# DETERMINANTS OF ADOPTION OF ORGANIC MANURES IN URBAN VEGETABLE PRODUCTION: (A CASE STUDY OF MIGORI MUNICIPALITY)

BY

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**A RESEARCH PROJECT SUBMITED TO THE DEPARTMENT OF ECONOMICS, KENYATTA UNIVERSITY, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF ARTS DEGREE IN ECONOMICS**

**MARCH 2008**

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*Determinants of adoption of organic*
2008/324046

**DECLARATION**

This research project is my original work and has not been presented for a degree in any other University.

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# DEDICATION

**To my dear children, Amos, Luke and Faith**

# ACKNOWLEDGEMENTS

The success of this study was possible because of the immense contributions of some individuals whom I owe a lot of gratitude. I greatly recognize those whose works have informed this study, because they provided ideas that guided the direction that this study has taken. The librarians who helped me to access some of the materials are dearly appreciated, especially Mary and Rose of University of Nairobi's College of Agriculture and Veterinary Sciences.

I am grateful to my supervisors in this work; Dr. Wesonga and Mr. Obere for their guidance and support throughout the study period. They were committed to enable me do a quality project and at every point made inputs that made my work more insightful. I also appreciate my research assistants, Kenneth Ojwang and Ibrahim Wesonga for their help in data collection. However, they would not have gathered the information if the respondents were unwilling to give information. Therefore, I recognize all those farmers from Migori Municipality that willingly gave information for this study.

The study required a lot of commitment, and sometimes I could not fully satisfy the needs of all the people around me. I thank my husband Tobias and our children; Amos, Luke, and Faith, for their prayers, encouragement and patience that cheered me all the way. Tobias provided all the finances that were needed to conduct this study. Doris was very helpful in our house. I know that without her sacrificial service, my attention towards this work would have not been sufficient. God bless you all.

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ASC | African Studies Center |
| FAO | Food and Agricultural Organization |
| GoK | Government of Kenya |
| GTZ | German Technical Cooperation |
| ICRAF | International Center for Research in Agro forestry |
| LVRLAC | Lake Victoria Region Local Authorities Cooperation |
| MDG | Millennium Development Goal(s) |
| NCST | National Council of Science and Technology |
| RoK | Republic of Kenya |
| SRA | Strategy for Revitalizing Agriculture |
| SWC | Soil and Water Conservation |
| SMP | Soil Management Project |
| UN | United Nations |
| WFS | World Food Summit |

## OPERATIONAL DEFINITION OF TERMS

**Absolute poverty incidence** - The proportion of Kenyans whose levels of consumption during the Integrated Household Budget Survey-2005/06 were insufficient to meet basic food and non food needs.

**Compost** - Refers to organic manure prepared from animal, plant and household wastes, left to decompose for at least six weeks, by action of bacteria and other microorganisms before being used on the farm

**Farmyard manure** - Refers to manure prepared mainly from livestock excreta and urine, together with any materials that have been used as bedding/litter in the livestock houses. Also used after decomposition

**Food Poverty incidence** - The proportion of Kenyans whose food consumption levels during the Integrated Household Budget Survey-2005/06 were insufficient to meet their basic daily energy requirements of 2250 kilocalories per adult equivalent per day

**Organic manures** - Are materials prepared from plant and animal wastes, used as soil amendments on the farms to add nutrients and to improve the general conditions of soils for high crop yields.

**Socio-economic factors** – Refer to characteristics of farmers that describe their social and economic conditions that influence their choice of behaviour, and includes such factors as age, gender, level of education, occupation, level of income and membership in organization

**Soil and Water Conservation Measures** - Activities carried out on farms to prevent loss of soil moisture and fertility

**Urban areas**- refer to towns. These are areas demarcated in physical plans for urban land uses.

**Urban agriculture** - The practice of growing crops and rearing livestock within and towns by urban dwellers

**Vegetable** - Kales and the three commonly grown traditional vegetables *(kunde, osuga and dek)*

## ABSTRACT

This study was conducted to estimate the rate of adoption, identify and analyze factors determining adoption of organic manures in urban vegetable production by farmers in Migori municipality. A household survey was conducted among 89 farm households between 10th and 14th of December 2007. A logit model was used to analyze the impacts of age, gender, experience, extension, education, training, objective, land tenure, type of labour, membership in organization, off farm income and distance to main market, on probability of adoption.

