objectives;-

i) To find out the economic factors that affect farmers' adoption of recommended agricultural technologies in banana production in Mukono district.

ii) To determine farmers' characteristics that affect adoption of recommended agricultural technologies in banana production in Mukono district.

iii) To establish the extent to which institutional factors affect farmers' adoption of recommended agricultural technologies in banana production in Mukono district.

1.6 Research hypotheses

The hypothesis of the study were;-

i) Economic factors affect farmers' adoption of recommended agricultural technologies.

ii) Farmers' characteristics affect adoption of recommended agricultural technologies.

iii) Institutional factors affect farmers' adoption of recommended agricultural technologies.

1.7 Conceptual framework

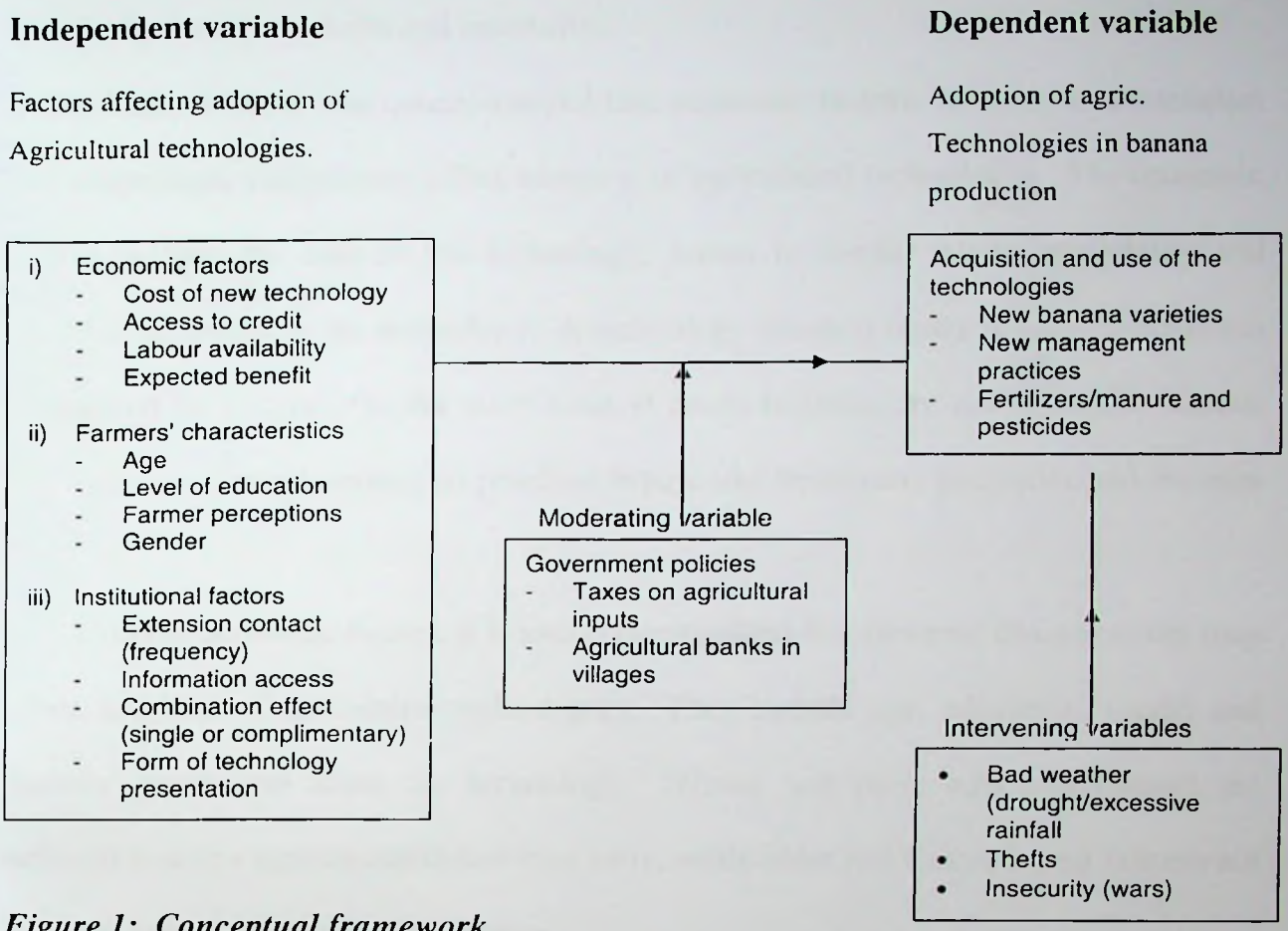


Figure 1: Conceptual framework

Source: Adopted and modified from Akinwumi A. Adesina & Jonas Chianu-Agricultural systems (2004)

In Figure 1 above, the researcher presented the relationship between the variables under study based on the literature reviewed. The frame work examines the factors affecting adoption of agricultural technologies in banana production as the independent variable and adoption and use of the agricultural technologies as the dependent variable. The moderating variables are the government policies that include taxes on agricultural inputs

and establishment of agricultural banks and many others. The intervening valuable include, bad weather, thefts and insecurity.

In the frame work, it was conceptualized that economic factors, farmers' characteristics and institutional factors may affect adoption of agricultural technologies. The economic factors include the cost of the technology, access to credit, labour availability and expected returns from the technology. A technology which is costly is more likely not to be adopted by farmers. On the other hand, if credit facilities are not available, farmers may not have enough money to purchase inputs like fertilizers, pesticides and the new varieties.

In addition to economic factors, it is also conceptualized that farmers' characteristics may affect adoption of agricultural technologies. They include age, education, gender and farmers' perception about the technology. Young and more educated farmers are believed to adopt agricultural technology early, while older and less educated farmers are believed to be conservative in adoption.

Besides, economic factors and farmers' characteristics, it is also conceptualized that institutional factors may affect farmers adoption of agricultural technologies. The institutional factors include extension contact, information access, complimentary effect and form of technology presentation. Farmers who have frequent contact with extension personnel are believed to adopt a technology. Farmers will have access to information on the technology and be able to evaluate the advantage and disadvantage of the technology. On the other hand farmers who are involved in technology generation and evaluation are

believed to adopt the technology easily. This is because they are able to see the benefits of the technology as it is being experimented compared to the old practice. Government policies are also believed to have an overall effect on the requisition and use of agricultural technologies. High taxes on agricultural inputs will increase the actual cost of inputs and farmers will not afford to purchase them while lack of agricultural banks in villages reduces accessibility to credit facilities. Extraneous variables that include bad weather, theft and insecurity can also have an effect on adoption of technologies. In the framework, adoption of agricultural technologies implied, acquisition and use of the recommended agricultural technologies. The technologies included biological innovation (new banana varieties), chemical innovations (fertilizers and pesticides) and agronomic innovations (new management practices).

1.8 Significance of the study

The study findings are hoped to be significant to stakeholders like government both at local and central levels, other government organizations, the academia, service providers, non-government organizations and our development partners. Specifically, the findings were expected to be significant as indicated here below;-

i) Findings may help the National Agricultural Research Organization (NARO), the National Agricultural Advisory Services (NAADS) and change agents to be aware of the factors affecting adoption of agricultural technologies in banana production and be able to design strategies that will enhance farmers' uptake of the improved agricultural technologies.

ii) Future researchers on the same subject will obtain relevant information and identify gaps for further research.

iii) Findings are expected to be used by policy makers to formulate policies that are conducive to farmers' uptake of agricultural technologies, which are likely to improve banana production, food security and increased household incomes.

1.9 Justification of the study

The use of improved technologies has remained the major strategy used by developing countries to increase agricultural productivity and promote food security (Nguthu, 2007). The Uganda government is no exception in view of the fact that 80% of the population earns a living from agriculture. Due to the fact that banana is one of the most important staple food crop in Uganda, the National Banana Research Programme was established in 1989 at Kawanda Agricultural Research Institute. In collaboration with development partners, that included Rockefeller Foundation and International Development Research Centre (IDRC), UNBRP was tasked to develop and disseminate agricultural technologies in banana production which would increase farmer income and food security.

Despite the fact that a number of technologies have been developed and disseminated to farmers for adoption, banana production has continued to decline as observed by Tushemereirwe *et al*, 2003. This therefore justifies the study in an attempt to obtain results based on in-depth analysis of the factors affecting adoption of these technologies. The study findings will therefore come up with appropriate recommendations to policy

makers, researchers and Extension educators that will help to improve the uptake of the technologies, and hence reverse the declining banana production trends.

1.10 Scope of the study

1.10.1 Geographical scope:

The study was carried out in Mukono district, which is one of the traditional banana growing districts and this is where banana productivity has steadily declined over the last ten years. The sub-counties that were involved in the study included Kyampisi, Nagojje, Ntenjeru and Nakisunga as they were among the main leading banana growing sub-counties in the district.

1.10.2 Content scope:

The study content scope was restricted to factors that affect farmers' adoption of agricultural technologies in banana production. Focus was put on finding out how economic factors, farmers' characteristics and institutional factors affect adoption of agricultural technologies in banana production. The technologies included use of new banana varieties, fertilizers and pesticides and new management practices.

1.10.3 Time scope:

The study was limited to the period, 1989 to date when the Uganda National Banana Research Programme (UNBRP) was established to generate and disseminate appropriate environmentally friendly technologies that would lead to improved banana production. Since that time up to date, the UNBRP has generated and disseminated technologies to farmers that were hoped to have improved banana production and utilization.

CHAPTER TWO

LITERATURE REVIEW

iew the relevant literature related to the subject. The purpose
ghlights and clarification on the problem and provide theoretical
It looks at publications, papers, books, internet sources and
at have tried to handle the topic. The literature review is a study of
g adoption of agricultural technologies, reference to banana production
ict.

tical review

he important first steps towards maximizing a technology rate of adoption is to
tand the factors that influence its adoption. Several theories have been used to
ain adoption of technological innovations. They include diffusion of innovation, the
doption perception theory, the economic constraints theory, farmer characteristic theory
and so many others. This study was guided by one theory, the diffusion of innovation
theory (Rogers, 2003).

The diffusion of innovation theory is the most widely used frame work to explain and
predict adoption of new technologies. Diffusion of innovation is a theory of how, why
and at what rate new ideas and technology are taken up in a population. Rogers (2003)
defines diffusion as a process in which an innovation is communicated through certa
channels over time among members of a social system. Diffusion is a special typ

n the spread of message that are perceive

he adopters perceive it as new (Mark and Poltrock, 2001).

does not necessarily have to be new, it only needs to be

would-be adopters. The definition emphasizes four important

on of new ideas which are:

hat represents the new idea or practice (innovation)

ns channels which represent the way information about the new

lows from change agents (extension staff) to final user of adopter

period over the which a social system adopts a technology and

cial system.

ding to Rogers (1995) the likelihood that a technology will be adopted depends

ly on its attributes (qualities). Technology attributes include relative advantages,

mpatibility, trialability, complexity and observability. Basically these attributes are

economic in the sense that they relate to how much effort must be expanded in adoption

compared with the benefit of adopting, especially compared with the cost and benefit of

not adopting.

Relative advantage refers to the degree to which an innovation is perceived as better than

the practice it replaces. Relative advantage is often expressed in terms of economic

social or other benefit. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be.

Compatibility refers to the degree to which an innovation is perceived by potential adopters to be consistent with the existing practices. Compatibility with what is already in place makes the new practice seem less uncertain, more familiar and easier to adopt.

Complexity refers to the degree to which an innovation is considered as difficult to understand and use. If potential adopters perceive an innovation as complex, its adoption rate is low. New ideas that are simpler to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understandings.

Trialability refers to the extent to which an innovation may be subjected to limited experimentation. New ideas that can be tried on the installment plan will generally be adopted more quickly than innovations that are not divisible. An innovation that is triable represents less uncertainty to the individual who is considering it for adoption who can learn by doing.

Finally, observability refers to the degree to which the result of an innovation is visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt it. In some innovations, it is easy for others to use the results of adoption from those who have already adopted the technology. However, this is not the

case with all innovations. Moore & Benbasat (1991) split observability into two;- result demonstrability (the ability to demonstrate that positive results have occurred for the user) and visibility (the ability to share those demonstrations with others).

Another important element of diffusion of innovations is communication channel. A communication channel is the means by which messages get from one individual to another. Access to information regarding a new technology is the principal factor affecting the adoption decision process (Hooks *et al.*, 1983). An innovation can be communicated through mass media or through interpersonal communication. The two channels play different but complementary roles, while many individuals may initially hear about an innovation through mass communication channels, it is the interpersonal communication that is likely to influence adoption decision (Mark & Poltrock, 2001; Lowery & Defleur, 1995). Most individuals evaluate an innovation, not on the basis of scientific research by experts but through the subjective evaluation of near-peers who have adopted the innovation. By using the theory, the study will be guided to find out whether smallholder farmers in Mukono District access agricultural information or not, and which communication channels are being used and how effective are they?

Time of adoption is another important element of diffusion of innovations frame work. One way that the model refers to time is in the stages through which adopters pass when deciding about adoption of new technologies or ideas. Depending on when they adopt an innovation, people are grouped into innovators 2.5% (those who adopt at the very earliest

arly majority 34%, late majority 34% a..

ona & Linker, 2008).

pass through when deciding to adopt a new technology are illustrated in Figure 2.

e are the first individuals to adopt an innovation. They are oungest in age, tend to be experimentalists, have large farms, more e the highest social class, have good financial status and are more risk

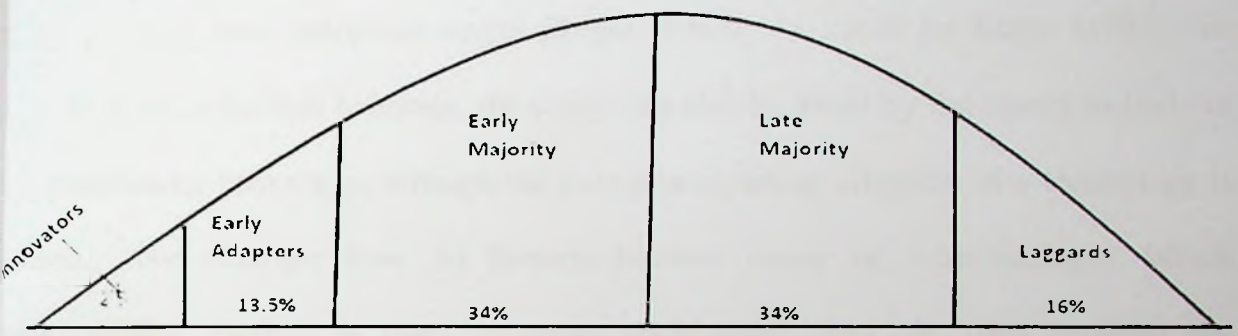
opters:- This is the second fastest category of individuals who adopt an ion. They have the highest degree of opinion leadership among the other ter categories. They are typically younger in age, have a higher social status, ve good financial status, advanced education and are more socially forward than late adopters.

i) Early majority:- This category adopts an innovation after a varying degree of time. Their adoption time is significantly longer than the innovators and early adopters. Early majority tend to be slower in the adoption process, have above average social status. They are more conservative but open to new ideas, active in community and influence to neighbours.

iv) Late majority:- Individuals in this group will adopt an innovation after the average member of the society. They approach an innovation with a high degree of skepticis and after the majority of the society has adopted the innovation. They are older,

educated, fairly conservative and have below average social status, with poor financial status.

Laggards:- They are the last to adopt an innovation. Laggards are very conservative, have small farms and capital, oldest and least educated. They tend to be focused on "traditions" and have lowest social status.



igure 2: Categories of adopters

ource: Chigan & Linker (2008)

nigona & Linker (2008) identifies five phases in adoption decision process. They clude, knowledge phase (awareness) where an individual is exposed to an innovation t lack information about the technology. An attitude about the innovation which can favourable or unfavourable is formed in the persuasion phase (interest). In this stage e individual is interested in the innovation and actively seeks information or details out the technology. The decision (evaluation) phase follows the persuasion where the opter weights the advantage and disadvantages of using the innovation and decides

whether to adopt or reject the innovation. The innovation is put to use in the implementation (trial) phase. In this phase the usefulness of the innovation is determined and further information may be searched. The confirmation (adoption) is the last phase. In this phase the individuals finalizes their decision to continue or discontinue use of the innovation. These stages in the adoption process imply a time lag between awareness and adoption. It is usually measured from knowledge until a decision is made whether to adopt or not. Hence the adoption is not a random behavior but is the result of events passing through these adoption stages (Roger, 1983). As stated by Roger (1983) that adoption is not a random behavior, the study will also be aided by the theory to find out how smallholder farmers go through the four phases before adoption of a technology is effected. For example how do farmers become aware of a technology? Which communication method is used to create awareness? How do they evaluate the advantages and disadvantages of a technology before a decision is made to adopt or reject it?

The social system is the last element of the diffusion of innovation theory. A social system is defined as "a set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (Roger, 2003). The members or units of a social system may be individuals, informal groups, organizations and or sub-systems. Innovations spread through social systems thus aspects of such systems will also affect adoption. According to Dearing and James (2004), the second important impetus that potential adopters consider in the adoption decision process is "what they think other think about

the innovation". That is, potential adopters are greatly influenced by opinions within their social networks.

Other authors also re-affirm that social influence is more likely to occur through opinion leaders of the social systems (Dearing 2004; Kincaid 2004; Haider & Kreps 2004). Dearing (2004) explains, "Opinion leaders through communicating or social modeling do the rest (of diffusion) as long as their attitudes are favourable towards the new practice and other positively identified the opinion leader with the innovation.

Therefore, the rapid spread of innovation can be attributed in part to the high degree of support of acceptance that opinion leaders allocate to the innovation. When innovations spread rapidly, it means they have accorded a high degree of approval from opinion leaders in a social network. On the other hand the opposite may occur when opinion leaders show the active rejection of the innovation, thereby hindering adoption. In many situations, change agents (Extension personnel) could also be considered performing such role within social networks (Rogers. 1995). The theory will therefore be used to find out the role played by opinion leaders and extension agents in a social system to influence adoption of technology or its rejection.

2.3 Determinants of Adoption

Many studies aimed at establishing factors under-lying adoption of various technologies have been the subject of different disciplines. Researchers from sociology, economics, political science, communication, agriculture and public health have studied the adoption of innovations (Wejnert, 2002). As such there is an extensive body of literature on different theories of technology adoption. Several factors have been found to affect adoption of agricultural technologies, these include government policies, technological change, economic factors, environmental concerns, farmer characteristics, institutional factors delivery mechanisms and so many others (Banabana, 2002). Although not tested, it appears that three of these broad items may be more related to agricultural technology adoption in banana production. They include;-

i) Economic factors: Cost of technology, access to credit, labour availability and level of expected benefit.

ii) Farmer characteristics: Age of potential adopter, education level, gender related aspects and farmer perceptions.

iii) Institutional: Extension service, information access, complimentary effects and form of technology presentation.

Because of the extensive literature on technology adoption, the following section provides a review of the three selected factors as they are related to agricultural technology adoption in banana production.

2.3.1 Economic factors

Agricultural production requires capital, labour, land and management skills. These are economic requirements (factors) for agricultural production. Capital is required for purchase of capital items for example, machinery, tools, construction of buildings etc, while circulating capital is required for purchase of raw materials for example, seeds, fertilizers, planting materials, pay for labour etc. Labour is required to do farm work. It can be human or machinery labour. Human labour can be skilled, semi-skilled or unskilled. Land is a natural resource which is used in production of both crops and livestock. Production on land can be increased by increasing land size or by using improved technologies on the same land size. Management skills combine the three factors of production (land, labour and capital) to produce goods and services. In this study, economic factors will include, cost of technology, access to credit, labour availability and level of expected benefit. The choice of these economic factors is based on the fact that Mukono is a traditional banana growing district therefore land is not a problem to affect adoption. It is also assumed that since farmers have been growing banana for along time, they have a lot of experience, therefore management skills is also not a problem to affect adoption of agricultural technologies.

