THE ROLE OF SOCIAL-ECONOMIC AND POLITICAL FACTORS IN ADOPTION OF TISSUE CULTURE BANANA TECHNOLOGY AMONGST SMALL HOLDER FARMERS IN UGANDA.

CASE OF WAKISO DISTRICT

A POSTGRADUATE DISSERTATION

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DEDICATION

This research report is dedicated to the Almighty God, my refuge and fortress and to my lovely parents Mr. & Mrs Kagoda for the valuable gift of education they gave to me.

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LIST OF ABBREVIATIONS

ACORD	Agency for cooperation and Research in Development
ASARECA	Association for Strengthening Agricultural Research in East and Central Africa
DSIP	Agricultural sector development strategy and investment plan
GOU	Government of Uganda
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MAFAP	Monitoring African Food and Agricultural Policies
MFPED	Ministry of Finance, Planning and Economic Development
NAADS	National Agricultural Advisory services
NAP	National Agricultural Policy
NARL	National Agricultural Research Laboratories (NARL)
NDP	National Development Plan
OWC	Operation Wealth creation
PMA	Plan for Modernization of Agriculture
TCB	Tissue culture Banana
UBOS	Uganda Bureau of Statistics
VIF	Variance Inflation Factor

ABSTRACT

Banana *(Musa spp)* is an important starchy food and cash crop in Uganda with potential for food and livelihood security. However, it is under threat of reduced productivity and sustainability with the actual banana yields on small holder farms far less than the estimated potential yield. This is attributed to a number of biophysical and socio-economic factors. In order to revert this trend, the government introduced banana tissue culture technology as a measure of increasing productivity and sustainability of this important crop as well as draw farmers out of poverty but many have still rejected this technology and have reverted to land races. Hence, it remains unclear whether this shift is due to socio-economic factors as affected by the politics of the time or as a result of other factors. A survey was conducted amongst small holder farmers in Wakiso District, Central Uganda to determine the drivers of socio-economic factors influencing tissue culture banana technology adoption, examine the role of socio-economic factors in tissue culture banana production and to establish the influence of agro-related policies in tissue culture banana technology adoption. 115 farmers who had adopted tissue culture banana technology under various government programs were randomly selected and interviewed between February 2018 to May 2018. The data obtained was analyzed using SPSS software (Ver.16.0).

Results from the study revealed that the drivers of the socio-economic factors influencing tissue culture banana adoption were respondents' main occupation ($P = 0.028$), market accessibility ($P = 0.006$) and proximity to source of planting materials ($P = 0.000$). Access to extension services were great motivators to enhanced adoption of tissue culture banana ($R^2 = 0.539$) while accessibility to free tissue culture plantlets contributed 25.6% in the adoption ($R^2 = 0.256$). Age and mode of land acquisition were significant contributors to tissue culture banana yield ($P<0.05$). In regard to influence of agro-related policies in tissue culture banana adoption, the findings showed that 72.2% of the respondents were aware of Plan for Modernization of Agriculture policy,4.3 % were aware of National Agricultural Policy, 11.3% were aware of National Development Plan while 2.6% were aware of the Agricultural sector development strategy and investment plan. However, further analysis revealed weak negative correlations for awareness of PMA ($r = -0.17$), NDP ($r = -0.10$) and NAP ($r = -0.109$) polices and adoption of banana tissue culture and a weak positive correlation for DSIP ($r = 0.148$). A chi-square test showed that awareness of agro-related policies was equally insignificant in adoption of tissue culture banana.

The study recommended increasing access to extension services, developing distribution centers for tissue culture plantlets at District level and equipping farmers with knowledge on agro-related policies.

CHAPTER ONE
GENERAL INTRODUCTION

1.0 Introduction

This chapter highlights the back ground to the study, the statement of the problem, the general and specific objectives as well as scope of the study. It further delves into the significance of the study, its justification, definition of key terms as well as conceptual framework.

1.1Background to the study

Governments' world over have used improved technologies as a major strategy towards increased agricultural productivity; promotion of food and livelihood security; employment creation and poverty alleviation (Ndungu *et.al.*2017). Tissue culture technological development is a major scientific milestone widely accepted as a means of addressing food productivity, food unavailability, its access and affordability to many households with surpluses reaching the market to generate the much-needed income to many peasant farmers worldwide (Ndungu *et.al.*2017).

Tissue culture or *in vitro* culture refers to a technique through which small plant organs, embryos, cells or protoplast are aseptically isolated and grown on artificial nutrient media under controlled environment into complete plants (Wandui *et.al.*, 2013). The technique allows mass multiplication of species that are difficult to regenerate by conventional methods of propagation such as the banana which is a staple food crop for 13 million rural Ugandans (Nguthi *et.al*., 2007; ACORD Uganda, 2010). The banana is also an important starchy food and cash crop in Uganda and has potential for food and livelihood security. The largest producer of banana in Uganda is western particularly Isingiro district with a tonnage of 204,109 per year followed by Mubende district in the Central producing 204,109 tons then Mbale in the East with 99011tons and lastly Arua in the North with 17106 tons (Nyombi 2013; Nguthi, 2007; UBOS, 2016). However, banana is under a

threat of reduced productivity and sustainability and the actual banana yields on small holder farms are far from the estimated potential yield (Nyombi, 2013). The reduction in productivity is attributed to a number of biophysical and socio-economic factors.

Socio-economic factors greatly impact on the adoption of new farming technologies. Farmer characteristics such as; gender, employment status, family size, education level and age, while farm characteristics which include; farm size, land tenure, off-farm income, distance to the nearest market, income diversification and access to extension service have a great impact on the adoption of tissue culture banana technology amongst many farming households (Langat *et.al*., 2013). Further studies done by Wanyama *et.al.* (2013) reveal that access to tissue culture banana plantlets increases the likelihood of farmers to adopt the technology while age is also important, with younger farmers more likely to adopt. He further states that farmers who engaged in off farm occupation were likely to intensify tissue culture banana production by expanding banana acreage using the superior tissue culture banana plantlets for enhanced production which is in line with economic theory that more income means higher purchasing power for consumers. Availability of labor was equally crucial in enhanced investment in tissue culture banana technology intensification and thus family size is vital in adoption of the above technology while contacts with Government extension agents enhanced the intensification of the tissue culture banana technology.

On the other side of the coin, political aspects such as policy, funding, research, among others affect the agro ecology of banana production especially amongst small holder farmers. This is evidenced by Ndungu *et.al* (2017) who highlights that policy is a key factor in terms of accelerating adoption of new agricultural technologies and particularly in addressing such concerns as food security, income generation, poverty and employment. A number of agro related policies have been developed in Uganda in a bid to increase uptake of agricultural technologies. Such policies

include Plan for Modernization of Agriculture (PMA), National Agricultural Policy (NAP), National Development Plan (NDP), Agricultural Sector Development Strategy and Investment Plan (DSIP) amongst others.

Thus, this study sought to evaluate the socio-economic factors in adoption of banana tissue culture and as well ascertain the effect of the agro-related policies on its adoption.

1.2 Problem statement

The adoption of banana tissue culture technology is aimed at increasing food production as well as livelihood security (Nguthi, 2007). Tissue culture banana technology was introduced in Uganda a decade ago to draw farmers out of poverty and for food security although many have rejected the technologies and have reverted to land races with studies indicating propagation of banana by use of tissue culture at barely 8% (Albertson, 2016). However, it is not clear whether this shift is due to social economic factors as affected by the politics of the time or as a result of other factors. Thus, this research aimed at evaluating the socio-economic factors influencing tissue culture banana technology adoption in the context of political agroecology amongst small holder farmers in Uganda.

1.3 Objectives of the study

1.3.1 General Objective

To evaluate the role of social, economic and political factors in adoption of tissue culture banana technology amongst small holder farmers in Uganda.

1.3.2 Specific objectives

1 To determine the drivers of socio-economic factors in influencing tissue culture banana technology adoption.

1 To examine the role of socio-economic factors in tissue culture banana production among smallholder farmers in Wakiso District.

2 To establish the influence of agro-related policies in tissue culture banana technology adoption

1.4 Research questions

1. What are the drivers of the socio-economic factors influencing tissue culture banana technology adoption?
2. What is the role of socio-economic factors in tissue culture banana production among smallholder farmers in Wakiso district?
3. Do agro-related policies influence the adoption of tissue culture banana technology?

1.5 Scope of the study

The study was an evaluation of the socio-economic factors affecting adoption of tissue culture banana technology in the context of political agroecology. The research focused on small holder farmers who were utilizing tissue culture as a measure of banana propagation on their farms and was conducted within Wakiso District, Central Uganda. It sought to identify the drivers of the

socio-economic factors affecting adoption of banana tissue culture, the role of the various socio-economic factors as well as the impact of the various agro-related policies in adoption of banana tissue culture. The study was carried out between January and April 2018 and basing on the time and financial constraints, the researcher deemed that time fit for the study.

1.6 Significance of the study

To the farmers especially those dealing in banana production, the findings of this research will provide information on the various drivers of the socio-economic factors affecting adoption of tissue culture banana as well as their roles. Thus, appropriate measures to the various drivers can be put in place in a bid to increase adoption of banana tissue culture technology. To the government and other policy makers, the research findings will lead to accelerated agro-related policy awareness thus leading to increased uptake of agricultural technologies while to the academia, this research will contribute to the pool of knowledge and available literature.

1.7 Justification of the study

The National Food Security Assessment held in January 2017 indicated that 10.9 million Ugandans were experiencing acute food insecurity of which 1.6 million were in a critical situation (GOU, 2017). This was attributed to the increasing population which had outpaced the agricultural sector growth. Thus, in a bid to meet the growing food requirements, there is need to embrace agro technologies such as banana tissue culture that yield sustainable production. Adoption of banana tissue culture has also been greatly impacted by various socio-economic which have been highlighted by various literature however the drivers of such socio-economic factors as well as their role in regard to adoption of banana tissue culture have not been articulated. Therefore, identifying such drivers and roles will play a great part in increasing adoption of the technology. Furthermore, the government of Uganda has put in place various agro-related policies but their

influence in adoption of agricultural technologies has not been documented thus a need to document the findings. This will in turn increase production and productivity leading to food security and improved farmer incomes.

1.8 Conceptual framework

The conceptual framework is defined as the visual presentation of key variables, factors and concepts and their relationship amongst themselves. The conceptual framework (Figure 1.1) shows how low banana tissue culture adoption has been caused by lack of awareness of agro-related polices, inaccessibility to markets, limited extension services amongst other socio-economic factors. This has resulted into low farmer incomes, food insecurity and reduced banana production. Thus, in order to avert the current situation, there is need to increase agro-related policies, train farmers and increase market access which will lead to improved food security, increased banana yields and continual use of tissue culture banana.

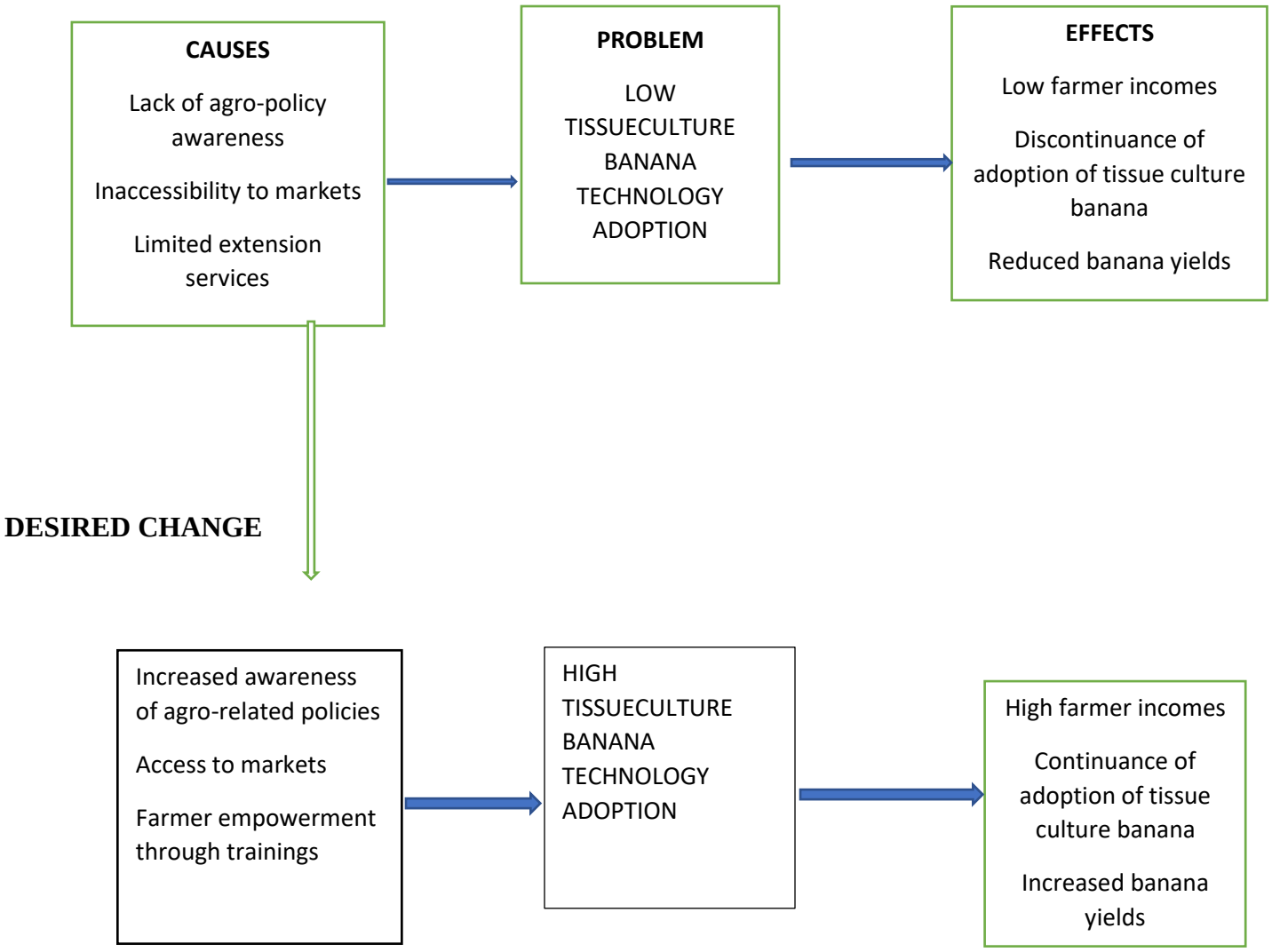

Figure 1.1 Conceptual framework

1.9 Definition of key terms

Small holder farmers: These are farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labor.

