Adoption of Kilimo Kwanza Policy by Smallholder Citrus Farmers in Muheza District, Tanga Region

Mzamiru Saidi

A dissertation submitted to the Faculty of Agriculture in partial fulfillment of the requirement for the award of the Degree of Master of Science in Research Methods of Jomo Kenyatta University of Agriculture and Technology

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DECLARATION

I, **Mzamiru Saidi** declare that this dissertation is my original work and has not been submitted for a degree in any other university. All sources of materials used in this dissertation have been fully acknowledged.

Signature ……………………………………. Date………………………………

Mzamiru Saidi.

This dissertation has been submitted for examination with our approval as University Supervisors.

1. Signature……………………………… Date………………………………

Prof. Kavoi M. Muendo.

JKUAT, Kenya.

2. Signature……………………………… Date…………………………………

Dr. Emma T. Liwenga.

UDSM-IRA, Tanzania

DEDICATION

"I dedicate this work to my lovely parents, my family, my younger brothers and sisters. May Almighty God bless them and guide them through out their life and give them all the goodness in this life and after" Aamiin.

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ABBREVIATIONS AND ACRONYMS

AgCLIR	Agriculture-Commercial Legal and Institution Reform
CHARM	Cordillera Highland Agriculture Resource Management Project
DAI PESA	Development Alternatives Inc. Private Enterprise Support Activities
DALDO	District Agriculture and Livestock Officer
ECI	Ebony Consulting International Ltd
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practices
HODECT	Horticultural Development Council of Tanzania
IPM	Integrated Pest management
JKUAT	Jomo Kenyatta University of Agriculture and Technology
MAC	Ministry of Agriculture and Cooperatives
MAFC	Ministry of Agriculture Food Security and Cooperatives
MAFS	Ministry of Agriculture and Food Security
MIGA	Multilateral Investment Guarantee Agency
PHDEB	Pakistan Horticulture Development & Export Board
SAT	Sustainable Agricultural Technology
SPSS	Statistical Package for Social Science
TNBC	Tanzania National Business Council
TPAWU	Tanzania Plantation and Agricultural Workers Union
TZS	Tanzania Shilling
UDSM-IRA	University of Dar-es-salaam-Institute of Resource Assessment
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar

ABSTRACT

Smallholder farmers in the citrus sub-sector of Tanzania particularly in Tanga Region are adversely faced by many challenges compared to other groups of farmers. Poor farming practices, poor post harvest management skills, low quality of produce and limited information to external markets compound the impediments to their production. This study assessed the adoption of Kilimo Kwanza Policy by Smallholder citrus farmers in Muheza District, Tanga Region. This policy was initiated by the Tanzania government in 2009 to support a "green revolution" in the agricultural sector through "10-pillars" with multi-stakeholder involvement. A multistage sampling technique was employed at three stages to get the study sample. In the first stage a purposive selection of Wards from different Divisions was done followed by proportionately allocation of farmers from each Village within the Wards in the second stage. Finally, a random selection of farmers was done in each of the Villages resulting to one-hundred farmers from the district. Six executive agricultural officers from the district were also included in the sample. Data was gathered using survey questionnaires for structured interviews and observations. Some descriptive statistics and Logit model were used to analyze both quantitative and qualitative data collected. About 21 percent of farmers were found to be adopters of Kilimo Kwanza Policy. The model results indicated that, the socio-economic, farm and institutional factors were the determinants of the policy's adoption. The results further revealed that, the policy was more likely to be adopted by elderly farmers or those with larger farms or those who were registered in farmers' associations. Challenges and opportunities in the sub-sector toward adoption of the policy were identified. Low levels of adoption were found in application of fertilizers; in membership of farmers' associations as well as in accessing reliable sources of farm credit and market information. More effort should be put on implementing these recommendations so as to bring about the necessary changes to the farmers and the sub-sector in general.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Horticulture is the fastest growing industry with export growth at 8-10% per annum (Tanzania Horticulture Association (TAHA), 2009). The industry earns the country more than USD 130 million per annum (TAHA, 2009). According to Ministry of Agriculture Food Security and Cooperatives (MAFC) (2008), horticultural crops account for over 50 percent of all non-staple food production in the country. Between 2007 and 2008, fruit production increased by 19.8 percent from 1.62 million tons to 1.94 million tons respectively (MAFC 2008). Tanzania has a potential of producing 2 million tons of fresh fruit worth more than Tshs. 1 trillion per annum, whereby citrus, mangoes and pineapples account for 96 percent and the rest (4 percent) for other fruits (Ebony Consulting International Ltd (ECI), 2003b; MAFC, 2008).

During the financial year 2005/2006 Tanzania exported 1,706.48 metric tons of fruits and vegetables (Nishwitz, 2009). The sector earns approximately USD 130 million each year and creates jobs at the average of about 40,000 people (Nishwitz, 2009). Similarly, the action research report by Tanzania Plantation and Agricultural Workers Union (TPAWU) (2011) shows that, the horticulture sub-sector providing the alternative employment of not less than 10,000 people and add the country more than USD 45 million annually. The official record for year 2004/2005 shows that, the exported horticultural products to Europe totaled to USD 24.4 million (Multilateral Investment Guarantee Agency (MIGA), 2006). In 2001/2002 Tanzania produced approximately 1.1 million Metric tons of horticultural products, of which the total amount for fruits and vegetables was nearly 533,000 and 550,000 Metric tons respectively (ECI, 2003b).

Available information from Ministry of Agriculture and Food Security of Tanzania (MAFS) (2002) reveals that, horticultural exports increased to 4.6 percent from early 1990s to 2001. Also it has been growing from about USD 9 millions in 1999 to USD 14 millions in 2004 (Ashimogo & Greenhalgh, 2007). According to MAFS (2002), the estimated domestic consumption of horticultural crops from 1993 to 2000 was 9,805.5 and 11,599.7 tons respectively and has kept on rising. For instance between 2000 and 2001, earnings from export of horticultural products increased by 18 percent. The industry earns the country about USD 380 millions which is equivalent to 40 percent of the total export economy of the agriculture sector, and about 9 percent of the country's total export (TAHA, 2012).

The horticultural industry makes considerable contribution to Tanzania economy in terms of income to farmers and traders, new job creation opportunities, quality of diet and the nutrition of the population (MAFS, 2002). Most of the horticultural products from Tanzania are exported mainly to Europe, South Africa and other countries in the region (MIGA, 2006). The main production zones of horticultural crops are Coast Regions, Central plateau Region, Lake Regions, and the Northern and Southern Regions (ECI, 2003a; Ashimogo and Greenhalgh, 2007; Møinichen, 2008).

Production of horticultural crops in Tanzania is dominated by a large number of small-scale producers (ECI, 2003a; United Nations Conference on Trade and Development (UNCTD), 2005; MAFC, 2008). Approximately, over 95 percent (i.e. around 1,045,000 Metric tons) of the production comes from them (ECI, 2003a; b). About 80 percent of such production is for local consumption, and the remaining 20 percent is processed or exported to neighboring countries (UNCTAD, 2005). However the amount processed are less than 10 percent and about 40-60% of the annual crop is lost due to lack of processing capacity (Naiko, 2008).

The Horticultural Development Council of Tanzania (HODECT) indicates that, from 2004 to 2010 the export performance of horticultural products was generally good and it is projected to increase to USD 1850 million by 2020 based on an average annual growth rate of 25 percent. According to Naiko (2008), horticultural crops offer a gigantic opportunity for off season supply in temperate and other markets whereas the major destination for its products (e.g. fruits) is Gulf States. Although Tanzania has a high potential of horticultural production compared to most of the African countries, it is yet to be realized though few players are present in the fruit sub-sector (UNCTAD, 2005).

Citrus fruits are one of the main horticultural commodities produced in Tanzania. It was estimated that, more than 150,000 tons of citrus fruits is produced per year (Møinichen, 2008). Citrus production in Tanzania especially oranges started in early 1900s in Tanga Region (Mbiha & Maerere, 2002). Effective propagation of citrus fruits was started by Mlingano sisal research station near Muheza District of Tanga Region in 1930s and 1940s (Mbiha & Maerere, 2002). The general opinion among scholars exemplify that the production of citrus fruits particularly oranges in Tanga grew to be of major economic importance since 1970s (Tu, 2008). Approximately, 23 percent of the country's total annual production comes from Tanga Region (Table 1).

Generally, the production potential of citrus fruits in Tanzania is enhanced by the favorable climate and good growing conditions of the country (ECI, 2003a; Ngasongwa, 2006;

Ashimogo & Greenhalgh, 2007; MAFC, 2008; Møinichen, 2008). The country is located along the equatorial climate which has favorable weather throughout the year. The hottest months occur from November to February averaging between 25^{o}C to 31^{o}C. The coldest period is between May and August, averaging between 15^{o}C to 20^{o}C. In the highlands, the temperature may be as low as 10^{o}C during cold season. Moreover the country has two rainfall seasons. The first season is between December and April covers most of the Southern, Western and Central Regions. The second season is between March and May covers most of the North and North East. Coastal areas has two rainy seasons, short rains (Vuli) which fall in the months of November and December, and the long rains (Masika) fall during the months of March and May.

The citrus sub-sector of Tanzania is dominated by a large number of Smallholder farmers who produce around 194, 978 tons per annum, harvested from 23,062 hectors resulting in 8.5 tons/hectors yield (Møinichen, 2008). However, citrus farmers are constrained by a number of challenges in their production. Some of the main challenges are perceived to be;- poor crop husbandry and post harvest management practices, little use of better technology in farming and harvesting, inadequate extension services, poor quality fruits, poor market linkage to farmers, poor distribution of price at the market, inaccessibility to farm credit, pest and diseases incidence, lack of enough cold storage facilities as well as poor infrastructure from the production points (DAI PESA, 2003; 2004; ECI, 2003a; Izamuhaye, 2008; Møinichen, 2008; Tu, 2008).

In spite of all the challenges, citrus ranked among the potential fruits in Tanzania (UNCTAD, 2005). For instance, in year 1999/2000 to 2001/2002 the production was increased from 140,000 to 145,000 Metric tons (ECI, 2003b). In year 2003/4 to 2005/6 the data from Tanga

Region (as significant producer) had shown the increase of the production from 61,020 to 65,200 tons per annum (Tu, 2008). Currently, it is estimated that over 72,000 tons of citrus fruits is produced per year (The Guardian, 2012). If policies are well organized and better implemented, they would be able to bring the necessary transformation in the citrus sub-sector. Ultimately, farmers and other stakeholders would be willing to adopt them. Different agricultural policies have been passed by the government of Tanzania. Most of them were aimed at improving the agricultural sector to increase the production capacity at regional and national level. So, different sub-sectors in agriculture (e.g. horticulture), were included in those plans and initiatives. The current initiative (i.e. policy) on board is the "Kilimo Kwanza" (*Agriculture first*) policy.

According to Agriculture-Commercial Legal and Institution Reform (AgCLIR) (2010), Kilimo Kwanza Policy was initiated in 2009. It is a package of 10-pillars with multi-stakeholder involvement to support a "green revolution" in agriculture sector of Tanzania (AgCLIR, 2010). Timmer (1988) indicates that, in order for agriculture to take part in a multiplicity of positive roles, resources and favorable developmental policies are needed. Policies refer to set of instruments aimed at reaching specified objectives (Ministry of Agriculture and Cooperatives (MAC), 1997). Basically, Kilimo Kwanza Policy aims at renewing government focus on agriculture, through new funding for subsidized inputs, road repairs and irrigation schemes (Porter et al., 2010).

In an attempt to transform the agriculture sector of Tanzania, Kilimo Kwanza Policy operates under 10-pillars to accomplish its objective. Those pillars include;

- National vision on Kilimo Kwanza;
- Financing Kilimo Kwanza;

- Institutional reorganization for management of Kilimo Kwanza;
- Paradigm shift to strategic framework of Kilimo Kwanza;
- Land for Kilimo Kwanza, Incentives for Kilimo Kwanza;
- Industrialization for Kilimo Kwanza;
- Science, technology and human resources for Kilimo Kwanza;
- Infrastructure development for Kilimo Kwanza and
- Mobilization of Tanzanian for Kilimo Kwanza (Tanzania National Business Council (TNBC), 2009).

Moreover each pillar contained a number of recommendations for fostering the implementation of the policy. With those pillars "Kilimo Kwanza" stands as a macro-economic policy for agricultural performance as it covers various aspects of agricultural economy. In the citrus sub-sector in particular, the following policy recommendations are expected to be implemented for attaining the outlined objective. These recommendations grasp the necessity of being adopted by the farmers particularly the small-citrus farmers and other stakeholders (e.g. private organs), as the sub-sector faces a lot of challenges. They include;

- Modernisation and commercialisation of agriculture for peasant and small producers;
- Establishment of social security arrangements for farmers;
- Strengthen farmers' organizations for full partnership with Government in agricultural policy adoption and its implementation;
- Increase fertilizer production and utilization, improve seeds/seedlings production, and increase local production of Agrochemicals (i.e. *backward linkages*);
- Management of post-harvest losses as well as the enhancement of trade integration and management (i.e. *forward linkages*);

- Institute mechanism for effective utilization of science, technology and human resources for Kilimo kwanza (e.g. extension services);
- Identify infrastructure development needs like the establishment of adequate storage facilities of agricultural crops (like citrus fruits) at all levels e.g. cold storage, household storage and
- Establishment of market centers at Ward level linked with production centers (see Appendix 1*)*.

Therefore Kilimo Kwanza Policy is expected to bring about such transformation in the sub-sector so long as the farmers and other stakeholders are willingly prepared to adopt it.

1.2 Statement of the problem

The citrus sub-sector of Tanzania particularly in Tanga Region faces a number of challenges which hinder its growth and development. Citrus farmers particularly the smallholder farmers are affected by poor farming practices and poor post-harvest management skills which result in relatively low production (productivity). Moreover low quality of produce and limited information to external markets compound the impediments to productivity. This situation leads the farmers particularly the smallholder farmers to earn less from the citrus value chain (DAI PESA 2003; 2004; ECI, 2003a; Izamuhaye, 2008; Møinichen, 2008, Tu, 2008).

For several years the government of Tanzania has been initiating different policies for transforming its agriculture sector. Kilimo Kwanza Policy is among the current initiatives on progress, it was initiated in 2009. This study was conducted based on the argument that, since the introduction of "Kilimo Kwanza" policy the levels of its adoption are not known nor the factors affecting the process. So it is for that purpose this study was conducted to determine the adoption of Kilimo Kwanza Policy by Smallholder citrus farmers and the factors influencing the process of adoption particularly in Muheza District of Tanga Region.

1.3 Research objectives

1.3.1 Overall objective

The general objective of the study was to assess the extent of adoption of Kilimo Kwanza Policy and the factors influencing the adoption process by Smallholder citrus farmers in Muheza District, Tanga Region.

1.3.2 Specific objectives

The specific objectives were;

1. To identify the proportion of Smallholder citrus farmers who have adopted Kilimo Kwanza Policy in Muheza District, Tanga Region.
2. To identify the factors influencing the adoption of Kilimo Kwanza Policy by Smallholder citrus farmers in Muheza District, Tanga Region.
3. To analyze critically the opportunities and challenges towards adoption of Kilimo Kwanza and policy implications.

1.4 Research questions

The study has tried to answer the following questions;

1. To what extent the Smallholder citrus farmers in Muheza District had adopted the Kilimo Kwanza Policy?
2. What are the possible factors influencing the adoption of Kilimo Kwanza Policy by Smallholder citrus farmers in Muheza District, Tanga Region?
3. What opportunities and constraints exist in the citrus sub-sector of Muheza District, Tanga Region towards adoption of Kilimo Kwanza and policy implications?

1.5 Significance of the study

Adoption studies are important for agricultural research impact assessment, because they help in prioritizing research and giving information for policy reform to foster adoption decisions (Olwande, Sikei and Mathenge, 2009). The information on Kilimo Kwanza Policy adoption and factors influencing the adoption were revealed. Moreover, the study has identified a number of challenges and opportunities within the citrus sub-sector toward adoption of Kilimo Kwanza and policy implications. These findings will help different stakeholders in citrus sub-sector such as the extension agents, policy makers and researchers to enhance a campaign on “Kilimo kwanza” policy adoption. As for farmers, the study has put some necessary recommendations which need to be implemented by farmers themselves with the help of other stakeholders in the sub-sector, so as to boost and transform their production as far as Kilimo Kwanza Policy is concerned.

1.6 Scope of the study

The study was conducted on Smallholder citrus farmers in Muheza District, particularly their adoption to Kilimo Kwanza Policy. Muheza is the leading citrus producing district in Tanga Region (ECI, 2003a; DAI PESA 2003; 2004; Izamuhaye, 2008; Tu, 2008; Mbogo, Mubofu, and Othman, 2010). The region has a total area of 27,342 km^2 of which 572 km^2 are covered by water; its total area is about 2.9 percent of total area of Tanzania (The United Republic of Tanzania (URT), 2008). Approximately, Tanga Region has 840,000 citrus fruit trees (equivalent to 8400 hectares) with more than 80 percent found in Muheza District (The Guardian, 2012). The district is located in 5^o latitude and 38.92^o longitude in the Northeast corner of Tanga Region, bordered by Tanga city to the South-east, Pangani to the south, Korogwe and Lushoto to the West, Kenya to the North and the Indian Ocean to the East. The district headquarter is 36 kilometers from Tanga City. Muheza climate is warm and humid, with temperatures ranging between 24^oC in the cool months to 32^oC during the hottest months. Its average temperature is 27^oC. The heaviest rains come mainly in the months of April and May, with shorter rains in the months of November and December. On average, the annual rain ranges from about 800mm to 1,000mm. The topography of Muheza District varied from the coastal plains to the mountain belt. The district shares the same agro-ecological zone with other districts i.e. Korogwe and Handeni of Tanga Region. Muheza District has a total area of 4922 km^2, whereby 4818 km^2 and 104 km^2 are covered by land and water bodies respectively (URT, 2008). Only 1.74 percent of Muheza is covered by dense forest, whereas 9.21 percent is bush land, 1.21 percent is under open forest. Muheza District has 4 Divisions, 23 Wards and 175 Villages. The district has a total population of approximately 294,326 people (URT, 2008). The following map shows the location of the study area (Figure 1.1).