2.3.1.1 Cost of technology

The decision to adopt is often an investment decision. Therefore adoption can be expected to depend on cost of a technology and whether the farmer posses the required resource. Technologies that are capital-intensive are only affordable by wealthier farmers

(El-Osta & Morchart, 1999) and hence the adoption of such technologies is limited to larger farmers who have the money (Khanna, 2001). In addition, changes that cost little are adopted more quickly than those requiring large expenditure (Green & Ngogola, 1993), hence both extent and rate of adoption may be dependent on the cost of a technology. Although it may be true that extent and rate of adoption may depend on the cost of a technology, but if it pays to adopt a technology many farmers can go in for it. For example, in tomato production, spraying is very costly yet many farmers still do it because it pays. In banana production, it is not known whether the technologies developed by UNBRP are costly or not. This will be revealed by this study.

2.3.1.2 Access to credit

Access to credit through a bank loan or savings in cooperative society is expected to increase the probability of adoption of a technology (Lubwama, 1999; Bonabana, 2002 & Nguthi, 2007). However, to be eligible for a loan, the size and efficiency of operation of the borrower is crucial. Farmers operating large farms tend to have greater financial resources and have better chances of receiving credit than those with small farms. While farmers with bigger farms have a greater advantage to access credit facilities, it is also important to consider crop acreage on which technology is practiced. This is because crop acreage is a superior measure to predict the rate and extent of adoption of a technology. The study will therefore established whether banana farmers are able to access credit from various lending institutions to finance the various banana activities which are necessary for successful banana production.

ility

of technology to be adopted, labour availability may also affect
nology. According to Baide (2005), farmers may find labour
n issue to consider when thinking about changing to sustainable
es. This is due to complexity of sustainable agricultural practices.
Foundation (2004) found out that increased labour demands represent a
er to adoption for many conventional farmers while for farmers who had
ed sustainable practices, labour concerns ceased. Labour issues seem to be
cern in the decision to adopt conservation tillage (Kassie, Zikhali, Manjur &
2009). Specifically, the probability of adopting conservation tillage, relative to
tion, increased with the number of household members who actively provided
abour. However, Nguthi (2007) reported that there was no clear relationship
een household size (labour availability) and adoption. It can be positively or
gatively related to adoption depending on availability of land and labour markets. On
ne other hand enterprises that are labour intensive but highly paying, for example, zero
grazing dairy animals, adoption of technology may not be affected due to lack of labour.
The labour requirement for banana production is not well documented to ascertain its
effect on technology adoption. In this enterprise, labour can be hired and the cost can be
offset by good returns from the enterprise.

2.3.1.4 Level of expected benefit

Farmers must see an advantage or expect to obtain greater profit in adopting a new technology. In addition, farmers must perceive that there is a problem that warrants an alternative action to be taken. Without a significant difference in outcomes between two options and in the returns from alternative and conventional practices, it is less likely that farmers especially small-scale will adopt the new practice (Abara & Singh, 1993). Kivlin & Fliegel (1966) also found that technology attributes affected the rate of adoption. In this case, technologies perceived as "most rewarding and least risky" were adopted more quickly. It is also important to note that expected benefits from a technology must be sustainable. Use of improved banana varieties requires continuous replenishment of soil fertility and control of pests especially nematodes and weevils. These are costly practices and the return on investment in banana production is yet to be known. Probably this could be one of the reasons for low adoption rates of the recommended banana production technologies.

2.3.2 Farmers characteristics

Different writers have classified farmers' characteristics as demographic factors, while others as social factors. In most classification, farmers' characteristics include: Age, Education, Gender, Perception, Experience, Household size and Farm size. In this study, farmers' characteristics will only include farmers' personal characteristics which are age, education, gender and perception as to which one affect adoption of agricultural technologies. Farmers' experience will not be considered because the study is to be

ried out in a traditional banana growing district, therefore it is assumed farmers have experience. As for farm size, only farmers with at least ½ an acre (200 banana stools) d above will participate in the study. Household size will be covered in the economic tors as labour availability.

3.2.1 Age of adopter

ge is one of the factors thought to affect adoption. Different researchers have reported ifferent findings in relation to age as a factor affecting adoption. Therefore there is a ontention on the direction of the effect of age on adoption. Younger farmers adopted se of improved maize varieties and chemical fertilizers in Mozambique than old farmers (CIMMYT, 1993). In studies on adoption of land conservation practices in Niger (Baidu-Forson, 1999), rice in Guinea (Adesiina & Baidu-Forson, 1995). Hybrid cocoa in Ghana (Boahene, Snijder & Folmer, 1999) age was either not significant or was negatively related to adoption.

On the other hand age was found to positively influence adoption of IPM on peanuts in Geogia (McNamara, Wetzstein & Donce, 1991), Sorghum in Burkina Faso (Adesiina and Baidu-Forson, 1995). It is believed that with age, farmers accumulate more personal capital and thus show a greater likelihood of investing in innovations (Uaiene *et al.*, 2009). However, Nguthi (2007) reported that younger farmers were more knowledgeable about a new practice, more flexible, willing to bear risk due to their longer planning horizons and hence likely to adopt new technologies. The age groups involved in banana

production in Mukono district is not known and how they affect adoption of agricultural technologies. This study will endeavour to establish the age groups involved in banana production and how they effect adoption of the recommended agricultural technologies.

2.3.2.2 Level of education

Many adoption studies show some association between technology adoption and level of education of the farmer. Education can be acquired through formal and informal education and farming experience. Formal education refers to what we typically know as public school education. Informal education refers to other types of training such as workshops, seminars and field days. It is assumed that formal education increased farmer's ability to understand and respond to information concerning new technologies (Feder & Slade, 1984). Educated farmers are said to be early adopters and apply the associated inputs more effectively (Feder, Richards & Ziberman, 1985). However, this may depend on the complexity of the technology, for example, Integrated Post Management (IPM) is frequently stated to be a complex technology (Boahene, Snijders & Folmer, 1999).

Studies show that farmers with more formal education tend to adopt more agricultural technologies (Chaves & Riley, 2001 and Strauss *et al.*, 1991). Adoption also occurs from increase in knowledge due to farmer field schools (FFS) participation (Bonabana, 2002), participation in farmer groups (Caviglia – Harris 2003; Strauss *et al.*, 1991; Adesiina *et al.*, 2000) and exposure to extension information (Bonabana, 2002). However, the

applicability of such an idea in Mukono district is not known and remains the concern for this study.

2.3.2.3 Gender

Gender refers to socially constructed maleness and femaleness and varies widely across cultures. The role of gender in livelihood generation cannot be over-emphasized. This is because men and female bear different responsibilities and have different options in household livelihood generation. The concept of gender is used to describe all the socially given attributes, roles, activities and responsibilities associated with being a male or a female in a given society.

Most researchers have shown mixed evidence regarding the different roles men and women play in technology adoption. Doss & Morris (2001) in their study on factors influencing improved maize technology adoption in Ghana, and Overfield & Fleming (2001) studying coffee production in Papua New Guinea showed insignificant effects of gender on adoption. However, according to Nguthi (2007), women farmers play a key role in most African farming households. It has been reported that although tradition often specifies some tasks or crops as women's and some as men's, these gender divisions of labour become less rigid as new opportunities arise.

Although men may not take over women's responsibility of food production for home consumption, they move into women's activities when these become easier and profitable

hence suggesting that male and female adopt practices equally. Generally when a task is made easier men tend to take over and leave the more difficult work to women. Kassei et al (2009) in their study on the adoption of organic farming technique in Ethiopia, found that households with a male head were less likely to adopt the use of compost, while they were more likely to either adopt conservation tillage or combine it with the use of compost. While (Adesiina *et al.*, 2000) found that male-headed households were more likely to adopt sustainable agricultural technologies, Kassie, Precious, Kibede & Sue (2009) in their findings understood the need to avoid generalizing the impact of gender on farm technology adoption, emphasizing that the impact of gender on technology adoption is technology specific.

In Uganda, while women are the main food producers, they lack access to and control over the means of production such as secure land, credit and control of labour. Agricultural technology adoption and impacts depends on complex interactions and there is need to understand household dynamics embedded in the complex and highly heterogeneous African farming households (Nguthi, 2007). Regardless of the targeted beneficiaries, individuals with greater power and access to resources are better able to take advantage of a change in circumstances than less powerful and poorer individuals. How true this is in Mukono district is a subject of confirmation of this study.

2.3.2.4 Farmer's perceptions

Farmer perception of the technology must be considered when examining the adoption decision (Adesiina & Zinnah, 1993). It is assumed that this variable answers as to whether or not the farmer sees the technology as appropriate or inappropriate for solving a particular problem. Baide (2005) in her studies, barriers to adoption of sustainable agricultural practices in Honduras, found that farmers were unable to perceive negative effects of conventional farming as they required proof that bad practices (of using pesticides) were harming them and their land. In Uganda, tomato farmers continue to spray fungicides to the crop up to harvesting period. They have a belief that this improved the keeping quality, though it is dangerous to human life. This study will therefore endvour to find out what banana farmers in Mukono think about these technologies and therefore come up with an appropriate recommendation.

2.3.3 Institutional factors

In this study, institutional factors are public or private organizations that are involved in technology generation and dissemination to farmers. Improved technologies are generated by researchers and disseminated to farmers by Extension agents. However, poor linkage between researchers, Extension agents and farmers may affect adoption of the technologies by farmers. The institutional factors to be considered in this study to affect adoption of agricultural technologies will include extension contact, information access, the combination effect of the technologies and form of technology presentation to farmers.

2.3.3.1 Extension contacts

Although farmers may be having a lot of experiences in what they do, intensive agricultural production requires information and training on methods and the scientific use and application of the various technologies. This information is provided by trained extension service providers. In Uganda, these are either government extension staff or non government extension staff. According to Bonabana, 2002 and Nguthi, 2007, the uptake of new technology is often influenced by good extension programs and farmer's contact with extension service providers. Extension agents provide source of improved varieties and technical advice. Increased exposure to extension agent and participation in farmer groups has been correlated to higher adoption rates (Adesiina *et al.*, 2000; Strauss *et al.*, 1991 & Bonabana, 2002). In the study by Bonabana, institutional/informational factors were found to have the most significant impact on adoption of IPM technologies. These factors included on-farm trials, farmer field schools (FFS) training and extension agents information. This study will therefore try to establish the number of extension agents in the various banana growing sub-counties in Mukono district and how often are they in contact with farmers? Technology adoption heavily relies on the farmers' accessibility to good quality and appropriate extension service.

2.3.3.2 Information access

Access to information on new technologies is crucial as it creates awareness and attitudes towards technology adoption (Place & Dewees. 1999). Information reduces the uncertainly about a technology's performance hence may change individual's assessment

from purely subjective to objective over time (Caswell *et al*., 2001). Manale Kessie *et al.* (2009) in their study on Adoption of Organic farming techniques in Ethiopia found out that access to agricultural extension services had an impact on adoption of all technology choices. Contact with extension services gives farmers access to information on innovations, advice on inputs and their use and management of technologies. In most cases, extension workers establish demonstration plots where farmers get hands-on learning and can experiment with new farm technologies. Consequently, access to agricultural extension service is often used as an indicator of access to information (Adesina et al. 2000 & Honlonkon, 2004)

Young (2003) reported that farmers in the United Kingdom, Spain and Brazil lacked enough information about the economic viability of organic farming and needed to be sure that organic farming represented an economically viable option in order to adopt it. Information can also be acquired through informal sources like the media, farm visits, meetings, field days, workshops and farm organizations and through formal education. It is important that this information should be reliable, consistent and accurate. In Mukono district, it is not known how banana farmers access information on new technology. For crops like coffee, vanilla, tea etc, there are various organizations that are responsible for passing on information to farmers, for example, Uganda Coffee Development Authority and Uganda Tea Growers Association.

2.3.3.3 The combination effect

Most adoption literature concentrates on adoption of single technology, for example, hybrid cocoa (Boahene, Snijder & Folmer, 1999) and improved varieties like beans (Kato, 2000) and many more. Other studies investigated adoption of a combination of technologies such as improved varieties and fertilizer (Nkonya, Schroeder & Norman, 1997; Shakya & Flinn, 1985). As such some literature (Feder Just & Zilbernman, 1985; Rogers, 1995) suggests that adoption of technologies may in effect be enhancing because of complementarities that exist between the technologies.

Complementarities occur at two levels, at factor level and at technology level. At the factor level, complementarities occur from the manner in which combinations of factors act together to influence adoption (Bonabana, 2002). Additionally, complementarities between factors occur where all inputs considered together have a significant effect on adoption but when the influence of one is held constant, correlation between the other remaining inputs and technology is greatly lowered (Bonabana, 2002).

Therefore, where inputs are critical for adoption and are in short supply, for example, water supply that is critical for irrigation technology adoption, if not available may hinder adoption. It is therefore important that inputs must be readily available in order to encourage adoption. At the technology level, complementarities occur because one technology enhances the positive inputs of another. For example, the high yielding varieties of seed can be realized only if fertilizers are applied. For example, in Tanzania, farmers tend to adopt improved maize seed in combination with fertilizers (Nkonya,

Schroeder & Norman, 1997). In banana production, yield is greatly affected by pests and diseases, application of manure or fertilizers, control of weeds and soil and water conservation measures. This study therefore, will endvour to find out whether these technologies are being used in combination by the smallholder farmers or not and if not what are the reasons for not using all of them since they are a pre-requist for increased banana production.

2.3.3.4 Form of technology presentation

For research to be effective there must be an efficient mechanism whereby its results can be used by the farmers (Oradho, 1983). The process of making available fruits of research is the function of the extension service. The role of the extension service is to help farmers to;-

i) Experiment with new technology or new farming systems.

ii) Gain access to relevant information from a variety of information services.

iii) Evaluate and interpret this information for their own situation and learn from their experiences.

A number of approaches are used by the extension service to effectively and efficiently disseminate research technologies to farmers. According to Oradho (1983), the approaches include, farmer-group approaches, farmer field schools, field days, demonstrations, visit to research institutions, public media, seminars, publications and agricultural shows. The approaches the extension providers use to disseminate research

technologies to banana farmers in Mukono are not known and remain the concern for this study.

2.3.4 Summary

From the review of relevant literature, it is clear that many factors may help to explain the pattern of technology adoption. However to attempt to include all of them in the study may not be a viable option. Limited research funds and time may limit the amount of data that can be collected. The above summary indicates that there are still research gaps that should be addressed in order to explain farmers' adoption adequately. For instance, Baide (2005) found that depending on the type of technology, labour availability would also affect technology adoption, while Nguthi (2007) found that there was no clear relationship between labour availability and adoption. This therefore requires further investigation to clarify the contradiction. As for age, Adesiina & Baidu-Forson (1995), Boahene, Snijder & Folmer (1999) reported that age was either not significant or was negatively related to adoption. On the other hand McNamara, Wetztein & Donce (1991) found out that age positively influence adoption of IPM on peanuts in Georgia. This also requires further investigation as regards banana production. The effect of gender on adoption is also not clear, for example Doss & Morris (2001), Overfield & Fleming (2001), reported insignificant effect of gender on adoption while Kassie, Precious, Kibede & Sue (2009) found out that the impact of gender in technology adoption is technology specific.

Considering the different countries and regions these adoption studies have been carried out and none in Mukono on banana, this study will attempt to provide further investigation and evidence on some of the findings that have been reported to explain farmer adoption behavior in banana production. This will probably form a basis of pointing out why banana farmers in Mukono exhibit different characteristics in the adoption of various agricultural technologies.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methods and procedures that were used to collect data. It gives the background against which data was collected, assessed and analyzed. The methodology is thus presented under the sub-themes; research design, study area, study population, sample size and selection, sampling techniques, data collection methods and data collection instruments, data quality control (reliability and validity), data collection procedures and data analysis techniques used in this study.

3.2 Research design

A cross sectional descriptive survey design was used. The design was used to enable the researcher collect data once over a specific period of time within a range of days to a month. It described the events as they were at the time. A cross section of people who were involved in the research were able to give their opinions about factors affecting adoption of recommended agricultural technology in banana production in the District of Mukono. The study used both primary and secondary data sources to obtain quantitative and qualitative data. Quantitative data provided meaningful distribution of variables using statistical procedures while qualitative data generated, helped to argument the quantitative data, to give meaningful information about the situation. The design enabled sufficient information to be obtained from a large number of respondents over a short

time in terms of experiences, opinions, [illegible]
affecting adoption of recommended agricultural tech[illegible]
uction. It was also possible to use quantitative data from the design to
ferences about the wider population.

3.3 Area of study

The study was conducted in Mukono District (Appendix vi) which is located in the Central region of Uganda and is the third largest district in Uganda after Kitgum and Moroto districts. It is bordered by the districts of Kayunga to the North, Buikwe to the East, Lake Victoria to the south, Wakiso in the North West, Kampala and Mpigi to the west. It lies between latitude $1^0$38'N and $1^0$00'S and longitudes $32^0$31'E and $33^0$26'E. The district was purposively chosen because it is one of the traditional banana growing districts in the country (others include Masaka, Mpigi, Wakiso and Mubende) and this is where banana production had steadily declined (Tushemereirwe *et al.*, 2003). Choosing this district therefore was seen to provide representative information of the factors affecting farmers' adoption of recommended agricultural technologies in Uganda with specific reference to banana production.

Mukono covers an area of 11,764km^2 with water 7,117km^2, forests 564.6km^2 and arable land 2,529.43km^2. The district comprises four (4) counties; Nakifuma, Buvuma Islands, Mukono and Buikwe. There are 28 sub-counties, 145 parishes and 1,120 villages

(Tourism and Investment Infrastructure, 2009).

/ two types of farming systems namely;-

Banana-coffee system which covers the southern half of the district and

avanna mosaic banana-coffee systems which covers the Northern half of the

t (Mukono District Environment Profile, 2003).

udy population

sample study population comprised the sub-county agricultural staff and banana rmers in four sub-counties; namely Nakisunga, Ntenjeru, Nagojje and Kyampisi. At the sub-county level, the sub-county NAADS coordinator and the Chairperson Farmer Forum were purposely selected. At farm level, banana farmers in the four sub-counties with at least ½ acre of banana plantation (200 banana stools) were randomly selected.

3.5 Sample size and selection

The sample size and selection procedures were based on Krejcie and Morgan (1970) tables (Appendix III). The sample selection included key informants from the four banana growing sub-counties that generated qualitative data and banana farmers in the four sub-counties who generated quantitative data (Table 1) and (Appendix vii).

Table 1: Study population selection procedure

Category	Accessible population	Sample size	Selection procedure
Sub-county staff (NAADS/Agricultural Extension staff and chairpersons farmer forum)	8	8	Purposive sampling
Banana farmer households	720	254	Simple random sampling
Total	**728**	**261**	

Source: Kreijce and Morgan (1970) with modification of the survey data

3.6. Sampling techniques and procedure

To obtain respondents for this study, purposive sampling procedure was used. From a list of banana growing sub-counties in Mukono District, with the help of the District Agricultural Officers, four banana growing sub-counties were identified, two from the northern two from the southern part of the District. Nakisunga and Ntenjeru represented the southern part while Nagojje and Kyampisi represented the northern part of the District (Appendix vi). From each of the selected sub-county with the help of the sub-county NAADS Extension Officer, three banana growing parishes were identified (Appendix vii). From each of the selected parishes, three villages were randomly selected. Finally from a list of 20 banana farmers with at least 200 banana stools from

age, a list was drawn with the help of the NAADS L.

to randomly select seven banana farmers that were interviewed by

stant who filled the questionnaire on behalf of farmers. Overall a total of 4 sub-unties, 12 parishes, 36 villages were selected in the district. In terms of sample size, 63 banana farmers were selected in each sub-county giving an overall sample size of 252 respondents for quantitative data. For qualitative data, a total of 4 NAADS Agricultural staff and 4 chairpersons of farmer forum were interviewed from the four sub-counties. Given the homogeneity of banana farming communities in Mukono, information collected from this sample was a representative of banana farmers in the district.

3.7 Data collection methods

In the study, data was obtained using a questionnaire survey, interviewing and documentary analysis. The selection of the methods was guided by the nature of data to be collected, the time available as well as the objectives of the study. The overall aim of the study was to examine the factors affecting farmers' adoption of agricultural technologies in Uganda with specific reference to banana production in Mukono district.

3.7.1 Questionnaire survey

The researcher used this method to obtain quantitative data. This involved the use of self administered questionnaires to collect a lot of information from a big sample size of banana farmers over a short period of time. In seeking for quantitative data, close ended questionnaires in a scale form of 2 = No and 1 = Yes were used.