Food security: Food security as defined by the United Nations Committee on World Food Security is the condition in which all people, at all times, have physical, social and economic access to sufficient and safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life**.**

Plant tissue culture: This refers to the growing and multiplication of cells, tissues and organs of plants on defined solid or liquid media under aseptic and controlled environment (Asmita *et.al*. 2017)

Agroecology: The application of ecological principles to the design and management of sustainable farming systems (Gliessman, 2000).

Policy: Policy refers to a set of principles which guide decisions in order to achieve desired outcomes.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter introduces us to the theoretical framework guiding the study, the drivers of the various socio-economic factors affecting agro technology adoption, the role of the socio-economic factors in agro technology adoption as well as various agro-related policies in Uganda. It examines literature from scientific articles such as published journals, reports, text books amongst others and seeks to give an insight about other scholars' views in relation to the topic of study.

2.1 Theoretical Framework

2.1.1 The diffusion theory

This study will be guided by the diffusion theory which is one of adoption models as designed by Rogers (1995) in his book *Theory of Innovations*. Diffusion of Innovations seeks to explain how innovations are taken up in a population (Les Robinson, 2009). Greg (2003) also explains diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system.

An innovation is an idea, behavior, or object that is perceived as new by its audience. (Les Robinson, 2009). Rogers (1995) points out four factors that influence the adoption of an innovation which include the innovation itself, communication channels used to spread information about the innovation, time and the nature of society to whom it is introduced and he further states four major theories that deal with the diffusion of innovations which include the innovation decision process theory, the individual innovativeness theory, the rate of adoption theory and the theory of perceived attributes.

The innovation-decision process theory is based on time and five distinct stages as discussed by Nutley *et.al.* (2002). These are; the potential adopters must first learn about the innovation, secondly, they must be persuaded because of the merits of the innovation, thirdly they must decide to adopt the innovation. The adopters should further implement the innovation and also confirm that their decision to adopt was the appropriate decision (Figure 2.1).

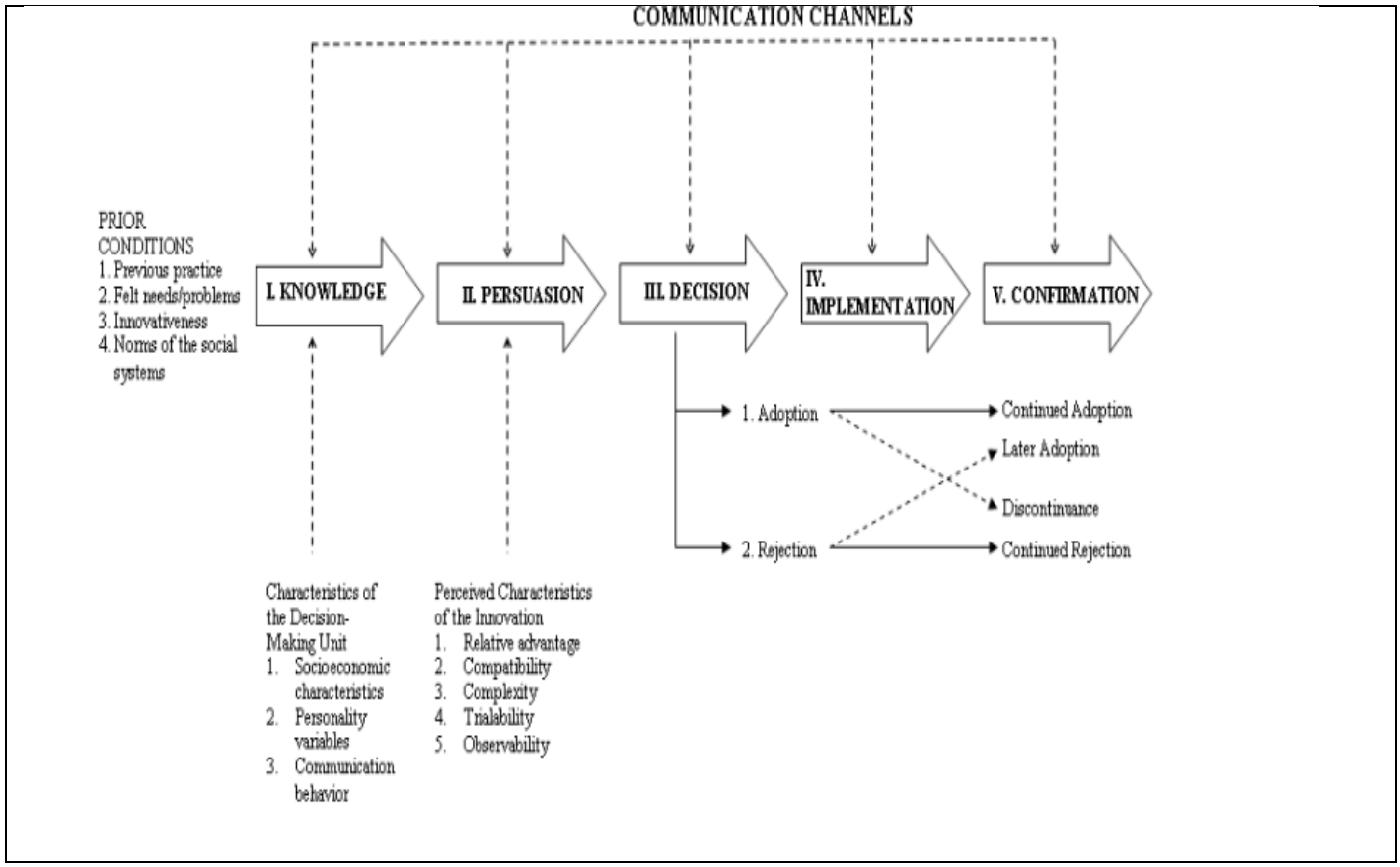

Figure: 2.1: A model of the five stages of innovation- decision process
Source: Rogers (2003).

Adoption- Nutley *et.al.* (2002) also explains the individual innovativeness theory which is based on who adopts and when. It is illustrated by bell-shaped curve (Figure 2.2). This theory categories adopters as innovators, early adopters, late adopters and laggards.

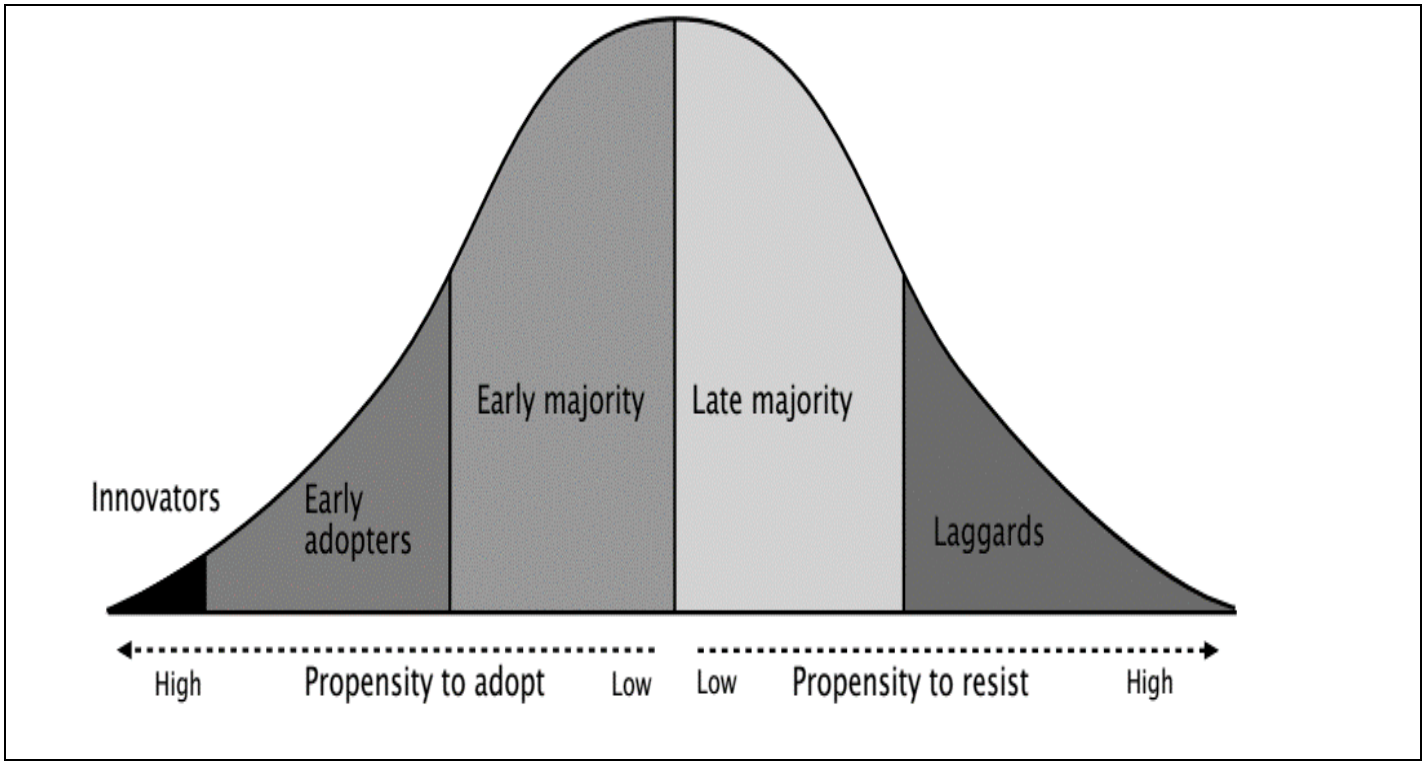

Figure 2.2: Illustration of Individual innovativeness theory

Source: Robinson (2009).

The theory of rate of adoption holds that adoption of an innovation grows slowly and gradually in the beginning. It will then have a period of rapid growth that will taper off and become stable and eventually decline (Rogers, 1995). It is best represented by an s-curve on a graph (Nutley *et.al.*, 2002).

Lastly, the theory of perceived attributes which is based on the notion that individuals will adopt an innovation if they perceive that the innovation has the following attributes (Nutley *et.al*., 2002). The innovation must have some relative advantage over an existing innovation, compatible with existing values and practices, is not too complex, cannot be tested for a limited time without

adoption and lastly offer observable results. Second, it is important the innovation be compatible (Rogers, 1995).

However, Waterman (2004) highlighted that the limitation of the diffusion theory was that it never considered the possibility that people would reject the innovation even if they fully understood it.

2.2 Drivers of socio-economic factors influencing banana tissue culture technology adoption

Agriculture forms the backbone of Uganda's economy with a large portion of its population dealing in it directly or indirectly. Countrywide, most agricultural activity takes place on farms averaging 0.9 ha, although average farm size varies by region and has been declining over the years (Uganda, 2007). Uganda grows about 16 major crops which include cereals (Maize, Millet, Sorghum, Rice); Root crops (Cassava, sweet potatoes, Irish potatoes); Pulses (Beans, Cow peas, Field peas, Pigeon peas); Oil crops (groundnuts, soybeans, Simsim), bananas and coffee (UBOS, 2016). These are either grown for export, home consumption or sold to nearby local markets. According to Kabunga *et.al.* (2011), banana production is currently gaining popularity as a cash crop in some regions as a result of fluctuations in coffee and tea prices.