Figure 1.1: A map of Tanzania showing the area of the study

Source: The United Republic of Tanzania (URT) (2008).

1.7 Limitations of the study

During this study several limitations were observed including the limited time and resources; the weather barriers which led to the postponements of the study for several times. In addressing these barriers, the available resources were well planned so as to accomplish the purpose and objectives of the study. Also, the time for data collection was extended so as to complete the process.

1.8 Organization of the study

The dissertation is structured into five major chapters. Chapter 1 presents the introduction part covering background information of the horticultural sub-sector of Tanzania; the problem statement; the research objectives and questions; the significance of the study; scope of the study as well as the limitations of the study. Chapter 2 addresses literature review covering an overview of citrus economies of the world and in Tanzania; an overview of technology adoption in agriculture; prior studies utilizing technology adoption approaches in agriculture as well as the conceptual framework of the study. Chapter 3 presents the research methodology covering the introductory part; the study population; research design; sample framing and sampling; the data collections and variables as well as the data analysis techniques and procedures. Chapter 4 includes the research findings and the discussions. The final chapter (i.e. Chapter 5) presents the summary, conclusions and the recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter has four sub sections; section 2.1 covers the introductory part of the chapter; section 2.2. reviews economies of citrus in the world and in Tanzania; section 2.3 gives an overview of technology adoption in agriculture; section 2.4 reviews prior studies utilizing technology adoption approaches in agriculture and section 2.5 presents the conceptual framework of the study.

2.2 Economies of citrus in the world and in Tanzania

Citrus fruit is the important tree fruit crop in the world. It is among the most valuable fruit crops in global trade (Khan, Shah, Saeed and Shah, 2010; Abdul, Atta-Rehman, Javed, Ullah and Mehboob, 2012). It occupies a distinguished position in fruit industry of the world (Abdul *et al*., 2012). Citrus is a recognized agricultural commercial fruit crop grown in many countries with sub-tropical or tropical climate in a belt within 35^{o} latitude north or south of the equator, in not less than 125 countries (Khan *et al*., 2010; Abdul *et al.*, 2012). The production of citrus fruits in the world is divided into four groups: oranges, mandarins, lemons and grapefruits (Pakistan Horticulture Development & Export Board (PHDEB), 2005; Naseer, 2010). The world continues to experience expanding markets for citrus, whereby the exporting countries are further expanding their market share as new markets open up (PHDEB, 2005).

Current annual worldwide citrus production is estimated at over 105 million tons, with more than half of this being oranges (Naseer, 2010). Yusuf and Salau (2007) and Naseer (2010) reveal that, the increase of global production of citrus fruits is due to general improvement in transportation and packaging, general rise on incomes and the consumer preference for healthy foods as well as the increase in cultivation areas.

According to FAO statistics of 2011, the top ten leading citrus producing countries are Brazil, the United States, India, Mexico, China, Spain, Iran, Italy, Indonesia, and Egypt. The developing countries contribute about 40 percent of citrus fruits in the world trade, while the Mediterranean basin contributes about 60 percent of fresh citrus in the world trade and 20 percent in Mediterranean agricultural industry (D'Onghia, 2009). The final report by Irish Aid and DANIDA (2012) shows that, the price of world trade in the fresh fruits and vegetables sector has quadrupled in the last two decades, reaching USD 108 billion in 2004. Of which the horticultural products (i.e. both fresh and processed fruit and vegetable) accounted for 22 percent of total agricultural exports from developing countries.

The common practices in citrus production include the use of organic fertilizers with other chemical inputs; the use of furrow and drip irrigation, pruning and removal of old trees as well as the use of fertigation (in large orchards). Nearly all the activities in citrus farm exclude inorganic fertilizers due to its effect on the citrus trees age (CHARM, 2005; Ait-Oubahou, 2006). In handling the incidence of pests and diseases, the commonly used method is the Integrated Pest Management Method (IPM) (Urquhart, 1999; Oyedele and Yahaya, 2010).

Integrated Pest Management (IPM) combines various techniques for combating diseases and pest infestations to economically acceptable levels without affecting the health and environment of living things (Fernandez-Cornejo, Beach and Huang, 1994). Pests (i.e. aphids and scale insects) and diseases (e.g. citrus greening) are ranked as the most limiting constraints which greatly affect citrus fruits (Ait-Oubahou, 2006; Pole, Ndung'u, Kimani and Kagunu, 2010). Other constraints are poor crop husbandry as well as poor quality and quantity produced (Urquhart 1999; Ait-Oubahou, 2006). Oyedele and Yahaya (2010) added the issue of premature fruit drop and lack of capital among other constraints. In additional, low yields, old and aging trees, high transportation costs, lack of know-how in value addition, theft and poor markets compound the problems particularly in most of the Sub-Saharan citrus economies (Pole *et al*., 2010). The application of improved farming practices and the use of organic inputs are of major importance for citrus fruits production (CHARM, 2005; Ait-Oubahou, 2006).

Pole *et al.* (2010) indicate that, the market identification, pests and diseases control as well as know-how on citrus value addition are among the ways which help in boosting the production of citrus fruit. According USAID (2005), horticulture is a highly technical knowledge dependent process whose success is derived from adoption of appropriate cultivars, management technologies as well as having knowledge of market necessities and practices with correct inputs and infrastructure investment. Citrus fruit consumer surveys for market standards have identified that fruits that are easy-peeler, residue-free, seedless and with a good shelf-life are much preferable by citrus consumers in the world (PHDEB, 2005).

In Tanzania citrus production takes place throughout the year, whereas the production differs from zone to zone due to seasonality. Production of citrus fruits in Tanzania is rain-fed and commonly organic. The Coastal Regions including Tanga are the main producing zones in Tanzania. The regions produce about 51 percent of the country total production in a year (Table 2.1). Tanga Region is a major producer of fruits including citrus (ECI, 2003a; Ashimogo & Greenhalgh, 2007; Møinichen, 2008, Izamuhaye, 2008). The production of citrus fruits in Tanzania particularly in Tanga Region is classified into three groups based on the farm size i.e. small farm (0.4 to 2 hectares), medium farm (2 to 6 hectares) and the large scale farms (6 hectares and above) (Izamuhaye, 2008). Monoculture and intercropping with cash crops are the most common practices in citrus production of Tanzania (ECI, 2003a; Izamuhaye, 2008).

Table 2.1: Production of citrus fruits in Coastal Regions of Tanzania

Region	Area planted with citrus fruits (in Hectares)	Productivity (Tons/ha)	Average hectares per citrus growing household
Tanga	9,342.34	22.41	1.3
Coast	7,635.31	18.31	1.0
Dar-es-salaam	2,022.27	4.9	0.7
Lindi	1,869.39	4.5	0.7
Mtwara	368.91	0.9	1.4
Sub-total	**21,238.22**		
Other regions	20,404.71		
Total	**41,642.93**		

Source: Extract from Møinichen (2008).

Manual treatment of tree crops like removing the infected trees is more common particularly to Smallholder citrus farmers. The age of citrus orchards in Tanzania usually differ with the location, technology used and the farm size (ECI, 2003a; Izamuhaye, 2008; Tu, 2008). About seven major different varieties identified to be grown in Tanzania include Early Valencia, Late Valencia, Washington navel, Jaffa, Pineapple, Mediterranean and Zanzibar (ECI 2003a; Izamuhaye, 2008; Møinichen, 2008). The varieties grown differ in term of their general characteristics (see Appendix 4).

ECI (2003a) and Tu (2008) indicate that, the citrus sub-sector of Tanzania particular oranges has five major channels i.e. the Hawker channel; high and low seasons domestic channel; processing channel; export channel (i.e. to Kenya) and the formal retail channels. In the citrus value chain, retailers have the ability to determine price due to their influence on matters related to chain governance. Such a role makes retailers to earn about 50 percent of the share from the chain and leaves the farmers earning little from the chain (Tu, 2008). Exports to neighboring countries are becoming an important marketing opportunity of surplus citrus fruits produced in high season (DAI PESA 2003; 2004). In Africa, Kenya is the major importer of Tanzania citrus. It is estimated that around 60% of citrus fruits produced in Tanzania (particularly in Tanga) is exported to Kenya (ECI, 2003a; Møinichen, 2008). However there are no exports to countries outside Africa as the orange cultivars and the quality of the fruits fail to meet the international market standards (ECI, 2003a). Other factors which affect the citrus market of Tanzania are poor market linkages, poor distribution of price at market and inaccessibility to market information (ECI, 2003a; DAI PESA, 2004; Izamuhaye, 2008). So far medium and large scale farmers are doing better in citrus marketing than smallholder farmers since their farms are located close to the main roads connecting main markets (ECI, 2003a).

According to Ashimogo and Greenhalgh (2007), the Small scale producers in agriculture sector of Tanzania have serious difficulties in accessing markets for their produce as they face difficulties in adhering to safety and quality standard of produce. Still the majority of horticultural commodities like citrus fruits in Africa are produced by Smallholders who depend on medium to large scale agribusiness to organize their produce for export (MIGA, 2006).

2.3 An overview of technology adoption in Agriculture

2.3.1 Definition of the concepts

Adoption is the act of accepting or making decision to use a new idea, technology, method, practice or tool (Obel, 1988; Mihiretu, 2008). Bonabana (2002) in her study describe adoption, as an outcome of a decision to accept a given technology. Colman and Young (1989) as cited in Arega (2009) referred adoption as the use or no-use of new technology by a farmer at a point in time or during unlimited period of time. On other side (Rogers, 1983 cited in Arega, 2009) define diffusion, as the course of action of spread new innovations within a particular place. Moreover he explained diffusion as a successive process in successive time. Kisaka-Lwayo (2012) defines diffusion as the rate of adoption and communication of a technique or an idea through certain channels over time within a social system. Social system includes individuals (e.g. farmers), institutions or agencies and their adoption approaches (Kisaka-Lwayo, 2012). So, the terms adoption and diffusion almost have the same meaning in adoption studies.

The term technology has been defined in several ways by different authors. Baumüller (2012) indicates that, technology is the application of knowledge in practical ways which allow efficiency of doing things or to do things that were not possible before. In the study by Bonabana-Wabbi (2002) and Deressa, Hassan, Alemu, Yesuf and Ringler (2008), technology was described as a set of new ideas associated with some degree of uncertainty which lack predictability on their outcome. In the study by Kisaka-Lwayo (2012) the term technology defined as "any idea, object or practice that is perceived as new by the members of social system". On the other hand, we have the term innovation(s). Innovation means the same as technology, because the words are always used interchangeably in adoption studies (Bonabana-Wabbi, 2002; Kisaka-Lwayo, 2012). However, technology or innovation does not work in void as it requires adjustments in accustomed practices and the realization of full potential of that technology or innovation (Baumüller, 2012).

Agriculture technology refers to knowledge, equipment, inputs and practices embodied in modern agricultural production practice (MAC, 1997). Bonabana-Wabbi (2002) reveals that, technology is the general knowledge or information that permits particular tasks, services or manufacturing of a product. From that definition, agriculture technology could refer to the body of information that allows effective agricultural practices so as to increase the quality and capacity of production. Baumüller (2012) in his study establishes that, agricultural technology may include both physical objects as well as new farming methods. Furthermore he indicated that agricultural technology may not be new but novel to the farmer. However any technology or practice utilized by individuals signifies a particular way to solve problem(s) and entails trade-offs between positive and negative behaviors (Mihiretu, 2008).

Different stages could be passed through by farmers toward adoption decisions. Kiptot, Hebinck, Franzel and Richards (2007) and Mihiretu (2008) in their studies indicate that, adoption of an agricultural technology is a mental process which follows various stages to decision making. Some scholars (Fernandez-Cornejo *et al*., 1994) describe the innovation decisions as a process with several stages which sequentially start from awareness, to information seeking, to formation of an opinion about the innovation and to decision making (i.e. whether or not adopt). However technology adoption is neither a permanent behavior nor necessarily follows the stages from awareness to adoption (Mihiretu, 2008). Kiptot *et al.* (2007) indicate that, adoption is not only to the technology, socio-economic issues, research and extension method applied, but it is due to complex interaction between people, technologies and institutions. The technology innovations can be explained as a product or as a process or as a repositioning of the existing technology or as a paradigm shift (e.g. agricultural policy).

The technological adoption (e.g. agricultural technology) may be measured by both timing and the extent of new technology utilization by individual. Timing of adoption can be split at three levels i.e. decision process to adopt or not, innovativeness in terms of when to adopt and the rate at which the technology is adopted. On the other hand the level of adoption can be measured by intensity of a particular activity e.g. cultivation. So, measures of adoption may show both the timing and extent of new technology utilization by individuals (Baumüller, 2012).

Several micro and macro-surveys studies have been done on agricultural technology adoption. The main purpose of these studies is to generate necessary information about the use of agricultural technologies. In most cases, these studies employ a cross-section analysis at the micro-level to give information about the technology adoption. These studies include also the information about farmers' current practices, what farmers are doing and possibly the factors influences their decisions (Doss, 2003).

In adoption studies different categorizations were used to explain the nature of adoption. Some studies have used normal categorization of adopters and non-adopters (Bonabana-wabbi, 2002; Douthwaite, Manyong, Keatinge and Chianu 2002; Lawal and Oluyole, 2008; Banerjee, 2009; Feng & Chenqi, 2010; Asfaw, Shiferaw, Simtowe and Haile, 2011; Owombo *et al*., 2012). Other studies (Kiptot *et al.*, 2007) have used different types of categorization which included early adopters, non-adopters, laggards, innovators and testers.

2.3.2 Determinants of adoption

Normally in the adoption studies a set of variables are being employed to explain the adoption of agricultural technology. The categorization of those variables depends much on the nature of the subject studied. Various categorizations of the factors have been done in these studies. For instance some studies (Adesina & Baidu-Forson, 1995) classify the factors into socio-economic, demographic and institutional factors. In Arega (2009) the factors grouped into farm, economic, institutional, psychological as well as personal and demographic factors. Others (Bonabana-Wabbi, 2002) group the factors into economic, social and institutional factors. Some (Adesina, Mbila, Nkamleu, and Endamana, 2000) classified them into farm and village characteristics as well as into socio-economic and institutional factors. Others (Mihiretu, 2008) group the factors into economic, institutional, socio-psychology as well as personal and demographic factors. The current study has chosen the very last categorization for the discussion.

2.3.2.1 Socio-economic characteristics of farmer

The socio-economic characteristics of a farmer are among the factors related to technology adoption. From this category variables include farmer's age, farmer's education level, farming experience, farmer's gender as well as income level were reviewed in this study. Previous studies considered the mentioned aspects to have influence on adoption decisions. For instance (Bonabana-wabbi, 2002; Mihiretu, 2008; Kassie, Zikhali, Manjur and Edwards, 2009; Owombo, Akinola, Ayodele and Koledoye, 2012) had shown that, socio-economic characteristics of the farmer influence the adoption of agricultural technologies. Age was found to have positive influence on adoption of Sustainable Agricultural Technology in the Loess plateau in China (Feng & Chenqi, 2010).

In contrary Kankwamba, Mangisoni, Simtowe, Mausch, and Siambi (2012) showed that, age variable has a negative influence on adoption of improved seed technology in Central Malawi. Olwande *et al*. (2009) revealed that with age, farmers tend to be conservative and do not accept any changes. On the other hand, they are deemed to have more experience and efficiency pertaining to readiness in adopting new technologies. Adeogun, Ajana, Ayinla, Yarhere and Adeogun (2008), in their study on Hybrid Clarias in Lagos State, found age variable to be insignificant in explaining hybrid catfish adoption. So, age variable is unpredictable as it may influence or not influence the adoption of agricultural technology.

Education of the farmer is another socio-economic characteristic, believed to have influence on the adoption of agricultural technologies. Education is a means of accessing different useful information as well as knowledge and act with it accordingly. The studies by Deressa *et al*., (2008) and Adeogun *et al*. (2008) had indicated the positive influence of farmer's education on adoption decisions. Kassie *et al.* (2009) reported the positive influence of farmer's education on adoption of organic farming techniques in semi-arid region, Ethiopia. Feng and Chenqi (2010) revealed that, better educated farmers are more likely to adopt agricultural technologies than less educated farmers. This is because the educated farmers are believed to have the ability of making appropriate adoption decisions (Arega, 2009). Also, the educated farmers are believed to have access to information on improved technologies (Deressa *et al*., 2008; Olwande *et al*., 2009).

Doss, Mwangi, Verkuijl and de Groote (2003) and Bett, Kyalo, Freyer and Lagat (2009) indicated that, farming experience had positive influence on adoption. Abebe (2007) also established that, with farm experience farmers get more understanding of farm management practices and activities. On the contrary, Mihiretu (2008) indicated that farming experience had negative influence on adoption of agricultural technology. This implies that less experienced farmers are unwilling to try new technologies because of low knowledge on farm management practices. Some studies (Adeogun *et al*., 2008, Mihiretu, 2008 and Owombo *et al*., 2012) found that, farming experience was not significant in adoption decisions.

Another factor in socio-economic characteristics is the gender of the farmer. Deressa *et al*. (2008) indicated that, male-household farmers are more likely to adopt a new agricultural technology than female farmers. This is because male-household farmers tend to have more access to resources and information. In the study by Ishami (2002), female gender found to be insignificant in explaining adoption of fertilizer in rural Tanzania. On other side, some studies (Adesina *et al*., 2000; Bonabana-Wabbi, 2002; Mihiretu, 2008) showed the influence of male gender on adoption decisions. All in all, the issue of gender on adoption is technology-specific (Kassie *et al*., 2009).