3.7.2 Interviewing

To obtain qualitative data, interviews and documentary reviews were applied. Interviews were used that enabled the researcher to obtain in-depth data from key informants which was not possible to get from banana farmers using structural questionnaires. Complete and honest information was obtained by using probing questions.

3.7.3 Documentary reviews

Documentary review method was used to source for secondary data in all relevant documents. It was intended to get a profile of the study area that included geographical information. Secondary data was also obtained from documentary review in relation to factors affecting adoption of agricultural technology in general. These were sources from journals, text books and other relevant reliable sources.

3.8 Data collection instruments

3.8.1 Questionnaires

The researcher used a self administered questionnaire which consisted of both close nded and open-ended questions designed to obtain data on the respondents' background, actors affecting adoption of recommended agricultural technologies and their effect on quisition and utilization of the technologies. A questionnaire was preferred because of e big number of respondents that would be accessed to get information, hence reduce random error, it was also cheaper. Research Assistants were employed who erviewed farmers and filled the questionnaires on their behalf.

3.8.2 Interview guide

The researcher also used an interview guide (Appendix II) which facilitated face to face communication between the interviewer and the interviewee (Sub-county NAADS coordinators and Chairpersons Farmer Forum). This enabled the researcher to clarify unclear questions to the two agricultural sub-county staff. It also allowed the respondents to express themselves in a more detailed way and this helped to compliment results from the questionnaire. The selection of the respondents for the in-depth interviews at the sub-counties was based on the fact that they had the knowledge of how banana farmers in their areas were carrying out their banana farming activities. They were therefore in position to give more information as regards factors affecting banana farmers to adopt recommended agricultural technologies. The in-depth interviews entailed asking questions, listening to and recording the answers and then posing additional questions to clarify or expand on a particular issue.

3.8.3 Documentary review checklist

The study also carried out reviews of existing documents at the district and the four sub-counties that were involved in the study. Information obtained from the review included geographical infrastructure and agricultural information. Reviews of existing documents by other scholars in relation to factors affecting adoption of agricultural technologies in general were also carried out. This gave an overview of how much has been addressed in this line.

uality control (Validity and reliability)

collection tools were pre-tested on a smaller number of respondents who were
e study population but outside the sample that participated in the study. This was
o ensure that the questions were accurate and clear in line with the objectives of
dy thus ensuring validity and reliability.

Validity

dity is the degree to which results obtained from the analysis of the data collected
ally represent the phenomenon under study (Mugenda & Mugenda, 2003). It is the
ent to which research instruments measure what they are intended to measure (Oso &
en, 2008). In order to ensure the validity of the instrument, the drafted questionnaires
ere scrutinized by two experts to evaluate the relevance of each item on the scale: very
elevant (4), quite relevant (3), somewhat relevant (2) and not relevant (1). The content
validity index was calculated by dividing the number of items rated 3 or 4 by both judges
by the total number of items in the questionnaire. The two scores from both experts were
38 and 43 out of 50 items in each questionnaire. The two scores gave an average of 40.5
out of the 50 items in the questionnaires.

alidity index was calculated as indicated below.

$$\frac{38}{50} + \frac{43}{50} = \frac{40.5}{50} = 0.81$$

itent validity index = 0.81.

ding to Amin (2005), for a research instrument to be valid, the content validity should not be less than 0.7. Therefore, the content validity index of 0.81 qualified esearch instrument to be valid. From the assessment by the two experts, necessary stments and changes were made to the final questionnaire accordingly (Appendix I).

9.2 Reliability

eliability is the degree to which a research instrument yields consistent results whatever t is measuring (Mugenda & Mugenda, 2003). It is the degree to which an instrument measures the same way each time it is used under the same condition with the same objects (Barifaijo, Basheka & Oonyu, 2010). The reliability of the questionnaire in relation to consistency of respondents' answers was tested. Twenty sets of questionnaires were produced and administered once to twenty banana farmers. The farmers were within the study population but outside the sample that participated in the study. The twenty sets of the questionnaires were then collected from farmers and were randomly divided into two groups of ten.

es on every item in the questionnaire were obtained per set within the group
ix V). The final total score for the ten sets of the questionnaire per group was
ed. The Pearson correlation coefficient was run for the two group totals to
ine the reliability of the instrument. The test results were presented in table 2. The
n correlation coefficient was found to be 0.871*. According to Amin (2005), for an
ment to be relevant, the Pearson correlation coefficient should be 0.7 and above.
efore, from the Pearson correlation coefficient results of 0.871, we concluded that
instrument used was reliable.

ble 2: Reliability determination

orrelations

		VAR00001	VAR00002
VAR00001	Pearson Correlation	1	.871
	Sig. (2-tailed)	.	.001
	N	10	10
VAR00002	Pearson Correlation	.871	1
	Sig. (2-tailed)	.001	.
	N	10	10

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

dure of Data Collection

g to the field to collect data, the researcher obtained a letter from Uganda nt Institute (Appendix IV) introducing him to the district and sub-counties ral staff and local council leaders in the survey area. After briefing the four S Extension Officers about the research to be carried out in their areas, Research ant at the rank of Assistant Agricultural Officers were identified by the sub-county ADS Extension Officers to carry out the survey interviews using the questionnaire veloped. The identification of the Research Assistants was based on their experience ith surveys, familiarity with the study area and their capability. One Research Assistant was identified for every sub-county being assisted and supervised by the area sub-county NAADS Extension Officer. The researcher was the overall supervisor of data collection in the four sub-counties. At the beginning of the survey, the researcher moved in turns with each sub-county NAADS Extension Officer and the Research Assistant to collect data and also to familiarize himself with the study area. Subsequent supervision within the sub-counties was made by the NAADS Extension Officer. Prior to actual data collection, a one day training for NAADs Extension Officers and the Research Assistants was conducted by the researcher. The training covered the following;-

i) Briefing and discussions regarding the research, its objectives and expectations of the research.

ii) Explanations of all questions in the questionnaire.

iii) Sensitization in procedures for an interview before the questionnaire is filled.

Before the actual survey, a pre-survey visit was arranged for the researcher and survey team to meet with local council leaders of the survey area. The purpose was to inform the local leaders about the research and survey in order to enlist support and assistance. It was also to formally introduce the survey team to the various respective areas where the survey was going to be conducted. Data collection lasted for one month in all the four sub-counties, there after data was cleaned, coded, analysed, interpreted and this report was produced.

3.11 Problem encountered in data collection

The researcher encountered some challenges during the study that included the following;-

i) The study was conducted among specific category of farmers across the district, thus making it cumbersome and expensive to reach the target respondents.

ii) It was not easy to get the NAADS staff and chairpersons of farmer forum in time for the in-depth interview. This was because most of the time they were very busy with farmer programmes. This made the exercise very costly in terms of time and the frequent visits made by the researcher to the four distant sub-counties that were involved in the study.

Despite the above challenges that I encountered during data collection, I am grateful to Dr. Africano Kangire, the Head of the research centre who consistently provided me with transport and fuel that enabled me to complete data collection in time.

3.12 Data management and analysis

Data for the structural questionnaires was captured in the Statistical Package for Social Sciences (SPSS) for analysis. Before analysis, data was processed through manual editing and coding. Editing involved removing all incomplete and inconsistent filled questionnaires. Coding involved assigning numbers to each variable that were later entered into the computer for analysis.

Descriptive statistical analysis generated a general summary and features of the data. The features obtained included, frequencies, percentages, mean and standard deviation. Inferential statistical procedures were carried out that included T-test analysis for testing the difference in mean between variables and to test the hypotheses. Regression analysis was also carried out to investigate the effect of the independent variables on the dependent variable. In correlation and regression analysis, the level of significance was considered as $p = 0.05$.

Data analysis for qualitative data for the three objectives of the study was done using content analysis. Each piece of work answered in the interview guide was read to identify themes or categories where it belongs. The number of times each answer appeared was counted to obtain the number of responses in each respect. Qualitative data analysis utilized words to make narrative statements on how categories or themes are related. Once the themes or categories were established, data was evaluated and analyzed to determine the adequacy, credibility, usefulness and consistency of the information.

3.13 Measurement of variables

The categorical variables were measured using the Nominal and ordinal Scale, with numbers being assigned to each category only to identify similar objects within a category from elements in another category that are different. The nominal scale used in the measurement of variables ranged from 1 to 2. To assess the effect of economic factors on adoption of agricultural technologies, find out how farmers' characteristics affect farmers adoption of agricultural technologies, establish the extent to which institutional factors affect farmers adoption of agricultural technologies, the researcher used a 2-point measurement scale with 1 = Yes and 2 = No.

CHAPTER FOUR

ANALYSIS AND INTERPRETATION OF RESULTS

the findings of the study which examined factors affecting farmers' ural technologies with reference to banana production in Mukono in the light of the fact that since 1989, a number of banana production ve been developed by the Uganda National Banana Research Programme Kawanda that would have led to improved banana productivity. Despite the of the technologies, banana production has continued to decline due to low ate of the technologies. It is for this reason that this study was undertaken to the various factors at play in determining the adoption of the technologies oped by UNBRP and come up with appropriate recommendations that will ence utilization of the technologies and hence improve banana productivity.

This chapter presents the findings according to the objectives of the study which were;-

i) Assess how economic factors affect farmers' adoption of recommended agricultural technologies

ii) Determine farmers' characteristics that affect adoption of recommended agricultural technologies

iii) Establish the extent to which institutional factors affect farmers' adoption of recommended agricultural technologies.

Study first presents the response rates which show the actual number of respondents participated in the study. The demographic and farming characteristics of the respondents are presented. Quantitative results on adoption, economic, farmers' characteristics and institutional factors are presented in frequency, percentage, mean and standard deviation. Interview results are also presented to supplement the quantitative data. Inferential statistics to test hypothesis and to shows the magnitude of effect the independent variables have on dependent variable are also presented.

1Response rate

Response rates show participants that were involved in the study. Respondents included Ghana farmers who were interviewed by Research Assistants and filled the questionnaires on their behalf, sub-county NAADS/Extension Agricultural staff and chairpersons of farmer forum that were interviewed by the researcher. The response rate is as presented in Table 4.1.

Table 4.1: Summary of study response rate

Category	Population sample	Sample size	Response rates	% of response rate
Questionnaire				
Banana farmer	720	252	251	99.6%
Interviews				
Sub-county NAADS/Agric. Officer and Chairperson of farmer forum	8	8	8	100%
Total	**728**	**260**	**259**	**99.6%**

Source: Survey Data, 2010

In the study, the total population of all respondents who included banana farmers with at least ½ acre of banana (200 banana stools) and sub-county agricultural staff as well as chairpersons of farmer forum was established. This helped to determine the sample size of each category of respondents. In the study, as reflected in Table 4.1, a total number of 252 banana farmers were expected to participate in the study and 8 key informants but 259 respondents were interviewed representing a response rate of 99.6%. One respondent was not interviewed by the Research Assistants due to unknown reasons. In the four sub-counties, a total of eight respondents that included four NAADS/Agricultural Extension

ers and four Chairpersons of farmer forum were interviewed giving a response rate 00%. The overall response rate was 99.8% for both banana farmers and sub-county cultural staff and chairpersons of farmer forum. According to Amin (2005), response should never go below 50% for results to be relied upon. The lower the response rate more one should worry that those who have responded may not be typical of the vey population and so bias the results. Therefore, the results obtained from this study considered to be reliable based on the response rate of 99.8%.

2 Demographic characteristics of respondents

he study, the demographic information of respondents was established which included nder, age, marital status and education and were measured in terms of "majority".

2.1 Gender of the respondents

his was the sex of respondents and the researcher was interested to establish the ajority sex of people that participated in the study. The respondents were therefore sked to indicate their gender in the questionnaire and results were summarized in table .2.1.

Table 4.2.1: Respondents by gender distribution

Demographic characteristics	Frequency	Percentage
1. Gender		
(i) Male	132	52.6
(ii) Female	119	47.4

Source: Survey Data, 2010

Results in Table 4.2.1 show that 52.6% of the banana farmers in Mukono were males while 47.4% were females, indicating that males were the majority in the study. This implied that banana is a male crop as it is both a food and cash crop. Since males are the head of the family, they have to ensure food availability as well as cash income to cater for other family requirements, for example medical care and education

4.2.2 Age of the respondents

This was the age bracket of respondents and the study aimed at finding out if the respondents were suitable to be involved in the study or not, since only adults were expected to participate in the study. This is because adults are expected to have more reasonable thinking hence reliability of the answers. Respondents were asked to indicate their age in the questionnaires administered to them and the findings were summarized in the table below.

Table 4.2.2: Respondents by age distribution

Demographic characteristics	Frequency	Percentage
2. Farmer Age (yrs)		
(i) 20-30	17	6.8
(ii) 31-40	84	33.5
(iii) 41-50	90	35.9
(iv) 51 yrs +	60	23.9

Source: Survey Data, 2010

In the Table 4.2.2 above, the majority of the respondents 35.9% were in the age bracket of 41-50yrs and 33.5% between 31-40yrs compared to 23.9% of the respondents who exceed 51 years of age and only 6.8% were between 20-30 years of age. This implied that banana farming is an occupation of middle aged people between the age of 31-50 years.

4.2.3 Marital status of the respondents

This was the marital status of the respondents and the researcher was interested to establish which types of people were involved in banana production. Table 4.2.3 shows a summary of the findings.

Table 4.2.3: Respondents by marital status

Demographic characteristics	Frequency	Percentage
3. Marital status		
(i) Single	22	8.8
(ii) Married	201	80.1
(iii) Divorced	6	2.4
(iv) Widowed	18	7.2
(v) Separated	4	1.6

Source: Survey Data, 2010

Results in the table above showed that 80.1% were married compared to 8.8% who were single, 7.2% were widowed, 2.4% were divorced and only 1.6% were separated. This implied that this was a crop of married households, because it provided food security to family households and also a source of cash income for purchase of other household necessities, children education and medical care.

4.2.4 Education level of the respondents

The researcher was interested to establish the education level of the respondents because level of education helps to get views that are relevant and useful to the study, since educated people are expected to have constructive arguments in any subject under study. Results were as indicated in table 4.2.4.

Table 4.2.4: Level of education of the respondents

Demographic characteristics	Frequency	Percentage
4. Highest level of education		
(i) No formal education	30	12
(ii) Primary	114	45.4
(iii) Secondary	86	34.3
(iv) Tertiary institutions	21	8.4

Source: Survey Data, 2010

Results in Table 4.2.4 revealed that the majority of farmers, 45.4% attained primary level education, 34.3% secondary education compared to 12% with no formal education and only 8.4% with tertiary education. This implied that the majority of the respondents 88.1% attained formal education and were therefore in position to give relevant and useful information about the study.

4.3 General farming characteristics

The study considered farm size, farming experience, crops grown, banana acreage and types of livestock reared as the general farming characteristics.

4.3.1 Farm size of the respondents

The farm size of the respondents was included in the study because it is an indicator of farmers' ability to diversify agricultural production as revealed in table 4.3.1.

Table 4.3.1: Farm size of the respondents

Farming characteristics	Frequency (f)	Percentage distribution
Total farming size		
(i) < 1 acre	5	2
(ii) 1 acre	26	10.4
(iii) 2 acres	48	19.1
(iv) > 2 acres	172	68.5

Source: Survey Data, 2010

Results in Table 4.3.1 clearly indicate that 68.5% of the respondents had more than 2 acres of land as their total farm size, 19.1% had 2 acres, 10.4% one acre and 2% less than an acre. This implied that banana farmers in Mukono were wealthy since the majority had more than 2 acres of land. They were therefore able to grow a variety of crops and raise livestock, thereby diversifying their farming enterprises.

4.3.2 Number of years as farmer

Farmers' farming experience was included in the study because the researcher was interested to know whether farmers were in position to make appropriate decisions that were necessary to make profit in banana farming. Findings were summarized in Table 4.3.2.

Table 4.3.2: Farming experience of the respondents

Farming characteristics	Frequency (f)	Percentage distribution
No. of years as farmer		
(i) 1-5 yrs	18	7.2
(ii) 6-10 yrs	53	21.1
(iii) 11-15 yrs	37	14.7
(v) > 15 yrs	143	57

Source: Survey Data, 2010

Results in Table 4.3.2 revealed that the majority of the farmers had a wide experience in banana production of more than 15 years (57%), 21.1% of the respondents had experience ranging from 6 to 10 years while 14.7% had farm experience of 11 to 15 years and remaining 7.2% had farm experience of 1 to 5 years. This implied that the majority of the farmers had been growing banana for a long time and therefore banana was still a traditional crop in the district. The findings also revealed that most of the farmers were fulltime and had time to concentrate on their farming business. This further showed that farmers had high experience in farming which was necessary for adoption of agricultural technologies.

4.3.3 Types of crops grown

Types of crops grown were included in the study to enable the researcher to establish whether both food and cash crops grown by the respondents. Results of the finding were as indicated in Table 4.3.3.

Table 4.3.3: Types of crops grown

Farming characteristics	Frequency (f)	Percentage distribution
Types of crops grown		
(i) Food crops	58	23.1
(ii) Cash crops	1	0.4
(vi) Food and cash crops	192	76.5

Source: Survey Data, 2010

Results from Table 4.3.3 revealed that 76.5% of the respondents grow both food and cash crops, 23.1% grow food crops and only 0.4% grows cash crops. This implied that both food and cash crops were equally important to the farmers. The food crops grown by farmers include sweet potatoes, cassava, ground nuts, beans, maize, banana and vegetables while coffee is grown as the main cash crop.

4.3.4 Banana acreage for the respondents

Banana acreage was included in the study because the researcher wanted to find out the proportion of the banana crop in relation to total farm size. Banana acreage was summarized in Table 4.3.4.

Table 4.3.4: Banana acreage

Farming characteristics	Frequency (f)	Percentage distribution
1. Banana acreage		
(i) 0.5 acres	139	55.4
(ii) 1 acre	76	30.3
(iii) 1.5 acres	15	6.0
(iv) 2 acres	16	6.4
(v) > 2 acres	5	2.0

Source: Survey Data, 2010

Results in Table 4.3.4 above show that 55.4% of the farmers had 0.5 acres planted with banana, 30.3% one acre, 6.4% 2 acres, 6% 1.5 acres and 2% more than 2 acres. This implied that the majority of the farmers (55.4%) had at least 200 banana stools on their farms which are enough as a source of food and income to purchase other household requirements.

4.3.5 Livestock ownership

Livestock ownership of the respondents was included in the study because it was meant to find out whether farmers were practicing mixed farming or not. Mixed farming is useful to farmers because manure from livestock is a cheap source of organic fertilizers for maintaining soil fertility in crops while by-products from crops can also be fed to livestock.

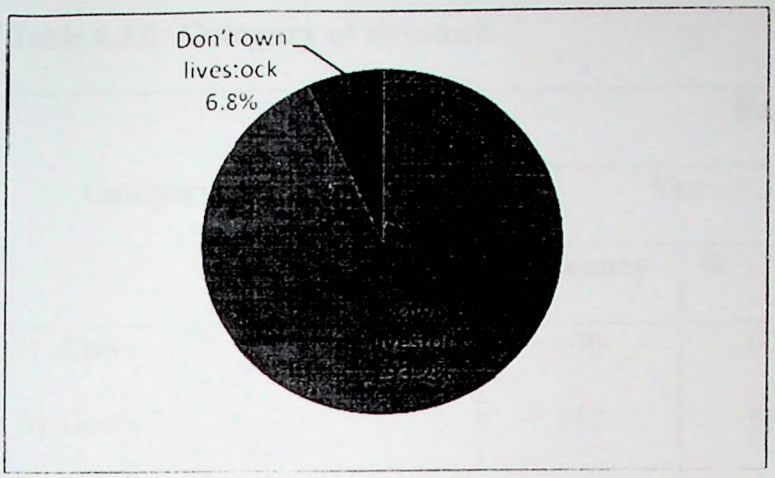


Figure 3: Livestock ownership

Source: Survey Data, 2010

Results in Figure 3 clearly revealed that 93.2% of the farmers owned livestock and only 6.8% did not own livestock. This implied that the majority of the farmers practice mixed farming whereby farmers gain from both crops and livestock farming. The after harvest from sweet potatoes, banana, maize, beans and cassava, were fed to cows, pigs and goats, while the manure from livestock was used to maintain soil fertility in crops.