Region	**Planted area (Hectares)**	**Production in tons**
Central	326,082	1,039,837
Eastern	69,504	342,234
Northern	9,195	31,626
Western	511,096	2,883,648

Table 2.1: Area and Production of Banana in Uganda
Source: UBOS (2016).

Banana is mainly grown in Uganda by small scale farmers and traditionally, they are vegetatively propagated using suckers. However, this practice fosters the transfer of pests (especially weevils and nematodes) and diseases (especially fungi and bacteria), consequently reducing potential yield from the beginning in newly established banana orchards. (Kabunga *et.al*.,2011) Thus banana tissue culture technology forms an alternative measure of propagation. However, the uptake of improved technologies such as banana tissue culture in developing countries still remains challenging and continues to beset Africa's food insecurity reduction efforts and economic development generally (Muyanga,2009; Langat *et.al.,* 2013).

Technological adoption is measured by the degree to which a new technology is used by farmers or adopters in the long run or at a small farm level, it relates to a farmer's decision to use a new technology in the production process (Barua, 2015). Foster and Rosenzweig (2010) highlight the major drivers of successful agricultural technology adoption in developing countries as availability and affordability of technologies as well as farmer expectations that adoption will remain profitable. Low adoption of agricultural biotechnology in developing countries has been attributed to factors such as lack of credit, limited access to information, aversion to risk, inadequate farm size, inadequate incentives associated with farm tenure arrangements, insufficient human capital, chaotic supply of supplementary inputs, rapid evolution and divergent perception of biotechnology, inadequate supply of TCB plantlets (Wanyama *et.al*., 2013; Sandy 2003). Langat *et.al*. (2013) further highlights that gender, off-farm employment, household size, education level, age, land size, off farm income and extension services have had significant influence on adoption of tissue culture banana production. This is equally evidenced by Barua (2015) who states that the lack of output markets where farmers could sell their produce backed by the poor infrastructure

discourage small holder farmers to increase their yield through adoption of modern agro technologies.

Parva (2011) further states that farm size may act as a proxy for many other socio-economic indicators such as access to credit because of availability of more collateral value

2.3 Roles of socio-economic factors in tissue culture adoption

Various studies have found that land, size, education level, access to inputs, head of household, access to credit, access to extension services as well as favorable geographical conditions play a great role in agro technology adoption (Barua,2015). The availability of cultivable land as argued by Kasirye (2013) helps reduce liquidity constraints faced by households, reduces risk aversion as well as facilitates experimentation with new technologies thus leading to early adoption. Thus, households with bigger land acreage are more advantageous as compared to those with small land acreages.

Technology adoption as a result of integration of various socio-economic factors contributes to nutrition, food security and overall health of small holder farmers in countries like Uganda. This is because most of these technologies lead to increased production and yield thus leading to increased access to food resulting into better health of the farmers (Figure 2.2).

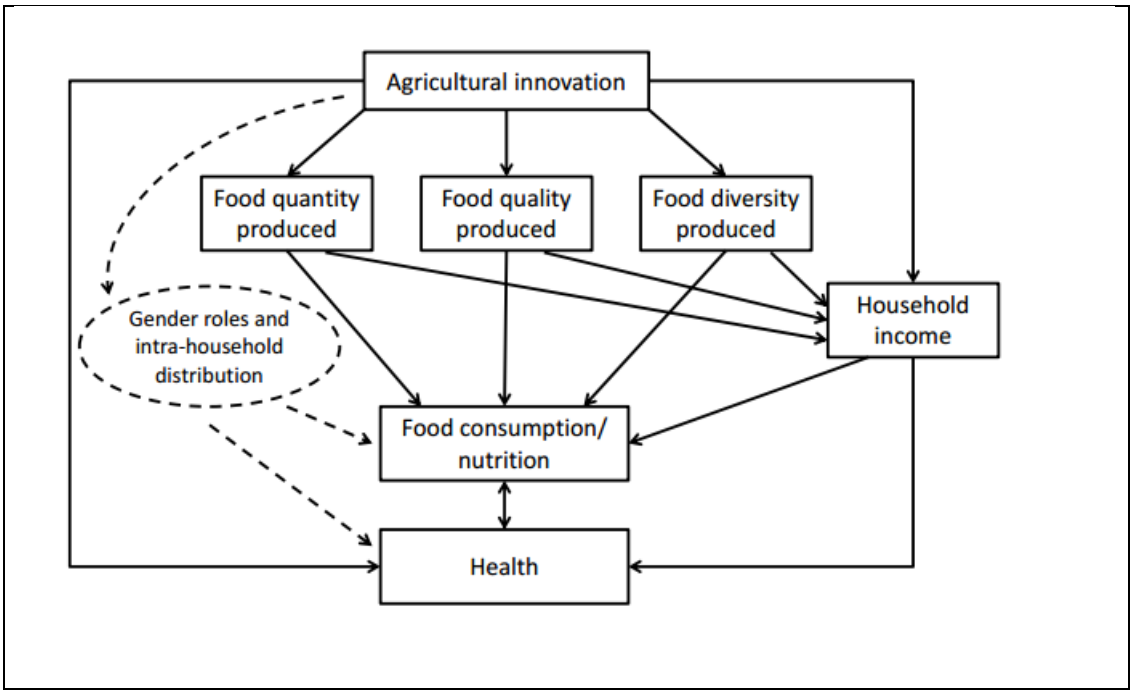

Figure 2.2: Impacts of agricultural innovations on nutrition and health in farm households
Source: Qaim (2014).

Effective technology adoption equally relies on learning whereby individuals must combine their own experience and expertise with advice from various sources in order to make initial adoption decisions and to improve their utilization of new technologies through time (Barham *et.al*., 2015). This is because farmers who are educated can easily learn and acquaint themselves with a new technology as opposed to farmers who are illiterate.

Inadequate supply of TCB plantlets coupled with the high cost has greatly impacted on the adoption of this technology. This is explained by Dubois *et. al.* (2013) who states that TC plantlets are obtained at a cost greater than sucker materials. Thus, a small-scale farm household cannot ably adopt to this technology as a result of the cost of the TCB plantlets.

Access to extension services is paramount in adoption of agro technologies. This is evidenced by Donkor *et. al*. (2016) in his study regarding impact of agricultural extension on adoption of chemical fertilizer where he indicates that extension contacts significantly play a great role in

promotion of adoption of chemical fertilizers in Africa. Access to extension service also enhances the adoption of improved agricultural technologies by reducing supply-side constraints that arise due to information market inefficiencies (Wossen *et. al.,* 2015).

Furthermore, availability of labor is vital for agro technology adoption in any given community. Labor availability is measured by disaggregating household labor by the number of men in the household, the number of women in the household and the number of children in the household (Albertson, 2016). Parva (2011) further emphasizes that the labor demands of any particular agro technology must match the labor availability in a targeted community. Thus, since many small-scale farm households depend on family labor for production, the family size plays an indirect role in adoption of an agro technology.

2.4 Influence of Agro-related policies in banana tissue culture adoption.

The government has been put in place a number of policies which influence adoption of agro-related technologies directly or indirectly. Policies in relation to education, land ownership, market accessibility, access to tissue culture plantlets, extension are some of the policies which play a role in adoption of agro-technologies in Uganda. Access to land influences adoption of banana tissue culture however, lack of security on tenure is a disincentive for women to invest in modern technologies such as TC banana (Ndungu *et.al*, 2017).

Tissue culture plantlets are also produced and supplied by a few organizations both private and public and as such access to plantlets becomes challenging to a small holder farmer. TC plantlets equally come at a cost, which is greater than using sucker material, and the economic benefits of using them need to be assessed across banana-producing areas and situations in East Africa (Dubois *et.al*, 2013). The sustainability of the banana TC industry according to Dubois *et. al.*

(2013) is also compromised in countries where the distribution chain of TC plantlets is heavily subsidized. The author further highlights a case where countries purchase TC plantlets for aid programs like Operation Wealth creation programs, which have good intentions but lack the technical support for management of TC material. The decision to adopt is often an investment decision therefore adoption can be expected to be dependent on cost of a technology and on whether farmers possess the required resources (Kinyangi, 2014).

Access to information about agro-technologies is paramount in technology flow. This is because Access to extension services and information access about a new technology demystifies it and makes it more available to farmers thus significantly affecting farmers' choices about it (Kinyangi, 2014). Uganda's policy on free education for all which was implemented more than a decade ago has greatly played a role in adoption of agro-related technologies such as banana TC. According to Kabunga *et. al*. (2011), educated farmers are more likely to adopt, which is a common finding in the technology adoption literature. Thus, a number of people have been able to access education through Universal primary and secondary programs in Uganda.

On the other hand, the government also put in place other policies in a bid to boast agriculture and technology uptake in Uganda. Such policies included PMA, DSIP, NAP amongst others. These are further explained in the subsequent paragraphs.

Plan for Modernization of Agriculture policy (PMA): refers to a holistic, strategic framework for eradicating poverty through multi-sectoral interventions enabling the people to improve their livelihoods in a sustainable manner. According to MAFAP (2013), PMA was developed in 2000 as a framework and was composed of seven implementation areas. These included research and development, NAADS, agricultural education, rural financial services, marketing and agro-

processing, sustainable use and management of natural resources as well as physical infrastructure. According to MAAIF, PMA aimed at accelerating agricultural growth in Uganda by introducing profound technological change throughout the sector and this can be achieved through supporting the dissemination and adoption of productivity-enhancing technologies. NAADS which was a major part of the wider PMA aimed at changing the orientation of farmers from subsistence to commercial by providing advisory services and it operated through farmer groups as well as increasing farmer access to productivity enhancing technologies by provision of inputs amongst others (Kasirye, 2013). NAADS was further replaced by Operation Wealth creation in a bid to increase farmers' incomes as well improve their standards of living.

Agricultural Sector Development Strategy and Investment Plan (DSIP): this focuses on four broad and mutually reinforcing investment programs. These are; enhancing agricultural production and productivity, improving access to and sustainability of agricultural markets, creating an enabling environment for investment in agriculture as well as institutional strengthening in the agriculture sector. However, this policy is affected by the low access to inputs and extension by women and youth as well as limited participation of women in commercial agriculture. (MFPED, 2016).

National Development Plan (NDP): this was formulated in 2010 according to MAFAP (2013) and it comprised of interventions and strategies to address various agricultural constraints. Thus, the strategies included improving agricultural technology development, ensuring effective delivery of advisory services, improved technology in controlling pests, vectors and diseases as well as enhancing productivity of land through sustainable land use and management of soil and water.

The National Agriculture Policy (NAP): this was specifically designed to actualize an agricultural revolution in Uganda (MAAIF, 2013). However according to MFPED (2016) various gender issues were identified with this policy where vulnerable households (women and children headed, elderly, the poor and persons with disabilities (PWDs) and ill are less productive and the need thus gender equity and affirmative action to resolve such issues.

2.5 Research Gaps

The literature reviewed does not give a clear picture on the various policies in Uganda and their role. Thus, with such scanty literature, it is hardly possible to know how such policies influence adoption of banana tissue culture in Uganda and adoption of other agro-technologies as a whole. Therefore, this study intends to bridge that literature gap by establishing the relationship between knowledge of agro-related policies and adoption of banana tissue culture by small holder farmers in Wakiso District.

Furthermore, the literature reviewed does not clearly explain the challenges banana tissue culture farmers face as a result of adopting the above technology and the possible solutions. Thus, this research will help add on to the wealth of literature by identifying constraints related to adoption of this particular technology as well as favorable measures to overcome such constraints.

In addition to the above, the literature does not give a clear relationship between technology adoption and improved food security amongst adopters since it's the overall objective of many agro-technologies. Hence there is need to create a linkage between adoption of banana tissue culture and improved food security amongst small scale households in Wakiso District.

CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the description of the study area, the research design for each objective, description of the study area, sampling procedure and sample determination, procedure of data collection, quality control measures, ethical considerations, data processing and analysis and limitations to the study.

3.1 Research Design

This chapter delves into the various research strategies which were used to achieve the objectives for the study which was carried out in the study area as described in section 3.2. The research design used was cross-sectional surveys. The cross-sectional survey design was used because it was less costly to perform and did not require a lot of time and can also be used to capture various variables at a time.

3.1.1. Determination of the drivers of socio economic factors influencing tissue culture banana technology adoption.

The first objective of the study was to determine the drivers of socio economic factors in tissue culture production. This objective employed the cross-sectional survey research design. Cross sectional surveys involve the collection of data at a single point in time from a sample drawn from a specified population. These are often used to document the prevalence of particular characteristics in a population. Data was also obtained by using secondary data as well as questionnaires. The socio-economic factors were obtained from the already available literature and then confirmed using questionnaires. Kothari (2004), notes that when the researcher utilizes secondary data, then she has to look into various sources from where she can obtain them as well as ensure suitability, reliability and adequacy of the data.