Similarly, farmer's income showed to have influence on various studies (Deressa *et al*., 2008; Arega, 2009). With income farmers can afford the cost of farm technologies such as farm inputs, agrochemicals and fertilizers. But some studies (Adesina *et al*., 2000; Farid, Silong and Sarkar, 2010; Owombo *et al*., 2012) showed that the variable is neutral to adoption decision.

2.3.2.2 Institutional factors

Institutional factors are also considered to have influence on the adoption of agricultural technologies. The reviewed factors in this category include extension intensity, access to farm credit and membership of farmers' association. Frequent contact with extension services is believed to help farmers to access information on agricultural technologies (Feng & Chenqi, 2010). An example of extension services which are usually provided to farmers include trainings, workshops, as well as field visiting. Through these services farmers are supplied with technical and professional advisory which help them in farming activities (Wobst & Mhamba, 2003). Adesina *et al*. (2000) showed that, contact with extension agencies positively affects the probability of adoption of alley cropping in the forest zone of Southwest Cameroon. Adeogun *et al*. (2008) indicated that, extension contact is an important factor in promoting farmers adoption to technology. Similarly Kassie *et al*. (2009) revealed that, access to extension services is usually used as an indicator of access to information. Moreover, Adeogun *et al*. (2008) indicated that, frequent extension services to farmers upgrades their knowledge and skills for adopting a particular agricultural technology. On other side, the variable is said to be neutral to adoption decisions. For instance in the study by Adesina and Baidu-Forson, (1995) contact with extension agencies reported to be insignificant on adoption of modern mangrove rice varieties in Guinea.

Also the accessibility to farm credit had shown to have influence on the adoption of agricultural technologies in the previous studies. The study by Olwande *et al*. (2009) shows that, lack of access to credit limits the adoption of agricultural technologies. The studies by Isham (2002), Mihiretu (2008) and Feng and Chenqi (2010) showed that, the access to farm credit by farmers exert a positive influence on the adoption of technologies. However Deressa *et al*. (2008) indicated that, availability of farming credit allows farmers to purchase farm inputs and improved crop varieties as a way of implementing a particular technology in agriculture.

Membership in farmers' association is believed to have influence on the adoption of agricultural technologies. This is because farmers associations are believed to offer farmers a range of services such as credit, extension information and markets (Adesina *et al*., 2000).

However, the variable has been mostly reported to have positive effect on adoption of agricultural technologies (Adesina *et al*., 2000; Bonabana-wabbi, 2002; Mihiretu, 2008; Lawal & Oluyole, 2008; Kassie *et al*., 2009).

2.3.2.3 Farm related factors

The farm related factors are shown to have influence on adoption of agricultural technologies. Farm size and type of technology used are among the factors reviewed in this study. The study by Feng and Chenqi (2010) indicated that, farm size positively influenced adoption of agricultural technologies. In the study by Abebe (2007), farm size reported to be positively influenced adoption of improved box hive in Atsbi Wemberta District of eastern zone, Tigray Region. Deressa *et al*. (2008) and Olwande *et al*. (2009) indicated that, farmers with large farm size are expected to have more ability to adopt new technologies and to bear risk if it fails. This is because large farm size is said to be associated with greater wealth. Kankwamba *et al.* (2012) established that, the increase of farm size by a unit (i.e. hectare or acre) would increase the probability of adopting agricultural technology.

Type of technology used is also considered to have influence on adoption decisions. Payne, Fernandez-Cornejo and Daberkow (2003) indicated that, farmers who are conversant with a certain technology are inclined to adopt a related one. Some studies however, (Payne *et al.*, 2003; Adeogun *et al*., 2008; Juma, Nyangena and Yesuf, 2009) showed the influence of the technology used on adoption decisions. The types of technology include biological and chemical technologies. Biological technology such as organic fertilizers, seeds or seedlings varieties and type of crops grown usually are associated with technology adoption. For instance, Fernandez-Cornejo *et al*. (1994) showed that the type of crops or seeds grown had influence on adoption of Integrated Pest Management (IPM) by vegetable growers in U.S.A. Similarly, Adesina and Baidu-Forson (1995) established that varieties of crops grown had influence to adoption of new agricultural technologies in Burkina Faso and Guinea in West Africa. Also, Doss *et al.* (2003) indicated that the use of fertilizers is associated with adoption decisions. On other side, chemical technologies such pesticides showed to have influence on adoption decisions (Bonabana-Wabbi, 2002; Abebe, 2007). Both farm size and type of technology used at the farm found to be significant on adoption decisions.

2.3.2.4 Socio-psychological variables

Socio-psychological variables also are considered to have influence on the adoption decisions. To adopt or not to adopt is the behavioral change process which involves cognitive engagement in decision making (Arega, 2009). Socio-psychological variables such as farmer's ability, belief, expectations, habit and custom (Abebe, 2007) as well as needs, perception and knowledge (Arega, 2009) are important determinants of farmer's adoption behavior. Selection of such factors depends on study context as well as its purpose. The study by Adesina and Baidu-Forson (1995); Mihiretu (2008); Arega (2009); Farid *et al.* (2010) associated socio-psychological variables with adoption decisions. Farming objective in particular, is among of socio-psychological variables explained to have influence on adoption decisions in the study by Doss *et al.* (2003). The authors further established that, the issue of sorting out the relationship between farming objectives and adoption decision is a little bit challenging because of ever changing objectives of farmers in relation to new technologies or new information. The exclusion of socio-psychological variables in adoption model might lead to biasness in the results, because such variables are important and possibly influences individuals' adoption behavior (Arega, 2009).

2.4 Prior studies utilizing technology adoption approaches in Agriculture

Different studies have been done on studying the adoption of agricultural technologies. The studies used different analytical research methods (i.e. models) to study the adoption of agricultural technology at farm level or otherwise.

Payne *et al.* (2003) assessed the likelihood of adopting corn rootworm (CRW) BT seed technology with the data from the United States Department of agriculture's 2001 Agricultural Resources management Survey. Ordered Logit model was employed to study factors affecting the likelihood of adoption. Factors include operator age, farm type and size, rootworm loss and its treatment, off farm labor as well as the corn borer technology found to be significant on explaining the adoption. The reviewed study concluded that, the likelihood of adoption did not appear to be related to crop rotation, tillage system, new variant CRW Region, or education. The authors recommended for further study on differences between expected and actual adoption behavior particularly on technology adoption.

Nzomoi, Byaruhanga, Maritim and Omboto (2007) investigated the determinants of technology adoption in the production of horticultural export produce in Kenya. The study employed a Logit model for analysis purposes. Multistage and random sampling techniques were used to obtain the study areas and the farmers respectively. One-hundred and twelve respondents were interviewed using structured questionnaires. Positive coefficients were reported for levels of education, role of government, availability of funds and membership to professional bodies by the firms. The study further revealed that failure to use technologies was caused by financial constraints, inappropriate technologies, and nature of the businesses, poor infrastructure, and lack of technical knowledge, poor access to information as well as the absence of technologies at a place. The study concluded that education levels, government involvement, access to finance and membership to professional organizations positively influence technology adoption.

Olwande *et al.* (2009) applied a double hurdle model on a ten-year panel household survey data for 1275 households to examine determinants of fertilizer adoption and use intensity in

Kenya. Econometric estimation results showed that age, education, credit, presence of a cash crop, distance to fertilizer market and agro ecological potential are statistically significant in influencing the possibility of adopting the fertilizer. Gender, dependency ratio, credit, presence of cash crop, distance to extension service and agro ecological potential were found to be the strongest determinants of fertilizer adoption. This study was recommended on micro and macro-economic adjustments towards adoption decisions.

Feng and Chenqi (2010) used econometric analysis to study the Adoption and Diffusion of Sustainable Agricultural Technology (SAT). A logistic regression model was used to evaluate the determinants of adoption of SAT among smallholder farmers in rain-fed farming systems based on surveyed data of a previous year. Factors including socio-economic, farm related, institutional and bio-physical factors were related to the adoption. The results showed that, farmer's age, the size of the family, the number of ruminants owned, perception of erosion problems, attitudes towards SAT and the level of family income were significant determinants of the adoption. They concluded that farmers having contacts with extension agencies, access to credit and training, participatory evaluation exercises, and participation in the GFG project have higher rate of adoption of SAT. It was further shown that non-consideration of socioeconomic aspects of the household can lead to inappropriate targeting of farmers in perception of benefits of SAT to develop a positive assessment. Also it concluded that the slope of the field and the fallow practice variables also play a critical role in adoption.

F.B. Olajide-Taiwo, L.O. Olajide-Taiwo and Alabi (2011) in their study examined the farm level effect of adoption of budded citrus technology in Benue State, Nigeria. They used a multistage sampling technique with 32 citrus farmers. Frequency counts, percentages, ranking, Chi square and PPMC were used in data analysis. Sex and marital status were found to be significant related to the farm level effect of adoption. Their study showed that disease and pests infestations were the most important threat factors linked with adoption of the technology. The study was recommended for the improvement of the technology by combating the prevailing threats factors in promoting economic gains of the farmers.

The reviewed studies have given the information on how previous adoption studies (i.e. in agriculture) were done. Numerous research methods were incorporated in these studies to come up with results. The studies gives direction on how to select the model of analysis, the variables of interest, the size of sample to be used as well as the type and kind of data. Secondary data and primary data were both used in these studies. Also different econometrics analytical models like Logit and Probit were employed too. However, most of these studies accessed the technology adoption as a product, some as a process and other as a repositioning of old technology. Little is known about the technology as a paradigm shift (e.g. agricultural policies). The current study is attempted to fill and add on this knowledge gap.

2.5 Conceptual framework of the study

As explained in the previous discussions, adoption of a given technology (i.e. agricultural technology) is assumed to be influenced by a number of factors. Technology adoption can be influenced by personal attributes, environmental and socio-economic factors. Factors influencing adoption are neither absolutely economic nor purely non-economic. The adoption behavior may be depicted by a number of variables which may be discrete choice or continuous variables (Abebe, 2007).

Likewise the disparities on adoption rates do exist between different groups of farmers. This is due to differences in the accessibility to resources, credit and information as well as perception of risks and profits linked with the new technology. Also the direction and degree of impact of adoption differs due to type of technology and conditions of areas where the technology is to be introduced respectively (Mihiretu, 2008).

In this study, a few factors were chosen based on the purpose of the study. CIMMYT (1993) indicates that, limited number of factors is always chosen in adoption study due to a number of reasons e.g. the existence of several potential audiences. The current study has associated the socio-economic, institutional, farm related and socio-physiology factors to the policy adoption by Smallholder citrus farmers in Muheza District as shown in Figure 2.1 below.

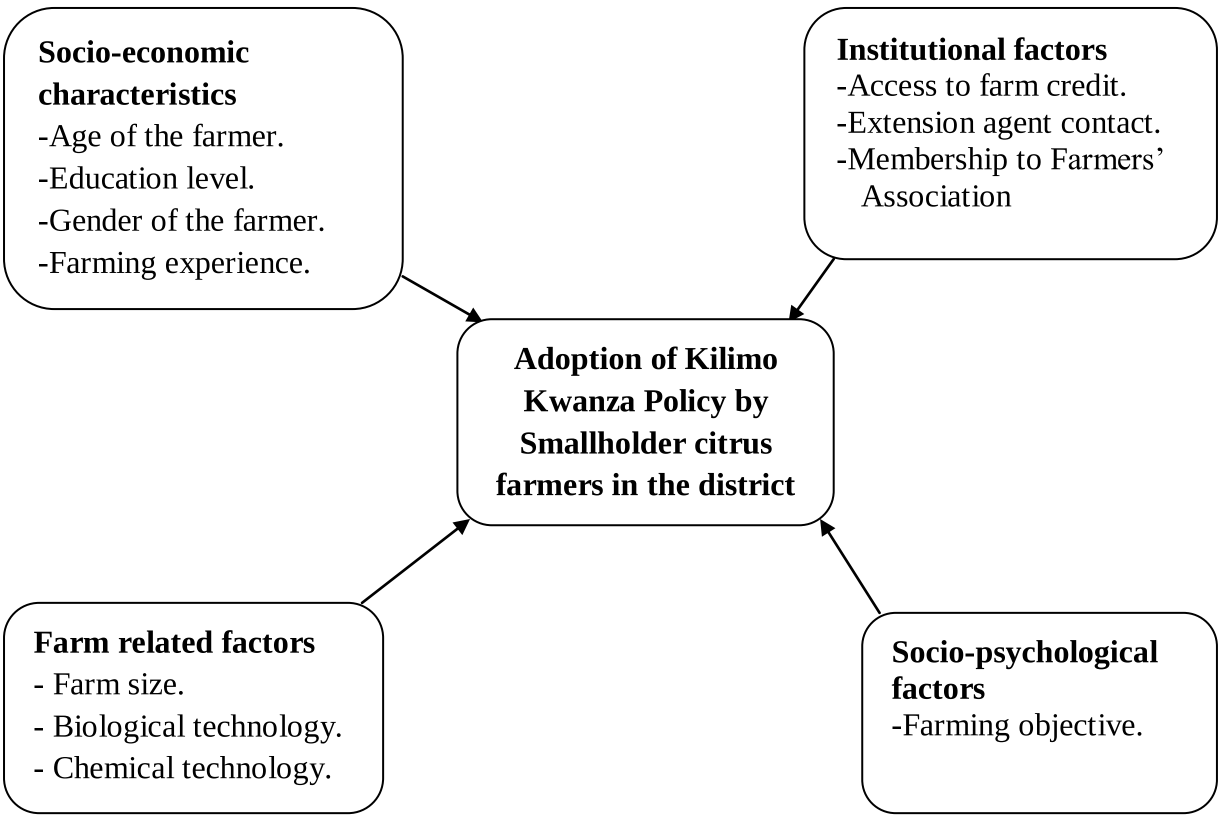

Figure 2.1: Conceptual framework of the study.

Source: Adopted from Mihiretu (2008).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter has six sub-sections; section 3.1 covers the introductory part of the chapter: section 3.2 explains the study population; section 3.3 explains the research design; section 3.4 presents sample framing and sampling; section 3.5 presents the data collection and variables and lastly, section 3.6 presenting data analysis techniques and procedures.

3.2 Research design

This study used a cross-sectional survey approach to accomplish its objectives. The design fitted in the collections of data to test hypothesis or answer current questions related to the subjects of the study (Justus, Kombo, Murumba and Edwin, 2011). The study assessed the policy's adoption at the farm level. The primary data was collected from both Smallholder citrus farmers and key informants (i.e. Agricultural officers) in the district. Other information was obtained from secondary data sources maintained at the district. Purposive and multi-stage sampling techniques were used to get the study sample. A total of one hundred Smallholder citrus farmers and six Agricultural officers from the district were attended for data collection.

3.3 Study population

The targeted population in this study was Smallholder citrus farmers in Muheza District in Tanga Region with 1-5 acres of farm plots. The population was identified with the help of *District Agriculture and Livestock Development Officer* (DALDO) using farmers' census of 2010/2011 in the district. The sampling was made up by 994 farmers from two Wards (i.e. Muheza and Mtindiro) in the district (Table 2). Agricultural officers as the key informants were also included in the study because they constitute a set of knowledgeable persons in the sub-sector. The officers included: *District Agriculture and Livestock Development Officer* (DALDO), *Subject Matter Specialist-Horticulture* (SMS-Horticulture), *Ward Agriculture and Livestock Development Officers* (WALDOs) and *Village Extension Officers (VEOs)*.

3.4 Sample framing and sampling

In this study, both purposive and multi-stage sampling techniques were employed to get a representative sample. Purposive sampling was used to identify divisions and the area of interest, while multi-stage sampling was used at three stages to get the study sample. The multi-stage sampling ensures a high degree of representativeness by providing the sampling units with the same chances of being included as part of the sample (Nzomoi *et al*., 2007). In the first stage, guided by the *DALDO* and *SMS-Horticulture* in Muheza; two Divisions i.e. Bwembera and Muheza were purposively selected based on the information of where Kilimo Kwanza Policy implementation began. Subsequently, a Ward was randomly selected from each Division based on the assumption mentioned above. In the second stage, with the help of the *WALDOs*, farmers were allocated proportionately from each Village within the Wards. A total of 11 Villages were included in this stage i.e. 5 Villages from Mtindiro Ward and 6 Villages from Kwafungo Ward. Finally, a random selection of farmers was done in each Village. About one-hundred Smallholder citrus farmers made the sample population. Nevertheless, six Agricultural officers from the Wards (i.e. two *WALDOs* and four *VEOs*) were randomly selected and included in the sample (see Table 3.1).

Formal survey of technology adoption which covers 2 to 4 years after the release of technology, approximately 60 to 120 sample sizes are enough for producing reliable results (CIMMYT, 1993). The current study was conducted 3 years after Kilimo Kwanza Policy initiation in 2009. The acceptable sample size for a survey population in descriptive studies is the one set at the confidence interval of 95 percent (Durodola, Ayedun and Adedoyin, 2012).

It should be noted that the confidence interval of 95 percent is equivalent to 5 percent level of significance. Firstly, the 5 percent method was employed in computing the sample size, but it failed to provide enough sample size based on the reviewed literature. Alternatively, the method of 10 percent was opted for which resulted to a representative sample of 100 Smallholder citrus farmers from the accessible population. Thus, the 10 percent approach method can also be used in sampling as the scholars do not agree on the exact proportion that should form the sample size in descriptive studies (Justus *et al*., 2011).