4.3.6 Types of livestock

Types of livestock raised by the respondents were included in the study to enable the researcher to establish the availability of manure from the different livestock types. Different types of livestock produce different quantities of manure. The findings were summarized in Table 4.3.6.

Table 4.3.6: Category of livestock

Category of livestock	Response category			
	Yes		No	
	Frequency	%	Frequency	%
i) Cows	170	67.7	81	52.3
ii) Goats	147	58.6	104	41.4
iii) Sheep	43	17.1	208	82.9
iv) Pigs	129	51.4	122	48.6
v) Chicken	212	84.5	39	15.5

Source: Survey Data, 2010

Table 4.3.6 gives a summary of the different category of livestock that were reared by the banana farmers in Mukono. Findings revealed that of the 93.2% who own livestock, 84.5% had chicken, 67.7% had cows, 58.5% had goats, 51.4% rear pigs and only 17.1% rear sheep. This implied that the manure which farmers applied on banana and other crops to maintain soil fertility was mostly obtained from poultry and cows.

1.4 Find out the economic factors that affect farmers' adoption of recommended agricultural technologies.

This objective was set to find out economic factors that affect adoption of agricultural technologies based on cost of technology, access to credit, labour availability and expected benefit of the technology.

4.4.1 Which technologies are affordable or expensive?

In this study, the researcher sought to establish whether farmers were able to acquire and use the recommended technologies. This was important because it is useless to recommend a technology which farmers cannot afford to use. In the questionnaire, farmers were given the different technologies recommended for banana production and were asked to indicate the technologies which were affordable and those that were expensive. The findings were as indicated in Table 4.4.1.1

Table 4.4.1.1: Farmers' opinion on which banana technologies are affordable or expensive

Technology	Affordable		Expensive			
	Freq	%	Freq	%	Mean	Standard deviation
i) Tissue culture banana planting materials	115	45.8	136	54.2	1.54	0.5
ii) Fertilizer/manure	66	26.3	185	73.7	1.74	0.44
iii) Hand weeding	231	92	20	8.0	1.08	0.27
iv) Use of herbicides	59	23.5	192	76.5	1.76	0.42
v) Mulching	145	57.8	106	42.2	1.42	0.49
vi) Removal of excess suckers	240	95.6	10	4	1.05	0.27
vii) Control of pests and diseases	106	42.2	145	57.8	1.58	0.49
viii) Soil and water management	135	53.8	115	45.8	1.46	0.5
ix) Post harvest	182	72.5	68	27.1	1.27	0.45

Source: Survey Data, 2010

Results in Table 4.4.1.1 show that the following technologies were reported to be expensive which included use of herbicides 76.5%, fertilizer/manure application 73.7%, chemical control of pests and diseases 57.8% and use of tissue culture banana planting

materials 54.2%. The technologies which were affordable included removal of excess suckers 95.6%, hand weeding 92%, postharvest handling 72.5%, mulching 57.8% and soil and water management 53.8%. This implied that all technologies that had to be purchased especially those from farm supply shops (fertilizers, pesticides & herbicides) were expensive, therefore farmers had difficult of acquiring and using them and yet they are the most important technologies in banana production.

However, the cultural technologies that include mulching, removal of excess suckers, post harvest handling and hand weeding are equally important as they compliment the expensive technologies. The mean responses of 1.76 (herbicides), 1.74 (fertilizer/manure), 1.58 (chemical control of pests and diseases), 1.54 (tissue culture banana planting materials) are also a confirmation that these technologies were expensive since their mean are more than 1.5. The standard deviation of 0.5 (tissue culture banana planting materials, soil and water management), 0.49 (chemical control of pests and diseases, mulching), 0.44 (fertilizers/manure), 0.42 (use of herbicides) indicates that farmers had divergent views as regards to affordability of the identified technologies.

Interview results from the eight respondents at the sub-counties ranked fertilizer/manure as the most expensive followed by pesticides such as herbicides and insecticides, while tissue culture banana planting materials were also reported as expensive. They pointed out that farmers were not able to break-even when they use these technologies. This was probably due to the low farm gate price of the bananas. However, the recent increase in

food prices could encourage farmers to purchase the inputs to increase production and hence benefit in the price increase of food crops.

4.4.2 Source of funding for the banana activities

The study sought to find out how farmers were funding the banana activities. This was important because access to credit empowers farmers to purchase the necessary recommended technologies in time, for example pesticides, fertilizers and improved varieties. In the questionnaire, farmers were asked to indicate the source of funds, whether they used securities to obtain, credit facilities, period for processing the funds and the repayment period. Table 4.4.2.1 summarized the findings.

Table 4.4.2.1 Source of funding for banana activities

Parameter	Response category			
	Frequency	Percentage	Mean	Standard deviation
1. Source of funds				
- Own money	204	81.3	1.19	0.39
- Bank loan	47	18.7		
2. Use of security to obtain funds				
- Yes	23	9.2	1.91	0.29
- No	228	90.8		
3. Period for processing funds				
- A month	247	98.2	1.02	0.13
- > than a month	4	1.6		
4. Repayment period				
- 6 months-1yr	238	94.8	1.05	0.22
- > a year	13	5.2		

Source: Survey Data, 2010

Results in Table 4.4.2.1 above revealed that 81.3% of the respondents used their own money and only 18.7% got credit facilities from banks or leading institutions. This implied that farmers who did not have enough savings or credit access to banks were not able to purchase essential production inputs for example fertilizer/manure, pesticides,

herbicides and the improved banana varieties. The mean response rate of 1.19 is an indication that the majority of the farmers were in agreement that they used their own money to finance the banana production activities.

Farmers who obtained funds from the bank, the researcher wanted to know whether they had to give the banks security before they could access bank funds. Results in table 4.4.2.1 clearly show that only 9.2% of the respondents gave bank or lending institutions securities to acquire loans. This implied that the majority of the farmers who obtained funds from lending institutions used micro-finance institutions to access loans and the few who used securities got loans from known commercial banks. The micro-finance lending institutions are known to give loans to farmers when they are in groups (for example 10 farmers) without securities. The members in a group are the security for any member who applies for a loan.

On the loan processing period, the researcher wanted to find out how long it took a farmer to get a loan from a lending institution. This was important because most of the banana activities have a time limit. If the farmer cannot get funds in time, the activity has to be deferred to the next season. For example fertilizer application and pest control, have to be done during the rain season. Results from the table above clearly show that 98.4% of the farmer processed loans within a period of one month and only 1.6% processed loans for more than a month. This implied that farmers were able to get funds in time to finance their banana activities.

As regards the loan repayment period, the banana crop being a perennial crop, the researcher wanted to find out whether farmers were given enough time to be able to pay back the loan. Results in Table 4.4.2.1 show that 94.8% of the farmers paid the loan within a period of 6 months to one year and only 5.2% paid back the loan in a period of more than one year. This implied that most farmers had difficult in paying back the loan. They were not able to pay back loans from sales of banana because the maturity period of banana is more than one year. Farmers therefore had to use other sources of funds to pay back the loans. Farmers who paid loans after one year are more likely to have got loans from commercial banks and not micro-finance institutions. Loans from micro-finance institutions are known to be for a short period usually not exceeding one year.

Respondents from the sub-county who were interviewed also confirmed that the majority of the farmers were using their own money to finance the banana production activities. Some of the chairpersons of farmer forum added that, "it is only recently that the NAADS programme had just started giving credit to banana farmers in form of material supplies". The materials include banana planting materials, pesticides, herbicides and fertilizers.

4.4.3 Reasons for not borrowing funds from banks/lending institutions

In this study, the researcher wanted to know the main reasons as to why farmers did not acquire loans from lending institutions to finance the banana production activities, despite the fact that there are many lending institutions which give credit facilities to business

enterprises including farming. In the questionnaire, farmers were given different reasons and they were asked to choose the appropriate reasons. Results of the findings were summarized in Table 4.4.3.1

Table 4.4.3.1: Farmers' reasons for not borrowing funds from banks/lending institutions

Reasons	Response category			
	Frequency	Percentage	Mean	Standard deviation
1. No banks in villages	61	24.3	1.76	0.43
2. High interest rates	161	64.1	1.36	0.48
3. No security to give the bank	173	68.9	1.31	0.46
4. No knowledge of bank funds	39	15.5	1.84	0.36
5. Fear bank to take farmer property	166	66.1	1.34	0.47

Source: Survey Data, 2010

From the findings in Table 4.4.3.1 above, 68.9% of the respondents revealed that they had no security to give the banks, 66.1% could not risk mortgaging their property, 64.1% feared the high interest rates of the banks, 24.3% of the respondents revealed that there were no banks in villages while 15.5% had no knowledge of bank funds being available to banana farmers. This implied that the majority of the farmers were practicing banana

farming enterprises on land that had no titles, therefore did not have full ownership of their land. As for farmers who feared to mortgage their property, it could be that they were not commercial banana farmers. They did not take banana farming as a business. They were not sure whether banana farming was profitable. They thought that it was difficult to recover the borrowed funds from sales of bananas. The low farm gate prices could have also discouraged farmers to take bank loans with high interest rates.

The standard deviation of 0.48 (High interest rates), 0.47 (Fear bank to take property) and 0.46 (No security to give the bank) was an indication that there were divergent views as regards the three reasons.

During the interview, the agricultural extension staff and Chairpersons of farmer forum in the sub-counties confirmed the non-existence of banks in villages. One Chairperson of the farmer forum said "if you want to deal with banks, go to Mukono town, you will find several of them there". They also reported the high interest rates and lack of securities to give the banks. The Agricultural extension officers added "farmers fear to take loans due to natural calamities, for example extended drought, pests and diseases". They gave examples of the Banana Bacterial Wilt and the coffee wilt disease in coffee, In addition. they said banana farmers are exploited by middlemen due to lack of market information. The farm gate price is usually low. The Agricultural extension staff also said "unlike some crops like coffee, tea, vanilla and cocoa which are supported by government through organizations like Uganda Coffee Development Authority, Uganda Tea Growers Authority, Vanilla Association, the banana crop has no government support". Therefore

banana farmers have nowhere to seek for financial assistance without strings attached. They concluded by claiming that banks are for the rich people not small farmers.

4.4.4 Benefits from the recommended banana technologies

In the study, banana farmers in Mukono district were asked whether they had realized benefits from the recommended technologies they had adopted. This was based on the argument from different writers that for farmers to adopt a technology there must be a significant difference in outcome between the new practice and the conventional practices. In the questionnaire, farmers were asked to indicate YES for benefits and NO for no benefits. In addition, they had to indicate the type of benefits which included income and food. Table 4.4.4.1 gives a summary of the findings.

Table 4.4.4.1: Benefits from recommended banana technologies

Benefits from technologies	Response category			
	Frequency	Percentage	Mean	Standard deviation
1. Whether these are benefits or not				
- Yes	207	82.5	1.18	0.38
- No	44	17.5		
2. Types of benefits				
- Income	58	23.1	1.77	0.42
- Food	193	76.9		

Source: Survey Data, 2010

Results in Table 4.4.4.1. above clearly show that 82.5% of the farmers indicated that they benefited from the technologies they adopted, while 17.5% did not benefit. This implied that the majority of the farmers who adopted the recommended technologies realized that there was a big difference in banana production compared to traditional banana production practices. The mean response of 1.18 and standard deviation of 0.38 is an indication that the majority of the respondents were in agreement that recommended banana technologies are beneficial.

Farmers were also asked to mention the type of benefits obtained from the technologies. This was based on the fact that technologies for different crops have different benefits, for example, adoption of integrated pest management practices have benefits of reduced cost on pesticides, less exposure of human contact to agricultural chemicals and reduced contamination of the environment with pesticides. Results in the table above revealed that 76.9% of the respondents got more food while 23.1% obtained extra income from the technologies. This implied that the majority of the banana farmers in the study area were growing bananas for food supplies and very few for income generation. This is also an indication that the majority of the farmers were subsistence farmers and very few commercial farmers.

During the interview, Agricultural extension staff and Chairperson of farmer forum said "farmers who adopted the technologies benefited through increased yields and income which were obtained from sales of bananas and planting materials that had good

characteristics for example, high yielding, resistant to pests and good food taste". They gave an example of good varieties like Mpologoma and Nakitembe.

4.4.5 Household labour availability for banana activities and other enterprises on the farm

The researcher in this study sought to find out the household labour availability for banana activities and for other enterprises on the farm. This was in light of the fact that for some technologies, labour must be available for adoption to take place. For example vanilla production requires a lot of labour especially at flowering stage. In this study, farmers were asked to indicate the household labour availability for banana activities as well as for other enterprises on the farm. Results of the findings were summarized in Table 4.4.5.1

Table 4.4.5.1 Household labour availability for banana activities and other enterprises

Category	Response category			
	Frequency	Percentage	Mean	Standard deviation
1. Household labour availability for banana activities				
- 1-3 members	119	47.4	1.53	0.5
- > 3 members	132	52.6		
2. Household labour availability for other enterprises				
- 1-3 members	141	56.2	1.45	0.52
- > 3 members	109	43.4		

Source: Survey Data, 2010

Results in Table 4.4.5.1 show that 52.6% of the respondents reported that banana production requires more than three household members while 47.4% of the respondents reported that between one to three (1-3) household members are enough for successful banana production. This implied that for farmers, who were practicing banana farming as a business, they require more than three household members to work on the banana farming enterprise to be able to adopt the recommended technologies while for farmers who were practicing subsistence farming, between one to three household members were enough.

Farmers were also asked to indicate the number of household members that work on other enterprises other than banana production. This was intended to find out what proportion of family labour is engaged in other enterprises on the farm. Results in Table 4.4.5.1 above show that between 1-3 household members (56.2%) work on other enterprises and 43.4% of the respondents reported that more than three household members work on other enterprises. This implied that most of the family labour is utilized on banana production, since a small number of family labour is employed on other enterprises (56.2%). However a standard deviation of .052 was an indication that there were divergent views as regards household labour utilization for other enterprises.

4.4.6 Hired labour required for banana activities

In this study, the researcher wanted to establish whether banana farming requires hired labour or not. This was based on the argument that depending on the type of technology

to be adopted, labour availability may affect adoption. Farmers were therefore asked to indicate whether they were using hired labour or not in the banana production enterprise. Results of the findings were as shown in Table 4.4.6.1 below.

Table 4.4.6.1 Hired labour required for banana activities

Hired labour required	Response category			
	Frequency	**Percentage**	**Mean**	**Standard deviation**
i) YES	133	53	1.47	0.5
ii) NO	118	47		

Source: Survey Data, 2010

Results in Table 4.4.6.1 clearly show that 53% of the respondents reported that hired labour was required in banana production while 47% reported that hired labour was not required. This implied that if banana farming was taken as a business hired labour was required especially at the initial stage of banana establishment, which include digging holes of 60cm x 60cm and constructing soil erosion control bands. These are technologies which household members may not manage to do. On the other hand, the 47% of the respondents who do not hire labour is not a small number and these are likely to be subsistence farmers who grow the banana crop for feeding the family only and therefore pay little attention to adoption of recommended agricultural technologies. The standard

deviation of 0.5 was an indication that there were divergent views between respondents who hire labour and those who did not hire labour.

4.4.7 Test of the hypothesis one

The first hypothesis in this study was, economic factors affect farmers' adoption of recommended agricultural technologies. To verify this hypothesis a null hypothesis was derived and tested. The null hypothesis (H_0) states, economic factors have no effect on adoption of recommended agricultural technologies. To test this hypothesis, the researcher used the survey questionnaires (Appendix I). Items on adoption were measured using a scale rating Yes = 1 and No = 2. Items on the economic factors were also measured using the same rating where Yes=1 and No=2.

4.4.8 Correlation analysis on the economic factors that affect farmers' adoption of agricultural technologies

To measure this objective using correlation analysis, it was basically to find out the relationship between the variables as indicated in the table below.

Table 4.4.8.1: Correlation analysis on the economic factors that affect farmers' adoption of agricultural technologies

Correlations

		DV2	EC2
DV2	Pearson Correlation	1	.147*
	Sig. (2-tailed)	.	.020
	N	251	251
EC2	Pearson Correlation	.147*	1
	Sig. (2-tailed)	.020	.
	N	251	251

*. Correlation is significant at the 0.05 level (2-tailed).

In the Table 4.4.8.1 DV2 is the Dependent variable which is the Adoption of Agricultural technologies in banana production and EC2 are the Economic factors that affect farmers' adoption of agricultural technologies in banana production (independent variable).

The results in the table shows that economic factors significantly affect adoption of agricultural technologies with adoption correlation = 0.147 at $p<0.05$. From the results in Table 4.4.8.1 , the researcher rejected the null hypothesis (H_0) and verified the (H_1) which states that there is a statistically significant relationship between economic factors and adoption of agricultural technologies since the p-value (0.02) is less than the significant level (0.05). The type of relationship is weakly positive in the linear sense based on Pearson correlation p = 0.147 which is also less than the absolute value of +1 (strongly positive). This finding were supported with the interview results from the NAADS/Agricultural extension staff and Chairpersons of farmer forum who stated that

high cost of agricultural inputs (e.g. fertilizer, pesticides, tissue culture planting materials) and lack of access to credit affect adoption of agricultural technologies.

4.5 Determine farmers' characteristics that affect adoption of the recommended agricultural technologies

This objective was set to measure adoption of agricultural technologies based on farmers' age, education, gender and perception. To achieve this objective, banana farmers were asked to indicate in the questionnaire, their age, education, gender and perception of the technology. The findings are in Table 4.5.1.

Table 4.5.1: Farmer characteristics

Characteristics	Frequency	Percentage
1. Age of farmer		
(i) 20-30	16	6.4
(ii) 31-40	84	33.5
(iii) 41-50	91	35.9
(v) 51+	60	23.9
2. Highest level of education		
(i) No formal education	30	12
(ii) Primary	114	45.4
(iii) Secondary	86	34.3
(iv) Tertiary institution	21	8.4
3. Gender		
(i) Male	132	52.6
(ii) Female	119	47.4
4. Usefulness of technology (perception)		
(i) Yes (useful)	216	86.1
(ii) No (not useful)	35	13.9

Source: Survey Data, 2010

4.5.2 Age of the banana farmer

Different researchers have reported different findings in relation to age as a factor affecting adoption. In this study the researcher wished to establish the age groups involved in banana production and determine how the different age groups affect adoption of the agricultural technologies in banana production. Respondents were asked

to indicate their age in the questionnaire administered to them and the findings are summarized in Table 4.5.1 above.

Results from Table 4.5.1 revealed that 35.9% of the respondents were in the age bracket of 41-50 years of age, 33.5% were between 31-40 years, 23.9% were above 51 years and only 6.4% were between 20-30 years. This implied that banana production is an occupation of middle age people between the age of 31-50 years. The findings further indicated that since banana is a food crop, it is mostly grown by middle aged people probably because they have to feed their families. On the other hand the older group 23.9% (51^{+} yrs), their family sizes could have reduced at that age, therefore have less demand for food crops but more in need of cash crops like coffee, which are a source of revenue for their survival. The findings further indicate that the majority of the respondents were old enough to understand what was being asked and the results obtained were therefore dependable.

4.5.3 Highest level of education

In this study, the researcher tried to find out the education levels of respondents that were involved in the study. This was meant to establish whether their education levels affect adoption of agricultural technologies as reported in many adoption studies that there is some association between technology adoption and level of education. Respondents were asked to indicate their education levels in the questionnaires and the results are summarized in the table 4.5.1 above.

Results in Table 4.5.1 revealed that the majority of the respondents who participates in the study. 45.4% attained primary level education, 34.3% had secondary level education while 8.4% had attended tertiary institutions and only 12% had no formal education. This implied that majority of the respondents had formal education and therefore qualified for the study. Although many adoption studies show some association between technology adoption and level of education, despite the low level of formal education, farmers may be able to adopt agricultural technologies through farmer training, radio programmes and farm visits by agricultural extension workers.

4.5.4 Gender of respondents

This was the sex of respondents and the researcher was interested to establish the effect of gender on the adoption of agricultural technologies. It was also important to know the majority of gender who were involved in the study. The respondents were therefore asked to indicate their gender in the questionnaire and the results are summarized in table 4.5.1

Results clearly show that 52.6% of the respondents involved in the study were male and 47.4% were female, indicating that male were the majority respondents in the study. This implied that banana is a male crop providing both food and revenue to family households. Though males are the majority (52.6%), the females are equally important (47.4%) as they play a big role in food production for the family households.