3.1.2 Examination of the role of socio economic factors in tissue culture banana production among smallholder farmers in central Uganda.

This objective of the study followed cross-sectional survey. Correlational designs involve the systemic investigation of the nature of relationships, or associations between and among variables rather than direct cause-effect relationships (Valmi *et.al*., 2007). This design enabled the researcher describe and predict how the variables were naturally related without any attempt by the researcher to alter them or assign causation between them. In this case, the researcher was able to establish the relationship between the socio-economic factors and the adoption of banana tissue culture technology amongst small holder farmers in central Uganda.

3.1.3 Establishing the influence of agro related politics in tissue culture banana technology adoption

This third objective of the study focused on the relationship between awareness of agro related politics and adoption of tissue culture banana technology. It delved into finding out farmers' awareness about various agro related policies, the contribution of these policies to adoption of banana tissue culture as well as any amendments needed to boast adoption and to this effect, a cross-sectional survey research design was employed.

3.2 Description of the Study Area

This study was carried out in Wakiso District located in Central Uganda. Wakiso District is one of the banana growing areas with 12.1% of its population growing bananas according to UBOS, 2017 and is comprised of 17 sub-counties. The district occupies a total area of 1,906.7km^2 and lies within $00^0$24'N and $32^0$29'E with a population of 1,997,418 of which 949,035 are male and 1,048,383 are females (UBOS, 2017). The district lies in the banana coffee farming system located in the Lake Victoria Crescent agro ecological zone. The area consists of lakes and rivers covering 52% of the total area, crop lands covering 42% and forests taking up 4%. The Lake Victoria crescent is

characterized by sandy clay alluvial soils and receives bimodal rains from March to May and August to October with a range of 1750mm-2000mm on average thus sustaining banana production. The temperatures annually vary from 19^0C to 27^0C and relative humidity varies from 57% to 97%.

The study area was chosen for the study because it is a beneficiary of the National Agricultural Advisory Services program (NAADs) as well as Operation Wealth Creation program (OWC). These programs are mandated to support management of agricultural input distribution chains and strategic interventions for value chain development focusing on the upper end of the commodity chains. These programs supply selected agricultural inputs to farmers such as seeds, fertilizers, pesticides amongst others. Through these programs, small holder farmers are supplied with tissue culture banana plantlets in a bid to increase banana production. In addition, the farmers receive free agricultural advisory services from the agricultural service providers in relation to banana production.

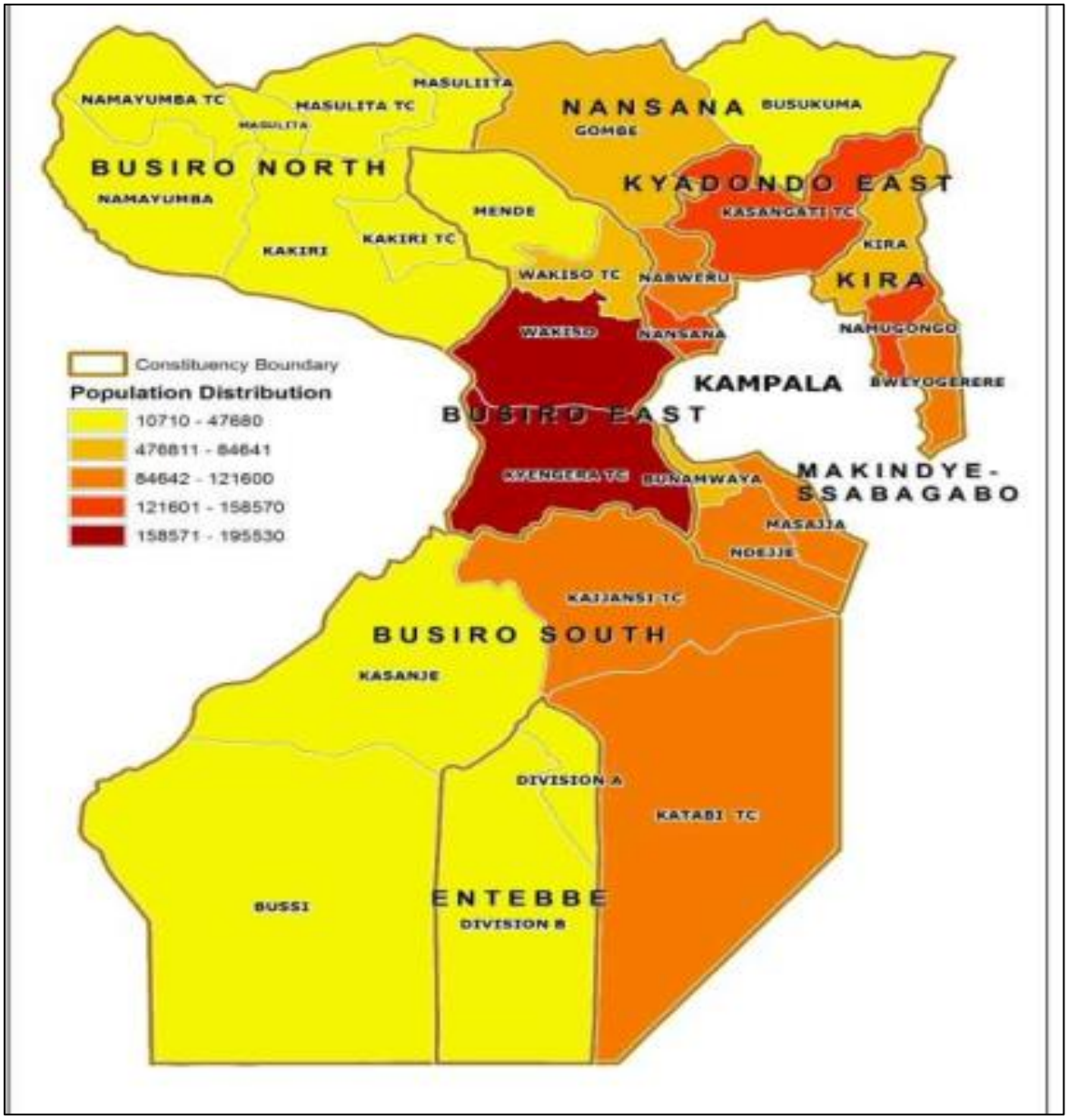

Figure 3.1: Map showing the study area and population distribution.
Adapted from UBOS (2017)

3.3 Sampling Procedure and Sample Selection

A sample of respondents for the study was obtained using purposive sampling. According to Maina (2012), purposive sampling allows the researcher to use cases that have the required information with respect to the objectives of the study. Thus, in this case, the researcher obtained lists of

farmers who had obtained tissue culture banana plantlets under Operation Wealth creation / NAADS program from various sub counties within Wakiso with the help of the respective agricultural officers between 2014 and 2016. The beneficiaries were then sampled randomly in order to eliminate bias and a total of 115 respondents was obtained from 10 sub-counties within Wakiso District. According to Mugenda and Mugenda (2003), a sample size of 10%-30% is considered adequate for a descriptive study, thus considering the upper limit of 30% against the accessible population of 380, this gives a sample size of 115 respondents (Table 3.1).

SUBCOUNTY	**POPULATION**	**SAMPLE**
Division A-Entebbe	34	10
Division B-Entebbe	40	12
Busukuma S/C	33	10
Kyengera Town Council	51	16
Katabi Town council	49	15
Kasanje Town council	18	6
Kasangati Town Council	43	12
Namayumba S/c	65	20
Wakiso Town council	30	9
Kajjansi Town council	17	5
Total	**380**	**115**

Table 3.1: Beneficiaries of tissue culture banana per Subcounty

Source: Office of the Sub-county Agricultural Officers.

3.4 Data Collection Methods and Instruments

The data for the study was collected using primary and secondary methods. Primary methods involved use of questionnaires while secondary methods involved review of journal articles, books, conference proceedings, newspapers, internet amongst others which were related to the subject of the study. The methods of data collection according to Kothari (2004) mainly depend on the nature, scope and object of enquiry, availability of funds, time factor as well as precision required.

3.4.1Questionnaire method

This study used a questionnaire to obtain data from the various respondents (Appendix I). Four enumerators who were residents in the various sub counties and were conversant with Luganda and English were identified. After training, these were used to administer the questionnaires to the respondents. The questionnaires were first pre-tested before administering them to ensure that the language could easily be understood and to correct any errors. 115 questionnaires were administered to the individual respondents and data obtained. The questionnaires were used for this study because they enabled the researcher to collect in-depth information and as well allow for further probing and building rapport with the respondents.

3.4.2 Document review and analysis

Literature relevant to the study from different sources was reviewed. This was further analyzed and information obtained was compared to the findings from the primary data.

3.5 Data Collection Procedure

Data for the study was obtained through various methods like observations, individual interview and use of questionnaires as well as use of secondary data sources. Examining the drivers of the socio-economic factors affecting adoption of banana tissue culture and the role of the socio-

economic factors were handled by use of questionnaires, observation methods and secondary literature. According to Kothari (2004), the author states that *u*nder the observation method, the information is sought by way of investigator's own direct observation without asking from the respondent. Wangusa (2007) notes that questionnaires play a central role in data collection during surveys, census, case studies, experiments and document analyses.

Data in relation to establishing the influence of agro related politics in tissue culture banana technology adoption was obtained by use of individual interviews and self-administered questionnaires. The interviews enabled respondents to give in depth information about the different agro-related policies like PMA amongst others. Thus, the researcher was able to rate farmers' knowledge about the different policies and their influence in adoption of banana tissue culture.

3.6 Validity and Reliability

In order to enhance quality, data collection tools were reviewed and edited in order to eliminate any errors. They were also pretested in the field with the enumerators to ensure that information collected was consistent as well as to minimize errors.

According to Thatcher (2010), validity is defined as the extent to which any measuring instrument measures what it is intended to measure. Validity is divided into three types namely; content validity which looks at whether the instrument adequately covers all the content that it should with respect to the variable, construct validity which refers to whether you can draw inferences about test scores related to the concept being studied and lastly criterion validity which deals with extent to which a research instrument is related to other instruments that measure the same variable. the extent to which a research instrument accurately measures all aspects of a construct (Heale, 2015).

On the other hand, reliability is referred to as the consistency, stability and repeatability of results (Twycross, 2004). It is further described as to when a researcher's approach is consistent across different researchers and different projects.

With the help of the supervisor, the researcher assessed the content validity of the instrument to ensure that it measured the concept under study appropriately.

3.7 Ethical Considerations

High ethical standards and integrity were part of this study in a bid to enhance confidentiality of the respondents and their information. The researcher explained to the respondents the purpose of the study and why they had been chosen to participate in it. The researcher further sought their consent before administering the questionnaires. Names of the respondents were withheld and their responses during the research process were not attributed to their identity in order to enhance trust, rapport and respect.

3.8 Data Processing and Analysis

The data collected using semi structured questionnaires was processed manually, edited, coded and entered in to Microsoft excel. The data was then subjected to bivariate and multivariate analysis using Statistical Package for Social Sciences (SPSS) which provided descriptive statistics and associations between and among variables

3.9 Limitations of the Study

Loss of information during interviews as a result of interpretation of the questions from English to the local languages. This was overcome by thoroughly training the enumerators before the start of the survey as well as pre-testing all the data collection tools. Responses will also be recorded to give the researcher time to analyze them.

CHAPTER FOUR
PRESENTATION OF RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents analyzed results and interpretation of the findings based on the three objectives of the study. These were to determine the drivers of socio-economic factors influencing tissue culture banana adoption amongst small holder farmers, to examine the role of the socio-economic factors in tissue culture banana adoption and establish the influence of agro-related policies in tissue culture banana technology adoption in Wakiso District, Central Uganda.

4.1 Demographic characteristics

This section discusses the socio and demographic characteristics of the respondents based on gender, age, education levels, household headship, main occupation, family size, marital status and land acreage (Table 4.1).

Research Parameter (n=115)		Frequency	Percentage
Gender	Male	64	55.7
	Female	51	44.3
Age	15-25	14	12.2
	26-35	29	25.2
	36-55	34	29.6
	56-65	26	22.6
	Above 65	12	10.4
Education background	No formal training	1	0.9
	Primary level	20	17.4
	Secondary level	61	53.0
	Tertiary level	33	28.7
Main occupation	Farming	62	53.9
	Business	30	26.1
	Civil service	17	14.8
	Other (student)	6	5.2
Household headship	Male headed	89	77.4
	Female headed	26	22.6

Table 4.1: Demographic characteristics of the respondents

4.1.1 Gender

Results from the study revealed that 55.7% (n=64) of the respondents were male while 44.3% (n=51) were female (Table 4.1). This implied that more men adopted TC banana as compared to the women in Wakiso district. The high uptake of TC banana by more men than women is attributed to the increased access to information, land, credit and extension services. Nyang *et. al.*, (2011) reveals that male have more power to make decisions regarding the factors of production on the farms as compared to women. Ngugi (2007) further states that despite women being the main food producers, they lack access to and control over the means of production such as secure land tenure, information, credit and control of labour which could result in limited uptake of agricultural technologies. This therefore calls for gender mainstreaming in regard to adoption of agricultural technologies.