Table 3.1: Sampling and the sample size of Smallholder citrus farmers in Muheza District

Division	**Ward**	**Village**	**Total population (N =994)**	**Approx. sample size (N × 10%)**	**Key informants**	**Total sampled**
Bwembera	**Mtindiro**	Kwabada	229	23	1	24
		Kwabote	N/A	-	-	-
		Kibaoni	151	15	1	16
		Mtindiro	133	14	1	15
		Maduma	164	16	-	16
		Sub-total	**677**	**68**	**3**	**71**
Muheza	**Kwafungo**	Kwafungo	31	3	1	4
		Bagamoyo	58	6	-	6
		Makole	67	7	1	8
		Panga-mlima	54	5	-	5
		Mbambala	60	6	1	7
		Songa-kibaoni	47	5	-	5
		Sub-total	**317**	**32**	**3**	**35**

Table 3.2 shows the study sample by gender. The study included a sample of 29 male and 3 female farmers from Kwafungo Ward. On the other hand, 55 male and 13 female sample farmers were included from Mtindiro Ward. This made the total sample of 84 male farmers and 16 female farmers from the district.

Table 2:2 Summary of sampled Smallholder citrus farmers by gender

Ward (s)	Total sampled farmers (n=100)		
	Male (n)	Female (n)	Total
Kwafungo	29	3	32
Mtindiro	55	13	68
Total	**84**	**16**	**100**

3.5 Data collection and variables

The data were collected from April 2012 to June 2012 from a sample of one hundred Smallholder citrus farmers and six executive agricultural officers from Muheza District in Tanga Region. Collection of both primary and secondary data employed quantitative and qualitative research methods to gather as much information as possible. The instruments used for data collection included survey questionnaires by means of face to face interviews and observations. Observations were employed in support of the questionnaire findings in the field. Two separate survey questionnaires were used, one for the farmers and another for key informants in the district (see Appendix 2 & 3). The survey questionnaires were self-administered by the researcher.

The data from the farmers was gathered using survey questionnaires (i.e. structured and unstructured) by means of face to face interviews. The questionnaires for the farmers were designed based on the literature review and policy recommendations. The questionnaire included: the general information of the farms, institutional and financial aspects as well as the socio-economic characteristics of the farmers (Appendix 2). The farmers involved varied as some were identified to be citrus traders, citrus brokers and others representatives of farmer's associations. Quantitative data from the farmers was collected using survey questionnaires by the means of face to face interview while the qualitative data was collected using the same mentioned tools together with the personal observation.

Nevertheless, the data from key informants was taken using the same tools i.e. structured questionnaires and unstructured questionnaires by the means of face to face interviews. Generally, survey questionnaire for key informants covered the information on citrus sub-sector and Kilimo Kwanza Policy implementation in Muheza District (Appendix 3). It is worth noting that, the interview schedule for key informants (i.e. a desk research) was done prior to the field data collection, with a view to gain insights about the farmers and their production. Collection of data involved also note taking and a voice recording. The information which was captured through the voice recorder device was based on the consent of the informant. All the information was then stored for future review. Additional information about the farmers and the sub-sector in general, was obtained from secondary sources such as reports, documents and records maintained at Muheza District Agricultural Office. Model variables were derived or computed from the collected data.

***Dependent variable*:** Limited dependent variable models are usually used to evaluate the adoption of agricultural technologies (Olwande *et al*., 2009). The models are based on the assumption that the farmers operates between alternatives (i.e. adopted or otherwise) depending on identifiable characteristics. In this study the dichotomous dependent variable was used. The variable takes the value “1” for smallholder farmers who have adopted Kilimo Kwanza Policy and “0” for Smallholder citrus farmers who have not adopted the policy.

Currently, there is neither standard system for defining adoption of agriculture technology nor its measures. The situation leads to varying in categorization of adopters across the adoption studies. However, the consideration of whether the latter is a discrete state with binary values or is a continuous measure is of importance. The complexity of defining the technology being adopted makes the categorization a challenge. In that case, the appropriateness of the process may depend on the context of the study and the knowledge of the farmer's history on usage of a particular technology (Doss, 2003).

In this study, the decision on whether to select a farmer who had adopted or not adopted Kilimo Kwanza Policy was based on its selected pillars (see Appendix 1). The recommendations of the pillars were internalized to match the research context. Therefore, the aspects which were considered included;

- Farmer's objective to production either for commercial purpose or otherwise,
- Whether the farmer was a registered member of an association,
- Whether the farmer uses fertilizer in production,
- Whether the farmer uses certified and quality seedlings,
- Whether the farmer uses agrochemicals,
- Whether the farmer was receiving extension services,
- Whether the farmer had access to near-by market centers (i.e. in the Village or Ward),
- Whether the farmer had access to reliable sources of market information,
- Whether the farmer had access to reliable sources of farm credit and
- The way a farmer manages the produce (i.e. whether storage was as per recommended standards).

Farmers in Sub-Saharan Africa have low levels of technological adoption (Aker, 2010). In this study therefore, it was assumed that farmers who had adopted at least five recommendations of the policy had made a good attempt and hence deemed to be adopters.

Further classification was done on the adopters as follows; those who had adopted only five recommendations were classified as beginners, 6-7 recommendations as middle adopters and finally at least 8 of the recommendations as full adopters. As a result, there were 4 beginners, 10 and 7 middle and full adopters respectively.

***Independent (explanatory) variables*:** Variables which were expected to have influence on adoption of Kilimo Kwanza Policy included; farmer's socio-economic characteristics, farmer's socio-psychological variable, institutional and farm related factors. The variables were selected based on previous literature. The variables used in the econometric model are discussed here under. In parenthesis is the variable abbreviation as used in the model.

1. **Age of the farmer (FAMAGE)**

It is a discrete variable and was measured in number of years. Literature reveals that farmer's age has a significant role on technology adoption decisions, aged farmer are less flexible in adoption decisions than young farmers. Younger farmer are innovative as they have longer planning prospects with lower risk aversion (Motamed & Singh cited in Abebe, 2007 and Adesina *et al.*, 2000). Therefore, it was anticipated that farmer's age and adoption of the policy have negative relationship.

2. **Farming experience of the farmer (FARMEXP)**

This is a continuous variable and was measured in number of years. Experienced farmers are believed to have a lot of knowledge on farming practices and farm management skills. With farming experience, a farmer is likely to adopt new agricultural technologies and leaves behind the old technologies (Mihiretu, 2008). So the farming experience was expected to have positive influence on adoption.

3. Education status of a farmer (FAMEDU)

Different adoption studies (Deressa *et al*., 2008; Feng & Chenqi, 2010) on agricultural technologies showed the influence of farmer's education on adoption decisions. High education levels influence participations in technologies (Kankwamba *et al*., 2012). In the current study the variable was anticipated to influence the adoption positively. It was treated as a dummy variable. If a farmer reached high level of education (i.e. from ordinary level to tertiary level of education) has coded as "1" and "0" if otherwise.

4. Gender of the farmer (GENDER)

This is a nominal variable and was treated as a binary variable (1 if male, 0 if female). Gender difference of the farmers found to have influence on agricultural technologies for instance in the study by Olajide-Taiwo *et al*. (2011). However, the variation of adoption is believed to exist between male and female farmers. In this study therefore, male farmers were expected to adopt Kilimo Kwanza and policy implications more than female farmers.

5. Farmers' income level (INCOME)

With income a farmer is able to purchase pesticides, fertilizers, modern farm tools and more other farm inputs. With no income decisions to adopt new technologies or to invest in technology adoption would be impossible. Farmer's income is likely to influence the adoption decisions (CIMMYT, 1993 and Mihiretu, 2008). The variable was measured in terms of amount earned in a year in Tanzania shilling. Farmer's income and the policy adoption were anticipated to have positive relation.

6. Contact with extension agents (EXTENS)

Nearly all the extension services and programs are actively engaged in encouraging new technologies with farmers. Extension services may undertake trainings, workshops, on farm trials and demonstrations which equipped farmers with skills on a particular farm technology (CIMMYT, 1993). So, farmers can possibly increase their productivity through adoption of new agricultural technologies if appropriate extension services are put in place. This variable was treated as a dummy variable, takes value "1" if farmer received extension services and, "0" if otherwise. The variable was expected to have positive influence on adoption.

7. Accessibility to farm credit (FAMCRD)

Credit accessibility is said to have influence on adoption decisions of agricultural technology (Abebe, 2007). A farmer is likely to adopt the technology if he/she has access to farm credit**.** It was treated as a dummy variable which takes value "1" if the farmer uses credit and "0" if otherwise. Therefore, it was anticipated that accessibility to farm credit by farmer would positively affect the adoption of the policy.

8. Membership in farmers' association (FAMORG)

Farmers' associations are found to be a vital source of information, farm credit, inputs and technical advice. It is believed that if farmer registered in these associations they are more likely to adopt the technologies (Mihiretu, 2008).The variable was treated as a dummy variable, takes 1 for a farmer who is a member of association and "0" if otherwise.

9. Farm size (FAMSIZE)

This is a continuous variable and was measured in acres. The farm size influences the adoption decision. Farmers with large farms size can bear risk when technology fails, unlike farmers with small farms size (Olwande *et al.*, 2009). In the current study it was anticipated that farm size and adoption of the policy have positive relationship.

10. Biological technology used (BIOTEC)

The variable included the use of organic fertilizers as well as the use of best citrus seedlings. Some previous studies (Doss, 2003 and Fernandez-Cornejo *et al.*, 1994) showed the influence of fertilizers and type of seeds grown on adoption decisions respectively. The variable was expected to have positive influence on the adoption. It takes value "1" if a farmer uses organic fertilizer and grows Valencia or seedless varieties, and "0" if otherwise.

11. Chemical technology used (CHEMTEC)

The variable included the use of agrochemicals such as pesticides (e.g. insect traps) and chemical fertilizers. The use of such technology helps in combating pests and diseases infestation as well as to increase on farm production. The variable was treated as a dummy variable, which takes value "1" if a farmer uses either pesticides or chemical fertilizers or both, and "0" if otherwise. It was anticipated that the adoption of Kilimo Kwanza Policy would be positively affected by the application of pesticides and chemical fertilizers.

12. Farming objectives (FAMOBJ)

It is a dummy variable. The variable was coded as "1" if the primary objective of the farmer is for commercial purpose and, "0" if otherwise. If farmers grow citrus for commercial purpose, they are more likely to go with the policy. It is anticipated to have positive influence on the policy adoption.

3.6 Data analysis techniques and procedures

3.6.1 Theoretical basis of technology adoption

Previous studies indicated that agricultural technology includes modern crop varieties, crop and resources management, plant health management and postharvest (Alene, Manyong, Gockowsky, Coulibaly and Abele, 2006). However, agricultural technologies may also include the issue of agricultural policies. Most of the initiated agricultural policies aim at boosting agriculture performance just as tangible technology. Policies may come up with a number of recommendations which act as the guidelines for implementation.

Adoption of agricultural technologies (e.g. agricultural policies) can be at farm level or at the aggregate level. The current study assessed the agricultural technology i.e. Kilimo Kwanza and policy implications at farm level. Kaliba et al. (1998) indicate that, adoption at the farm level portrays the realization of farmer's decision to apply a new strategy in the production process. In most cases when studying the adoption of agricultural technology, models are being used to explain the adoption decisions (Deressa *et al*., 2008). The models are based on farmers' utility maximizing behaviors, of which the utility is not directly observed while their actions are observed from the choices they make (Deressa *et al.*, 2008). Most studies on technology adoption are used either continuous value range or discrete choices to explain adoption decisions. To adopt or not adopt is a discrete choice whereas the discrete choice econometrics models have been commonly employed in such kind of model (Nzomoi *et al*., 2007). For that case, the discrete choice econometric model was used for analyzing the adoption of Kilimo Kwanza and policy implications.

Probit and Logit models as an example of discrete choices econometric models are commonly used to study the adoption of agricultural technology. They may incorporate either binary or multivariate models based on the number of available choices toward decision making on a particular agricultural technology. Deressa *et al*. (2008) reveals that, Binary Probit and Logit models are used when dealing with the dichotomous choices. Probit and Logit model are not suitable when dealing with the adoption choices that have a continuous value range (Olwande *et al*., 2009). Similarly Bett *et al.* (2009) indicate that, qualitative response models or dichotomous models are often used to evaluate farmer's decision on adoption of agricultural technology.

On the other hand, multivariate models are often used to extend the Binary Logit and Probit models to study the adoption of agricultural technology. These models are used when there are more than two choices. An example of these models is either a Multinomial Logit or Multinomial Probit models. Multivariate choice models diverge from binary models as they allow exploration of both factors conditioning specific choices or combination of choices. They take care of self-selection and interactions between alternatives (Mihiretu, 2008).

Diederen, Van meijl, Wolters, and Bijak (2003) revealed that, different econometrics models are used in adoption studies depending on the nature of the study. The nature of the study mostly covers issues like the study objectives as well as variables of interest to be studied. Because the current study based on the assumption that farmers are faced by two alternatives (i.e. whether or not to adopt the policy), a Logit model was chosen.

3.6.2 Specification of the empirical model

Logit model particularly a binary logistic regression model was chosen as a research method for analysis purpose. Farid *et al.* (2010) show that, the Logit model is much used in social science studies due to the recognition of its preciseness on studying the level of adoption. The Logit model is also easier to compute than other type of models as it employs the cumulative logistic probability functions in the prediction of the likelihood of the technologies adoption (Adeogun *et al*., 2008). The logistic model has commonly been applied in adoption studies with dichotomous outcomes. The binary logistic regression model represents a close estimation to the cumulative normal distribution (Feng & Chenqi, 2010). Use of Logit model in adoption studies has a high expectation to produce the best fit model which would explain a particular phenomenon.

Based on the previous literature on technology adoptions (Adesina *et al*., 2000; Bonabana, 2002; Abebe, 2007; Nzomoi *et al*., 2007; Adeogun *et al*., 2008) the function form of Logit model can be expressed as:

$$p_i = \frac{1}{1+e^{-Z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}} \qquad (1)$$

Where:

p_i = The likelihood that the agricultural technology is adopted by the i[th] farmer

Z_i = Function of a vector of explanatory variables/ effectiveness of agricultural technology

e = Base of natural logarithms

Parameter **Z_i** in equation **(**1) which is a linear function of explanatory variables is expressed as;

$$Z_i = \alpha + \sum_i^n \beta_i X_i + u_i \ldots\ldots (2)$$

$i = 1,2,3 \ldots \ldots n.$

Where:

Z_i = A fundamental and unobserved stimulus index for the i[th] farmer

α = Constant term

β_i = Coefficient associated with an explanatory variable

X_i = A set of core explanatory variables

u_i = Stochastic error term

i = Observation on variables for the adoption model

The odds of adoption of agricultural technology to non-adoption of agricultural technology can be written as;

$$Odds = \frac{p_i}{1-p_i} \ldots\ldots (3)$$

Using equation (2) and (1) above, the logistic equation can be modeled into a linear form by changing the probability into log odd or Logit;

$$Logit\ (p_i) = Ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \sum_{i=1}^n \beta_n X_n = Z_i \ldots\ldots (4)$$

Where:

p_i= The probability of presence of the characteristics of interest.

α = Constant term

β_n= Coefficient associated with an explanatory variable

X_n = A set of core explanatory variables

From equation (4) above, $\frac{p_i}{1-p_i}$ is the likelihood of adoption agricultural technology to non-adoption of agricultural technology or the odds ratio (refer equation 3).

Therefore the Logit model can be presented as:

$$Logit(p_i) = Ln\left(\frac{p_i}{1-p_i}\right) = z_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_n X_n + u_i \ldots\ldots\ldots (5)$$

3.6.3 The expected model of analysis

As explained in the previous chapter, socio-economic characteristics of the farmer, farm related, institutional and socio-psychological were among of the factors selected for this study. The chosen variables from these factors were farmer's age, gender, farming experience, income of the farmer, the farm size, membership in farmers' association, access to farm credit, extension intensity, biological technology used, chemical technology used and farming objective. All the variables were related to Kilimo Kwanza Policy. Below is the model which was expected to explain the policy adoption by the farmers;

$$\begin{aligned} The\ likelihood\ of\ adopting\ Kilimo\ Kwanza\ policy \\ = \alpha + \beta_1 FAMAGE + \beta_2 FAMEXP + \beta_3 FAMEDU + \beta_4 GENDER \\ + \beta_5 INCOME + \beta_6 EXTENS + \beta_7 FAMCRD + \beta_8 FAMORG + \beta_9 FAMSIZE \\ + \beta_{10} BIOTEC + \beta_{11} CHEMTEC + \beta_{12} FAMOBJ + u_i \end{aligned}$$

Where:

α = Constant

$FAMAGE$ = Farmer's age,

$FAMEXP$ = Farming experience,

$FAMEDU$ = Education level,

$GENDER$ = Gender of the farmer

$INCOME$ = Farmer's income,

$EXTENS$ =Extension intensity,

$FAMCRD$ = Access to farm credit,

$FAMORG$ = Membership in farmers' association,

$FAMSIZE$ = Farm size,

$BIOTEC$ = Biological technology used in farm,

$CHEMTEC$ = Chemical technology used in farm and

$FAMOBJ$ = Farming objective.

u_i = Error term

3.6.4 Data analysis procedure

The data from questionnaires were coded, compiled, organized, summarized and inspected before they were entered into the computer. Data analysis was done using IBM-SPSS (19.0 version) statistical software. Qualitative data obtained through interviews and observation was organized in the field. During the analysis, a multiple of analytical research methods were used to identify the level of policy adoption and the factors influencing the adoption. Both descriptive analysis and multivariate analysis were employed in the study. The descriptive statistics such as mean, standard deviation, percentage, chi-square test and t-test were used for analysis. T-test was used to determine the relationship between the continuous explanatory variables and Kilimo Kwanza Policy adoption. Also, the chi-square test was used to analyze the relationship between discrete variables and the policy adoption. On the other hand, the multivariate analysis i.e. the Logit model was employed to determine the factors that influence the policy adoption.