4.5.5 Usefulness of the agricultural technologies in banana production

In this study, the researcher sought to find out farmers' perception of the technologies that were recommended in banana production. This was based on the different researchers who reported that if farmers are to adopt a technology, they must see the technology that, it is appropriate for solving a particular problem. Respondents were therefore asked to indicate in the questionnaire whether the recommended technologies were useful or not. Results in table 4.5.1 show that the majority of the farmers (86.1%) indicated that the recommended technologies were useful and only 13.9% of the respondents reported that the technologies were not useful. This implied that the majority of the respondents had observed that there were differences in production between the conventional practices and the recommended improved practices. This could probably be due to increased yields and incomes from banana sales.

4.5.6 Testing of hypothesis two

The second hypothesis (H1) in this study was; Farmers' characteristics affect farmers' adoption of the recommended agricultural technologies. To verify this hypothesis, a null hypothesis (H_0) was derived and tested. The null hypothesis (H_0) states; farmers' characteristics (gender) have no effect on adoption of the recommended agricultural technologies. To test this hypothesis, the researcher used an independent t sample.

Table 4.5.6.1: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Adoption	Equal variances assumed	.855	.356	-3.173	249	.002	-.0448	.01412	-.07262	-.01700
	Equal variances not assumed			-3.174	246.480	.002	-.0448	.01412	-.07262	-.01700

From the study, it was revealed that there is a statistically significant difference between male and female in adoption rates of recommended agricultural technologies in banana production. This was evidenced by the obtained t-test results p = 0.002 (sig 2 tailed) table 4.5.6.1 which is smaller than 0.05 (the 95% confidence value) significance level. Therefore, the results are statistically significant. This confirms the finding in Table 4.2.1 that there were more male involved in banana production than female as they are the head of the households that requires them to ensure availability of food and income to purchase other household requirements. From the results above in Table 4.5.6.1 the researcher rejected the null hypothesis (H_0) and used the (H_1) hypothesis which stated that; farmer characteristics (gender) affect farmers' adoption of agricultural technologies in banana production.

Farmers' age is another characteristic that was verified under the null hypothesis that stated; farmers' characteristics have no effect on adoption of the recommended agricultural technologies in banana production. To test this hypothesis, the researcher used a one way Anova since the independent variables were more than two.

Table 4.5.6.2: Statistics on mean adoption rate by age groups

DV2

	N	Mean	Std. Deviation	Std. Error
20-30	16	1.4696	.12046	.03012
31-40	84	1.4385	.10883	.01187
41-50	91	1.4322	.12568	.01317
51+	60	1.4649	.09566	.01235
Total	251	1.4445	.11339	.00716

Table 4.5.6.3: ANOVA

DV2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.052	3	.017	1.347	.260
Within Groups	3.162	247	.013		
Total	3.214	250			

Table 4.5.6.2 shows the mean adoption rate by age groups. Results show that the mean adoption rate was higher in the age groups between 20-30 (1.4696) followed by the older age group 51 years+ with a mean of 1.4649, 1.4385 for the age group of 31-40 years and 1.4322 for the age group of 41-50 years.

Results in Table 4.5.6.2 clearly show that there is a difference in mean adoption rate between the age groups, but statistical analysis in Table 4.5.6.3 shows that there is no statistically significant difference between age groups of farmers and adoption of recommended agricultural technologies in banana production. This is evidenced by the

obtained ANOVA results of p = 0.260 (sig) which is bigger than 0.05 (the 95% confidence value) significance level. Therefore, from results in table 4.5.2.7, the researcher accepted the null hypothesis (H_0) and rejected the (H_1) hypothesis which states; farmers' characteristics (Age) affect adoption of recommended agricultural technologies in banana production.

Farmers' level of education is also another characteristic that was verified under the null hypothesis which states; Farmers' characteristics (level of education) have no effect on adoption of recommended agricultural technologies in banana production. The hypothesis was tested by the researcher using a one way Anova as the independent variables were more than two

Table 4.5.6.4: Statistics on mean adoption rate by level of education

DV2

	N	Mean	Std. Deviation	Std. Error
None	30	1.4454	.15890	.02901
Primary	116	1.4566	.09878	.00917
O-A level	84	1.4385	.11183	.01220
Tertiary institution	21	1.4008	.11439	.02496
Total	251	1.4445	.11339	.00716

Table 4.5.6.5: ANOVA

DV2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.060	3	.020	1.567	.198
Within Groups	3.154	247	.013		
Total	3.214	250			

Table 4.5.6.4 show the mean adoption rate by level of education. Results revealed that respondents with primary level of education had the highest mean adoption rate (1.4566), those with no education had a mean adoption rate of 1.4454, while those with O-A level of education, the mean adoption rate was 1.4385 and lastly the mean for the tertiary institution was 1.4008. Although results from Table 4.5.6.4 revealed that there is a slight difference in mean adoption rate between the different levels of education, results in Table 4.5.6.5 shows that there is no statistically significant difference between farmers' level of education and adoption of recommended agricultural technologies in banana production. This is evidenced by the obtained ANOVA results of p=0.198 (sig) which is higher than 0.05 (the 95% confidence value) significance level. Therefore from results in Table 4.5.6.5, the researcher accepted the null hypothesis (H_0) and rejected the (H_1) hypothesis which states; farmers' level of education affects adoption of recommended agricultural technologies in banana production.

During interview of the agricultural extension staff and Chairpersons of farmer forum, the Agricultural extension staff re-affirmed that age and education do not affect adoption of agricultural technologies in banana production. They claimed that banana is a cultural crop in Mukono district and adoption of a technology depends on what other successful farmers had done.

4.6 The extent to which institutional factors affect farmers' adoption of recommended agricultural technologies

This objective was set to measure adoption of agricultural technologies based on access to agricultural information, personnel that gave out the information, membership to farmer organization, facilitators of farmer organization meetings/seminars and form banana technologies were presented to farmers.

4.6.1 Access to agricultural information

Access to information on new technologies is crucial as it creates awareness and attitudes towards technology adoption. In this study the researcher tried to find out how farmers were accessing agricultural information. This was meant to establish whether access to agricultural information had an effect on adoption of recommended agricultural technologies. Respondents were given several options of information sources and were asked to select the appropriate sources they were accessing. A summary of the findings are revealed in Table 4.6.1.1

Table 4.6.1.1 Access to agricultural information

Source of agricultural information	YES		NO			
	Freq	%	Freq.	%	Mean	Standard Deviation
i) Radio	179	71.3	72	28.7	1.29	0.45
ii) Newspapers	46	18.3	205	81.7	1.82	0.39
iii) Farmers organizations	162	64.5	89	35.5	1.35	0.48
iv) Agricultural extension staff	133	53.0	117	46.8	1.47	0.5
v) NAADS extension staff	203	80.9	48	19.1	1.19	0.39
vi) NGO Agric. Staff	123	49	128	51.0	1.51	0.5
vii) Agricultural meetings	159	63.3	92	36.7	1.37	0.48
viii) Farm visits	145	57.8	106	42.2	1.42	0.48
ix) Visit to research institutes	47	18.7	204	81.3	1.81	0.39
x) Visit to Agric. Dev. Centres	40	15.9	211	84.1	1.31	0.37

Results in Table 4.6.1.1 clearly show that the majority of the respondents 80.9% access agricultural information from NAADS Agricultural extension staff, 71.3% from agricultural radio programmes, 64.5% from farmer organizations, 63.3% from agricultural meetings/seminars, 57.8% from farm visits, 53.% from agricultural extension staff and 49% access agricultural information from Non-governmental organization (for example, VEDICO, Plan International). Very few respondents, 18.7% access information from Agricultural Research Institutes and 15.9% from Agricultural Research

Development Centres and these were likely to be farmers surrounding the research centres. Results also revealed that 18.5% of the respondents access agricultural information through Newspapers. This implied that in sub-counties where there were no NAADS programmes, farmers had difficulty in accessing agricultural information and therefore adoption of agricultural technologies was very low. In sub-counties where NAADs has established its programmes, farmers have to form farmers' organizations (groups). Formation of farmer organizations enables farmers to constantly hold farmer agricultural meetings and demand for agricultural services from the NAADs staff.

Though 71.3% of the respondents were able to access information from radio programmes, farmers only listen to radio programmes without exchanging information with presenters of the agricultural programme. The method is therefore partly ineffective because it is a one way system of information flow, since there is no feedback from farmers. The mean response of 1.19 (Table 4.6.1.1 is also a clear indicator that the majority of the respondents were in agreement that NAADS agricultural staff were the main source of agricultural information to farmers. On the other hand, a mean response of 1.81 in Table 4.6.1.1 is also a clear indication that the majority of the farmers did not access agricultural information from Agricultural Research Institutes, though they are the generators of the technologies.

Despite the fact that 53% and 49% of the farmers reported that they access information from agricultural extension staff and NGOs' agricultural staff respectively, there were

divergent views as revealed by the standard deviation of 0.5 for both sources of agricultural information.

During interviews, the Chairpersons of farmer forum confirmed that the NAADS Agricultural extension staff was the main source of agricultural information. They explained "since the introduction of NAADS ten year ago, farmers are required to form farmer groups through which they access agricultural information for the various crops and livestock". It's through these groups that farmers can demand for agricultural services. Farmers were also able to access agricultural information from Radio programmes but these programmes were mainly on coffee and livestock production and hardly any on banana production. Most times farmers do not know the appropriate time the agricultural programmes are broadcasted.

Usefulness of agricultural information and time of adoption

In this study, the researcher was interested to know farmers' perceptions as regards the usefulness of the agricultural information they receive from the various sources. This was based on the fact that farmers must be convinced that the information they access on a technology is appropriate to solve a particular problem. Farmers were asked in the questionnaire to indicate whether the information they access was useful or not. Farmers were also asked to indicate the appropriate time they adopt a technology. Results of the findings are as shown in Table 4.6.2.1

Table 4.6.2.1 Usefulness of agricultural information and time of adoption

Parameter	YES		NO			
	Freq.	Percentage	Freq.	Percentage	Mean	Standard Deviation
1. Usefulness of agricultural information	173	68.9	78	31.1	1.31	0.46
2. Time of adoption						
- Soon after learning about technology	165	65.7	-	-	1.34	0.46
- After majority have adopted	86	34.3	-	-	-	-

Results in Table 4.6.2.1 revealed that the majority of the respondents 68.9% reported that the agricultural information they accessed was useful and only 31.1% claimed it was not useful. This implied that farmers benefited from the information accessed because the information could have been utilized to adopt technologies that yielded better results compared to conventional practices.

Farmers were also asked to indicate how soon it took them to adopt a technology after accessing the appropriate information. This was based on the finding that people go through different stages before adopting a new technology. The stages include

innovators, early adopters, early majority, late majority and laggards (those who never adopt).

Results in Table 4.5.6.2 also show that the majority of the respondents 65.7% adopted the technology soon after learning about it and only 34.3% adopted after the majority of farmers had adopted. This implied that the majority of the respondents fall in the category of early adopters in the adoption process. This group is young in age, had the highest degree of opinion leadership among other adopter categories and can therefore influence many other people to adopt a technology.

4.6.3 Personnel involved in giving farmers agricultural advice on banana production and frequency of extension contact with farmers

In this study, the researcher was interested to find out the various extension service providers who were involved in providing information to banana farmers. This was meant to establish whether farmers were getting advice from trained agricultural personnel. This is because appropriate advice can only be given by qualified agricultural extension educators. Farmers were therefore given a number of extension service providers in the questionnaire and were required to indicate the appropriate service providers that were providing them agricultural advice. Farmers were also asked to indicate how frequent the service providers were visiting them. Results of the findings were as shown in Table 4.6.3.1.

Table 4.6.3.1: Personnel giving agricultural advice to farmers

Parameter	YES		NO			
	Freq.	%	Freq.	%	Mean	Standard Deviation
Category of staff giving agricultural advice						
i) Agricultural extension staff	124	49.4	127	50.6	1.51	0.50
ii) NAADS staff	197	78.5	54	21.5	1.22	0.41
iii) NGO staff	102	40.6	149	59.4	1.59	0.49
iv) Local leaders	54	21.5	197	78.5	1.78	0.41
v) Others	16	6.4	235	93.6	1.94	0.24
Frequency of extension visits to farmers i) Once every six months	209	83.3	-	-	1.17	0.37
ii) One a year	42	16.7			-	-

Results in Table 4.6.3.1 clearly show that the majority of the respondents 78.5% received agricultural advice from NAADS agricultural staff, 49.4% agricultural extension staff, 40.6% NGO agricultural staff and only 21.5% from local leaders. This implied that farmers were able to get advice on banana farming from trained and well qualified agricultural staff. Therefore they were able to have hands-on learning experience through methods and result demonstrations.

Farmers were also asked to indicate the frequency within a year they were in contact with the extension personnel. This was intended to measure whether the extension contacts with farmers were adequate or not. Findings in Table 4.6.3.1 clearly shows that the majority of the farmers (83.5%) were able to get agricultural advice from agricultural extension staff at least once every six months and only 16.7% of the respondents indicated once every year. This implied that the majority of the farmers were in contact with the extension agricultural staff at least two times in a year and were probably exposed to current information which was expected to stimulate adoption

Results in Table 4.6.3.1clearly show a mean response of 1.22 which is an indicator that the majority of the respondents were in agreement that the NAADS agricultural staff were the major source of agricultural information. However, there were divergent views as regards agricultural extension and NGO staff being sources of agricultural information. This is clearly explained by the mean response of 1.51 with a standard deviation of 0.5 (Agricultural extension staff) and mean response of 1.59 with a standard deviation of 0.49 (NGO staff).

The interview results from Chairpersons of farmer forum and the agricultural extension staff also confirmed the NAADS agricultural staff being the major service provider of agricultural information to farmers. This was because they were better facilitated by the NAADS programme to provide advisory services to farmers than the agricultural staff under the Ministry of Agriculture and NGO agricultural staff. However, one Chairperson

commented "the number of NAADS or agricultural staff providing advisory service is very small in a sub-county. There are more than fifty villages in a sub-county and each village has more than five farmer groups and all groups are handled by one extension or NAADS personnel". He estimated the NAADS extension staff, farmer ratio to be one to twenty thousand farmers (1:20000) in every sub-county.

As regards the frequency of visits to farmers, the NAADS agricultural extension staff stated "the visit of extension staff to farmers depends on the need of the farmers, if farmers' urgently needs advice; they call the extension officer whom they have to facilitate with transport". "The normal visits to farmers depend on the extension officer's programmes they make for the whole year for the whole sub-county".

4.6.4 Membership to farmer organization, usefulness of farmer organization and frequency of farmer organization meetings/seminars attended a year

Membership to farmer organization was included in the study because farmers within groups learn from each other how to grow and manage different crops or livestock. This network effects are important for individual farmer decisions in the adoption process. In this study farmers were asked to indicate whether they were members of farmer organizations, whether farmer organizations were useful and the number of farmer organization meetings/seminars they attend in a year. Table 4.6.4.1 revealed a summary of the findings.

Table **4.6.4.1 Membership to farmer organizations, usefulness of farmer organizations and number of farmer organization meetings attended in a year**

Parameter	YES		NO			
	Freq.	**%**	**Freq.**	**%**	**Mean**	**Standard Deviation**
1. Member of farmer organization	173	68.9	78	31.1	1.31	0.46
2. Usefulness of farmer organizations	157	62.5	94	37.5	1.37	0.48
3. Number of farmer organization meetings attended in a year						
(i) 1-3 meetings	93	37.1	-	-	-	-
(ii) > 3 meetings	158	62.9	-	-	1.63	0.48

Results in Table 4.6.4.1 shows that 68.9% of the banana farmers belong to farmer organizations while 31.1% do not belong to farmers' organization. This implied that the majority of the farmers were able to utilize farmer organization meetings to discuss their problems or interests on agricultural production which were likely to influence adoption of agricultural technologies positively or negatively. This is because groups have been reported to be important for a large number of farmers to make significant impact on agricultural production.

As regards usefulness of farmer organization, results in Table 4.6.4.1 show that 62.5% of the farmers in Mukono appreciated the usefulness of farmer organizations and only 37.5% reported that they were not useful. These findings revealed that farmers have benefited from the NAADS programme. This is because it is through the NAADS programme that farmer organizations are formed to enable them to demand for services which the groups think are beneficial for agricultural production.

As for the number of farmers' organization meetings which farmers attend in a year, results in Table 4.6.4.1 show that the majority of the farmers, 62.9% attend more than three meetings in a year and only 37.1% of the respondents attend between one to three meetings in a year. These findings revealed that the majority of the farmers were able to access agricultural information through contact with extension service providers because extension service provider are the one who organizes these meetings. In the farmer organization meetings, the extension service providers are in position to get in contact with many farmers compared to individual farm visits.

4.6.5 Forms technologies are disseminated to farmers and whether farmers use all the technologies in combination

Agricultural extension staff uses a number of approaches to disseminate research technologies to farmers. In this study, the researcher sought to find out which approaches were being used to disseminate technologies to banana farmers in Mukono. Farmers were therefore given several approaches from which they selected the methods used by

extension agents to disseminate research technologies to them. Farmers were also asked to indicate whether they use all technologies in combination. The findings are as indicated in Table 4.6.5.1

Table 4.6.5.1: Form of technology presentation to farmers and combination use of technologies

Parameter	YES		NO			
	Freq.	**%**	**Freq.**	**%**	**Mean**	**Standard Deviation**
1. Form of technology						
(i) Farm demonstration	120	47.8	131	52.2	1.52	0.5
(ii) Farm visits	142	56.6	109	43.4	1.43	0.5
(iii) Agricultural seminars	67	26.7	184	73.3	1.73	0.44
(iv) Farm field schools	9	3.6	242	96.4	1.96	0.19
(v) Others	1	0.4	250	99.6	-	-
2. Combination of technology use	100	39.8	150	59.8	1.6	0.49

Results in Table 4.6.5.1 show that technologies were disseminated to farmers through farm visits 56.6%, farm demonstration 47.8% and through agricultural seminars 26.7%. However, technologies were also disseminated to farmers through farm field schools but on a very small scale, 3.6%. This implied that most of the technologies were disseminated through individual contact and this means that very few farmers were contacted by the extension service providers at any one time. However, though the

majority of the farmers reported that technologies were disseminated through farm visits, there were divergent views between technology dissemination through farm visits and farm demonstrations as indicated in table 4.6.5.1with standard deviation of 0.5 for each form technology presentation.

In the study, farmers were asked whether they were adopting all the recommended technologies in combination. This was meant to measure the level of production in relation to the technologies adopted. Results in Table 4.6.5.1revealed that only 39.8% of the farmers were able to use all the technologies in combination while 59.8% were not able to use all of them. This implied that most of the banana fields in the study area are below average production because high banana production is influenced by use of better varieties, pesticides, fertilizers and use of recommended management practices.

During interview, the agricultural extension staff explained the different approaches they use to disseminate new technologies to farmers. Top on the list were the farm demonstrations. In this approach, farmers practically learnt how the technology was used (method demonstration) and at the end of the demonstration they were able to see the difference between the new technology and the conventional practice (result demonstration). Other methods used include, agricultural seminars, field days and taking farmers to agricultural shows, for example at Jinja where an agricultural show is held annually. The Chairpersons of farmer forum confirmed that technology presentation was also through exchange visits whereby farmers visited fellow farmers who had adopted a

new technology. Through exchange visits, farmers interacted and those who had not adopted were in position to know what the adopters think about the technology. As long as the attitudes of the adopters were favourable towards a new practice, visiting farmers were also willing to adopt the technology.

4.6.6 Test of hypothesis three

The third hypothesis in this study was; institutional factors effect farmers' adoption of recommended agricultural technologies. To verify this hypothesis, a null hypothesis was derived and tested. The null hypothesis (H_0) states; institutional factors have no effect on adoption of recommended agricultural technologies. To test this hypothesis, the researcher used the survey questionnaire (Appendix I). Items on adoption were measured using a scale rating where Yes = 1 and No = 2. Items on the institutional factors were also measured using the same rating Yes = 1 and No = 2.

4.6.7 Correlation analysis on the effects of institutional factors on adoption of agricultural technologies

To measure this objective using correlation analysis, it was basically to find out the relationship between variables indicated in Table 4.5.3.7.