4.1.2 Age

These various gender variations cut across the different age groups with 29.6% (n=34) of the respondents being between 36 and 55 years of age, 25.2% (n=29) between 26-35 years, 22.6 % (n=26) between 56-65 years, 12.2% (n=14) of the respondents between 15-25 years, while the least percentage of 10.4% (n=12) were attributed to respondents above 65years of age (Table 4.1)**.** These findings show that respondents aged between 36 and 55 years were more interested in TC banana technology adoption as compared to other age groups. This is attributed to their enhanced knowledge and experience in banana farming and specifically banana tissue culture. Older farmers are equally presumed to have gained knowledge and experience over time and are better able to evaluate technology information than younger farmers (Mignouna *et.al.*,2011; Kariyasa

et.al.,2011). On the other hand, its argued that younger farmers are typically less risk-averse and are more willing to try new technologies (Mwangi *et.al.*,2015).

4.1.3 Education

Further analysis showed that the majority of the respondents had attained some degree of education with the majority having attained a minimum of secondary education (53%), 28.7% tertiary level, 17.4% having attained primary level, while only 0.9% had not received any formal education (Table 4.1). This implies that adoption of TC banana is highly influenced by level of education of the respondent. The attainment of secondary education by most of the respondents is attributed to the increased access to free education through the universal primary and secondary programs within the district. These findings agree with the findings of Kabunga *et.al*. (2011) which reveal that educated farmers were more likely to adopt banana tissue culture. Education level of a farmer increases the ability to obtain; process and use information relevant to adoption of a new technology (Mignouna *et. al*., 2011)

4.1.4 Main Occupation

Farming is the major economic activity of the people of Wakiso (53.9%) followed by business (26.1%,) then civil service (14.8%) and other who mainly constitute of students (5.2%), (Table 4.1). This implies that respondents whose major occupation was farming had higher chances of adopting TC banana. This is because farmers can easily experiment new agro-technologies like banana tissue culture as compared to other respondents who are preoccupied with other activities.

4.1.5 Household headship

77.4% of the households were male headed as compared to 22.6 % which were female headed (Table 4.1). This implies that majority of the households that adopted TC banana were male headed. This is attributed to more access to resources such as land, credit, information and extension services which are vital in adoption of agro-technologies. These findings agree with the findings of Nyang *et.al.* (2010) who states that male headed households have mobility, participate in different meetings and have more exposure to information related to tissue culture banana.

4.1.6 Household size

Regarding household size, the findings of the study revealed that the average number of members within a specific household was 6 with a minimum of 2 and maximum of 16 (Table 4.2). Household size is simply used as a measure of labor availability (Mwangi *et.al.*, 2015). The stated household size was higher than the average national household size of 4.7(UBOS, 2017). This is because Wakiso is a peri-urban area and surrounds Kampala which is the capital city, thus many people migrate to it in search for employment.

4.1.7 Land accessibility

Access to land equally plays a great role in adoption of agro-technologies such as tissue culture banana since farmers can ably experiment such new technologies. Results from the study showed that the average size of land owned by the respondents was 2.8 acres with a minimum of 0.25 acres and a maximum of 20 acres (Table 4.2) Wakiso is a fast-growing area in terms of population and thus this explains the limited available land owned by the respondents.

	n	Minimum	Maximum	Mean	Std. Deviation
Household size	115	2.00	16.00	5.5043	2.58665
Estimated land size	115	.25	20.00	2.8274	3.09832

Table 4.2 Household size and estimated land size of the respondents

4.3 Drivers of socio-economic factors affecting banana tissue culture adoption

This section seeks to identify and elaborate on the various drivers that prompted the people of Wakiso District to engage in production of tissue culture banana. It involves cross tabulations of various demographic characteristics against various response factors as well as tests for multi-collinearity.

4.3.1 Multi-collinearity tests for regressed demographic Factors for TC banana adoption

Results from the study reveal that education level of the respondent, main occupation, estimated land size, market accessibility as well as proximity to source of TC banana plantlets had tolerance values above 50% while age had a tolerance value of 46.8%. This implies that these factors were independent of each other to a great extent. The Variance Inflation Factors for all the parameters were less than 3 which rules out multi-collinearity (Table 4.3)

Table 4.3: Regressed demographic factors for TC banana adoption

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.105	.220		-.478	.633		
	age of the respondent	-.022	.022	-.117	-.998	.321	.468	2.137
	education level of the farmer	.036	.032	.097	1.099	.274	.818	1.223
	main occupation of the respondent	.063	.028	.224	2.232	.028	.639	1.565
	estimated land size of respondent	.017	.009	.200	1.866	.065	.559	1.789
	major markets where bananas are sold	.072	.026	.239	2.817	.006	.893	1.119
	Proximity to Source of TC banana plantlets	.204	.049	.365	4.183	.000	.847	1.181

Table 4.3: Regressed demographic factors for TC banana adoption

4.3.2: Influence of occupation on TC Banana adoption.

The findings of this study reveal that main occupation of the respondents was highly significant in the adoption of banana tissue culture ($P<0.05$), (Table 4.3). Respondents whose main occupation was farming were most likely to adopt banana tissue culture at a percentage of 53% with an actual count of 61 against the expected count of 57.7. Similarly, respondents who mainly engaged in business, civil service and other occupations had rates of 23.5%, 13.9% and 2.6% respectively with higher expected counts of 27.9, 15.8 and 5.6 respectively as opposed to their actual counts of 27, 16 and 3 respectively. This implies that the people of Wakiso District adopted TC banana

because they were farmers and thus could experiment new agro-technologies. Occupation of the respondent was equally significant in the adoption of land race (P< 0.05) and hybrid banana (P=0.05).

			main occupation of the respondent			
			farming	business	civil service	other
Response factor	yes	Count	61	27	16	3
		Expected Count	57.7	27.9	15.8	5.6
		% of Total	53.0%	23.5%	13.9%	2.6%
	No	Count	1	3	1	3
		Expected Count	4.3	2.1	1.2	.4
		% of Total	.9%	2.6%	.9%	2.6%

Table4.4: Cross tabulation between TC banana adoption and respondents' occupation

4.3.3 Effect of proximity to source of planting materials in adoption of TC banana

Proximity to source of planting material according to this study is defined as the distance to the source of planting material. Proximity to source of planting materials significantly determines the adoption of TC banana (P<0.01, Table 4.3). 71.1% (n=91) of the respondents obtained TC banana plantlets under the NAADS/ OWC government programs, 10.4% (n=12) from private commercial nurseries like Agro-Genetic Technologies and only 0.9% (n=1) from government multiplication sites like namely National Agricultural Research Laboratories (NARL) located at Kawanda. Much as NARL provides TC banana plantlets at subsidized prices, farmers were not aware of it being a source of planting materials and the distance to the institute was equally a barrier to many farmers as compared to planting materials which were supplied to their various sub-counties in which they resided. This implies that enhanced access to source of planting material played a great role in adoption of TC banana by the people of Wakiso District. Enhanced access of farmers to Tc banana technology increased the demand for TC banana plantlets against the low supply (Wanyama

et.al.,2013). This therefore calls for appropriate and sustainable measures for increasing accessibility to planting materials.

			Source of TC banana plantlets				
			NARL-Kawanda	Private commercial nursery	OWC	others	Total
TCB adoption	yes	Count	1	12	91	3	107
		Expected Count	.9	11.2	87.5	7.4	107.0
		% of Total	.9%	10.4%	79.1%	2.6%	93.0%
	no	Count	0	0	3	5	8
		Expected Count	.1	.8	6.5	.6	8.0
		% of Total	.0%	.0%	2.6%	4.3%	7.0%

Table 4.5: Cross tabulation of Source of TC banana plantlets and its adoption.

4.3.4 Influence of markets on adoption of TC banana

Availability of markets for the tissue culture banana was highly significant in its adoption (P=0.006), (Table 4.3). 82.6% of the respondents sold their bananas on farm, 5.2% through middlemen, 9.6% of the respondents never sold their banana because these were retained for home consumption while the rest sold to nearby local markets (Figure 4.1). This implies that 82.6% of the respondents in Wakiso sold their banana on farm because only surplus was sold but most of the bananas were retained for home consumption, therefore because of limited harvest left for sale, it was cost effective to sell on the farm as opposed to nearby local markets.

The results of this study agree with the findings of Kinyangi (2014) who reveals that market availability is significant in the adoption of agricultural technology. The more the distances to the product market the less likelihood of Tc banana intensification because the longer the distance the

more the transaction costs and the less the profit that accrue to the farmer (Wanyama *et.al.*, 2013). Qaim (2014) equally reports that productivity growth through TC technology directly contributes to better food availability at the household level.

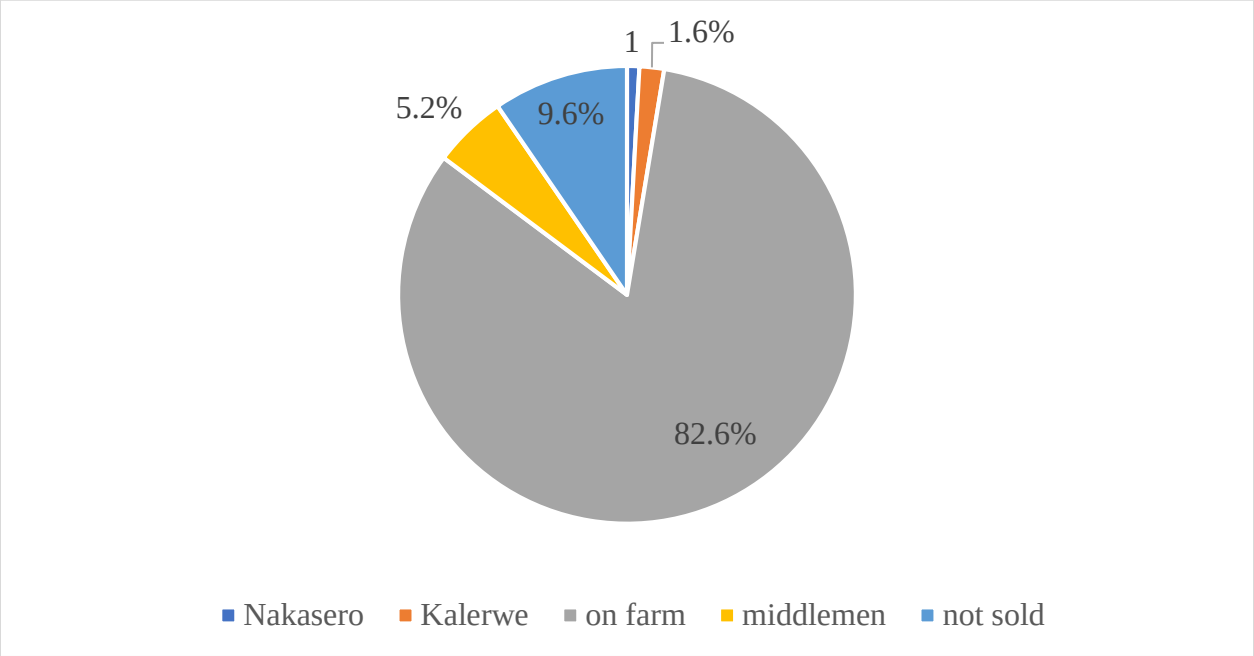

Figure 4.1: Markets for TC banana

4.3.5: Influence of education in adoption of TC banana

This study reveals that the expected count of tissue culture adoption for respondents who had at least obtained secondary level was 56.8 which was higher than the actual count of 56 while for tertiary the expected (n=30.7) was higher than the actual (n=30). However, respondents who had accessed primary level had an actual count of 20 which was higher than their expected count of 18.6 while those who had not obtained any formal training, their actual count (n=1) was higher than the expected (n=0.9) as shown in Table 4.6. These results imply that the higher the level of education, the higher the expected adoption of TC banana since one gets more acquainted with information regarding TC banana. However, as respondents' education level increases, respondents tend to engage in other activities and shun away from farmer trainings, thus this

explains the lower actual count as compared to the expected count for secondary and tertiary education levels.