Prior to model fitting, the variables were tested for the existence of multicollinearity. The results of the tests revealed that the variables were not subjected to multicollinearity (Appendix 7). During model fitting, the most insignificant variables were removed from the model so as to get the best fit model of analysis. The removal of insignificant variables is among the methods which are used in model fitting so as to get good results (Hosmer & Lemeshow, 1989 cited in Bonabana-Wabbi, 2002). The results of analysis are presented in chapter four.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 General Descriptive Analysis

Overall results showed that, 21 percent of the sampled farmers were adopters of Kilimo Kwanza Policy and 79 percent were non-adopters. Furthermore the results revealed that, 15 percent of the sampled farmers from Mtindiro Ward were adopters and the remaining 53 percent were non-adopters. From Kwafungo Ward, 6 percent were adopters and 26 percent were non-adopters (Table 4.1).

Table 3.1: Summary of demographic characteristics of sampled farmers by adoption

Ward (s)	Total sampled farmers (n=100)			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Kwafungo	5.0	1.0	24.0	2.0
Mtindiro	13.0	2.0	42.0	11.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

Specifically, the study reported high adoptions in the use of best citrus seedlings (94 percent), in the use of agrochemicals (76 percent) and in receiving of extension services (71 percent). Nevertheless, the study also reported low adoptions in application of fertilizers (29 percent), in accessing reliable sources of farm credit (12 percent), in membership of farmers' associations (23 percent) as well as in accessing reliable sources of market information (4 percent). Intensive presentations of the above mentioned results are covered in the specific sub-sections accordingly.

In regard to the sampled key informants (i.e. Agricultural officers), approximately 87 percent of them reported that, the farmers were using recommended citrus seedlings as well as agrochemicals in their farm plots and were receiving extension services on time. About 17 percent of them notably reported that the farmers were accessing reliable sources of farm credit. Considerably, more than 50 percent of the key informants reported that the farmers were neither using fertilizers in their farm plots nor being supplied with the reliable market information. Furthermore, 50 percent of the key informants indicated that, the farmers were neither registered in farmer's associations nor accessing reliable market sources. However, the majority (83 percent) of the sampled key informants reported that farmers were getting support (i.e. funds, technical help) from private organs for their production. On social security schemes for farmers, approximately 33 percent of the key informants reported their presence in the district (Appendix 5).

4.1.1 Socio-economic characteristics

Farmer's age

Mean age (FAMAGE) of sampled farmers was 44.15 years with more farmers (6 percent) having 45 years. The maximum age of the farmers was 78 years while the minimum age was 24 years. The sampled male farmers had the maximum age of 78 years and the minimum age of 24 years. For sampled female farmers, their minimum and maximum age was ranging from 25 to 50 years. Likewise, the mean age of adopters was 42.67 years with approximated standard deviation of 11.11. The mean age of non-adopters was 44.54 years with standard deviation of 11.89. Majority of adopters (14 percent) had 45 years, while the majority (8 percent) of non-adopters found at age of 41 and 43 years. The minimum and maximum age of adopters ranges from 24 to 65 years, while the minimum and maximum age for non-adopters ranges from 25 to 78 years. There is significant mean difference between mean age of adopters and non-adopters (Table 4.2). This implies that farmers' age is associated with the policy adoption.

Citrus farming experience

With regard to farming experience (FAMEXP), the average years of experience for the farmers was 14.55 years with standard deviation of 9.69. The maximum year of experience was 42 years and the minimum was 2 years. The results indicated that, 45 percent of sampled farmers had farming experience of 1-10 years, 31 percent with experience of 11-20 years, 14 percent with experience of 21-30 years, 8 percent with experience of 31-40 years and 2 percent with experience of 41-50 years. The average years of farming experience by gender were 14.58 and 14.38 years for males and females respectively. No significant difference was found between mean years of citrus farming experience for male and female farmers (p-value=0.938).

With regard to adoption category, the average years of farming experience for the adopters was 15.33 years with standard deviation of 10.54. Non-adopters average farming experience were 14.34 years with standard deviation of 9.5. Majority (15 percent) of the adopters farmers had six years of citrus farming experience, while the majority (10 percent) of the non-adopters farmers had farming experience of 10 to 12 years. The minimum and maximum years of farming experience for adopters were 4 and 34 years respectively, while the minimum and maximum years of farming experience for non-adopters ranges from 2 to 42 years. No statistically significant difference was found between mean years of farming experience for adopters and non-adopters at 5% level of significance (Table 4.2). Hence, farming experience is not associated with the policy adoption.

Table 4.2: Summary statistics for adopters and non-adopters for some continuous variables

Variables (Unit)	Total sampled farmers (n=100)				
	Adopters (n=21)		Non-adopters (n=79)		**Sign. At
	Mean	Std. Dev	Mean	Std. Dev	α=0.05
Farmer's age (Years)	42.67	11.11	44.54	11.89	**0.036**
Farming experience (Years)	15.33	10.54	14. 34	9.51	0.679
Farm size (Acres)	3.21	1.43	3.39	1.37	**0.091**
Distance travelled to input markets (Meters)	12950.00	14197.68	13922.13	9837.09	0.716
Distance travelled from the farm to feeder road (Meters)	424.37	775.72	469.03	845.93	0.827
Distance travelled from farm to main road (i.e. tarmac road) (Meters)	16142.86	8332.38	16829.11	8606.87	0.320

- ** Testing significant differences between the adopters and non-adopters.

Farmers' education

Based on education level of farmers (FAMEDU) the results showed that, 93 percent of the sampled farmers had acquired formal education, among these 84 percent had reached up to primary education level and 9 percent up to ordinary secondary level. Interestingly, none of the sampled farmers had reached above the ordinary secondary level. Still on, the results showed that 7 percent of the farmers had not acquired any formal education. In relation to this, 19 percent of adopters had acquired formal education, with 16 percent having reached up to primary education level while 3 percent up to ordinary secondary level. The results further showed that, 2 percent of the adopters had not acquired any formal education. Among the non-adopters, 74 percent of them had acquired formal education with 68 percent reaching up to primary level and 6 percent up to ordinary secondary education level. On the contrary, 5 percent of the non-adopters had not acquired any formal education. Amazingly, none of the sampled farmers had advanced secondary or tertiary levels of education. Furthermore, the results showed that farmers' education had insignificant relationship (χ^2 = 0.205, p-value= 0.651) with adoption of Kilimo Kwanza Policy (Table 4.3).

Table 4.3: Distribution of the sampled farmers by education levels

Education level	**Total sampled farmers (n=100)**			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Primary education	13.0	3.0	57.0	11.0
Ordinary secondary education	3.0	00.0	5.0	1.0
Advanced secondary education	00.0	00.0	00.0	00.0
Tertiary education level	00.0	00.0	00.0	00.0
Never attended school	2.0	00.0	4.0	1.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

- χ^2 = 0.205, p-value= 0.651.

Gender

Out of one-hundred sampled Smallholders citrus farmers, 84 percent of the farmers were male and 16 percent were female. When the entire sampled respondents were considered as far as adoption category is concerned, the results indicated that 18 percent were male and 3 percent were female. On the other hand, 66 percent were male non-adopters and 13 percent were female non-adopters. The results of chi-square analysis (χ^2=0.058, p-value=0.809) showed that there is no significant association between farmers' gender and the adoption of Kilimo Kwanza Policy at 5% level (Table 4.1).

Farmers' income

The total annual income (INCOME) for sampled farmers was Tshs. 231,300,000, whereas the average annual income was Tshs. 2,313,000 with approximated standard deviation of 366,166. The maximum annual income of the farmers was Tshs. 21,000,000 while the minimum was Tshs. 90,000. The average annual income for adopters was Tshs. 3,447,142.86, with the majority (24 percent) earning about Tshs. 500,000 per year. The minimum and maximum annual income of adopters ranged from Tshs. 100,000 to 21,000,000. On the other hand, the average annual income for non-adopters was Tshs. 2,011,518.99. The majority (12 percent) of non-adopters were earning Tshs. 1,000,000 and Tshs. 2,000,000 per year. The maximum and minimum annual earning of non-adopters was Tshs. 15,000,000 and Tshs. 90,000 respectively. No significant relationship (t=1.610 and p-value=0.111) was found between farmers' income and the adoption of Kilimo Kwanza Policy (Table 4.4).

Table 4.4: Summary statistics of annual income of the farmers in Muheza District

Distribution statistics	**Total sampled farmers (n=100)**		**p-value at α=0.05**
	Adopters (n=21)	Non-adopters (n=79)	
Total annual income (Tshs)	72,390,000	158,910,000	
Mean (Tshs)	3447142.86	2011518.99	*0.111
Standard deviation	6132778.44	2633496.31	
Maximum (Tshs)	21,000,000	15,000,000	
Minimum (Tshs)	100,000	90,000	

- * Not statistically significant, t=1.610, p-value 0.111.
- Currency exchange was 1.00 USD = 1575.00 Tshs. as at August, 2012.

Off-farm employment

The results indicated that, 18 percent of the sampled farmers were found in agriculture (i.e. farming and livestock keeping) of which 1 percent only keeps animals. Other off-farm activities in which farmers were participating included casual work (6 percent), handcrafts (2 percent), petty business (32 percent) and service rendering (42 percent) such as nurses, doctors and traditional healers. Moreover the survey results showed that, the majority of sampled farmers in both male (33 percent) and female (9 percent) were participating in service rendering. Among the adopters, 18 percent were participating in off-farm activities. Majority (10 percent) of the adopters were participating in service rendering, and the rest (8 percent) in petty businesses. Among the sampled farmers, adopters were not participating in livestock keeping, casual work and handcrafts activities. The results also revealed that, 64 percent of non-adopters were participating in off-farm activities. Moreover the results showed that, non-adopters were participating in all of the off-farm activities, whereby the majorities were found in service rendering (32 percent) and petty business (24 percent) (Table 4.5).

Table 4.5: Distribution of off-farm employment for sampled farmers

Off-farm activity	Total sampled farmers (n=100)			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Livestock keeping	00.0	00.0	1.0	00.0
Casual work	00.0	00.0	6.0	00.0
Handcrafts	00.0	00.0	2.0	00.0
Petty business	8.0	00.0	18.0	6.0
Service rendering	7.0	3.0	26.0	6.0
None	3.0	00.0	13.0	1.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

4.1.2 Farm characteristics

Farm size

The total farm size (FAMSIZE) of the sampled farmers was 336 acres with average farm size of 3.36 acres and standard deviation of 9.69. The minimum and maximum total farm size of the farmers ranges from 1-5 acres. Majority (33 percent) of the farmers had 5 acres of citrus farms. With regard to farmers' gender, the average farm size in male and female farmers was 3.39 and 3.12 acres respectively. No significant differences existed between mean farm sizes for male and female (p-value=0.562). With regard to adoption category, the average total farm size of the adopters and non-adopters were 3.12 and 3.39 acres respectively. Majority of the adopters (29 percent) and non-adopters (33 percent) had 5 acres of citrus farms. There was a significant difference between mean farm sizes for the adopters and non-adopters (p-value= 0.091) (Table 4.2). This implies that the size of the farm is associated with the policy adoption.

Distance travelled from citrus farm to feeder roads

Total average distance travelled from citrus farms to feeder roads by sampled farmers (FEEDDIST) was 459.65 meters. On average the distance travelled by adopters and non-adopters from citrus farms to nearest feeder roads were 424.37 and 469.03 meters respectively. Majority (15 percent) of adopters' farms located 100 meters from feeder roads, while the majority (18 percent) of non-adopters' farms located 3 meters from feeder roads. Maximum distance travelled from farms to nearest feeder roads for adopters was 3000 meters and 4000 meters for non-adopters. However both adopters and non-adopters had the same minimum (1 meter) distance travelled to nearest feeder roads. There was no significant difference between mean distances travelled for adopters and non adopters (Table 4.2). This implies that both the adopters and non-adopters are travelled almost the same distance to nearest feeder roads.

Distance travelled from citrus farm to main roads

Likewise the distance travelled by the farmers from citrus farms to main roads/tarmac roads (MAINDIST) was 14485 meters. Average distance travelled by adopters and non-adopters farmers from citrus farms to nearest main roads/ tarmac roads (MAINDIST) was 16,142.86 and 14,044.30 meters respectively. The minimum distance travelled of adopters was 1,000 meters and the maximum was 30,000. The maximum distance travelled by non-adopter was same as of adopters but the minimum distance travelled was 1,500 meters. The groups were not differing in distance travelled as the p-value was 0.320 (Table 4.2).

Application of biological technologies in citrus farms

The study revealed that, the best seedling varieties and application of organic manure were the most popular biological technologies (BIOTEC) by the farmers. Ninety-four percent of the sampled farmers reported to use best seedlings varieties (i.e. Valencia varieties), other grown varieties including Pineapple (1 percent), Jaffa (3 percent), and Washington navel (5 percent). Nine percent of the adopters had grown Late Valencia, 11 percent had grown Early Valencia and 1 percent had grown Washington navel. None of the adopters had grown Pineapple and Jaffa varieties. Among the adopters, majority (2 percent) of the female adopters had grown Valencia varieties while majority (9 percent) of male adopters had grown Late and Early Valencia. Also the results showed that 74 percent of non-adopters had grown Valencia varieties, 36 percent had grown late Valencia and 38 percent had grown Early Valencia. Other varieties grown by non-adopters were Pineapple (1 percent), Jaffa (3 percent) and Washington navel (1 percent). The study further revealed that, all the varieties except seedless varieties were grown by non-adopters. Twelve percent of female non-adopters had grown the Valencia varieties while 62 percent of the male non-adopters had grown it. Male non-adopters farmers had grown all the varieties unlike female non-adopters. Neither pineapple nor Washington navel varieties were found to be grown by female non-adopter farmers. However the results showed that, there was significant difference between user of biological technologies and non-user of the technology (χ^2 =17.440, p-value=0.000). Table 4.6 below summarizes the distribution of the sampled farmers by variety grown.

Table 4.6: The citrus varieties grown by the sampled farmers in Muheza District

Variety grown	Total sampled farmers (n=100)			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Late Valencia	9.0	00.0	30.0	6.0
Early Valencia	9.0	2.0	32.0	6.0
Pineapple	00.0	00.0	1.0	00.0
Jaffa	00.0	00.0	2.0	1.0
Washington naval	00.0	1.0	1.0	00.0
Seedless varieties	00.0	00.0	00.0	00.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

About 29 percent of the sampled farmers were found to be using organic fertilizers in citrus farms, while 71 percent did not use any fertilizer. In contrast, 20 percent of the non-adopters were using organic fertilizers compared to 9 percent of the adopters. Moreover the results showed that, all the female adopters were not using organic fertilizer while 9 percent of the male adopters were using it. However, 16 percent of the male and 4 percent of the female non-adopters were found to be using fertilizer in citrus farms. The results further established that, all of the sampled farmers were not using chemical fertilizers in their farm plot (Table 4.7).

Table 4.7: Application of fertilizers in citrus farms by the adopters and non-adopters

Fertilizer (s) application	Total sampled farmers (n=100)			
	Adopters		Non-adopters	
	Male %	Female %	Male %	Female %
Use organic fertilizers only	9.0	00.0	16.0	4.0
Use chemical fertilizers only	00.0	00.0	00.0	00.0
Not using fertilizers	9.0	3.0	50.0	9.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

Application of chemical technologies in citrus farms

Insects' traps and pesticides are the chemical technologies (CHEMTEC) which were found to be used by the farmers. The results showed that 76 percent of sampled farmers were using agrochemicals in their farm plots, and the remaining (24 percent) were not using chemical technologies. The majority (18 percent) of the adopters were reported to use chemical technologies in their farm plots. On the other hand, 58 percent of non-adopters reported to use chemical technologies in their farm plots. In contrary, 3 percent of adopters were not using chemical technologies compared to 21 percent of non-adopters sampled farmers. However the results showed that, there was significant difference between user of chemical technologies and non-user of the technology (χ^2 =27.04, p-value=0.000). Therefore, there is a significant association between application of chemical technology and the policy adoption. Table 4.8 below shows the use of chemical technologies by the sampled farmers.

Table 4.8: The use of chemical technologies in citrus farms by the sampled farmers

Application of chemical technologies	**Total sampled farmers (n=100)**			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Use insects traps	10.0	1.0	31.0	6.0
Use sprays	6.0	1.0	18.0	3.0
Not use any of them	2.0	1.0	17.0	4.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

The cropping patterns in citrus farms

The survey results revealed that 46 percent of sampled farmers had mixed cropping; 44 percent had grown citrus in a reserved land as monoculture; 2 percent had grown citrus varieties with other fruits crops; 2 percent grown citrus varieties with cash crops and 6 percent applied other systems in citrus production. The majority of male (41 percent) and female (8 percent) farmers had grown citrus varieties together with staple crops. Among female farmers, only 1 percent had grown citrus with other fruits crops. On the other hand few male farmers (2 percent) had grown citrus with fruits crops as well as citrus with cash crops. However the results revealed that, there is statistically significant difference on the cropping patterns (χ^2=12.288, p-value=0.015). This implies that, different cropping patterns have influence on the production of the farmer. Table 4.9 below shows the distribution of the farmers by cropping patterns.