Analysis of the data reveals a rate of adoption of 58.4 %. The estimation results of the logit model indicate that; age of household head, college education, and training in aspects of organic manure use, are significant in explaining the difference in adoption by the farmers. Although the impact of the other factors were found not significant at 5% or10% level of significance, the coefficient estimates indicate that extension, experience, subsistence production, tenure security and membership in farming organization increases probability of adoption, while hired labour and longer distances to main market reduces probability of adoption.

The study recommends that activities to enhance adoption of manure use in vegetable production in Migori should put into consideration these factors in their design and implementation.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background

### 1.1.1 The General Concern for Food security

Millennium Development Goal (MDG) 1, calls for eradication of extreme poverty and hunger by 2015, with a target of reducing by half the proportion of people whose income is less than one dollar a day and those who suffer from hunger (Republic of Kenya (RoK), 2003). World leaders committed themselves to this goal when one hundred and eighty nine (189) countries, Kenya included, adopted the millennium declaration in September 2000 (RoK, 2005). Attainment of food security has since remained a major focus in the development agenda of many countries.

The Government of Kenya (GoK) initiated the implementation process for the MDGs by considering as priority in its agenda, poverty reduction and advancement of human development (RoK, 2003). Several interventions have been made towards eradication of extreme poverty and hunger by intentionally shifting resources to priority sectors with a pro-poor focus, such as health, education, agriculture and infrastructure (RoK, 2005). The formulation and launch of the Strategy for Revitalization of Agriculture (SRA) and The "*Njaa Marufuku Kenya*" (Kick Hunger out of Kenya), are expected to contribute significantly towards increased agricultural production and hence reduction of poverty and hunger (RoK, 2005).

Food Security requires that all people, at all times, should have physical, social and economic access to sufficient, safe and nutritious food that meets dietary and food preferences for an active and healthy life (Sligh and Christman, 2007). The situation in Kenya however, indicates the country as continuing to witness high incidences of poverty and food insecurity. Table 1.1 summarizes the incidence of food poverty as revealed by the basic report on well being in Kenya based on the Integrated Household Budget Survey (KIHBS) -2005/06 (RoK, 2007).

**Table 1.1: Incidence of food and absolute poverty as a percentage of population**

| Year | National food poverty | Rural food poverty | Urban food poverty | Absolute poverty |
|---|---|---|---|---|
| 1997 | 48.3 | 50.7 | 38.2 | 52.3 |
| 2005/06 | 45.8 | 47.2 | 40.5 | 45.9 |

**Source**: Republic of Kenya (2007) *The basic report on well being in Kenya* based on the Kenya Integrated Household Budget Survey -2005/06

These figures indicate that in the period between 1997 and 2005/06, the incidence of food poverty in urban areas in Kenya rose up from 38.2% to 40.5%. This is quite critical especially in the face of the high rates of urbanization. Coupled with persistent unemployment, urban food poverty may be exacerbated as many urban households continue to experience decline in their purchasing power. Although the statistics report at some instances reduction in absolute poverty incidences, they cannot be interpreted as welfare improvements due to population growth. Poverty in absolute numbers increased from 13.394million in 1997 to 16.563million in 2005/06.

The KIHBS also revealed varied incidence of poverty (absolute and food) between different districts in the country. For example, among the urban areas food poverty

incidence ranged from about 30% to 50%. Nairobi city was the least food poor, while Nakuru municipality and the city of Mombasa were hardest hit. Migori district (from which 60 urban households were sampled), had 37.1% of individuals that are food poor (RoK, 2007). These incidences indicate that reducing extreme poverty and hunger is still an uphill task for Kenya

One of the major challenges Kenya faces in the efforts to reduce poverty and hunger is soil depletion, degeneration of natural resources and the environment (RoK, 2005). The situation requires farmers to use technologies that enhance regeneration of garden soils to sustain high crop yields. The use of inorganic fertilizers introduced by the green revolution has been minimal because majority of farmers, who are mainly small scale peasants have not been able to afford and use them at recommended rates (Sachs, 2005). Use of organic manures such as compost and farmyard manures have been identified as practical ways of addressing the problem since they are prepared from materials that are locally available to the farmers (Mose et al, 2000)

### 1.1.2 Urban Agriculture

Urban Farming was considered illegal and an undesirable activity in towns in many African countries for many years due to the general perception that it would cause all kinds of environmental hazards. Because of this, many countries implemented policies that discouraged urban agriculture, hence its practice was excluded from urban land uses. However, studies indicate that in the last few decades, an increasing number of the urban poor have been engaged in urban and peri-urban agriculture as a means of sustenance

(Lee-Smith et al, 1987, Onyatta, 2005).The practice has been interpreted as an adaptive response by urban households to improve their food situation, and to diversify their livelihood options under conditions of uncertainty and threats such as unemployment and declining purchasing power (Foeken, 2005). It ensures sustained supply of cheap, fresh and nutritious food, and also serves as a non-market access to food for the urban poor. It also leads to generation of income through market sales. The main crops grown in the different urban areas are vegetables (such as tomatoes, cabbages, kales, and spinach) and fruits. The urban poor grow the crops in open public spaces such as those besides roads and railway lines, along river banks, under power lines, and reclaimed wetlands. Crops are also grown in school and home gardens.