From this study, regression analysis revealed that education level played no significant contribution in the adoption of any banana variety. (P> 0.05, Table 4.3). This implies that the people of Wakiso district adopted TC banana because of other factors other than their education levels. This disagrees with Katungi (2007) who states that education influences the capacity of a farmer to acquire and synthesize information and knowledge about the problem and technologies which is critical for technology adoption. It further disagrees with the findings of Wambugu *et.al*. (2014) who states that tissue culture is a new technology and its adoption could create challenges to the less educated members of society unless backed up by farmer education and exposure.

			education background of the farmer				
			No formal education	Primary level	Secondary level	Tertiary	Total
Adoption of T C banana	yes	Count	1	20	56	30	107
		Expected Count	.9	18.6	56.8	30.7	107.0
		% of Total	.9%	17.4%	48.7%	26.1%	93.0%
	no	Count	0	0	5	3	8
		Expected Count	.1	1.4	4.2	2.3	8.0
		% of Total	.0%	.0%	4.3%	2.6%	7.0%

Table 4.6: Cross tabulation for TC banana adoption and respondents' education level

4.3.6 Influence of age on TCB adoption

A cross tabulation between age and adoption of banana TC reveals that respondents between 36 and 55 years contributed 28.7% (n=33) to the adoption, 26-35years contributed 22.6% (n=26), 56-65 years contributed 22.6% (n=26) while 15-22 years and those above 65 years contributed 9.6%(n=11) each. This implies that the expected adoption of TC banana decreases with an increase

in age. The high contribution to TC banana adoption by respondents aged between 36 and 55 years of age is attributed to increased access to production resources such as land, agricultural credit, information, labour amongst others. The low adoption by respondents aged between 15-25 years is due to limited access to resources such as land and credit while for those aged above 65 years it is because they are old and less productive and thus unable to experiment new agro technologies.

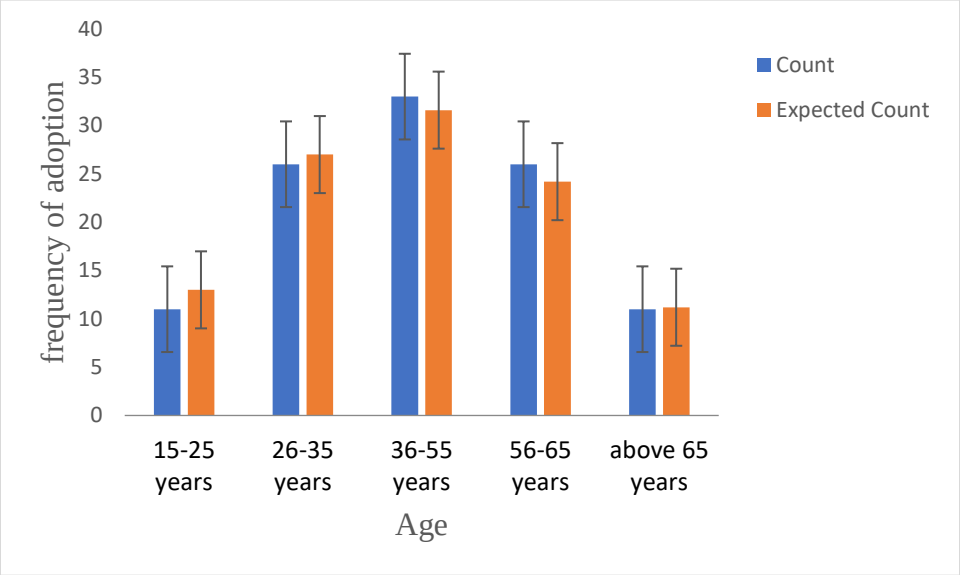

Figure 4.2: Age variations in TCB adoption

Whereas, various studies assume that older farmers have gained knowledge and experience over time and can easily evaluate technology information than younger farmers (Mignouna *et. al*., 2011; Kariyasa *et.al.*,2011), this study reveals that age was insignificant in the adoption of TC banana (Figure 4.2). This implies that adoption of TC banana technology is not attributed to any age group and any person of any age is free to adopt it. These findings agree with the findings of Ndungu *et.al*. (2017) who revealed that age was insignificant in the adoption of banana tissue culture in the lower Eastern region of Kenya.

4.3.7 Effect of land acreage on TCB adoption

Land acreage refers to the size of land owned by the farmer**.** Regression analysis reveals that land size contributes only 0.2% to the adoption of TC banana in Wakiso. However, Anova tests show no significant difference between size of land and adoption of banana tissue culture (P=0.065). This implies that any person with any land size could easily adopt to TC banana. Mwangi and Kariuki (2015) further argue that small farm size may provide an incentive to adopt a technology especially in the case of an input-intensive innovation such as a labor-intensive or land-saving technology. Therefore, Wakiso district being an urban and peri-urban area has limited land agriculture but even with the limited land, farmers are able to experiment on new agro-technologies.

4.3.8 Conclusion

Whereas all the factors had acceptable Variance Inflation Factor (VIF) and tolerance levels above 50% expect for age, the factors which contributed significantly to the adoption of TC banana in Wakiso with $P< 0.05$ were respondents' main occupation, proximity to source of TC plantlets and accessibility to TC banana markets. Respondent's education level, age and land size were insignificant in the adoption of TC banana in Wakiso District.

4.4 Roles of the socio-economic factors in banana tissue culture adoption

This section discusses the role of the various socio-economic factors with regard to adoption of TC banana. It deals with regression of the various factors and establishing prediction models to ascertain adoption of TC banana trends in Wakiso.

4.4.1 Regressed demographic factors for annual banana yield

This study hypothesized that adoption of TC banana would lead to increased bunch harvest. A linear regression model was used to estimate the influence of the demographic factors on the bunch harvest (yield) of the respondents. Collinearity statistics obtained from the study showed that tolerance and Variance Inflation Factor (VIF) for all the variables were not highly linearly related. VIF>5 is generally considered evidence of multi-collinearity, however, the results obtained from the study show that all variables had VIF<5. The tolerance levels for all the factors were above 60% with household headship being an independent predictor of yield at 85.3%, then gender at 83.7%, procedure of land acquisition at 75.3%, education level at 74.4%, age at 66.1% while main occupation of the respondent could be tolerated as an independent predictor for yield at 65.6% (Table 4.8).

Table 4.8: Regressed demographic factors for estimated annual banana yield (bunches/ farmer)

Model	Sig.	Collinearity Statistics	
		Tolerance	VIF
1 (Constant)	.015		
Gender	.612	.837	1.195
Age of the respondent	.012	.661	1.512
Education level of the farmer	.051	.744	1.344
Main occupation	.606	.656	1.524
Type of household headship	.193	.853	1.173
Procedure of acquiring land	.009	.753	1.329

Table 4.8: Regressed demographic factors for estimated annual banana yield (bunches/ farmer)

The results reveal that age of the farmer as well as procedure of land acquisition were significant contributors to the annual bunch harvest of the respondents ($P<0.05$). Inspite of gender, main occupation, level of education and household headship having high tolerance levels, their contribution to banana yield was not significant.

Age has an influence on the household labour requirements since small holder farmers mainly rely on family labour. Young and middle-aged farmers are often hard working, innovative and result oriented thus causing an increased bunch harvest as opposed to elderly persons who are less productive. According to Naheen *et.al.* (2014), the age composition of a population plays a very significant role as it helps in adoption of new ideas and practices which in turn bring economic benefits and make them food secure and prosperous. They further presume that at a comparatively younger age, people are more receptive to new ideas and practices, whereas at an advanced stage

people find it difficult to change from old-age practices, and they resist to adoption of innovation and their risk bearing capacity of gradually declines.

Land ownership is paramount in adoption of TC banana which leads to increased bunch size. Land tenure security factors are risk factors militating against long term innovation adoption among smallholder farmers in developing countries (Owombo *et. al.*, 2015). From the study, 51.3% (n=59) of the respondents purchased the land they were cultivating on, 43.5% (n=50) inherited the land from their forefathers and only 4.3% (n=5) are utilizing rented land. This implies that farmers can ably experiment long lasting technologies since they are having a high degree of land security. This also promotes innovativeness and ability to integrate improved practices in their plantations in order to achieve maximum yield.

Gyau *et. al*. (2014) states that limited land rights (use or control rights) granted to tenants and sharecroppers negatively affect land use by the farmers as they are mostly restricted to the type of crops which they can cultivate on the farms. IFAD (2008) further highlights that Land tenure security influences decisions on farm technology adoption, especially the extent to which farmers are prepared to invest in improvements in production, sustainable management, and adoption of new technologies and promising innovations. Albertson (2016) equally argues that banana is a perennial crop that can have longevity, in considering land ownership and land over which farmers have decision making powers on could highly impact a new variety's adoption process.

4.4.2. Relationship between response factors and adoption of TC banana

In as much as all the factors namely; good performance exhibited on demonstration farms, motivation by extension workers, motivation by researchers, motivation by other farmers, motivation by prices as well as access to free plantlets had high tolerance levels ranging from 93.7

to 67.8 (Table 4.9) which is an indication that each of these factors can be considered to have been independent in influencing adoption of TC banana to a great extent and acceptable VIFs all below 2 which ruled out multi-collinearity, statistically, adoption of Tc banana was greatly attributed to motivation by extension workers and access to free plantlets with P>0.05.

Table 4.9: Regressed response factors for adoption of TC banana

Model		Sig.	Collinearity Statistics	
			Tolerance	VIF
1	(Constant)	.196		
	good performance exhibited on demos	.186	.928	1.078
	motivation by extension workers	.000	.678	1.474
	motivation by researchers	.726	.934	1.071
	motivation by other farmers	.229	.857	1.167
	motivation by prices of products	.057	.937	1.067
	Access to free plantlets	.027	.702	1.424

The role of agricultural extension in adoption of Tc banana in Wakiso district cannot be under estimated. Agricultural extension aims at transferring of agricultural technology and persuading farmers to adopt the use of these technologies on their farms as well as enhancing flow of information and transfer of knowledge and scientific findings (Awad *et.al.,* 2015). The study reveals that 53.9% (R^2 =0.539) of the TC banana adoption was as a result of motivation by extension workers (Table 4.10).

Predictor	R	R square
Motivation by Extension	.734[a]	.539
Motivation by Research	.010[a]	.000
Performance exhibited on Demonstration farms	.159[a]	.025
Motivation by prices	.129[a]	.017
Motivation by other farmers	.130[a]	.017
Access to TCB plantlets)	.506[a]	.256

Table 4.10: Regression Analysis of socio-economic factors affecting of banana tissue culture
[a] Predictors: (Constant)

This implies that presence of extension workers at each sub county in Wakiso district facilitates flow of scientific findings as well as persuasion of farmers to experiment new agro-technologies since the farmers have an inbuilt trust in the extensionists. This agrees with the findings of Wanyana*et.al.* (2013) who reveals that contacts with government extension agents enhances the intensification of the Tc banana technology along with other banana value chain agents since extension agents are represented up to sub-locational levels. Donkor *et. al*. (2016) equally agrees that farmers who have adequate access to extension service have a higher probability of adopting chemical fertilizer. Dibba *et. al.* (2015) further argues that farmer contact with extension has a significant influence on exposure of, access to, and adoption of NERICA seeds since the seeds are disseminated to farmers through extension outlets, hence farmers who have contact with extension agents should know, access, and adopt NERICA.

Access to free TC banana plantlets under the NAADS/OWC programs was a great contributor to adoption of Tc banana in Wakiso district. Foster *et.al.* (2010) highlight that one of the major drivers of successful agricultural technology adoption in developing countries is availability and affordability of technologies. Therefore, availing farmers with free or subsidized TC banana plantlets greatly motivates them and increases their interest in taking up a new technology. Results

from the study show that free access to TC banana plantlets contributed 25.6% to the adoption of banana tissue culture in Wakiso (R^2= 0.256, Table 4.10). The price of TC banana plantlets is generally high for an average small holder farmer which is a limitation to technology adoption. Therefore, free access to such plantlets entices farmers who had initially desired to uptake Tc banana production.

Motivation by price contributed 1.7% (R^2=0.017) to the adoption of Tc banana, good performance exhibited on demonstration farms contributed 2.5 % (R^2=0.025), motivation by other farmers (early adopters) 1.7% (R^2 =0.017), however, these were not statistically significant in the adoption of TC banana in Wakiso District.

4.4.3 Conclusion

This section revealed that most of the farmers undertook TC banana cultivation because they were motivated by the extension workers within their localities and could easily acquire planting material under NAADs/OWC programs. It further revealed that age of the farmer as well as procedure of land acquisition were significant contributors to the annual bunch harvest of the respondents.

4.5 Influence of Agro-related politics in tissue culture banana technology adoption.

This section discusses the various agricultural related policies and their implications on Tc banana adoption. It delves into farmer' knowledge of agricultural policies like PMA, NAP, and how such policies come into play in the adoption of TC banana

4.5.1 Agro-related policies and their implications

Policy refers to a set of principles which guide decisions in order to achieve desired outcomes. The results of the study reveal that 83 of the respondents were aware of PMA policy, 5 were aware of NAP, 13 were aware of NDP while 3 were aware of DSIP (Figure 4.3). The wide awareness of PMA is attributed to the formation of NAADS of which Wakiso District is a beneficiary. Kasirye

(2013) reports that the NAADS program which was part of the wider Plan for Modernization of Agriculture replaced the supply led extension system which mainly focused on promoting cash crops for export in 2001.