Table 4.9: Distribution of the adopters and non-adopters by cropping patterns

Cropping pattern	Total sampled farmers (n=100)			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Land reserved for citrus only	6.0	00.0	33.0	5.0
Citrus varieties and staple crops	10.0	2.0	27.0	7.0
Citrus varieties and other fruits crops	1.0	00.0	1.0	00.0
Citrus varieties and cash crops	1.0	1.0	00.0	00.0
Other systems of farming	00.0	00.0	5.0	1.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

- χ^2=12.288, p-value=0.015

4.1.3 Institutional aspects

Within institutional aspects various aspects were discussed such as accessibility to farm credit, participation to farmers' association, contact with extension agents, accessibility to market outlets as well as the accessibility to sources of information. Here under are the descriptive results of the mentioned variables;

Accessibility to farm credit

It was found that 59 percent of the total sampled farmers had access to farm credit (FAMCRD), while 41 percent had no access to the credit. Farmers were found to access the credit from different sources such as the government (1 percent), private organs (3 percent), farmers' association (1 percent), Savings and Credit Cooperative Societies (SACCOs) and Microfinance institutions (7 percent) as well as from citrus traders/brokers (12 percent). Besides, 35 percent of the farmers borrow the money from their friends and neighbors. Among the adopters, 12 percent were found to have access to farm credit and the rest (9 percent) had no access to farm credit. Majority (7 percent) of the adopters were accessing the credit from their friends and neighbors. The results further showed that none of the adopters access the credit from the government, private organs, farmer's association and SACCOs. On the other hand, 47 percent of non-adopters were found to have access to farm credit whereas the majority (28 percent) borrows the money from their friends and neighbors. All the sources were reported to be used by non-adopters in accessing the credit. Moreover the results showed that, there is significant relationship between access to farm credit and adoption of Kilimo Kwanza Policy (χ^2=6.640, p-value=0.010). Table 4.10 presents the distribution of the adopters and non-adopters by accessibility to farm credit.

Table 4.10: Accessibility of farm credit by the sampled farmers in Muheza District

Source of farm credit	Total sampled farmers (n=100)			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Government	00.0	00.0	1.0	00.0
Private organs	00.0	00.0	2.0	1.0
Farmers' associations	00.0	00.0	1.0	00.0
SACCOs	00.0	00.0	6.0	1.0
Brokers & traders	4.0	1.0	6.0	1.0
Others e.g. friends	7.0	00.0	24.0	4.0
No access	7.0	2.0	26.0	6.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

- χ^2=6.640, p-value=0.010.

Farmers' associations

The majority (23 percent) of total sampled farmers were found to be registered in farmers' associations (FAMORG), and the rest 77 percent were reported to be not registered. Out of the registered ones, 10 percent registered themselves before the policy's initiation (i.e. in 2009) and the rest (13 percent) after its initiation (Appendix 6). Seven percent of the adopters were members of associations, whereas the majority (4 percent) was registered in the private associations. Among the female adopters none of them were reported to be a member of farmers' association. On the other hand, 16 percent of the non-adopters were reported to be members of associations. In contrast, 2 percent of the female non-adopters were members compared to 14 percent male non-adopters. Besides, the majority (11 percent) of non-adopters were found in the community owned associations. However, the results showed that, there is significant association between the membership in farmers associations and Kilimo Kwanza Policy (Table 4.11).

Table 4: Distribution of the adopters and non-adopters in farmers' associations

Owner of the association	**Total sampled farmers (n=100)**			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Government	1.0	00.0	1.0	00.0
Private organs	4.0	00.0	3.0	1.0
Community	2.0	00.0	10.0	1.0
Others	00.0	00.0	00.0	00.0
Not a member	11.0	3.0	52.0	11.0
Total	**18.0**	**3.0**	**66.0**	**100.0**

- χ^2=42.4660, p-value=0.000

Contact with extension agents

The results showed that, 71 percent of the total sampled farmers have contact with extension agents (EXTENS). The majority (24 percent) of sample farmers were reported having frequently contact with extension agents in a year. About 12 percent of the farmers did not know how frequent they had contact with extension agents. Among the adopters, 19 percent were reported having contact with extension agents, whereby the majority (6 percent) had met with extension agents twice in a month. In the contrary, 2 percent of the adopters did not have any contact with extension agents compared to 27 percent of the non-adopters. With regard to gender, all of the female adopters were reported having contact with extension agents unlike their counterpart male adopters. Besides, 52 percent of the non-adopters farmers were reported having contact with extension agents whereas the majority (19 percent) had frequent contacts. Contact with extension agents was found to have positive and significant association with adoption of Kilimo Kwanza Policy at 1% significant level (Table 4.12).

Table 4.12: Distribution of sampled farmers by frequency of contact with extension

Time of period	Total sampled farmers (n=100)			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Once in a month	2.0	1.0	10.0	2.0
Twice in a month	6.0	00.0	4.0	3.0
Frequently	4.0	1.0	16.0	3.0
Not known	1.0	1.0	6.0	00.0
Others e.g. once in a year	3.0	00.0	6.0	2.0
No contact	2.0	00.0	24.0	3.0
Total	**18.0**	**3.0**	**66.0**	**100.0**

- χ^2=13.093, p-value=0.000

Accessibility to market outlets

With regard to the fruits sales and market outlets, 45 percent of sampled Smallholder citrus farmers were found using brokers channel; 28 percent sell direct to citrus traders (i.e. at farm gate); 22 percent send to open market outside the village; 1 percent send to nearby farm markets; 2 percent send to collections point in the village and 14 percent send their fruits to other regions. Among adopters farmers, the majority (10 percent) were using brokers channel to sell their fruits. Other sources of markets accessed by the adopters were open markets outside the village (4 percent); markets outside the region (5 percent) and the rest (2 percent) were selling their fruits direct to citrus traders. None of the adopters reported to use village collection points and nearby farm markets to sell their fruits. On the other hand, the majority (35 percent) of non-adopters were using brokers channel to sell their produce. Also the results showed that, village collections points and nearby farm markets were not used by the non-adopters. The result of chi-square analysis (χ^2=3.467, p-value=0.628) showed that, there was no statistically significant difference in accessing different market outlets. The study further reported that, 89 percent of the sampled farmers were organizing their sales two times a year, 8 percent once in a year and the rest (3 percent) all the year round (Appendix 6). Table 4.13 below shows the distribution of sampled farmers in different market sources.

Table 4.13: Accessibility to market outlets by the sampled farmers in Muheza District

Product destination	**Total sampled farmers (n=100)**			
	Adopters (n=21)		**Non-adopters (n=79)**	
	Male %	Female %	Male %	Female %
Direct to traders	2.0	00.0	11.0	3.0
Brokers channel	8.0	2.0	33.0	2.0
Village collection points	00.0	00.0	00.0	2.0
Open markets outside village	4.0	00.0	14.0	4.0
Nearby farm market	00.0	00.0	1.0	00.0
Other regions	4.0	1.0	7.0	2.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

- χ^2=3.467, p-value=0.628

Accessibility to market information

About 87 percent of the sampled farmers were reported having accessibility to market information, the remaining 13 percent did not have the access. From the total adopters and non-adopters, 2 percent and 66 percent were reported having accessibility to market information respectively. With regard to gender, 73 percent of sampled male farmers had access to market information compared to 14 percent of sampled female farmers. Table 4.14 below shows the distribution of total sampled farmers with accessibility to market information.

Table 4.14: Accessibility to market information by the sampled farmers in Muheza

Accessibility to market information	**Total sampled farmers (n=100)**			
	Adopters (n=21)		**Non-adopters (n=79)**	
	Male %	Female %	Male %	Female %
Access market information	18.0	3.0	55.0	11.0
Not access market information	00.0	00.0	11.0	2.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

Distance travelled to input markets

The mean distance travelled by sampled farmers to nearest input markets (INPUTDIST) was 13717.98 meters. Average distance travelled by adopters to reach the nearest input markets was 12950.00 meters while for non-adopters farmers was 14212.63 meters. The minimum distance travelled by adopters was 10 meters and the maximum distance was 50,000 meters. The minimum and maximum distance travelled by non-adopters was 3 to 30,000 meters. The majority of adopters (15 percent) had to travel 30,000 meters to nearest input markets while the majority of non-adopters (11 percent) had to travel 21,000 meters. However the t-test results indicated that no statistically significant mean difference for adopters and non-adopters on distance travelled to input markets (Table 4.2).

4.1.4 Socio-psychological aspect

Farming objective

Based on the survey results, 59 percent of sampled farmers reported to grow citrus for commercial purpose while 41 percent for subsistence. Among the adopters, 10 percent grow citrus for commercial purpose and the majority (11 percent) for other subsistence purpose. On the other hand, 49 percent of the non-adopters grow citrus for commercial purpose and the rest (30 percent) for subsistence purpose. The study further revealed that, for those farmers who engaged in citrus production for commercial purpose, the majority (37 percent) did it after the policy's initiation and the rest (22 percent) before its initiation (Appendix 6). The chi-square results showed that, there is no significant relationship between the farming objectives (FAMOBJ) and adoption of Kilimo Kwanza Policy (Table 4.15).

Table 4.15: Farming objective of the sampled Smallholder citrus farmers

Farming objective	**Total sampled farmers (n=100)**			
	Adopters		**Non-adopters**	
	Male %	Female %	Male %	Female %
Commercial purpose	9.0	1.0	43.0	6.0
Subsistence purpose	9.0	2.0	23.0	7.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

- χ^2= 1.423, p-value=0.233.

4.2 Challenges and opportunities toward adoption of Kilimo Kwanza and Policy implications

Challenges in the sub-sector

During the study, several challenges were identified including farm, financial, institutional as well as the marketing linkages challenges. These challenges and constraints were accelerated by low implementations of the policy recommendations and its implications by the extension agents (i.e. Public and private organs).

1. **Farm challenges**

The reluctance of farmers to use good agricultural practices in time and the invasion of fruit flies were found to be common in the district. The study has identified that a large proportion of Smallholder citrus farmers grow Valencia varieties though few of them grow other varieties including seedless varieties (Table 4.6). Seedless varieties were found in specialized shops and few are grown in farmers' nurseries. However, the majority (56 percent) of the farmers were intercropped citrus with other crops. According to Muheza agricultural officers, growing of citrus with other crops is not recommended because it reduces the production capacity of citrus fruits. In additional, few farmers use fertilizers at the recommended stage (i.e. when the tree set flowers). Moreover, some of them were not using fertilizers as they believe that their farms are fertile and productive (Table 4.7). Farmers also use traditional methods to reduce and combat the incidence of insects and diseases. About 48 percent of the sampled farmers reported to use traditional methods in their farms (Table 4.8). It was further observed that traditional traps are commonly used in farms to combat invasion of fruit flies such as *Bactrocera invadens*. Pests (i.e. *Bactrocera invadens*) and diseases (i.e. *Gummosis*) were reported to be the major threats to citrus farmers. On the hand farmers use some chemical sprays (i.e. Success bait, MazoFerm and Methyl Eugeno) to combat fruit diseases after consulting their extension officers, though they are not applied on regular basis.

2. Financial challenges

Financial barriers such as unreliable sources and unavailability of farming credit were among the challenges within the sub-sector. There are few well established financial institutions such as microfinance banks and SACCOs to serve farmers financially. The few available have high requirement and regulations. This situation forces the farmers to borrow money from citrus brokers and known citrus trader based on the established ties of agreements between them. About 12 percent of the farmers borrow money from citrus brokers and known citrus traders (Table 4.10). The lenders may sometimes take citrus from those farmers at a very cheap price to compensate what they provided to farmers. No subsidies are provided to citrus farmers. The government agriculture budget has excluded citrus farmers unlike other crops e.g. maize. This situation affects farmers as they fail to buy some agricultural inputs such as farming tools, agrochemicals and the certified quality seedlings. More than 60 percent of the sampled farmers reported the high cost of farming inputs and planting materials (Appendix 6).

3. Institutional challenges

Few (8) farmers association were reported to present in a place, of which six associations owned by community (i.e. villagers) and the rest (2) were private owned. Most of these associations are not active due to lack of cohesion's among farmers in strengthening them. Moreover, these associations lack clear and specified objectives to farmers toward the sub-sector development. Over 50 percent of the farmers were not members of these associations (Table 4.11). In rare cases these associations were reported to conduct trainings and give technical advice to the farmers. Moreover the study has identified that, the government serves a minimal role in organizing and controlling these associations. According to Muheza agricultural officers, the active operating associations in the district were Mtindiro Orange Farmers' Cooperative Society (MOFACOS), Kwabada Farmers Association (KWAFA) and the Association of Fruits Seedlings Growers in Maduma (UWMM). Likewise, farmers are faced by serious challenges of infrastructures such as storage facilities (e.g. cold storage facilities) and fruits processing industries for their produce. Currently no such facilities are available though are extremely needed. This situation leads to high postharvest losses. To avoid such situations, farmers sell their produce directly from the farm in order to minimize losses. Sometimes they sell their fruits at throw away price compared to the price set by citrus brokers and citrus traders at the market. Sixty-one percent of the sampled farmers were reported accessing the markets through brokers and citrus traders channels (Table 4.13). Moreover the study established that, none of the interviewed sampled farmers had joined in social security schemes for farmers. This might affect the farming activities of the farmers in case of losses caused by diseases and pest infestations, fire outbreak in farms plot or due to other natural calamities.

4. **Market linkages constraints**

Citrus farmers are also affected by poor market linkages and poor market information sources. Though different market sources and channels are available the main challenge is the linkages between production points and markets. Currently there are no operating market centers at Ward level linked with production centers. This situation leaves farmers with only two main channels of market i.e. through village brokers as well as citrus traders. It was also identified that the government and the private sector in rare occasions provide market information to citrus farmers. This situation pushes farmers to unreliable sources of information such as village brokers and citrus traders. Over 80 percent of the sampled farmers were reported accessing the market information through these channels. The village brokers and citrus traders exploit farmers because they have more information about markets and prices than them. The results further revealed that, there was significant difference in accessing different sources of market information (Table 4.16). This implies that, the latter might have effect on the accessibility of citrus markets.

Table 4.16: Distribution of the sampled farmers in different sources of market information

Source of information	Total sampled farmers (n=100)			
	Adopters (n=21)		Non-adopters (n=79)	
	Male %	Female %	Male %	Female %
Extension agents	2.0	00.0	1.0	00.0
Farmers' associations	00.0	00.0	1.0	00.0
Media e.g. radio	00.0	00.0	00.0	00.0
Traders and Brokers	16.0	3.0	53.0	11.0
No access to information	00.0	00.0	11.0	2.0
Total	**18.0**	**3.0**	**66.0**	**13.0**

- χ^2=7.672, p-value=0.043.

Opportunities in the citrus sub-sector

In spite of the mentioned challenges, the citrus sub-sector of Muheza District has a number of opportunities. The availability of a good number of citrus growers in a suitable land for production is among of the identifiable opportunities. In general the place has a good land which is suitable for any kind of humid and temperate fruits and crops. This attracted the number of farmers particularly the smallholder farmers to get involved in the production. According to the District agricultural officers, Mtindiro reported to be the leading citrus producing Ward with large number of citrus growers. Other leading Wards in citrus fruits production include Kwafungo, Mkuzi and Kilulu.

Also the district has a good number of passable feeder roads (i.e. feeder and main roads) which are located closer to citrus production points. These road networks help farmers in the transportation of their produce to market places. Similarly, the normal routines from farmers' places or from citrus farms to input markets are enhanced with these roads too. Moreover the study found that, most of the citrus farms are located along the highways. This facilitates the transportation of citrus fruits to other regions like Morogoro, Dar-es-salaam, Kilimanjaro and Arusha. Moreover the highways are used to channel the fruits to Nairobi and Mombasa in Kenya. So these roads serve a great role in citrus economies of Muheza District.

Extension services are relatively available for farmers in the District. For instance, farmers are taught how to use agrochemicals and fertilizer in citrus production. The technical advice and market information are also available and freely supplied to farmers at the time farmers are in need of them. In some cases, the extension agents supply the agricultural inputs (i.e. pesticides) at shared cost and conducts trainings as well as the consultations to farmers on a weekly or monthly basis (Table 4.12). In addition to that, the majority (71 percent) of sampled farmers were reported having home nurseries for preparing citrus seedlings (Appendix 6).

4.3 Factors affecting the adoption of Kilimo Kwanza Policy

As indicated in Table 4.17 and Table 4.18 below, seven (7) explanatory variables were found to be associated with the policy adoption.

Table 4.17: Summary statistics of continuous explanatory variables used in the model

Variables	**Mean across adoption category**				
	Adopters	Non-adopters	Expected sign	Observed sign	T-value
FAMAGE (Years)	42.67	44.54	-	+	0.652 (*)
FAMEXP (Years)	15.33	14.34	+	+	0.415(NS)
INCOME (Tshs)	3447142.86	2011518.99	+	+	1.610(NS)
FAMSIZE (Acres)	3.21	3.39	+	+	0.524 (**)

- ***, ** and * represent significant at 10, 5 and 1% of significance level respectively
- NS represents not significant.

Table 4.18: Summary statistics of dummy explanatory variables used in the model

Variables	Adoption category				
	Adopters	Non-adopters	Expected sign	Observed sign	χ^2-value
FAMEDU					
-up to standard seven (%)	16.0	68.0	+	+	0.205 (NS)
-From standard seven and above (%)	3.0	6.0			
GENDER					
-Male (%)	18.0	66.0	+	+	0.058 (NS)
-Female (%)	3.0	13.0			
EXTENS (% Yes)	19.0	52.0	+	+	13.093 (*)
FAMCRD (% Yes)	12.0	47.0	+	+	6.640 (*)
FAMORG (%Yes)	7.0	16.0	+	+	42.466 (*)
BIOTEC (% Yes)	20.0	74.0	+	+	17.440 (*)
CHEMITEC (%Yes)	18.0	58.0	+	+	27.040 (*)
FAMOBJ					
-Commercial	10.0	49.0	+	+	1.423 (NS)
-Others	11.0	30.0			

- ***, ** and * represent significant at 10, 5 and 1% of significance respectively
- NS represents not significant.