It is revealed that most of the urban producers use production technologies that are very simple with low productivity (African Studies Center (ASC), 2006). Use of highly productive technologies can greatly benefit urban farmers because increased production, would increase proportion of consumption from own production and reduce food purchases. The urban poor can then use the savings to finance other basic non produced food and non food requirements. It would also result into increased supply of these foods, which would be reflected in low prices charged for those who buy.

In as much as urban agriculture's role in enhancing food security and as an acceptable economic activity is continually becoming recognized, improperly practiced urban agriculture, conflicts with other land uses and leads to land degradation, water pollution, and is a threat to health and safety. Because of this, city and town council by-laws set

restrictions on the practice. Use of chemical inputs such as inorganic fertilizers in soil fertility management, use of untreated sewage water for irrigation, and production of crops that grow taller than one meter such as maize, are prohibited in urban agriculture (Foeken, 2005). Urban crop producers are encouraged to use safe methods of farming. In soil fertility management, the option is to use measures that ensure high productivity while ensuring environmental safety, such as use of organic manures.

### 1.1.3 Farm technology adoption

Technology is generally understood to refer to the means by which resources are combined to produce the desired output. Improved technologies are referred to as innovations, and include ideas practices or objects that are perceived as new to their recipients (Rogers et al, 1971). Agricultural innovations are many and diverse in nature. They are often developed from the national agricultural research systems and then disseminated to individual farmers, through promotion by agricultural organizations (Sechrest, et al, 1998). The promotions are undertaken in the belief that use of the innovations will improve quantity and quality of farm produce.

Adoption refers to the decision to make full use of an innovation as the best course of action available (Rogers, 1983). Whenever technologies are promoted by agricultural organizations, they all appear to be effective. However, the course of their adoption is often uncertain and slow. Since the development of any technology involve use of valuable resources, both monetary and human, it is important that we understand why uptake of innovations is variable.

The choice to adopt an innovation is not an abrupt decision, but is an outcome of a series of influences exerted by change forces on the behaviour of the decision maker through time (Lionberger, 1960). Adoption is therefore a process that represents change of behaviour on the part of the decision making unit in the system. It is dependent upon various influences which are classified into; incentives (reasons for) and disincentives (reasons against) adoption. It is the interactions of these two opposite forces that create tension that motivate actions that result into adoption or non adoption.

Adoption proceeds only if incentives outweigh disincentives (Leagans, 1979). To facilitate adoption, strategies that energize the incentives and weaken the disincentives are required, hence the need for a comprehensive identification and analysis of the factors that influence adoption behaviour of farmers. Studies on adoption of farming technologies have revealed that adoption behaviour of farmers is related to several factors. Some of these factors are regarded as internal, as they relate to the farmer's characteristics such as; age, gender, and level of education. Others are external, as they relate to the characteristics of the technology (such as; cost, suitability and complexity) and those of the environment.

The factors that significantly affect adoption of a particular technology are critical in formulation of effective policies. This is because effective policy design must take into consideration both economic and social complexities surrounding adoption decisions (Hattam and Holloway, 2004). These factors should be investigated and integrated into

technology development and transfer in order to ensure successful adoption (Faturoti et al, 2006).