59.1% of the respondents further argued that the agro-policies aid in empowering them to determine prices for their Tc banana, 39.1% argued that they motivate them in carrying out TC banana,7% stated that they regulate production standards for TC banana while only 5.2% agreed that they promote free and fair market for TC banana across borders.

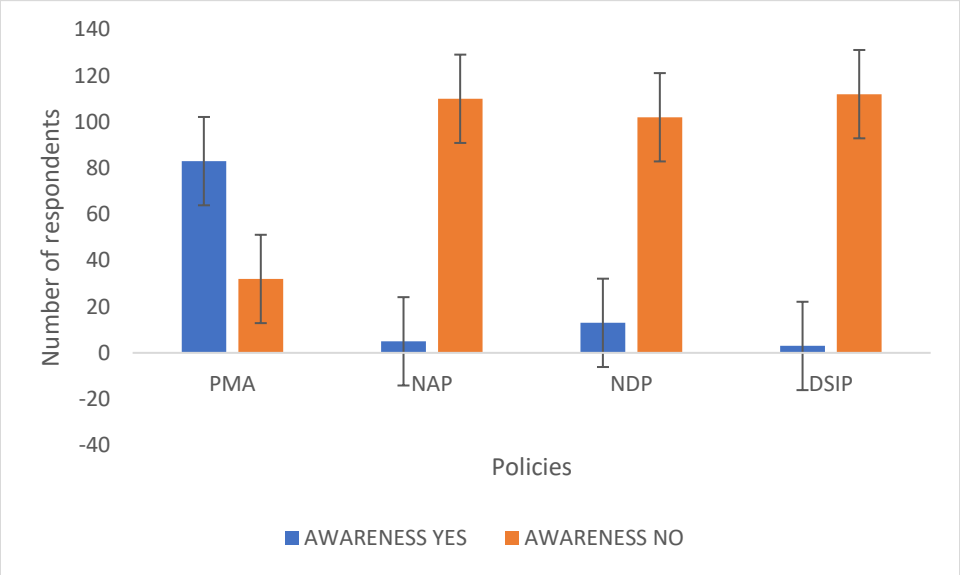

Figure 4.7: Respondents' awareness of agro-related policies

4.5.2 Relationship between demographic factors and Agro-related policy awareness

The study hypothesized that education level, age, market accessibility and gender influenced policy awareness thus leading to increased TC banana adoption. However, a correlation analysis reveals a weak positive relationship between age and awareness of NAP while a weak negative relationship is obtained for PMA, NDP and DSIP. Furthermore, a weak positive relationship is obtained for gender of the respondents and awareness of NAP and DSIP while weak negative relationships are obtained for PMA and NDP. Education level of the respondents reveals a weak negative correlation between it and all the polices while for markets, a weak positive correlation

for awareness of NDP and weak negative relationship for awareness of PMA, NDP and DSIP. This therefore implied that neither education level, age, market accessibility and gender were strong determinants in policy awareness (Table 4.11).

Correlations

		Gender	age	education level	major markets	NAP	PMA	DSIP	NDP
Gender	Pearson Correlation	1	-.079	-.022	.042	.104	-.164	.031	-.013
Age	Pearson Correlation	-.079	1	-.167	.009	.038	-.034	-.076	-.208*
Education level	Pearson Correlation	-.022	-.167	1	-.070	-.032	-.057	-.046	-.148
markets	Pearson Correlation	.042	.009	-.070	1	-.062	-.162	-.077	.132
NAP	Pearson Correlation	.104	.038	-.032	-.062	1	-.248**	-.008	-.076
PMA	Pearson Correlation	-.164	-.034	-.057	-.162	-.248**	1	.179	.038
DSIP	Pearson Correlation	.031	-.076	-.046	-.077	-.008	.179	1	-.013
NDP	Pearson Correlation	-.013	-.208*	-.148	.132	-.076	.038	-.013	1

Table 4.11: Correlational analysis for demographic factors and agro-related policy awareness

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

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

4.5.3 Relationship between policy awareness and TC banana adoption

A Pearson correlation analysis revealed a very weak negative correlation between farmers' awareness of PMA (r=- 0.017), NAP (r=-0.109) and NDP (r=-0.01) policies in relation to adoption of TC banana, however farmer's awareness of DSIP equally revealed a very weak but positive correlation (r=0.148, Table 4.12).

Correlations

		Adoption of Tissue culture banana	farmer's awareness of PMA	farmer's awareness of NAP	farmer's awareness of NDP	farmer's awareness of DSIP
Adoption tissue culture banana	Pearson Correlation	1	-.017	-.109	-.010	.148

Table 4.12: Correlation analysis between agro policy awareness and TC banana adoption

Awareness of the policies was equally insignificant in the adoption of TC banana in Wakiso. This implied that in as much as the policies were in existence, farmers decision to adopt Tc banana was not influenced by their awareness of such policies.

4.5.4 Challenges posed in the adoption of Tc banana

The major constraints expressed by the farmers in the adoption of TC banana were limited knowledge regarding TC banana production (54.8), difficulty in accessing TC banana plantlets (32.2%), high labour requirement needed in managing Tc banana plantations (30.45), high quantity of fertilizers required in production of TC banana (25.2%) and High cost of TC plantlets (25.2%), (Table 4.13).

Constraint		Frequency	Percentage
High labour requirement	yes	35	30.4%
	no	80	69.6%
Expensive TC banana plantlets	yes	29	25.2%
	no	86	74.8%
High fertilizer requirement	yes	28	25.2
	no	86	74.8
Difficulty in accessing Tc banana plantlets	yes	37	32.2
	no	78	67.8
Limited knowledge about TC banana	yes	63	54.8
	no	52	45.2

Table 4.13: Constraints faced by farmers adopting TC banana

The limited knowledge was attributed to the limited visits by extension workers within the area. Wanyama (2014) argues that farmer's exposure to more extension services leads to increased adoption since farmers are able to gain knowledge on Tc bananas farming. This study further reveals that majority of the respondents obtained TC plantlets under OWC/NAADS because they were free of charge while the minority who sourced from private commercial nurseries obtained them at an average cost of 2500-3000Ug. Shs. which was expensive for an average small holder farmer. Indimuli (2013) reports that the higher price of Tc plantlets as compared to conventional suckers played a big role in the discountenance in adoption of TC banana in Kenya. Thus, many

of the farmers who had adopted TC banana had limited expansion of their orchards because of high cost of TC plantlets. Furthermore, the challenge of high labour requirement was attributed to the need for watering especially during dry spells and manure application. This agrees with the findings of Indimuli (2013) who states that watering was the major labour demanding activity in Tc banana production since TC-plants demand a lot of water for their growth. Qaim (1999) equally reports that the cost of labour for the establishment of banana orchard was higher for farmers using TC plantlets than those using conventional suckers. This he attributed to labour intensive activities that included land preparation, land preparation, planting, manure application, weeding, watering, de-suckering, de-leafing, propping, harvesting and marketing. The high nutrient requirement which constrains the increased production of TC banana is as a result of declining soil fertility as reported by Nyombi (2003). Thus, farmers have to invest in organic and inorganic fertilizers in order to increase yield.

4.5.6 Suggested remedies to increased adoption of TC banana

86.1% of the respondents suggested an increase in funding for extension and research in order to boast uptake of Tc banana, 64.3 % suggested a subsidy of the Tc banana plantlets, 23.5 % opted for strengthened laws on land use and management while investment in value addition technologies and amending of the current agricultural policies took 16.5% and 17.4% respectively.

4.5.7 Conclusion

This section revealed that majority of the respondents were aware about PMA as compared to other policies, however a weak negative correlation was observed regarding policy awareness and adoption of TC banana except for DSIP which revealed a weak positive relationship. Major factors which adopters of TC banana were facing include limited knowledge about TC banana as well as difficulty in accessing Tc banana plantlets while the suggested remedies were increased funding for extension and research and subsidizing of TC banana plantlets.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0: Introduction

This chapter presents a summary of key findings from the study, the conclusion from the findings as well as recommendations to various stakeholders and policy makers.

5.1: Summary of findings

Results of this study reveal that;

- Banana is an important food security crop in Uganda and cooking banana is the predominant variety grown by farmers for food as well as for sale.
- Farmers in Wakiso District adopted tissue culture banana because farming was their main occupation, proximity to planting materials as well as accessibility to markets.
- Age, farmers' education level and size of land did not influence farmers' decision to adopt tissue culture banana in Wakiso District.
- Extension and accessibility to TC banana plantlets were significant contributors to the adoption of banana tissue culture in Wakiso District.
- Age and method of land acquisition contributed significantly to the yield of banana.
- Majority of the respondents were aware about PMA policy but little awareness was registered for NDP, NAP and DSIP.
- A weak negative relationship was observed between awareness of agro-related policies and adoption of TC banana except for DSIP which revealed a weak positive correlation.
- Awareness of agro-related policies was insignificant in the adoption of banana tissue culture in Wakiso District.

- The major constraints faced by the farmers in the adoption of TC banana were limited knowledge regarding TC banana production, difficulty in accessing TC banana plantlets and high labour requirement needed in managing Tc banana plantations.

5.2: General Conclusion

The study established that respondent's main occupation, proximity to source of planting materials as well as accessibility to market were major drivers to the adoption of tissue culture banana in Wakiso District. Furthermore, motivation by extension workers and access of planting materials were significant contributors to the adoption of TC banana while age and mode of land acquisition contributed significantly to the annual bunch harvest of the respondents. Awareness of agro-related policies was not significant in adoption of TC banana in Wakiso district.

5.3: Recommendations

Basing on the role of extension in adoption of banana tissue culture, government needs to increase funding and support to the extension workers so that they can ably strengthen the linkage between the farmers and research stations. This will aid in increased uptake of new agro-technologies thus leading to increased production and productivity as well as improved food security in the country.

Mode of land acquisition contributed to increased banana yield as permanent land owners were able to experiment various agro -technologies irrespective of time. Thus, Thus, there is need for land use planning and policy in Uganda in order to create sense of security to farmers who may be renting land to ably experiment certain technologies which last a few years.

The less awareness of the various agro-related polices intended to benefit farmers calls for need for enhanced awareness. This will enable farmers acquaint themselves with policies that are

beneficial to them. This can be done through mass media, agricultural shows, farmer trainings amongst other means.

Cost of TC banana plantlets as well as accessibility to various distribution centers provides a major challenge to the continuance of TC banana adoption in Wakiso district yet free supply under NAADs/ OWC is equally not sustainable and cannot benefit a large population. Therefore, government is urged to subsidize the cost of TC banana plantlets and as well establish distribution centers at District level.

Lastly it should be noted that the role of extension in adoption of agro-technologies TC banana is paramount. Thus, extension workers are urged to readily avail farmers with information and increase their contact visits to farmers in order to keep them motivated in adopting a particular technology.

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APPENDICES

Appendix 1: Household Questionnaire

This research is aimed at investigating the socio-economic factors in banana tissue culture technology adoption in the context of political agroecology amongst small holder farmers in Central Uganda. The findings of this study will aim at future policy improvements. The research is a non-profit assignment and is purely for academic purposes. All the responses provided will be confidential and will not be used to disclose any person's identity without their knowledge.

QUESTIONNAIRE NUMBER ----------(For data entry purposes).

Location details

DISTRICT

SUB-COUNTY

PARISH

VILLAGE

GPS COORDINATES X Y

Respondent's details

1. Position in the household

1.Household head 2. Spouse 3. Son 4. Daughter 5. Parent

2. Gender of the respondent

1. Male 2. Female

3. Age bracket

1.15-25years 2. 26-35years 3. 36-45years 4. 46-55 years 5. 56-65 years 6. Above 65 years.

4. Marital status

1. Married 2. Single 3. Other

5. What is your education background?

1. No Formal education 2. Primary level 3. Secondary level 4. Tertiary

6. What is your main occupation?

1. Farming 2. Business 3. Civil service 4. Others (specify)----------

Household characteristics and Demographics

7. What is the type of this household headship?

1. Male headed 2. Female headed 3. Child headed

8. How many members are there in this household?

Males …...… Females……...Total……....

9. What is the source of the household income?

1. Farming 2. Business 3. Civil service 4. Others (specify)----------

10. what is your monthly income range?

1. < 50,000shs.
2. 50,000- 150,000shs.
3. 150,000- 250,000shs
4. 250,000-500,000shs.
5. 500,000- 1000000shs.
6. Above 1,000,000shs.