The results of the econometric model are presented in the Table 4.19. A total of eleven (11) were included in the econometric model for analysis. Three variables out of eleven variables were found to be significant in explaining adoption of Kilimo Kwanza by Smallholder citrus farmers. The results further revealed that, 90% of the policy adoption is correctly predicted by the model, this implies that the model has a good explanatory power on the outcome. This model is statistically significant at 1% (χ^2= 54.029, p-value=0.000, d.f=10). Moreover, the model correctly predicted sample size of 71.4% and 94.9% for adopters and non-adopters respectively. This implies that, non-adopters are more precisely predicted than adopters.

Approximately 42% of the variation in the adoption of Kilimo Kwanza Policy was explained by the explanatory variables (Cox & Snell R square =0.417). The significant variables including membership in farmers' association, age of the farmer and the farm size. Membership in farmers' association, age of the farmer and the farm size were statistically significant at 1%, 5% and 10% respectively. The significant variables are discussed here under:

Farmer's age (FAMAGE): The variable is statistically significant at 5% probability level. The model results further indicated that; for a year increase in the age of the farmer, the odds of success for adoption of Kilimo Kwanza Policy increased by a factor of 1.12. This implies that, the elderly farmers are more likely to adopt the policy compared to the younger ones. This is because the elderly farmers had experienced benefits of different past agricultural technologies (i.e. agricultural policies), thus much easier for them to realize the benefits of new ones (i.e. Kilimo Kwanza Policy) and adopt it for production. The result is inconsistent with the hypothesized relationship.

Farm size (FAMSIZE): The variable is statistically significant at 10% probability level. Furthermore the results had shown that, for a unit increase in the farm size (i.e. in acres), the odds of adopting Kilimo Kwanza Policy increases by a factor of 2.06. This implies that, famers who had larger farms are more likely to adopt the policy than the one who had smaller farms. This is because; farmers with larger farms were found to be using appropriate farming methods i.e. proper spacing between citrus trees, better application of chemicals and biological technologies in their farms. Such practices placed them in a better position of adopting the policy. The result is consistent with the hypothesized relationship.

Farmers' associations (FAMORG): The variable is statistically significant at 1% probability level. The results further indicated that; For every 1 year increase in farmer involvement in farmers' organization, the odds of adopting Kilimo Kwanza Policy increased by a factor of 0.086. The small increase in the factor of adoption implies that, though these associations are important to farmers, somehow they operate inefficiently to support them. For instance, the associations rarely provided farmers with necessary information and technical assistance to adopting the policy's recommendations. Probably, inefficiency of these associations might be due to lack of neither financial nor technical support from the government.

Table 4.19: Logistic regression for factors influencing Kilimo Kwanza Policy adoption

Variables	**Coefficient (α)**	**S.E**	**Wald**	**Sig.**	**Exp (α)**
FAMAGE	0.109	0.055	3.980	0.046**	1.115
FAMEDU	0.803	1.752	0.210	0.647	2.233
GENDER	0.327	1.158	0.080	0.778	1.386
FAMEXP	-0.037	0.050	0.552	0.457	0.964
INCOME	0.768	1.873	0.168	0.682	2.155
FAMCRD	-0.974	0.817	1.421	0.233	0.377
FAMORG	-2.456	1.277	7.255	0.000***	0.086
FAMSIZE	0.722	0.438	2.724	0.099*	2.059
BIOTEC	-0.917	1.667	0.302	0.582	0.400
CHEMTEC	-1.611	1.054	2.336	0.126	0.200
FAMOBJ	-0.628	0.946	0.441	0.507	0.534
Constant	-0.790	3.160	0.063	0.803	0.454
Diagnostic test for the model					
-2 log likelihood	48.762				
Chi-square	54.029				
Cox & Snell R square	0.417				
Predicted Adopter	71.4%				
Predicted Non-adopter	94.9%				
Predicted Overall	90.0%				

***, ** and * represents 1%, 5% & 10% significance level respectively.

4.4 Discussions of results

It was found that, farmer's age had influence on adoption of Kilimo Kwanza Policy. The results further shown that, farmers' age and the policy adoption are positively related. This implies that elder farmers are more likely to adopt Kilimo Kwanza Policy than younger farmers. These study results are inconsistent with the hypothesized relationship. Similar findings were reported by Adesina and Baidu-Forson (1995), in the analysis of farmers' perceptions on adoption of new agricultural technology in Burkina Faso, West Africa. Also the result of this study is in line with Payne *et al.* (2003) and Banerjee and Martin (2009). On the other hand, the number of years of farming experience was hypothesized to influence the adoption decisions. However, the study result established the insignificancy of the number of years of farming experience on adoption of Kilimo Kwanza Policy. This implies that the number of years of farming experience is not associated with the policy adoption. This agrees with the findings by Adeogun *et al.* (2008) that the number of years of farming experience has no influence on adoption decisions.

Farmer's education was hypothesized to have influence on adoption of Kilimo Kwanza Policy. Previous literature (Mihiretu, 2008) established that, educated farmers can easily comprehend and take the information conveyed to them by development agents. Furthermore, it is believed that literate farmers have the ability to perceive, interpret and respond to new information much faster than illiterate farmers (Uaiene, 2007). However the study result was established that farmers' education has no influence on adoption of Kilimo Kwanza and policy implications. These results are inconsistent with *a priori* expectation. The results are in agreement with the study by Mazuze (2007) on assessing the analysis of adoption of orange-fleshed sweet potatoes in Gaza province in Mozambique. The result further agrees with

Lawal and Oluyole (2008), who indicated that farmers' education had no influence on adoption decisions among cocoa farming households in Oyo state, Nigeria.

Although women are said to play a vital role in the agricultural and rural economies in developing countries (SOFA Team & Doss, 2011), the situation is quite different in the citrus sub-sector of Muheza District. The study revealed that, more than 70 percent of the sampled farmers were male. This implies that, citrus fruit' farming in Muheza District is a male dominant activity. This is similar to what Olajide-Taiwo *et al*. (2011) found out when assessing the effect of adoption of budded citrus technology among farmers in Benue state, Nigeria. It is also in agreement with Pole *et al.* (2010) in a study on citrus farming in Kwale District, a case study of Lukore, Mombasa. This indicates that, citrus farming is a male dominant activity in some African countries (e.g. Tanzania, Kenya and Nigeria). However, gender of the farmer was found to be insignificant in explaining the adoption decisions. Similar findings were reported by Kisaka-Lwayo (2012), in the analysis of risk preferences and consumption decision in organic production in Kwazulu-Natal and Eastern Cape provinces of South Africa. The result is also supported by earlier study of Kankwamba *et al*. (2012).

Income of the farmers was also associated with adoption of Kilimo Kwanza Policy. The information was based on approximated total annual income obtained from various activities done by farmers. The study was established that over 80 percent of the sampled farmers participating on off-farm activities, this add to farmers other sources of income. In the study area, livestock keeping, casual work, hand crafts, petty business and service rendering were reported to be some of the off- farm activities in which sampled farmers were participating. Unlike the prior expectations, no significant relation was found between farmer's income and adoption of the policy. This implied that the variation of income in among farmers would not affect the adoption decisions. Empirical results of some of the studies (Adesina *et al.*, 2000 and Arega, 2009) also support these findings.

The farm size was found to be associated with adoption of Kilimo Kwanza Policy. This implies that, variations in the farm sizes might affect the adoption decisions by farmers. The econometric model results further revealed that, farmers with large farm sizes would be willing to adopt the policy than farmers with small farm sizes. Asfaw *et al.* (2011) established the same results in the study of "Agricultural technology adoption, seed access constraints and commercialization in Ethiopia". The results are also in agreement with the study by Uaiene, Mazuze, Mwangi, Langyintuo and Kassie (2011) on assessing the characterization of maize production Sub-systems in Mossourize and Sussungenga districts, Manica, Mozambique.

Regarding fertilizer application, it was found that none of the sampled farmers use chemical fertilizers in their farm plot. On other side, few farmers were found to be using organic fertilizers but in less amount and in rare cases. Most of them were using fertilizers at early planting stage and at a time the trees set flowers. Some farmers intentionally neglect the application of fertilizer in their farms due to perception that their land was fertile and productive. This kind of perception is reported by agricultural officers to be common to among farmers in the district. Moreover such perception is reported to affect and might affect the production sometimes in future. According to Mushobozi (2010), different agricultural management practices such as the application of fertilizers are always recommended for preserving soil fertility. In this study, some of the biological and chemical technologies were found to have influence on adoption of Kilimo Kwanza Policy. Similar findings were reported by Bonabana-Wabbi (2002), when assessing factors affecting adoption of agricultural technologies in the case study of Integrated Pest Management (IPM) in Kumi District, Eastern Uganda.

Contact with extension agents was also found to have influence on adoption of Kilimo Kwanza Policy as hypothesized. The farmers are facilitated with technical advice on good management practices in citrus farming, and also supported with farm inputs though at shared costs. In some cases, the extension agents are supplied farmers with the market information and trained them on farm cost management. So, farmers who have frequently contact with extension agents can be inclined to adopt Kilimo Kwanza Policy. The results are consistent with findings from previous studies by Adesina *et al*. (2000) and Owombo *et al*. (2012).

Farm credit is necessary for farmers as it serves for many functions in their agricultural activities. Different tasks and activities by farmers are accomplished through their accessibility to farm credit. In the current study the farm credit was found to have positive influence on the adoption of Kilimo Kwanza Policy. This indicates that the chance for adopting Kilimo Kwanza Policy is higher to farmers who have access to the credit than farmers who have no access to it. The results agree with findings of Isham (2003), which establish that there is significant relationship between adoption and access to farm credit. The results are also consistent with the findings from previous study by Mihiretu (2008). However, credit alone is not an assurance for technology adoption due to the fact that it may be used in other purposes like repaying of farm loans (Abebe, 2007).

Participation in farmers associations was found to have influence on adoption of Kilimo Kwanza Policy. These results are consistent with *a priori* relationship. Surprisingly, the model results revealed a low probability of policy adoption for farmers who have registered in farmers' associations. As previously mentioned, these associations were focusing more on social roles against the economic and technical ones. For that reasons, some farmers abandoned the associations on realizing they had low contribution to them. However, the significance of farmers' associations on adoption decisions was also shown in past studies by Adesina *et al*. (2000) and Mihiretu (2008).

The production of citrus fruits in Muheza District is commercial oriented. Over 50 percent of the sampled farmers reported to grow citrus on commercial basis. Unfortunately, farming objective reported to be insignificant for explaining the policy adoption. This implies that whether farmer grow citrus on commercial purposes or otherwise, cannot explain the adoption. Different citrus varieties were found to be grown in Muheza. However, Valencia varieties are the most preferred and commonly grown in the place. The varieties are said to be marketable compared to other types of varieties such as Jaffa, Washington navel and other varieties. Also the previous studies (ECI, 2003a; Izamuhaye, 2008) conducted in the same area reported the same results. This implies that Tanga Region is most significant producer of citrus fruits particularly Valencia varieties.

In the econometric model, membership in farmers' organization, farmers' age and the farm size were found to be significant determinants of the policy adoption. The sign of coefficient of the farm size was consistent with the chi-square results, while the signs of coefficients of membership in farmers and farmer's age were found to be different from the chi-square results. As indicated in the previous discussions the results shown that, elder farmers were more likely to adopt Kilimo Kwanza Policy than younger farmers. Furthermore, farmers with large farm sizes were more likely to adopt the policy than farmers with small farm sizes. Also membership to a farmer's association contributed on the adoption of the policy. These results indicate that, the socio-economic characteristics, farm related and institutional factors are significant determinants of the policy adoption by Smallholder citrus farmers in the place.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter has three sub-sections: section 5.1 summarizes the study i.e. the study area, the objective of the study, the study population, sample framing and sampling, data collection and management procedures, data analysis techniques and procedures as well as the findings of the study. Section 5.2 presents the conclusion of the study and lastly, section 5.3 presents the recommendations of the study.

5.2 Summary

The study was conducted in Muheza District in Tanga Region. Muheza is the leading citrus producing District. It is located in 5^{o} latitude and 38.92^{o} longitude in the Northeast corner of Tanga Region, bordered by Tanga City to the South-east, Pangani to the south, Korogwe and Lushoto to the West, Kenya to the North and the Indian Ocean to the East. The district headquarter is 36 kilometers from Tanga City. The topography of Muheza District varied from the coastal plains to the mountain belt. The district shares the same agro-ecological zone with other districts i.e. Korogwe and Handeni of Tanga Region. Muheza District has a total area of 4922 km^2, whereby 4818 km^2 and 104 km^2 are covered by land and water bodies respectively. The district has a total population of approximately 294,326 people. The main purpose of this study was to assess the extent of adoption of Kilimo Kwanza Policy and the factors influencing the adoption process by Smallholder citrus farmers in Muheza District, Tanga Region. Kilimo kwanza Policy is a package of 10-pillars with multi-stakeholder involvement to support a “green revolution” in agriculture sector of Tanzania.

One-hundred farmers in Muheza District were randomly selected. The instruments used for data collection included survey questionnaires by means of face to face interviews and observations. Both the qualitative and quantitative were gathered using structured and unstructured questionnaires for structured interviews. The tools were used so as to get as much information as possible. The collection of data were included the key informants (i.e. six agricultural officers) from the District. This is because they constitute a set of knowledgeable persons in the sub-sector. The interview schedule to key informants was done prior to the field data collection to gain insights about the farmers and their production.

Data from questionnaires were coded, organized, summarized and inspected before they were entered in the computer. Qualitative data obtained through interviews and observation was organized in the field. Data analysis was done using IBM-SPSS (*19.0 version*) statistical software. Generally, chi-square and t-test were employed to test the association between the selected variables with the policy adoption.

Based on the chi-square test for dummy variables and t-test for continuous variables; the following variables include farmers' age, the farm size, contact with extension agent, accessibility to farm credit, membership in farmers' association, application of biological and chemical technologies were revealed to have positive relationship with the policy adoption. On the other hand, the farming experience, farmers' income, farmers' education, gender and farmers' objective were found to have no significant relationship with the policy adoption.

Again, a binary logistic model was used for identifying the determinants of the policy adoption. The econometric model results revealed that a membership in farmers' association, farmers' age and the farm size were significant determinants of the policy adoption. The results further established that, the odds in favor of adopting Kilimo Kwanza Policy increased by factor of 2.06 for the farmers with larger farms; increased by factor of 1.11 for elderly farmers and increased by factor 0.086 for a farmer who had registered in farmers' association. Other variables such as farming experience, gender, biological and chemical technologies, contact with extension agents, farmer's education, farming objective, farmer's income and accessibility to farm credit were reported to be insignificant in determining the policy adoption.

Numerous challenges and opportunities were also identified in the citrus sub-sector toward adoption of Kilimo Kwanza and policy implications. The identified challenges were the lack of cohesioness to among farmers in strengthening their associations, unreliable sources of credit and market information, absence of subsidies to citrus farmers as well as poor agricultural practices and fruit husbandry. The study further revealed that, high requirement and regulations set by microfinance institutions were hindering the borrowing of money by the farmers. Finally, the study has revealed the minimal role played by the government in strengthening the farmers' associations in the district. On the other hand, the identified opportunities include the availability of a good number of citrus growers in a suitable land for production; extension services are relatively available for farmers; regular trainings and workshops conducted for farmers as well as the presence of abundant passable roads which are closer to citrus farms.

5.3 Conclusions

The descriptive statistics results showed the proportionate of adoptions in the selected policy recommendations. The adopters were reported to adopt a lot of policy recommendations, though their population is quite low compared to the non-adopters. Low levels of adoption were reported in these policy recommendations; in application of fertilizers, be registered in farmers' associations, in accessing reliable sources of farm credit and the market information. Based on the descriptive results, over 50 percent of the Smallholder citrus farmers were missed out in those policy recommendations. Furthermore neither District nor Ward cold storage facilities present for farmers in the District.

Additionally, the econometric results have identified factors which were determining the policy adoption. The factors include a membership in farmers association, farmer's age and the farm size which are statistically significant at 1%, 5% and 10% respectively. The results indicated that: (1) Farmers who registered themselves in farmers' associations were more likely to adopt the policy than the ones who were not members of the associations; (2) Older farmers were more likely to adopt the policy than younger farmers and (3) Farmers with larger farms were more likely to adopt the policy than farmers with small farms.

5.4 Recommendations

Support should be provided by different stakeholders to the farmers' associations towards implementing the policy. Currently, these associations have failed in accomplishing some of its tasks due to lack of funds and experts. For instance neither technical help nor market information is provided by these associations. Microfinance banks, SACCOs and other stakeholders involvement is highly recommended to revive these associations. Such involvement will ensure both consistency in supply of funds and technical support to these associations. Consequently, farmers will benefit with both technical and financial support from these associations for production activities.

Collaboration between extension agents and farmers' associations should be enhanced and more effort to be put on advising and assisting farmers on good agricultural practices. This will include the use of fertilizers on regular basis so as to increase capacity and quality of production. Farmers should grow seedless varieties such as *Delta valencia.* This will enable them to compete in both regional and international markets.

Establishment of market data centers and cold storage facilities for farmers is highly recommended in the sub-sector. The study showed that little has been implemented on the citrus sub-sector of Muheza. It is like the sub-sector is not highly considered by the policy implementers. So the study recommends a serious implementation of this policy's recommendation in the district so as to improve the economic performance of the sub-sector. There should be well established organs for connecting farmers to different market channels within and outside the country. In relation to this, cold storage facilities should be established at the place to reduce the post-harvest losses.

Due to limitation of time and financial resources, few variables were internalized in this study however substantial information was obtained. In future, more variables such as application of physical technology (e. g. hand hoe, plough), participation on off-farm activities and farmers' perceptions could be internalized to study the adoption of Kilimo Kwanza Policy and its implications.