Table 4.6.7.1: Pearson correlation Analysis

Correlations

		IVI2	DV2
IVI2	Pearson Correlation	1	.250**
	Sig. (2-tailed)	.	.000
	N	251	251
DV2	Pearson Correlation	.250**	1
	Sig. (2-tailed)	.000	.
	N	251	251

**. Correlation is significant at the 0.01 level

In the table above, IV12 are the institutional factors and DV2 is the dependent variable which is the adoption of agricultural technologies in banana production. Results from Table 4.6.7.1 revealed that, there is a statistical significant correlation between institutional factors and adoption of the recommended agricultural technologies. This was evidenced by the obtained p value = .000 which is smaller than 0.05 (the 95% confidence value) significance level. Therefore from the results in the table above, the researcher rejected the null hypothesis (H_0) and verified the (H_1) hypothesis which states that; institutional factors affect farmers' adoption of recommended agricultural technologies. During interview, the Chairpersons of farmer forum complained of the small number of extension staff in the sub-county. They reported that every sub-county had over twenty thousand farmers who were being attended to by one NAADS/extension staff. This number was too big for one extension worker and therefore greatly affected adoption of the recommended agricultural technologies.

4.7 Adoption of banana recommended production technologies

The researcher sought to examine the adoption status of banana recommended technologies in the four sub-counties of the study area. The study therefore specifically examined the type of banana varieties grown, reasons for not planting improved varieties, a comparison of the performance of improved varieties against certain characteristics and source of banana planting materials for the farmers. Other banana technologies examined included recommended management practices, use of manure or fertilizer to maintain soil fertility, use of pesticides to control pests and diseases and whether farmers participated in technology generation and evaluation. To obtain the above information banana farmers were asked questions in the survey questionnaire administered by the Research Assistant who filled answers in the questionnaire on behalf of banana farmers. The sub-county extension/NAADS staff and Chairpersons of farmer forum at the sub-county level were personally interviewed by the researcher as regards the adoption of banana recommended technologies in their sub-counties.

4.7.1 Types of banana varieties planted

The researcher wished to establish the types of banana varieties grown by the respondents. Farmers were therefore asked to indicate in the questionnaire the types of banana varieties they were growing and the findings were as indicated in Table 4.7.1.1

Table 4.7.1.1: Types of banana varieties planted by farmers

Type of banana variety	Response category					
	Yes		No		Mean	Standard deviation
	Freq.	%	Freq.	%		
1. Local varieties	249	99.2	2	0.8	1.01	0.089
2. Beer/Dessert type	165	65.7	86	34.3	1.34	0.476
3. Improved varieties	96	35.2	155	61.8	1.62	0.487

Source: Survey Data, 2010

Table 4.7.1.1 gives a summary on the types of banana varieties grown by the farmers. In Mukono 99.2% of the respondents were involved in the production of the local banana varieties that include Mpologoma, Kibuzi, Nakitembe, Kisansa, Nakabululu, Musakala and Nfuka while 65.7% of the respondents grew the beer/dessert types that include Gonja, Bogoya and Ndizi. As for the improved banana varieties that include Kabona 1, Kabona 2, Kabona 3 and Kabona 4, only 35.2% of the farmers produced them. This implied that the local banana varieties were still more important to farmers due to unknown reasons while the beer/dessert types are second to the local varieties probably because apart from being a source of food, they are also source of income to farmers. The mean response rate of 1.01 shows that the majority of the farmers were producing local banana varieties and mean response rate of 1.62 is an indication that very few farmers were growing improved varieties.

The survey questionnaire results were also confirmed by the interview results from the four sub-counties. In the four sub-counties, a total of eight staff were interviewed that included four Agricultural/NAADS staff and four Chairpersons of farmer forum. The interview results revealed that local varieties especially Mpologoma and Kibuzi were grown followed by the beer type for brewing beer. The improved varieties were grown on a very small scale with most farmers having less than five banana stools in their plantation on experimental basis.

4.7.2 Reasons for not planting improved varieties

In the study, the researcher was interested to know the various reasons for not planting improved varieties, despite the fact that they were high yielding and resistant to pests. A number of reasons were suggested in the questionnaire and the respondents selected the appropriate reasons. Table 4.7.2.1 gives a summary of the findings.

Table 4.7.2.1: **Summary of the various reasons for not planting improved banana varieties**

Reasons for not planting	Yes		No		Mean	Standard Deviation
	Freq.	%	Freq.	%		
1. Lack of planting materials	205	81.7	46	18.3	1.18	0.388
2. Lack of capital	207	82.5	44	17.5	1.18	0.381
3. High price of planting materials	206	82.1	43	17.1	1.17	0.379
4. No knowledge about planting materials	81	32.3	170	67.7	1.68	0.468
5. Improved varieties not good for food	210	83.7	40	15.9	1.16	0.367
6. Others	37	14.7	214	85.3	1.85	0.55

Source: Survey Data, 2010

Results in Table 4.7.2.1 above revealed that 83.7% of the farmers reported the food taste as the main reason for low adoption of the improved varieties while 82.5% of the farmers did not have capital to buy the planting materials. In addition, 82.1% complained of the high price of the planting materials while 81.7% claimed that they lacked planting materials of the improved varieties. This implied that the food taste of the improved

varieties needs to be improved upon, at the same time, farmers had to be assisted with loans while the prices of the planting materials needed to be reduced and commercial nurseries had to be established within the sub-county to increase on the availability and accessibility of planting materials.

During interview, results at the sub-counties confirmed the poor food taste as the main reason for not growing improved varieties. The improved types were more of the dessert type than the food type. They reported that FIA17 was somehow fair as regards to food taste but needs to be improved upon. On the other hand, FIA21 which is the dessert type had a weak stem but with a very big bunch, hence highly susceptible to breaking before maturity.

4.7.3 A comparison of improved banana varieties with selected characteristics

In the study, the researcher wanted to know from the respondents some of the qualities of the improved varieties in relation to the local varieties. A number of selected characteristics were suggested in the questionnaire for the farmer to select the most appropriate ones. Results were summarized in Table 4.7.3.1

Table 4.7.3.1: **Comparison of improved banana varieties with selected characteristics**

Selected characteristics	Yes		No			
	Freq.	**%**	**Freq.**	**%**	**Mean**	**Standard Deviation**
1. Early maturity	120	47.8	167	66.5	1.52	0.501
2. High yielding	147	58.6	107	42.6	1.49	1.39
3. Pest resistance	169	67.3	82	32.7	1.33	0.47
4. Disease resistance	106	42.2	145	57.8	1.58	0.495
5. Food taste not good	226	90	25	10	1.10	0.300

Source: Survey Data, 2010

Results from the table above clearly show that the food taste for the improved varieties was not good (90%), while 67.3% of the respondents reported that improved varieties were resistant to pests, 58.6% reported improved varieties to be high yielding. In addition, 47.8% observed that improved varieties were early maturing and 42.2% of the respondents reported that improved varieties were resistant to diseases. This implied that improved banana varieties were less likely to be adopted in traditional banana growing areas since they were considered not good for food. However, in areas where farmers cannot afford to buy pesticides, improved varieties were the best alternative since they are pest resistant.

The mean response of 1.10 as regard the food taste of improved banana varieties was another confirmation that the majority of respondents were in agreement that the food taste of the improved banana varieties was not good. However there were divergent views as regards early maturity and disease resistance of the improved varieties. This is confirmed by the standard deviation of 0.5 and 0.495.

4.7.4 Source of planting materials

The researcher was interested to know where farmers obtain their banana planting materials. This was important because collecting planting materials from any source could led to using poor quality planting materials that may not be of good performance. In the questionnaire several sources were suggested for the respondent to select the appropriate source. Figure 4 gives a summary of the findings.

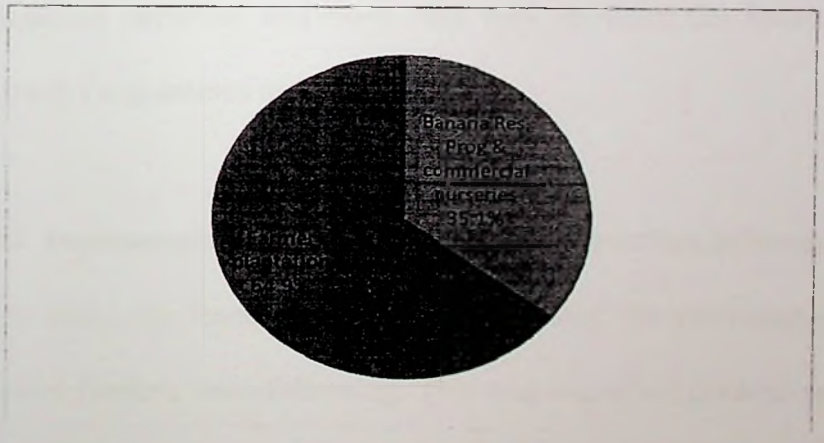


Figure 4: Source of planting materials

Results in Figure 4 revealed that 66.1% of respondents obtain banana planting materials from fellow farmers while 35.1% got planting materials from the Banana Research

Programme at Kawanda and banana commercial nurseries. This implied that most of the planting materials farmers obtain from fellow farmers were more likely to be infested with pests especially nematodes and banana weevils as we were not sure whether these farmers control pests in their banana plantation.

Interview results from Agricultural staff at the sub-counties also confirmed that the majority of the farmers obtained planting materials from fellow farmers. Farmers select planting materials based on the visual appearance of the banana plant that include high yielding, early maturity, pest resistance or drought resistance. They gave an example of Nakitembe, a local variety, being the best, followed by Mpologoma which is also good but requires very good management. From the interview, the researcher was also informed by the Chairperson of farmer forum that within the district there were very few commercial nurseries and were also very far from the farmers including the Banana Research Programmes at Kawanda.

4.7.5 Recommended banana management practices followed

In the study, the researcher wanted to establish the recommended banana management practices farmers were following. This was important because adoption of recommended practices led to improved yields if followed. In the questionnaire, farmers were given the various practices recommended for banana production and farmers ticked the appropriate practices they were following. Results were summarized in Table 4.7.5.1

Table 4.7.5.1: **Banana management practices followed**

Practices	Yes		No			
	Freq.	**%**	**Freq.**	**%**	**Mean**	**Standard Deviation**
1. Digging holes (60x60 cm)	195	77.7	56	22.3	1.22	0.47
2. Use clean planting materials	218	86.9	33	13.1	1.13	0.339
3. Plant at recommended spacing	177	70.5	74	29.5	1.29	0.457
4. Plant at the beginning of rains	215	85.7	36	14.3	1.14	0.351
5. Hand weeding of plantation	209	83.3	42	16.7	1.17	0.374
6. Mulching	128	51.0	123	49	1.49	0.501
7. Remove excess suckers	166	66.1	85	33.9	1.34	0.474
8. Remove male buds	222	88.4	29	11.6	1.12	0.320
9. Remove dry leaves	237	94.4	14	5.6	1.06	0.230
10. Intercrop during establishment of the banana plantation	186	74.1	65	25.9	1.26	0.439
11. Control soil erosion using grass bands	107	42.6	144	57.4	1.57	0.496

Source: Survey Data, 2010

Results in Table 4.7.5.1 show that 94.4% remove dry leaves, 88.4% removed male buds which are a source of spreading diseases by bees, 86.9% use clean planting materials, 85.7% establish banana plantations at the beginning of the rains, 83.3% control weeds

using hand hoes, 74.1% intercrop banana with other crops, 77.7% dig banana holes at the recommended depth, 66.1% remove the excess banana suckers while 51% apply mulch to their banana plantations. Basically all these management practices were cultural practices. This implied that since very little financial requirements was involved; most farmers in Mukono could afford to use the cultural management methods. However, using them alone could not lead to increased banana production.

Despite the fact that a higher percentage of the farmers indicated that they were following the recommended management practices (Table 4.7.5.1), the interview results from the Agricultural staff in the four sub-counties were somehow different. All the eight staff interviewed reported that only 30% of the banana farmers do follow the recommended banana management practices. In their view, farmers were not taking banana farming as a business, it was just a source of food, therefore as long as they would get food, there was no need of getting into extra burden of practicing good management practices. One Chairperson of the farmer forum said "farmers need to see that banana farming is profitable, within the four sub-counties, these were no model farmers who would be examples of the various recommended practices". The Chairperson further commented "seeing is believing" therefore role model farmers should be started at least at parish level.

4.7.6 Maintenance of soil fertility in banana plantations

Soil fertility is one of the major constraints that contribute to the decline in banana production. The researcher therefore, wished to establish how farmers in Mukono were

maintaining soil fertility in their banana plantations. Farmers were therefore given various methods of maintaining soil fertility in the questionnaire, from which they indicated the methods they were using. Findings were summarized in Table 4.4.6

Table 4.7.6.1 Maintenance of soil fertility in banana plantations

Types of soil fertility maintenance methods	Yes		No			
	Freq.	%	Freq.	%	Mean	Standard Deviation
1. Manure (cow/poultry)	217	86.5	34	13.5	1.14	0.343
2. Fertilizers (inorganic)	47	18.7	204	81.3	1.81	0.391
3. Mulch	95	37.8	156	62.2	1.62	0.486
4. Don't use any	19	7.6	232	92.4	1.92	0.265

Source: Survey Data, 2010

Results in the table above clearly show that 86.5% applied cow/poultry manure to their banana plantation, 37.8% applied mulch, 18.7% used fertilizers and 7.6% did not use any of the three. This implied that most farmers who keep cows and poultry were more likely to be the ones who applied manure, while those who had quite big areas of land could probably have access to mulch, while the few rich farmers could afford to use inorganic fertilizers. The mean response of 1.14 with a standard deviation of 0.343, confirms the majority respondents using manure to maintain soil fertility, however a standard

deviation of 0.486 is an indication that there were divergent views as regards the use of mulch as a means of maintaining soil fertility.

During interview, results from the sub-counties also confirmed that most farmers applied cow/poultry manure but at a very low level. They estimated that between 20% -30% of the farmers apply cow/poultry manure and it is only those that keep livestock that can afford to apply the manure because it is also expensive if you had to buy it. They added that while mulch is cheap, its not readily available therefore very few farmers can access it. As for the artificial fertilizers, they are very expensive and only the rich farmers could afford to use the fertilizers on their banana plantations.

4.7.7 Control of pests and diseases

Pests and diseases are a major problem in banana production. In this study the researcher sought to find out how farmers were controlling both pests and diseases. In the questionnaire, farmers were given alternative methods of controlling pests and diseases from which they indicated the method they were using. Table 4.7.7.1 gives a summary of the findings.

Table 4.7.7.1: Control of pests and diseases

Selected characteristics	Yes		No		Mean	Standard Deviation
	Freq.	%	Freq.	%		
5. Weevil free planting materials	187	74.5	64	22.5	1.25	0.437
6. Good husbandry practices	232	92.4	19	7.6	1.08	0.265
7. Use pesticides	73	29.1	178	70.9	1.71	0.455
8. Don't use any	5	2	246	98	1.98	0.140

Source: Survey Data, 2010

Results in the table above clearly show that 92.4% of the respondents practiced good husbandry practices that include clean weeding, pruning, trapping, removal of male buds and destroying diseased plants. 74.5% plant clean planting materials (free of pests and diseases), 29.1% use pesticides and 5% did not use any methods. This implied that the majority of the farmers (92.4% and 74.5%) were using cultural methods of controlling pests and diseases and very few used pesticides. The problem with the cultural methods is that they cannot be relied upon as one single method of controlling pests and diseases as it is with chemical control. This therefore implied that there were high chances of banana plantation in survey area of being infested with pests and diseases leading to a decline in production. The standard deviation of 0.265 is an indication that the majority of the respondents were in agreement that they were mainly controlling pests and diseases using

good husbandry practices. While a mean response of 1.71 is an indication that most farmers did not use pesticides.

Respondents who were interviewed at the sub-counties confirmed that the majority of the farmers use cultural methods to control pests and diseases in their banana plantations. One of the extension staff said "Though use of pesticides is the most effective method of controlling pests, most farmers cannot afford the high cost of pesticides". In addition, they claimed that some farm supply shops sale fake agricultural chemicals and this had forced farmers to abandon use of the chemicals due to poor quality.

4.7.8 Level of participation in technology generation and evaluation

In this study, the researcher wished to establish at what level farmers participated in technology generation and evaluation. The two processes influence farmers' rate of adoption as farmers would have participated in actual application of the technology and would have seen the difference between the new and old practice (method and result demonstration). In the questionnaire, farmers were asked to indicate the appropriate level they participated in technology generation and evaluation. The findings were as summarized in Table 4.7.8.1

Table 4.7.8.1: Level of participation in technology generation and evaluation

Level of participation	Freq.	%
1. Generation	18	7.2
2. Evaluation	30	12.0
3. Generation and evaluation	27	10.8
4. Didn't participate	176	70.1

Source: Survey Data, 2010

Results in the table above clearly show that 70.1% of the respondents did not participate at any level, 12% participated at the evaluation stage, 10.8% at generation and evaluation and only 7.2% at generation. This implied that the majority of the farmers did not have chance to participate in technologies generation and evaluation (method and result demonstration) processes. Therefore farmers were at the receiving end without knowing how the technology works and its benefits as compared to the conventional practice.

Respondents interviewed at the sub-counties were in agreement with banana farmers as regards participation and evaluation of technologies. One Chairperson of the farmer forum said "farmers are just at the receiving end, they just take whatever is given by the Extension staff, if it is not good then farmers abandon it, for example the improved banana varieties, though high yielding, the food taste is not good".

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study examined factors affecting farmers' adoption of agricultural recommended technologies with specific reference to banana production in Mukono district. In this chapter, the summary of the findings were presented, discussed, conclusions and recommendations of the study were presented according to the findings in chapter four. Recommendations for further research were also suggested. The chapter is presented in four sections as indicated below.

i. Summary of findings
ii. Discussion
iii. Conclusion
iv. Recommendations
v. Area for further study

5.2 Summary of findings

The study examined factors affecting farmers' adoption of agricultural technologies with specific reference to banana production. The study was guided by specific objectives which were to find out economic factors that affect farmers' adoption of recommended agricultural technologies, determine farmers' characteristics that affect farmers' adoption

of recommended agricultural technologies, establish the extent to which institutional factors affect farmers' adoption of recommended technologies. The study used cross-sectional descriptive survey design that used both qualitative and quantitative approach in the research process.

From the finding it was revealed that the most important factors associated with the adoption of agricultural technologies in banana production were; institutional (p=000), gender (p=0.002) and economic factors (p=0.002). However age (p=0.26) and education (p=0.198) were not significant factors.

5.3 Discussion of findings

5.3.1 Find out the economic factors that affect farmers' adoption of recommended agricultural technologies in banana production.

In this objective, the sub dimensions included, cost of technology, access to credit, labour availability level of expected benefit, were hoped to influence technology adoption in banana production. The results from the study revealed that economic factors significantly affect adoption of recommended agricultural technologies in banana production (p=0.02). The findings revealed that cost of the technology and credit availability are important in influencing adoption of recommended agricultural technologies in banana production. The high cost of production inputs namely; fertilizers/manure, pesticides, herbicides and improved varieties were expressed by the majority of the farmers as the main economic factors affecting adoption of agricultural technologies. These findings are in agreement with findings by El-Osta & Morchat

1999) who reported that technologies which are expensive are only affordable by wealthy farmers who have the money.

n addition, farmers expressed difficulty in accessing credit from leading institutions as ie interest rates were high, fear for the bank to take their property and some had no ecurity to give the bank which prevented them from investing in profitable banana chnologies. Access to credit through a bank loan or savings in cooperative societies as also reported to increase the probability of adopting technology (Lubwama, 1999; onabona, 2002 & Nguthi, 2007).In rural areas, access to financial services such as credit id savings is limited. Even where financial services are available, they are often highly disadvantageous to smallholder farmers, for example, interest rates are high and rrowing terms unfavourable for smallholder farmers, probably because lending ancial institutions often face difficulties in monitoring loans for smallholder farmers.

e research findings were also consistent with the results from Feder, Just & Zilberman 985) who reported that constrained access to credit among farmers was one of the main sons why technology failed to diffuse.

e findings were also in agreement with Drechsel *et al.*, 2004 who identifies capital and dit availability as one of the adoption constraints. They reported that farmers were ble to raise sufficient funds to invest in recommended technologies because of lack of ital, limited access to credit or temporally cash flow problems. This also concerns

nds to pay extra labour when the technology requires activities during peak period of ormal field work. It is against this background that farmers, as decision makers, when oed with constraints of productive resources namely, capital, labour and land, may ecide not to use the technology.