Land tenure and farming systems

11. What is the estimated size of your land? ……. Acres

12. How was your land acquired?

1. Inherited 2. Rented 3. Purchased 4. Others (specify) ……

.

13. What are the main uses of your land?

No.	Use	Estimated size of land (acres)
1	Housing structures	
2	Farming	
3	Forest/woodlot	
4	Other (specify)	

14. What are the major crops grown on the land?

No.	Crop type	Acreage
1	Maize	
2	Beans	
3	Bananas	
4	Coffee	
5	Fruit trees	
6	Rice	
7	Sweet potatoes	
8	Others (specify)	

If banana is one of the main crops in 14 above, then proceed to the next section

Determining the drivers of socio economic factors in influencing tissue culture banana technology adoption.

15. which type of banana do you cultivate on your farm

1. tissue culture banana

2.hybrid banana

3.landrace banana

16. What reasons led you into growing banana type indicated in 15 above?

1. Good performance exhibited on demonstration farms

2.Motivation by extension workers

3.Motivation by other farmers

4.Motivation by researchers

5.Motivated by the prices of the products

6.Others (Specify)----------

17. How many bunches do you harvest each year on average? (give your appropriate ranges where the respondents can select from

1. 50 and below

2. 51 -100

3.101- 200

4. 201- 300

5. Above 300 bunches

18. if you grow tissue culture banana, which varieties do you mainly grow on your land and why?

Banana Type	Acreage	Reason for growing the variety
1Cooking type (matooke)		
2Fruit type (Bogoya, Ndiizi)		
3Dessert type (Gonja, Kivuvu)		
4Beer type (Kisubi)		

19. If No, which factors limit you from growing tissue culture banana?

1.Expensive plantlets

2.Lack of knowledge about tissue culture banana

3.Require a lot of labor

4.Require a lot of fertilizers

5.Difficulty in accessing the plantlets

6.Other (Specify)----------

Examining the role of socio economic factors in tissue culture banana production among smallholder farmers in central Uganda

20. How did you get to know about tissue culture bananas?

1. Research Institute 2. Extension worker 3. Model farmer 4. Other (specify)----------

21. Where do you obtain tissue cultured banana plantlets from?

1. Kawanda Research Institute 2. Private commercial nursery 3. Operation Wealth Creation 4. Others(Specify)----------

22. At what price do you obtain the banana plantlets?

Ush. ……

23. Which major markets do you sell your bananas?

1. Nakasero 2. Kalerwe 3. Nateete

4. Nakawa 5. On farm 6. Through middlemen

7. Others (specify)…….

24.Select at least three greatest socio-economic factors which influence negatively adoption of tissue culture banana.

1. Land tenure system

2. Insufficient extension services

3. Distance to source of banana plantlets

4. price of the banana plantlets

5. Perishability and price fluctuations of bananas

6. High labor requirements

7. Others (Specify)…….

25.How do the following socio-economic factors affect tissue culture banana adoption? (Match appropriately)

Socio-economic factor	**Role**

1.Level of education	Increases access to plantlets
2.Land tenure system	Increases land size for production
3.Access to tissue culture plantlets	Increases banana acreage
4.Household income	Increases decision power
5.Age of the farmer	Empowers farmer with knowledge on agronomic practices
6.Size of household	Increases market potential
7.Location of the farm	Increases labor availability

Establishing the influence of agro related politics in tissue culture banana technology adoption

26. Who supplies the tissue culture banana plantlets to the farmers?

1 Operation Wealth Creation 2. Farmer groups 3. Individuals 4 Other (Specify).

27. What is the criteria of getting tenders to supply tissue culture banana supplies?

1. RDC 2.CAO 3. DAO 4. LC. V Chairman

5. OWC Coordinator 6. Other (Specify) ----------

28.Who determines the beneficiaries of tissue culture banana plantlets?

1.Extension worker 2. OWC coordinator 3. Political leaders 4. Community based facilitators 5. Others (Specify)----------

29. Are you aware of the following policies?

1.Plan for Modernization of Agriculture (PMA)

2. National Agricultural Policy (NAP)

3. National Development Plan (NDP)

4. Agricultural Sector Development Strategy and Investment Plan (DSIP)

30.How do the various agricultural polices affect adoption of banana tissue culture?

a. Motivate farmers to carry out banana tissue culture

b. Empower the farmer to determine the price of their products

c. Regulate production standards of tissue culture banana

d. Promote free and fair market for tissue culture banana across boarders

e. Others (Specify)----------

31. What best can government do to increase adoption of tissue cultured banana plantlets?

a. Increase funding in agricultural sector

b. Strengthen laws on land use and management

c. Subsidize prices for banana plantlets

d. Invest in value addition technologies for banana

e. Invest in research and extension

f. Revisit the agricultural policies in place

f. Others (Specify) ……

Appendix 2*:* Tables of results

Regression analysis of land and TCB adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.041[a]	.002	-.007	.2564	.002	.192	1	113	.662

a. Predictors: (Constant), estimated land size of respondent

Regressed demographic factors for estimated annual banana yield (bunches/ farmer)

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1 (Constant)	1.299	.524		2.479	.015		
Gender	.083	.163	.051	.509	.612	.837	1.195
Age of the respondent	.169	.066	.287	2.566	.012	.661	1.512
Education level of the farmer	.242	.123	.208	1.971	.051	.744	1.344
Main occupation	.052	.101	.058	.517	.606	.656	1.524
Type of household headship	-.251	.192	-.129	-1.310	.193	.853	1.173
Procedure of acquiring land	-.231	.086	-.280	-2.670	.009	.753	1.329

Regressed response factors for adoption of TC banana

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1 (Constant)	.348	.267		1.300	.196	-.182	.878		
good performance exhibited on demos	.049	.037	.084	1.330	.186	-.024	.122	.928	1.078
motivation by extension workers	.534	.057	.686	9.344	.000	.421	.647	.678	1.474
motivation by researchers	-.018	.050	-.022	-.351	.726	-.117	.082	.934	1.071
motivation by other farmers	.066	.054	.079	1.211	.229	-.042	.174	.857	1.167
motivation by prices of products	.079	.041	.120	1.921	.057	-.003	.161	.937	1.067
Access to free plantlets	-.108	.048	-.161	-2.236	.027	-.204	-.012	.702	1.424

a. Dependent Variable: adoption of Tc banana

Regression Analysis of socio-economic factors affecting of banana tissue culture

Predictor	**R**	**R square**	**Adjusted R square**	**Std Error of the Estimate**
Motivation by Extension	.734[a]	.539	.535	.1742
Motivation by Research	.010[a]	.000	-.009	.2566
Performance exhibited on Demonstration farms	.159[a]	.025	.017	.2534
Motivation by prices	.129[a]	.017	.008	.2545
Motivation by other farmers	.130[a]	.017	.008	.2545
Access to TCB plantlets)	.506[a]	.256	.249	.2214

a Predictors: (Constant)

Correlational analysis for demographic factors and agro-related policy awareness

Correlations

		Gender	age	education level	major markets	NAP	PMA	DSIP	NDP
Gender	Pearson Correlation	1	-.079	-.022	.042	.104	-.164	.031	-.013
	Sig. (2-tailed)		.402	.815	.656	.266	.080	.738	.891
	N	115	115	115	115	115	115	115	115
Age	Pearson Correlation	-.079	1	-.167	.009	.038	-.034	-.076	-.208*
	Sig. (2-tailed)	.402		.074	.923	.690	.721	.422	.026
Education level	Pearson Correlation	-.022	-.167	1	-.070	-.032	-.057	-.046	-.148
	Sig. (2-tailed)	.815	.074		.457	.735	.543	.627	.115
markets	Pearson Correlation	.042	.009	-.070	1	-.062	-.162	-.077	.132
	Sig. (2-tailed)	.656	.923	.457		.512	.084	.411	.160
NAP	Pearson Correlation	.104	.038	-.032	-.062	1	-.248**	-.008	-.076
	Sig. (2-tailed)	.266	.690	.735	.512		.007	.936	.419
PMA	Pearson Correlation	-.164	-.034	-.057	-.162	-.248**	1	.179	.038
	Sig. (2-tailed)	.080	.721	.543	.084	.007		.055	.688
DSIP	Pearson Correlation	.031	-.076	-.046	-.077	-.008	.179	1	-.013
	Sig. (2-tailed)	.738	.422	.627	.411	.936	.055		.894
NDP	Pearson Correlation	-.013	-.208*	-.148	.132	-.076	.038	-.013	1
	Sig. (2-tailed)	.891	.026	.115	.160	.419	.688	.894	

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

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

Correlation analysis between agro policy awareness and TC banana adoption

Correlations

		Adoption of Tissue culture banana	farmer's awareness of PMA	farmer's awareness of NAP	farmer's awareness of NDP	farmer's awareness of DSIP
Adoption tissue culture banana	Pearson Correlation	1	-.017	-.109	-.010	.148
	Sig. (2-tailed)		.855	.245	.913	.114
	N	115	115	115	115	115

Appendix 3: Map showing some of the respondents' locations

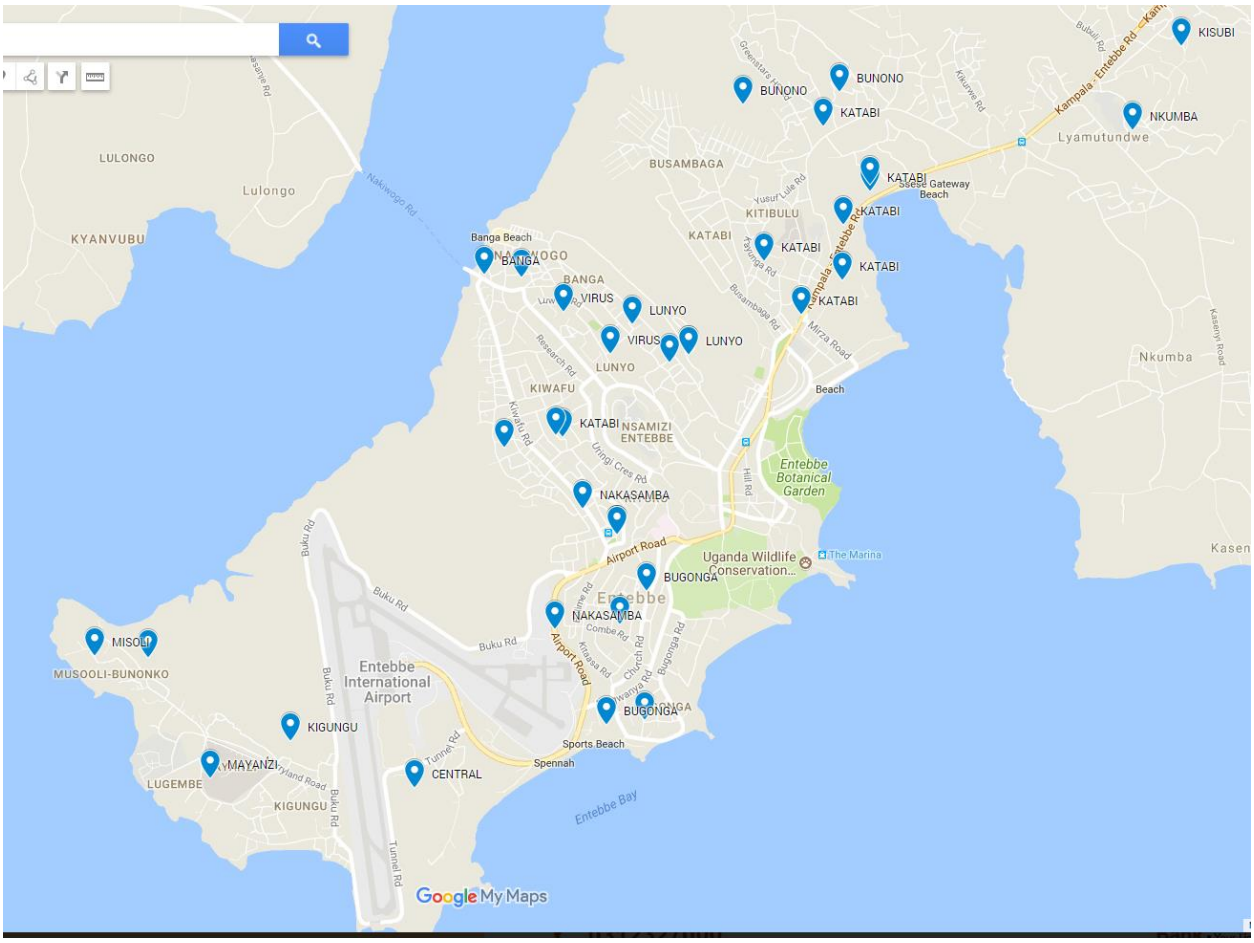

Fig 1 Stages of tc multiplication

Suckers

Cleaning and division under sterile conditions

Multiplication in controlled and sterile conditions

Rooted plantlets ready for hardening