There is need for further research on adoption of Kilimo Kwanza Policy to incorporate other sub-sectors in the field of agriculture. This could be through involving other stakeholders (i.e. extension agents, financial institutions) to bridge the gap.

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APPENDICES

Appendix 1: Kilimo Kwanza Policy and its recommendations (selected pillars)

PILLAR AND ACTIVITY	TASK	TIME FRAME RECOMMENDED BY POLICY
NATIONAL VISION ON KILIMO KWANZA Modernise and commercialise agriculture for peasant, small, medium and large scale producers;	-Transform peasant and small farmers to commercial farmers through emphasis on productivity and tradability.*	2009-2015
FINANCING KILIMO KWANZA Establish social security arrangements for farmers;	-Establish a specific social security fund for farmers, -Mobilize farmers to join social security schemes.*	Start August, 2009.
INSTITUTIONAL REORGANIZATION FOR MANAGEMENT OF KILIMO KWANZA Strengthen farmers' organizations for full partnership with	- Support capacity building of farmers and farmers' organizations in the implementation of KILIMO KWANZA programmes.*	Start August, 2009.

Government in agricultural policy and strategy formulation, implementation and evaluation;		
INDUSTRIALIZATION FOR KILIMO KWANZA Backward linkages: -Increase Fertilizer production and utilization; -Improve seeds production; - Increase local production of Agrochemicals; Forward linkages: Management of post-harvest losses;	- Enhance extension services to create demand and to ensure appropriate use of fertilizers.* - Facilitate availability of fertilizers. Subsidize high quality and certified seeds to small scale farmers.* - Train farmers on the requirements and proper application of agrochemicals.* - Establish District food storage facilities. - Train farmers on proper storage and the management of agricultural products.* - Establish market data/information centers to facilitate farmers	Continuous. Annually Continuous Start August,2009

Enhance trade integration and management;	understanding of market developments.*	
SCIENCE, TECHNOLOGY & HUMAN RESOURCES FOR KILIMO KWANZA Institute mechanism for effective utilization of science, technology and human resources for KILIMO KWANZA;	- Support extension officers to establish demonstration farms and to provide guidance on proper farming methods to farmers.* -Set performance targets for extension officers as basis for their evaluation.	
INFRASTRUCTURE DEVELOPMENT FOR KILIMO KWANZA. Identify infrastructure development needs for KILIMO KWANZA; Market centers in every Ward;	- Establish adequate storage capacity at all levels e.g. cold storage, household storage, national storage for commodities etc.* - Establish market centers at Ward level linked with production centers.*	Continuous. By 2015.
MOBILIZATION OF TANZANIAN FOR KILIMO KWANZA.		

Integration of KILIMO KWANZA in Government machinery.	- Integrate KILIMO KWANZA in the plans of the Central and Local Government.*	August 2009
Sensitization campaign on KILIMO KWANZA at national, regional, district, Ward and Village levels;	- Mobilize schools and colleges in the campaign on KILIMO KWANZA	Continuous.

- **N.B:** The tasks with *Asterik* (*) were internalized as the aspects for grouping the farmers into adopters and non-adopters in this study.

Appendix 2: Survey questionnaires to Smallholder citrus farmers.

A SURVEY QUESTIONNAIRE TO CITRUS FARMERS IN MUHEZA DISTRICT, TANGA REGION

All the information collected in this questionnaire will be completely confidential and will not be used to assess whether the respondent should receive this or other benefits.

Identification;

Ward name.	Village name.	Farmer ID.	Farmer Age.	Gender of the farmer
				1-Male, **2**-Female.

SECTION 1: General information of Small citrus farmer.

1. When did you start the orange farming (*experience in citrus farming*)? ___________.

2. What is the highest level of your education?

   (1) Primary. (2) Ordinary secondary level. (3) Advanced secondary level. (4) Tertiary (5) None. ( )

3. (a) What is the main reason for you to grow citrus?

   (1) For commercial purpose (2) for subsistence purpose (3) both. (4) Others e.g. for prestige…… ( )

   (b) If it is for commercial purpose, since when? ………………………..

4. What is the size of your farm under citrus? …………………………….

5. (a) What is the level of your income per year (*approximated total income*)? …………………………………………..

   (b) Do you have other source(s) of income apart from citrus farming?**1-Yes, 2-No** ( )

   (c) If yes. Which of these? (1) Livestock (2) Casual work (3) Handcraft

   (4) Petty business (5) others ( )

6. (a) Which orange variety is most grown in your farm?

   (1) Late Valencia (2) Early Valencia/ Msasa (3) Pineapple/ Pamba (4) Delta Valencia (5) Others…………….

   (a) Why do you grow the selected variety?

   ………………………………………………………………………………………

   ………………………………………………………………………………………

   ………………………………………………………………………………………..

   (b) Do you grow other variety(s) in your farm? **Yes/ No** Why?

   ………………………………………………………………………………………

   ………………………………………………………………………………………

7. (a) How do you perform most of your farming activities?

(1) Manually (2) Technically (*using sophisticated tools*) (3) Both ( )

8. Do you use any fertilizer in your farm? **1-Yes, 2-No** ( )

(a) If yes. At which stage? Why so? ……………………………………………..

(b) If Not. Why? ……………………………………………………………………..

9. (a) Do you receive any extension service(s) in a period of a year? **1-Yes, 2-No** ( )

(b) If yes. What kind of extension service(s) do you receive?

(c) And how often you communicate with extension officer(s)?

(1) Once a month. (2) Twice in a month. (3) Frequently. (4) Don't know.

(5) Other…………………. ( )

(d) If not why? ……………………………………………………………………….

10. (a) Is there any farmers' association at your place? **1-Yes, 2-No.** ( )

(b) Do you belong to any farmers' association? **1- Yes, 2-No.** ( )

(c) If yes, in which type of farmers' association do you belong?

(1) Government. (2) Private sector (3) Village (4) others………………… ( )

(d) When did you registered in farmers' association? ……………………………….

(d) Reason for you to be registered or not registered in farmers' association?

……………………………………………………………………………………

…………………………………………………………………………………….

11. (a) Are you registered in any social security scheme for your farming activities?

1-Yes, 2-No ( )

(b) If yes, since when…………………………………..

(c) And in which social security scheme you have registered for?

(1) Local Government. (2) Private sectors (3) Community.

(4) Others……………………… ( )

12. (a) How do you manage your produce/ harvest?

(1) Picked and stored waiting for consumers. (2) Picked and sent to the market immediately (3) Picked direct from the farm by citrus traders (4) Others… ( )

(b)In case you store, how do you store your produce?

………………………………………………………………………………………

13. How far your farm is from market center in your place (*approximated distance*)?

(1) Near to farm (……….) (2) Far from the farm (…………) (3) No market centre.

(4) I don't know ( )

SECTION 2: Citrus husbandry and farmer's activities in the sub-sector.

14. (a) What is the total number of oranges produced per acre in your farm? ………….

(b) What is the number of orange trees per acre in your farm? ………………………...

15. Which cropping pattern do you use most in your farm?

(1) Orange varieties mixed together.

(2) Oranges mixed with other fruits crops.

(3) Orange varieties mixed with staple crops varieties.

(4) A part of land reserved for oranges.

(5) Oranges mixed with cash crops

(6) Others…………………………………………………….

16. (a) Do you think the social security schemes are important for your production?

1-Yes, 2-No ( )

(b) Reason (*if yes or not*)?

……………………………………………………………………………………………

…………………………………………………………………………………………….

17. What do you do to control pests/ diseases in your citrus farm? ………………………

18. What type of fertilizer do you use in your farm?

(1) Organic fertilizer (2) Inorganic fertilizer (3) None (4) Others……………………..

19. (a) Do you use any agrochemical for controlling pests/ diseases in your citrus farm?

1-Yes, 2-No ( )

(c) If yes how often? If not why? ……………………………………………………

20. Which crop husbandry do you practice in your orange farm?

(1) Pruning (2) Weeding (3) Removal of old trees (4) Dripping irrigation (5) None

(6) Others……………… ( )

21. (a) Do you have any access to farming credit? **1-Yes, 2-No** ( )

(b) If yes, where do you get the farm credit from?

(1) Government (2) Farmers' associations (3) Private commercial banks & Microfinance (4) Savings and Credit Cooperative Societies (SACCOs) (5) Friends (6) Citrus traders (8) Village brokers

(9) Other________ ( )

22. How do you rate your performance in citrus fruit farming?

(1) High knowledge and skills in good citrus farming practices.

(2) Moderate knowledge and skills in good citrus farming practices.

(3) Insufficient knowledge and skills in good citrus farming practices. ( )

SECTION 3: The situation in small citrus farming toward Kilimo Kwanza Policy implementation.

23. Where do you get the farming inputs from?

(1) Government (i.e. subsidies) (2) Farmer organization (i.e. cost sharing)

(3) Personal purchase. (4) Others………………. ( )

24. (a) Do you receive any subsidies (i.e. farm inputs, credit) from government?

1-Yes, 2-No ( )

(b) If yes, what kind of subsidies? ……………………………………………………

(c) What distance separates your farm from farm inputs shop(s)? …………………..

(d) If Not. How do you rate the cost of farming inputs and planting materials?

(1)Affordable (2) Not affordable (3) No cost incurred (4) I don't know

(5) Others ………………………………… ( )

25. Where do you get the orange seedlings from?

(1) Home nurseries. (2) Neighbors. (3) Wild rootstock. (4) Specialized shop

(4) Others…………………….. ( )

26. (a) Do you have any access to the market information of your product (citrus)?

1-Yes, 2-No ( )

(b) If yes. Where do you get the information from?

(1) Extension staff(s) (2) Farmers' association (3) Newspapers (4) Traders

(5) Brokers (6) Others…….. ( )

27. How many times per year do you organize your sales of citrus fruits?

(1) Once a year. (2)Two times a year. (3) All the year round.

(4) Others……………………. ( )

28. What is/are the destination of your citrus (*harvest*)?

(1) Direct to citrus traders. (3) Village brokers. (4) Collection point in the village.

(4) Open market outside the village. (6) Near-by farm market. (5) Others…… ( )

29. How far is your farm from the road (*include the distance*)?

(1) From the feeder road.................... (2) From the main road…………………….

(3) I don't know ( )

Appendix 3: Survey questionnaire to key informants.

A SURVEY QUESTIONNAIRE TO KEY INFORMANTS IN MUHEZA DISTRICT, TANGA REGION

This questionnaire is to be filled by the executive officers in agriculture include District Agriculture & Livestock Development Officer, Subject Matter Specialist-Horticulture, Ward Agriculture & Livestock Development Officer(s) and Village Extension Officer(s) . All the information collected in this questionnaire will be completely confidential.

Date: ………………… Office: …………………………………. Position: …………………

Place: ………………………….

SECTION 1: General information about the citrus farming and citrus farmers.

1. What are the leading citrus producing Divisions in the District?

   ……………………………………………………………………………………

   …………………………………………………………………………… ………

2. What are the three leading citrus producing Wards in the District (in ascending order)?

   (1st)…………………………………

   (2nd)………………………………...

   (3rd)…………………………………

3. (i) How do you rate the number of citrus farmers in the District?

   (a) Very few (b) few (c) Average (d) High (e) Very high (f) I don't know ( )

   (ii) Which group makes the large proportion of citrus producers in the District?

   (a) Large scale farmers (b) Medium scale farmers (c) Small citrus farmers

   (d) I don't know ( )

4. (i) What kind of orange varieties grown in the District?

   …………………………………………………………………………………………

   ……………………………………………………..……………………………..

   (ii) Which is the most grown orange variety in the District and why?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

5. What methods are highly recommended by the government for combating pests and diseases in citrus farming (if any)?

   ....

   ....

6. (a) Is it important to use fertilizer in citrus farming? 1-Yes, 2-No. ( )

   (b) If yes why? At which stage(s)?

   …………………………………………………………………………….................

   ....

7. (c) If Not, why?

   ....….

SECTION 2: Kilimo Kwanza Policy in citrus farming

1. How do you rate the implementation of the Kilimo Kwanza Policy recommendations in the citrus sub-sector?

   (d) Very low (b) Low (c) Moderate (d) High (e) Very high (f) I don't know

   (g) None ( )

2. How do you rate the implementation of the Kilimo Kwanza Policy recommendations (by the government) to the small citrus farmers?

(e) Very low (b) Low (c) Moderate (d) High (e) Very high (f) I don't know

(g) None ( )

3. How do you rate the support from private organs toward implementing the Kilimo kwanza recommendations to small citrus farmers?

   (a) Very low (b) Low (c) Moderate (d) High (e) Very high (f) I don't know

   (g) None ( )

4. Please tick the appropriate response.

Required information	**Yes**	**No.**	**Don't know.**
Does the government provide subsidies to citrus farmers?			
Is there any farmers' organization in your District/Ward/Village?			
Is there any social security scheme for farmers in the District/Ward/Village?			
Does the government provide trainings to citrus farmers in the District/ Ward/ Village?			
Is there any market center linked with citrus production centers in the District / Ward/ Village?			
Does your office provide market information to citrus farmers?			

5. What condition (s) do you think are necessary for implementing Kilimo Kwanza Policy (i.e. the recommendations) particularly to small citrus farmers? ………………………………………………………………………………………………

   ………………………………………………………………………………………………

…………………………………………………………………………………………

……………………………………………………………………………………..

SECTION 3: Prevailing situation toward implementing Kilimo Kwanza Policy in the citrus sub-sector

6. What are the challenges toward implementing Kilimo Kwanza Policy particularly in citrus sub-sector in the District/Ward/Village (if any)?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

   ………………………………………………………………………………………

7. What are the opportunities toward implementing Kilimo Kwanza Policy in citrus sub-sector at your place (if any)?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

   ………………………………………………………………………………………….

Respondent's signature: **__________________________**

Respondent's name: **____________________________**

Appendix 4: Major citrus varieties grown in Tanzania and their importance.

Variety	Local name	General characteristics	Rank
Early Valencia	Msasa	High yield, medium size Early maturity Thin and smooth skin Good for long distance transport.	**1st**
Late Valencia	Valencia	Late maturing High yield Sweet and juicy when ripe Robust to transport	**2nd**
Mediterranean	Nairobi	Sweet Highly flowering Fruits drop down Low yield, medium size Last longer on tree	**4th**
Washington navel	Kitovu	Poor juice content Not sweet, Thick skin. Robust to transport, Seedless, Late maturing	**6th**
Jaffa	Shamoti	More juicy than others Not sweet, Not robust to transport high yield	**3rd**
Pineapple	Pamba	Very sweet soft fruit late ripening slow maturing	**5th**
Zanzibar	-	Sweet skin slightly thick	**7th**

Source: Adopted from Tu (2008).

Appendix 5: Some responses from key informants on issues regarding the Smallholder citrus farmers and their production in the district

Question (s) asked	Total sampled (n= 6)		
	Yes	**No**	**Not sure**
	n (%)	n (%)	n (%)
Whether farmers were using any recommended citrus seedling in their farms.	4 (66.7)	1 (16.7)	1 (16.7)
Whether farmers were using any agrochemicals in their production (e.g. insecticides).	4 (66.7)	1 (16.7)	1 (16.7)
Whether farmers were receiving the extension services in time.	4 (66.7)	1 (16.7)	1 (16.7)
Whether farmers were accessing the reliable sources of farm credit.	1 (16.7)	4 (66.7)	1 (16.7)
Whether farmers were using fertilizers in their production.	2 (33.3)	4 (66.7)	0 (00.0)
Whether farmers were involved in farmers' associations.	2 (33.3)	3 (50.0)	1 (16.7)
Whether farmers were being supplied with the reliable market information.	2 (33.3)	4 (66.7)	0 (00.0)
Whether farmers were accessing reliable sources of markets.	2 (33.3)	3 (50.0)	1 (16.7)
Whether there were any social security schemes for farmers in the district.	2 (33.3)	0 (00.0)	4 (66.7)
Whether farmers were getting any support from private organs in their production e.g. funds, technical help.	5 (83.3)	0 (00.0)	1 (16.7)

Appendix 6: Other information concerning the Smallholder citrus farmers in Muheza

Farmers' information	Percentage of farmers
Sales of citrus fruits	
-Twice a year	89
-Once a year	8
-All the year round	3
A time when the farmer engaged in commercial production	
-Before Kilimo Kwanza initiation	22
-After Kilimo Kwanza initiation	37
The purchase of farm inputs by the farmers	
-Affordable	36
-Not Affordable	64
The source of citrus seedlings	
-From home nurseries	71
-From neighbor farmers	15
-From specialized shops	14
A date the farmer registered in farmers' associations	
-Before Kilimo Kwanza Policy initiation	10
-After Kilimo Kwanza Policy initiation	13

Appendix 7: Correlation matrix for the explanatory variables

Variables	FAMAGE	FAMEXP	FAMEDU	GENDER	INCOME	FAMCRD
FAMAGE	1.000					
FAMEXP	-0.141	1.000				
FAMEDU	0.492	-0.011	1.000			
GENDER	-0.141	-0.067	-0.092	1.000		
INCOME	0.088	-0.191	0.007	-0.061	1.000	
FAMCRD	-0.170	0.153	-0.175	-0.121	-0.038	1.000
FAMSIZE	-0.403	0.044	-0.106	-0.154	0.054	0.013
BIOTEC	-0.212	-0.416	-0.131	0.153	0.047	-0.097
CHEMTEC	-0.057	0.187	0.047	-0.382	-0.128	0.044
FAMOBJ	-0.243	0.006	-0.182	-0.276	-0.045	0.120

Variables	FAMORG	FAMSIZE	BIOTEC	CHEMTEC	FAMOBJ
FAMORG	1.000				
FAMSIZE	-0.483	1.000			
BIOTEC	0.066	-0.062	1.000		
CHEMTEC	0.278	-0.053	0.200	1.000	
FAMOBJ	0.368	-0.436	-0.144	0.146	1.000