3.2 Determine farmers' characteristics that affect adoption of recommended agricultural technologies.

he researcher measured the effects of farmers' characteristics on adoption recommended gricultural technologies in banana production in terms of age, highest level of education, ender and farmer perception. The findings revealed that there was a statistically gnificant difference between male and female in adoption of recommended agricultural chnologies. This was evidenced by the obtained t-test results p-value (0.002). These ndings tend to suggest that the gender-linked differences in adoption could probably be ssociated to accessibility to key production inputs and contact with extension service.

most households, it is the men who own land, have access to funds and are more equent in contact with extension service. This therefore implies that men have the ility to purchase inputs for example, fertilizers, pesticides and can even invest in proved varieties unlike women who are always financially handicapped. Men are also ore often in contact with extension service provider than women. This is usually ough agricultural meetings or farm visits etc. This makes them more informed of new

echnologies than women. More access to funds and exposure to information make men dopt agricultural technologies better than women.

The findings are in agreement with Kimenye (2001) in his study as to why adoption rates f women farmers was low in adoption of improved sorghum varieties in Mbeera district, Kenya. Results from the study revealed that women did not adopt new sorghum varieties ecause the taste was not good and processing of the grain was difficult. It was also ound that women did not participate in the later stages of technology development and valuation. It was only the men who were in contact with extension service providers and erefore women lacked information about the improved varieties.

he findings are also consistent with the results reported by Kakooza *et al.* (2005) who vealed that in Uganda most agricultural programmes focus on men despite the edominant role played by women in agricultural production. He further pointed out that ere were gender gaps in decision making to purchase and use particular agricultural chnologies, like fertilizers, pesticides, storage facilities, all rest in hands of men. The nder differences also favoured men to attend farm demonstration, farmers training ssions and extension services.

owever, through the findings of this study and other studies done elsewhere indicate t there is a gender-linked difference in adoption of agricultural technologies, Doss & orris (2001) and Overfield & Fleming (2001) reported insignificant effects of gender on

doption of improved maize technologies in Ghana and coffee production in Papua New uinea.

s for the farmers' age. results revealed no significant difference between farmers' age d adoption of recommended agricultural technologies in banana production (p = 260). This tends to suggest that since banana is a cultural crop in the central region, age ifferences have no effect on adoption of improved technologies in banana production. rmers in the traditional banana growing areas have a cultural belief that they must grow nanas as it is the main source of food for the households and the surplus to be sold to t revenue for purchase of other household requirements. It's against this background it age does not matter in adoption of banana production technologies.

hough, Rogers (1983) reported that young farmers were found to be the first adapters a technology than their older counterparts, it is also argued that with age, farmers gain re experience and acquaintance with new technologies and hence are expected to have her ability to use new innovations more efficiently. Results from the study are in eement with studies on adoption of land conservation practices in Niger (Baidu-son, 1999), rice in Guinea (Adesina & Baidu-Ferson, 1995), Hybrid cocoa in Ghana ahene *et al.*, 1999) that age was either not significant or negatively related to ption. On the otherhand, McNamara, Wetzstein & Donce (1991) found that age tively influenced adoption of integrated pest management practices on peanuts in nea.

regards to farmers education, there was no significant difference between farmers' el of education and adoption of recommended agricultural technologies in banana oduction ($p = 0.198$). Results tend to differ with many of the adoption studies which owed some association between technology adoption and level of education of the mers. For example, Chaves & Riley, 2001 & Strauss *et al.*, 1991, reported that farmers h more formal education tend to adopt agricultural technologies more that farmers h less formal education. While Vaiene et al. (2009) in their study on determinants of icultural technology adoption in Mozambique also reported that educated farmers re in a better position to process information and search for appropriate technologies n uneducated farmers. Results from the study were also not consistant with the usion of innovation theory (Rogers, 1983) where educated farmers were reported to nore aware about a technology.

e education can be acquired through formal and informal education and through ming experience, farmers were able to adopt technologies through experience as the jority of the farmers (71.7%) had farming experience of over 11 years. Therefore, the l of education could probably have no significant effect on adoption of the mmended agricultural technologies in banana production. Therefore in banana uction, as regards farmers' characteristics, it can be concluded that it is only gender as an effect in adoption of recommended technologies while age and education have fect. The effect of age and education is probably offset by farmers' experience.

.3: The extent to which institutional factors affect farmers' adoption of ricultural recommended technologies

regard to this objective, the study findings revealed that institutional factors nificantly affect adoption of recommended agricultural technologies in banana duction ($p = 0.000$). The findings showed that institutional factors play a big role on ption of recommended agricultural technologies in banana production. Institutional tors basically involve passing on information to farmers and it is from this information essed that farmers can adopt or reject the technology. This can be through the ension agent visits to the farmers or the farmer visits to the extension office seeking ormation or advice.

ricultural extension is considered as a type of informal adult education that is intended enhance farmers' knowledge in certain areas and enables them to benefit from ilable agricultural technologies and improved practices. In this way, the extensions vice supplements the deficiency in the farmers' formal or informal education, lack of wledge about technology availability, benefits and effective use of the technology. s, the significance of institutional factors in farmers' adoption of recommended icultural technologies in banana production.

ese results are in conformity with other research findings, that the uptake of new cology is often influenced by good extension programs and farmers' contact with

ension providers (Bonabona, 2002 & Nguthi, 2007). Extension agents provide sources improved varieties, inputs and technical advice. Increased exposure to extension nts and participation in farmer groups was also reported to have high correlation to ption rates (Adesiina *et al.*, 2000; and Strauss *et al.*, 1991). The findings therefore are agreement with the diffusion of innovation theory (Roger 1983) which emphases ess to information as a principal factor affecting adoption of a new technology.

sults from the study were also consistent with findings from other studies that access to ormation on new technologies is crucial as it creates awareness and attitudes towards nology adoption (Place & Dewees, 1999, Caswell *et al.* 2001, Manale Kessiel *et al.*, 9). The implication of these findings is that extension contacts with farmers are ortant to technology adoption.

Conclusions

m the findings of the study, the following conclusions for each objective were reached resented below.

1 Find out the economic factors that affect farmers' adoption of recommended agricultural technologies.

is objective, the sub-dimensions included, cost of technology, access to credit, labour lability and level of expected benefit were hoped to influence technology adoption in a production. The results indicated that economic factors significantly affect

ption of recommended agricultural technologies in banana production (P = 0.02). m the analysis of results, the evidence revealed that two sub-dimensions which uded cost of technology and access to credit had an effect on farmers' adoption of mmended agricultural technologies. This therefore means that for technologies ch were expensive, banana farmers could not adopt them. The study results also aled that farmers had no access to credit facilities, therefore they were unable to hase and use the expensive technologies that had been recommended by researchers disseminated by extension agents.

2 Determine farmers' characteristics that affect adoption of recommended agricultural technologies in banana production

analysis of results from farmers' characteristics confirmed that of the four nsions used in the study, only gender had an effect on farmers' adoption of mmended agricultural technologies (P = 0.002). The researcher therefore concluded during technology generation, evaluation and dissemination by researchers and sion agents, gender balance was not considered and therefore affected technology ion.

The extent to which institutional factors affect farmers' adoption of recommended agricultural technologies

s from the study as to the extent to which institutional factors affect farmers' on of agricultural technologies indicate that the four dimensions used in the study

namely, extension contact, information access, technology combination and form of technology presentation had a significant effect on technology adoption in banana production (P = 0.000). The researcher therefore concluded that the research-extension contact with the farmers was inadequate due to the small number of extension agents handling very many farmers in every sub-county, farmers were not involved in technology generation and evaluation and therefore adoption of recommended technologies was affected.

5.5 Recommendations

From the findings of the study, the following recommendations were made.

5.5.1 To find out economic factors that affect farmers adoption of recommended agricultural technologies

i) This study recommended that government should enforce formation of farmer cooperative societies which should import inputs directly from suppliers and supply them to farmers at a relatively fair price. This will probably reduce the high cost and fake inputs in the market being experienced by farmers.

ii) Cooperative societies should supply inputs to farmers on credit so that farmers pay back after selling their produce. It is hoped that the interest rates will be low and all farmers will be able to access credit facilities even without titles.

5.5.2 Determine farmers' characteristics that affect adoption of recommended agricultural technologies

In this objective, the researcher recommended that research, extension agents and farmers should work together irrespective of gender. This means that equal opportunity should be given to both male and female by researcher and extension agents during technology generation and evaluation and during information dissemination.

5.5.3 The extent to which institutional factors affect farmers' adoption of recommended agricultural technologies in banana production

i) The study recommended that participatory research should be encouraged between researchers, extension and farmers. This will encourage farmers to own the technology at the initial stage of generation and will fully appreciate the benefits of the technology during evaluation. Participatory research will therefore increase farmers' adoption of the technology.

ii) The researcher also recommended the formation of farmer field schools in all sub-counties. In farmer field schools, farmers learn the different technologies in a group and in turn farmers train their fellow farmers. This means that many farmers can be trained in big numbers and in a short period of time who in turn become equipped to train many other farmers who have not attended the farmer field schools. This will help to increase on the number of extension agents that provide agricultural information to farmers.

iii) The number of extension agents in every sub-county should be increased to at least three, whereby the Agricultural Officer (Graduate) should be in charge of the sub-county who should be assisted by two Assistant Agricultural Officers who are Diploma holders. Increase of extension agents within the sub-county will improve on the frequency and efficiency of the extension agents and this is likely to improve on the adoption rate.

5.6 Area of further research

A cross sectional survey design was used in the study due to limited funds and the time period that was required to complete the study. To take this study further, it is recommended that a longitudinal type of study covering all traditional banana growing districts could be undertaken. This will give a broader picture of the factors affecting adoption of recommended technologies in banana production.

REFERENCES

Abara, I.O.C & Sing, S. (1993). "Ethics and Biases in Technology Adoption: The Small Farm Argument:. *Technology Forecasting and Social Change*, 43 PP: 289-300

Adesina, A. & Zinnah, M. (1993). *Technology characteristics, farmers' perceptions and adoption decisions. Agricultural economics* 9 PP: 297-311.

Adesina, A.A. & Baidu-Ferson, J. (1995). *"Farmers' Perceptions and Adoption of New Agricultural Technology: Evidence from Analysis in Burkina Faso and Guinea, West Africa". Journal of Agricultural Economics*, 13 PP: 1-9

Adesina, A.A, Mbila, D., Nkamleu, G.B & Endamana, D. (2000). *"Econometric Analysis of the Determinants of Adoption of Alley Farming in the Forest Zone of Southwest Cameroon". Agricultural Ecosystems and Environment* 80 PP: 255-265

Adupa, J.D. (1999). Opinion leadership in technology adoption among rural men and women in Mukono District, Uganda.

Akinwumi, A. & Chianu, J. (2004). *Determinants of farmers' adoption and adoption of alley farming technology in Nigeria.*

Amin, E.M. (2005). *Social Science Research Conception, Methodology and Analysis*, Yaounde, Cameroon

Ariga, J., Jayne, T.S., Kibaaru, B. & Nyoro, J.K. (2008). Trends and Patterns in Fertilizer use by smallholder farmers in Kenya.

Baide, J.M.R. (2005). *Barriers to Adoption of Sustainable Agricultural Practices.*

Baidu-Ferson, J. (1999). *"Factors Influencing Adoption of Land enhancing Technology in Sahel: Lessons from a case study in Niger". Agricultural Economics* 20 PP: 231-239

Bagamba, F., Karamura, E., Gold, C.S., Barekye, A., Blomme, G., Tushemereirwe, W.K. & Tinzaara, W. (2003). Socio-economic assessment of pest management practices in Lwengo sub-county, Uganda. Proceedings of the workshop on Farmer-participatory testing of IPM options for sustainable banana production in Eastern Africa held in Seeta, Uganda.

Banabana-Wabbi, Jackline (2002). *"Assessing Factors Affecting Adoption of Agriculture Technologies: The case of Integrated Pest Management (IPM) in Kumi District, Eastern Uganda.*

Barifaijo, M.K., Basheka, B.C. & Oonyu, J. (2010). *How to write a good Dissertation/Thesis*. Kampala, Uganda

Boahene, K, Snijders, T.A.B., & Folmer, H. (1999). "An Integrated Socio-economic Analysis of Innovation Adoption: The case of hybrid cocoa in Ghana". Policy modeling 21 PP: 167-184

Caswell, M., Fuglie, K., Ingram,C., Jans, S. & Kascak, C. (2001). *Adoption of Agricultural production practices: Lessons learned from the U.S. Department of Agriculture area studies project, Washington DC, U.S Department of Agriculture.* Resource Economics Division, Economic Research Service, Agricultural Economic Report No. 792.

Caviglia-Harris, J.L. (2003): "Sustainable Agricultural Practices in Rondomia, Brazil. Do local Farmer Organisations Affect Adoption Rates?" *Economic Development and Cultural Change* 52 PP: 23-49.

Chaves, B. & Riley, J. (2001): "Determination of factors influencing integrated pest management adoption in coffee berry borer in Colombian farms". *Agriculture, Ecosystems and Environment*, 87 PP: 159-177.

Chigona , W. & Linker, P. (2008). *Using Diffusion of Innovations Framework to Explain Communal Computing facilities Adoption among the Urban Poor.*

Dearing, James, W. (2004). "Improving the state of Health Programming by Using Diffusion Theory". *Health Communication* 9: 21-36.

Doss, C.R. & Morris, M.L. (2001). *"How does Gender Affect the Adoption of Agricultural Innovation? The case of Improved Maize Technology in Ghana". Agricultural Economics* 25 PP: 27-39.

Drechsel, P., Olaleye, A., Adeoti, A., Thiombiano, L., Barry, B. & Vohland, K. (2004). Adoption Driver and Constraints of Resource Conservation Technology in Sub-sahara Africa. Accra, Ghana.

El-Osta, H.S. & Morchart. (1999). *"Technology Adoption Decisions in Dairy Production aand the Role of Herd Expansion". Agricultural and Resource Economics Review* 28 PP: 84-95.

Feder, G., E.R. Just & Zilberman, D. (1985). *"Adoption of Agricultural Innovations in Developing Countries: A survey". Economic Development and Cultural Change*, 33 PP: 255-298

Feder, G. Slade, R. (1984). *The acquisition of information and the adoption of new technology.* American journal of Agricultural Economics 66 (2): 312-320

Gold, C.S., Ogenga-Latigo, Tushemereirwe, W., Kashaija, I. & Nankinga, C. (1993). *Farmer perceptions of banana pest constraints in Uganda: Results of rapid rural appraisal*, Kampala Uganda.

Green, D.A.G. & Ng'ong'ola (1993). "Factors Affecting Fertilizer Adoption in less Developed Countries: An Application of Multivate Logistic Analysis in Malawi". *Agricultural Economics*. 44(1): 99-109

Haider, M & Kreper, G.L. (2004). "Forty Years of Diffusion of Innovations: Utility and Value in Public Health". *Health Communication* 9: 3-11.

Hooks, G.M., Napier, T.L. & Carter, M.V. (1983). Correlates of Adoption Behaviours.

Honlonkou, A.N. (2004). "Modeling Adoption of Natural Resources Management Technologies: The Case of Fallow Systems". Environemnt and Development Economics 9: 289-314.

Hornik, R. (2004). "*Some Reflection on Diffusion Theory and the Role of Everti Rogers*". Journal of Health Communication 9: 143-148

International Maize and Wheat Improvement Center (CIMMYT, 1993). *The adoption of Agricultural Technology*. A guide for survey design.

Jalloh, A. (2001). *Promoting Appropriate Inter-cropping Technologies for Sustainable Agricultural Production in Africa.*

Kakooza, J., Kabasimba, E., Semakula, B. & Musisi, A. (2005). Gender Variation in Agricultural Technology: A comparative analysis of Two Ecological Zones in Uganda.

Kassie, m., Precious, Z., Kibede, M. and Sue, E. (2009). Adoption of Organic Farming Techniques.

Kato, E. (2000). *"Analysis of factors affecting adoption of K131 bean variety by women groups in Luuka county, Iganga district"*. MS thesis, Makerere University, 2000.

Khanna, M. (2001). *"Sequential Adoption of Site-specific Technologies and its Implications for Nitrogen Productivity: A Double Selective Model". Agricultural Economics* 83 PP: 35-51

Kimenya, L.N. (2001). "Understanding low rates of technology adoption by women farmers" a case study of the determinants of adoption of improved sorghum varieties by women farmers in Mbeera District, Kenya: *Agricultural Science and Technology.* PP: 30-40.

Kincaid, D.L. (2004). *"From Innovation to Social Norm: Bounded Normative Influence". Health Communication* 9: 37-57

Kivlin, J.E. and Fliegel, F.C. (1996). "Attributes of Innovations as Factors in Diffusion". A.M.J. Sociology 72 PP: 235-248

Lowery, S. & Defleur, M. (1995). *Milestones in mass communication Research.* White Plain, NY: Longman Publishers.

Lubwama, F.B. (1999). Social-economic and gender issues affecting the adoption of conservation tillage practices, Kampala-Uganda.

Manyewa-Mutamba & Nyagah, L. (2009). Africa : *Smallholder Agriculture Transforms Lives of Poor.*

Mark, G. and Poltrock, S. (2001). Diffusion of a collaborative technology across distance. Proceedings of the 2001 International Association of Computing Machinery SIGGROUP Conference on supporting Group Work, 232-241.

Mayee, C.D., Monga, D., Dhillon,S.S, Nehra, P.L. & Pundhir, P. (2008). *Cotton-Wheat Production System in South Asia. A success story*, Bangkok, Thailand

McNamara, K.T., Wetzstein, M.E. & Donce, G.M. (1991). *"Factors Affecting Peanut Producer: Adoption of Integrated Pest Management". Review of Agricultural Economics* 13 PP: 129-139

Manale, K, Zikhali, P, Kibede, M. & Sue, E. (2009). *Adoption of Organic Farming Techniques.*

Ministry of Finance, Planning and Economic Development (2007): Uganda Financial Overview 2007-2008, Kampala-Uganda.

Moore, G. & Benbasat, I. (1991). Development of and instrument to measure the perceptions of adopting and information technology innovation.

Mugenda, O.M. & Mugenda, A.G. (2003). *Research methods, Quantitative and Qualitative Approaches.* Nairobi-Kenya

Mukono District Environment Profile (2003). *Main Farming Activities by sub-counties*, Mukono District, Kampala-Uganda.

Mukono District – *Tourism & Investment Infrastructure*, 2009, Kampala-Uganda.

Munyambonera, E.F (2000). *Socio-Economic effects of the coffee with disease and its implications for coffee production in Uganda*, Kampala-Uganda.

Nankinga, C.M. (1994). *The potential of indigenous fungal pathogens for the Biological Control of the banana weevil, (cosmopolites sordidus)* in Uganda (MS.c Thesis, Makerere University, Faculty of Agriculture and Forestry) Uganda.

Nguthi, F.N. (2007). *Adoption of Agricultural Innovations by Smallholder Farmers in the Context of HIV/AIDS:* The case of tissue cultured banana in Kenya, Nairobi-Kenya

Nkonya, E., Schroeder, T & Norman, D. (1997). *"Factors Affecting Adoption of Improved Maize Seed and Fertilizer in Northern Tanzania". Agricultural Economics* 48 PP: 1-12

North West Area Foundation (2004). *"The Adoption of Sustainable Agriculture: Meeting the Challenge".*

Olwande, J, Sekei, G. & Mathega, M. (2009). *Agricultural Technology Adoption*. A Panel Analysis of Smallholder Farmers' Fertilizer use in Kenya, Nairobi-Kenya.

Oradho, A.B. *1983). Pasture research in Kenya. National Agricultural Research Station, Nairobi-Kenya

Overfield, D. & Fleming, E. (2001). *"A Note on the Influence of Gender Relations on the Technical Efficiency of smallholder Coffee Production in Papua New Guinea". Agricultural Economics.* PP: 153-156

Oso, W.Y. & Onen, D (2008). A General Guide to Writing Research Proposal and Report, Kampala-Uganda.

Place, F. & Dewees (1999). "Policies and Incentives for the Adoption of Improved Fallows" Agroforestry Systems 47: 323-343.

Rogers, E.M. (1983). Diffusion of Innovations, 3rd ed. New York: Free Press

Rogers, E.M. (1995). Diffusion of Innovations, 4th ed. New York: Free Press

Rogers, E.M. (2003). Diffusion of Innovations, 5th ed. New York: Free Press

Rutherfold, M. (2005). *Promotion of improved IPM practices for banana diseases and pests in Uganda.* Final Technical Report. Kampala-Uganda.

Shakya, P.B. & Flinn, J.C. (1985). "Adoption of Modern Varieties and Fertilizer use on Rice in the Eastern Tarai of Nepal:. Journal of Agricultural Economics, 36(3) PP: 409-419.

Soejitno, J. (1999). *Integrated Pest Management in Rice,* Indonesia – A success story. Bangkok-Thailand.

Strauss, J., Barbosa, M., Teixeire, S., Thomas, D. & Gomes, R. (1991): "Role of Education and Extension in the adoption of technology: A study of upland rice and soya bean farmers in Central-West Brazil". *Agricultural Economics* 5 PP: 341-359.

Tushemereirwe, W.K., Nowankunda, K., Sebuliba, R., Ragama, P. & Tenkonano, A. (2003). *Potential of improved banana cultivars as a food security and income generating crop: Preliminary results on adoption of the cultivars. Agricultural Science*, 8: 91-100

Uaiene, R.N., Arndt, C., Masters, W.A. (2009). Determinants of Agricultural Technology Adoption in Mozambique.

Uganda National Banana Research Programme (2003). A guide to successful banana production in Uganda, 2nd Ed. 2003, Kampala-Uganda

Uganda National Banana Research Programme. (2004): *Proceedings of the stakeholders' workshop for Promotion of Banana Production, Commercialization and Utilization Technologies in Luwero, Mukono and Kayunga Districts.* 25th -27th February 2004, Kampala-Uganda

Wejnert, B. (2002). *"Integrated Models of Diffusion of Innovations: A Conceptual Framework"*.

World Bank. (2008). "Agriculture for Development". World Bank Development Report 2008. Washington: World Bank.

Yaron, D., Dinar, A. & Voet, H. (1992). "Innovations of Family farms: The Nazareth Region in Israel: *Agricultural Economics Association*: 361-370

Young, Trevor (2003). "Adoption of Sustainable Agriculture Technologies: Economic and Non-Economic Determinants".

Yusof Basiron, B. (1995). *Palm Oil Industry in Malaysia* – A success story, Bangkok-Thailand.

APPENDIX I: SURVEY QUESTIONNAIRE

Identification of factors that affect the adoption of agricultural technologies in Uganda: A case study of banana production in Mukono District

Farm level survey questionnaire

SECTION A: IDENTIFICATION OF RESPONDENT

Date of interview..... Village: .....

Parish:..... Sub-county:.....

District:.....

SECTION B: DEMOGRAPHIC INFORMATION

1. Gender: Male ☐ Female ☐
2. Age: 1) 20-30☐ 2) 31-40☐ 3) 41-50☐ 4) 51+☐
3. Marital status: Single☐ Married☐ Divorced☐ Widowed☐ Separated☐
   Others specify:.....
4. Highest level of education: 1) None☐ 2) Primary☐ 3) Secondary☐
   4) Tertiary institution☐

SECTION C: GENERAL FARMING BACKGROUND

5. What is the total size of your farm? 1) Less than an acre☐ 2) 1 acre☐ 3) 2 acres ☐
   4) more than 2 acres ☐
6. No. of years as a farmer (1) 1-5 ☐ (2) 6-10☐ (3) 11-15☐ (4) >15 ☐

7(a) What types of crops do you grow? (Tick al that apply)

	Crops	Yes=1	No=2
1.	Banana		
2.	Sweet potatoes		
3.	G. Nuts		
4.	Beans		
5.	Maize		
6.	Cassava		
7.	Rice		
8.	Sorghum		
9.	Vegetables		
10.	Coffee		
11.	Others (specify)		

7(b) Acreage of banana crop. 1) 0.5 acres ☐ 2) 1 acre ☐ 3) 1.5 acres ☐ 4) 2 acres ☐
5) > 2 acres ☐

8. Do you own livestock? 1) Yes ☐ 2) No ☐

9. If yes, indicate type by ticking accordingly

Type of livestock	Yes=1	No=2
Cows		
Goats		
Sheep		
Pigs		
Chicken		
Others (specify)		

SECTION D: ADOPTION OF AGRICULTURAL TECHNOLOGIES

10. What type of banana varieties have you acquired and planted on your farm?
Indicate the type by ticking appropriately.

Cultivars	Types (e.g.)	Yes=1	No=2
Local cultivars	Mpologoma		
	Kibuzi		
	Musakala		
	Nakitembe		
	Nfuka		
	Kisansa		
	Nakabululu		
Beer/desert types e.g.	Beer type		
	Gonja		
	Bogoya		
	Ndizi		
Improved (exotic) types from Kawanda	(Example)		
	KABONA 1		
	KABONA 2		
	KABONA 3		
	KABONA 4		

11. If you have not planted the improved (exotic) banana varieties, what are the reasons for not planting them?

	Yes=1	No=2
i) Lack of planting materials		
ii) Lack of capital		
iii) High price of planting materials		
iv) I didn't know about improved varieties		
v) Improved varieties not good for food		

12. If you have planted improved banana varieties, comment on the characteristics as indicated below with YES or NO

Characteristics	Yes=1	No=2
Early maturing		
High yielding		
Pest resistance		
Disease resistance		
High food quality		
Others specify		

13. What is the source of your planting material?

1) Farmers plantations ☐ 2) Private commercial nursery ☐ 3) Kawanda UNBRP ☐

14. Which of the following recommended banana management practices are you following?

Recommended management practices	Yes=1	No=2
1. Digging holes for planting (60cm x 60cm)		
2. Use clean planting materials free of weevils		
3. Plant at recommended spacing (10ft x 10ft)		
4. Plant at the beginning of the rain season		
5. Control weeds by hand weeding or using herbicides		
6. Apply mulch		
7. Remove excess suckers and maintain 3 at different ages every time		
8. Remove male buds		
9. Remove dry leaves		
10. Intercrop at early establishment of the banana plantation		
11. Control soil erosion using grass bands, cover crops etc		

15. How do you maintain soil fertility in your banana plantation? (Tick that apply)

Types of manure	Yes=1	No=2
1. Apply cow or poultry manure		
2. Use fertilizers		
3. Use mulch only		
4. I don't use any of the above		

16. How do you control pests and diseases in your banana plantation?

	Yes=1	No=2
i) Use clean planting materials		
ii) Practice good husbandry		
iii) Use agricultural chemicals		

17. Have you participated in the generation and evaluation of any of the above recommended banana technologies 1 = Yes ☐ 2 = No ☐

18. At what level did you participated? 1 = Generation ☐ 2 = Evaluation ☐ Generation and Evaluation ☐ Didn't participate ☐

19. Which technologies have you found easy to adopt and why?.....

20. How can researchers improve on the technologies they developed so that they can easily be adapted by smallholder banana farmers?.....

SECTION E: FARMERS CHARACTERISTICS

21. In your banana plantation, who is responsible for the under listed activities?

Activity	Male	Female
Land preparation		
Digging holes		
Application of manure		
Planting		
Weeding		
Desuckering		
Controlling pests & diseases		
Harvesting		
Marketing		

22. Do you think it is useful to acquire and use the improved technologies in your banana plantations? 1= Yes ☐ 2= No ☐

SECTION F: ECONOMIC FACTORS

23. How affordable are the recommended banana technologies? Tick as may apply

Recommended technologies	1=Affordable	2=Expensive
Clean planting materials		
Use of fertilizers/manure		
Hand weeding		
Using herbicides		
Applying mulch		
Removing excess suckers		
Controlling pests and diseases		
Soil and water management		
Post harvest handling		

24. How have you been funding your banana production activities? E.g. controlling weeds, pest and diseases, manure application etc. 1 = Own money ☐ 2 = Bank loan ☐

25. If loan from the bank or other sources, did you use a security to obtain a loan?

1) Yes ☐ 2) No ☐

26. How long did it take you to get the money from date of application?

1= One month ☐ 2= More than a month ☐

27. What was the repayment period? 1= 6 months-1 yr ☐ 2=More than a year ☐

28. If you did not acquire a loan, tick the appropriate reason for not borrowing from the bank.

	Yes=1	No=2
i) No bank in the village		
ii) Interest rates very high		
iii) No security to give to bank		
iv) No knowledge about bank funds		

29. Since you have been using the recommended agricultural technologies, have you realized any benefit? 1 =Yes ☐ 2 = No ☐

30. If yes, mention the benefits. 1) Income ☐ 2) Food ☐

31. How many household members work on the banana production enterprise?

1) 1-3 ☐ 2) More than 3 ☐

32. How many household members work on other enterprises on the farm?

1) 1-3 ☐ 2) More than 3 ☐

33. Do you hire outside labour to work on your banana production enterprise? 1. Yes ☐ 2. No ☐

34. If yes, which agricultural activities in your banana enterprises do you engage this hired labour (e.g. digging holes, applying mulch, applying manure etc).....

SECTION G: INSTITUTIONAL FACTORS

35. How do you access agricultural information?

	Source	Yes = 1	No = 2
1	Radio		
2	Newspaper		
3	Farmer organizations		
4	MAAIF extension staff		
5	NAADS staff		
6	NGOs		
7	Agricultural meetings/seminars		
8	Farm visits		
9	Visit to Research stations		
10	Visit to agricultural development centres		
11	No source		
12	Others (specify)		

36. How useful is the information accessed? 1 = Useful ☐ 2 = Not useful

37. How early do you use the information you have accessed to adopt a technology?

1 = After majority farmers have adopted ☐ 2 = After observing benefits from other using it ☐

3 = Soon after learning about the technology ☐ 4 = Immediately ☐

38. Indicate the person who has been giving you agricultural advice on your banana farming enterprise?

	Yes=1	No=2
i) Sub-county agricultural extension officer		
ii) Sub-county NAADS extension officer		
iii) Agricultural officers from other organizations		
iv) Local leaders in the parish/village		

39. How often do you get advice from any of the above you have chosen?

1= Once every 6 months ☐ 2= Once a year ☐

40. Do you belong to any farmers' organization? 1= Yes ☐ 2= No ☐

41. If yes, are they useful? 1= Yes ☐ 2= No ☐ 3 = Not sure ☐

42. If you belong to any farmer organization, how many farmers' organization meetings/seminars did you attend in a period of one year? 1 = 1-3 meetings ☐ 2 = More than 3 meetings ☐

43. Who facilitated those meetings/seminars?

	Yes=1	No=2
i) Agricultural extension staff		
ii) NAADS extension staff		
iii) Agricultural officers from other organizations		
iv) Local leaders in the parish/village		

44. In what form are technologies in banana production presented to you for adoption?

	Yes=1	No=2
i) Farm demonstrations		
ii) Farm visits to model farmers		
iii) Agricultural seminars by extension staff		
iv) Farmer field schools		

45. To improve and increase banana production, you have to control pests and diseases, apply manure/fertilizers and improve on the management practices (weeding, desuckering etc). Have you been using all these technologies in combination? 1= Yes ☐ 2= No ☐

46. If no, what are the reasons for your failure to use them?

.....

47. What other issues do you suggest to be attended to for the improvement of banana production in your area?.....

END, THANK YOU

APPENDIX II: INTERVIEW GUIDE

nterview guide for in-depth interviews of the sub-county staff of Nakisunga, Ntenjeru, Kyampisi and Nama

entification of some factors that limit the adoption of agricultural technologies in Uganda. A case udy of Banana Production in Mukono District.

1. Date of interview.....

District:.....

Sub-county:..... Parish:.....

Village: ..... Respondent

ame.:.....

2. **Demographic Information**

1. Age
2. Marital status
3. Gender
4. Education

3. **Adoption of banana technologies**

i) What type of banana varieties do farmers in your area grow and why?

ii) Which recommended management practice do they follow?

iii) How do banana farmers in your area maintain soil fertility?

iv) How do they control pests and diseases?

v) How do farmers participate in technology generation and evaluation

vi) What is your advice to researcher on banana production

4. **Economic factors**

A number of banana production technologies have been developed by NARO at Kawanda, which include, use of fertilizers/manure, pesticides, introduction of new banana varieties etc.

i) In your opinion can the small holder banana farmers afford to buy and use these technologies?

ii) How do most farmers in your area finance their banana farming enterprises?

iii) Are they able to access credit from banks?

iv) Are there agricultural credit banks or lending institutions in your area to give credit to banana farmers?

v) How easy is it for the smallholder farmers to get credit facilities from banks?

vi) What are the interest rates?

vii) What is the repayment period?

viii) Is banana production labour demanding?

ix) Are farmers usually able to get the required labour to manage their enterprises?

x) If farmers use the recommended technologies in their banana enterprises. do you think they are able to make profits?

5. Institutional factors

i) Do you have Agricultural/NAADS Extension staff in your district/sub-county? And how many per sub-county?

ii) How often do they visit banana farmers?

iii) How are they facilitated

iv) Apart from extension/NAADS staff, how do farmers in your area access agricultural information?

v) In what form do agricultural/NAADS staff present agricultural technologies to far

6. Farmer characteristics

a) Give your comment on how the under listed farmer characteristics affect adoption of agricultural technologies in banana production on your area.

- Age
- Level of education
- Farmer perceptions
- Gender

APPENDIX III: DETERMINING SAMPLE SIZE

Sample size (s) required for the given population sizes (N)

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	256	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384

Note : From R. V. Krejcie and D. W. Morgan(1970), Determining sample size for research activities, Educational and psychological measurement, 30, 608, Sage Publications.

APPENDIX IV: INTRODUCTORY LETTER

UGANDA MANAGEMENT INSTITUTE

Telephones: 256-41-4259722 /4223748 /4346520
256-31-2265138 /39 /40
256-75-2259722
Telefax: 256-41-4259581 /314
E-mail: admin@umi.ac.ug

Plot 44-52, Jinja Road
P.O. Box 20131
Kampala, Uganda
Website: http://www.umi.ac.ug

Your Ref:

Our Ref: G/35

04 November 2010

TO WHOM IT MAY CONCERN

MASTERS IN MANAGEMENT STUDIES DEGREE RESEARCH

Mr. Godfrey Kibirige Kayongo is a student of the Masters Degree in Management Studies of Uganda Management Institute 20th Intake, 2009/2010 specializing in Project Planning and Management, Registration number: **09/MMSPPM/20/008.**

The purpose of this letter is to formally request you to allow this participant to access any information in your custody/organisation, which is relevant to his research.

His Research Topic is: ***"Factors Affecting Farmers' Adoption of Agricultural Technologies in Uganda: A Case Study of Banana Production in Mukono District".***

Benon C. Basheka
HEAD, HIGHER DEGREES DEPARTMENT

APPENDIX V: TEST SCORES FOR RELIABILITY

Test scores for reliability

	T_1		T_2
1-	203	2-	177
3-	187	4-	187
5-	171	6-	139
7-	168	8-	168
9-	180	10-	199
11-	183	12-	160
13-	125	14-	134
15-	142	16-	96
17-	102	18-	80
19-	179	20-	170
Total	**1639**	**Total**	**1510**

Correlations

		VAR00001	VAR00002
VAR00001	Pearson Correlation	1	.871
	Sig. (2-tailed)	.	.001
	N	10	10
VAR00002	Pearson Correlation	.871	1
	Sig. (2-tailed)	.001	.
	N	10	10

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

APPENDIX V: TEST SCORES FOR RELIABILITY

Test scores for reliability

T_1		T_2	
1-	203	2-	177
3-	187	4-	187
5-	171	6-	139
7-	168	8-	168
9-	180	10-	199
11-	183	12-	160
13-	125	14-	134
15-	142	16-	96
17-	102	18-	80
19-	179	20-	170
Total	**1639**	**Total**	**1510**

Correlations

		VAR00001	VAR00002
VAR00001	Pearson Correlation	1	.871
	Sig. (2-tailed)	.	.001
	N	10	10
VAR00002	Pearson Correlation	.871	1
	Sig. (2-tailed)	.001	.
	N	10	10

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

APPENDIX VI: MAP OF MUKONO DISTRICT



APPENDIX VII: RESPONDENT SELECTION

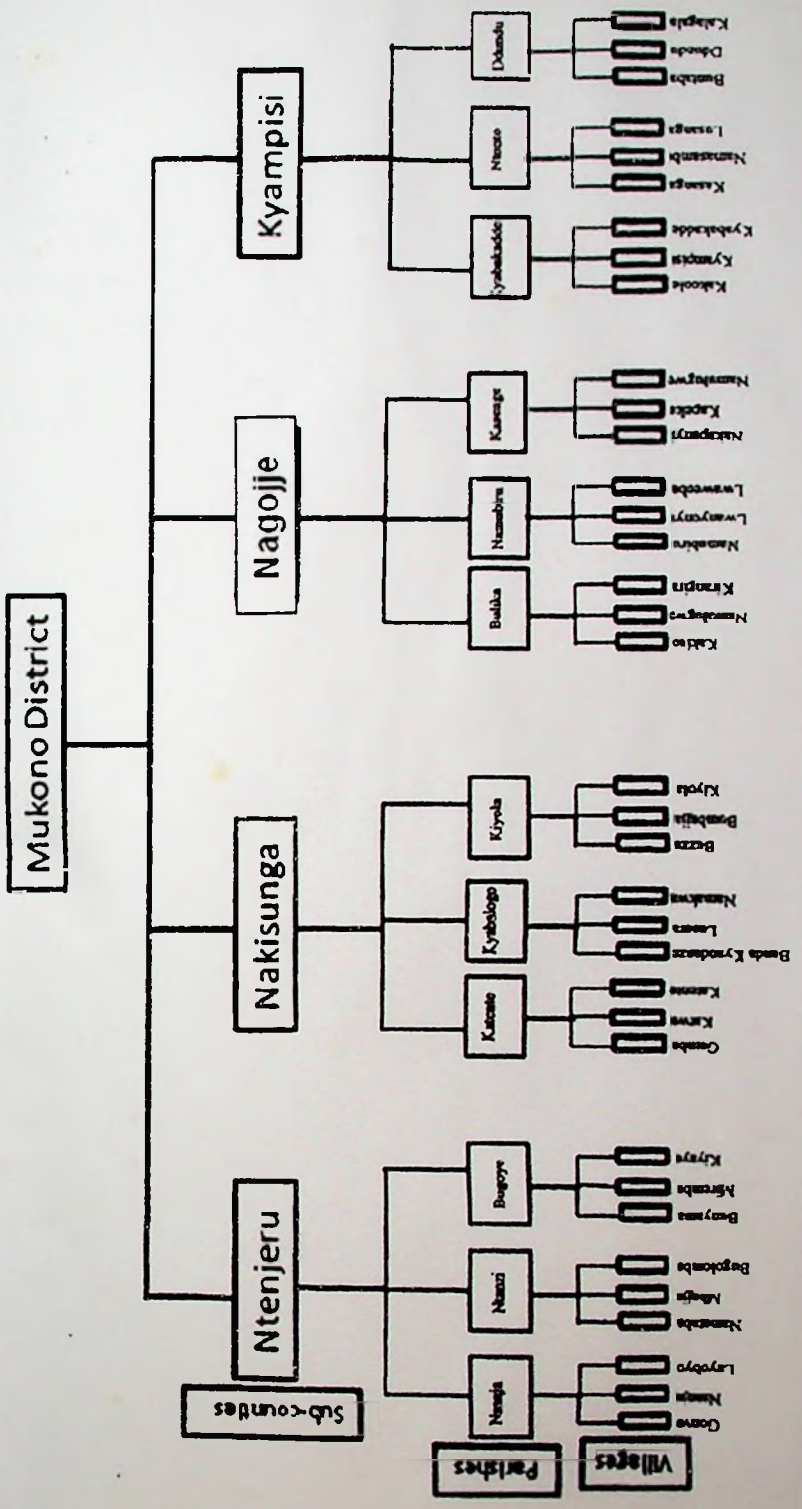


Fig. 3.2: Respondent selection