### 1.1.4 Potential of organic manures in urban agriculture

The utility of organic manures such as compost and farmyard manure in soil fertility management has been on for a long time. Before the introduction of the artificial fertilizers, farmers mainly depended on organic manures derived from animal excreta and decayed vegetation (Dulac, 2001). For a long time, urban and peri-urban farmers in India made use of compost derived from urban solid waste, mainly mined from garbage dumps (Nunan, 2000). In Nairobi (Kenya) it is reported that urban and peri-urban farmers are generally aware of the benefits of using compost in crop fields, which include among others; production of many crops, reduction in chemical fertilizer requirement, softening (loosening) of soil for easy cultivation, achieving long term soil fertility and production of vegetables that remain fresh for along time (Allison et al, 1998)

The Organic manures are free from chemical pollutants, and their preparation ensures recycling of organic wastes, which could otherwise pollute the environment, hence they provide a potential for sustainable environmental management. Their use in soil fertility management increases soil organic matter content, which helps to build good soil structure, ensures good drainage and aeration, and releases plant nutrients, which promote high crop yields. The increased organic matter content increases the water retention ability of garden soils. This promotes growing of crops in areas that receive little rain and makes irrigation water more useful to the plants. Because they are added to soils when

fully decomposed the impacts in improving soils last longer. The materials used in their preparation are readily available to farmers, hence they are considered cheaper and more practical to small scale producers who may not be able to afford fertilizers (Baldwin and Greenfield, 2006).

Because of these benefits, organizations that promote sustainable agricultural production, such as Kenya Institute of Organic Farmers, Manor House, and Effective Microorganisms (EM) technology, conducts research into ways of simplifying preparation and handling of these manures, offer training to farmers so as to equip them with the necessary skills in the use of manures.

Many urban crop producers still do not use organic manures in their crop production systems. This was revealed in a study by Foeken (2005) on situation of urban farming in three East African towns. Table 1.2 summarizes his findings.

**Table 1.2: Percentage of crop cultivating households using chemical inputs and Manure in urban crop cultivation by Town**

| | Nakuru | Morogoro | Mbeya |
|---|---|---|---|
| Use of chemical inputs | 48 | 80 | 83 |
| Use of manure as fertilizer | 53 | 34 | 62 |

**Source:** Foeken (2005): *Urban Agriculture in East Africa as a tool for Poverty Reduction*

The findings indicate that use of chemicals in crop production is widespread among urban farmers. The use of manures as fertilizer is above average among farmers in

Nakuru and Mbeya, but below average for Morogoro. This clearly indicates that the use of different fertilizer materials by urban crop producers vary between different towns.

## 1.2 The statement of the problem

Kenya has continued to experience high rates of urbanization. According to the annual state of the world population report for 2007, Kenya's urban population growth rate is stated at 21% (Barasa, 2007). The high rate of growth is attributed to rural to urban migration of those seeking employment in formal sectors, high population growth rates, and the expansion of urban boundaries, which has brought into urban settlement people whose environments were previously rural. The latter are faced with the challenges of changing land use patterns.

Migori municipality, like other towns in Kenya, has experienced rapid growth in the recent past. Expansion of the urban boundaries has resulted into absorption of areas that were previously rural to urban settlements. Although the residents engage in urban related activities such as trade and formal employment, majority derive their livelihood from agricultural production, especially the natives. Due to sale and subdivision of land, the sizes of land used in agricultural production by individual households have greatly diminished. Meaningful output from the diminished land parcels can only be attained with use of highly productive technologies. The farmers must carefully manage soil fertility to realize sustained high yields.

Local authority and city by-laws prohibit use of chemical inputs such as inorganic fertilizers in urban crop systems because of the potential risks of pollution of water sources. The option for the urban farmers is to use organic manures to manage soil fertility. Interventions to influence farmers to use organic manures in urban crop production systems require clear and effective policies. These can only be achieved with knowledge of how different urban farmers, characterized by their socio-economic status, choose between different soil fertility management technologies.

Many studies have been conducted to assess the factors that influence soil fertility management technology adoption. However, much focus has been on the conventional rural agriculture. It is therefore evident that how different urban farmers in Migori, adopt the technologies, is not well understood. In order to fill this gap and inform policy formulation and devising of strategies to enhance adoption of organic manures, this study was conducted so as to provide answers to the following questions;

- What is the rate of adoption of organic manures in vegetable production by farmers in Migori municipality?
- What are the major factors influencing the use of organic manures in vegetable production by the urban farmers?
- How do these factors affect the use of organic manures in vegetable production by farmers in Migori municipality?
- What are the implications of these factors for policy?

## 1.3 Objectives of the study

The purpose of the study was to identify and analyze the social and economic factors that determine the adoption of organic manures in vegetable production by urban farmers in Migori municipality. The specific objectives were;

- To determine the rate of adoption of organic manures in vegetable production by farmers in Migori municipality
- To identify and analyze the social and economic factors that influence use of organic manures in vegetable production by the urban farmers in Migori municipality
- To determine how these factors affect the use of organic manures in vegetable production by farmers in Migori municipality
- To recommend possible policy actions that can increase use of organic manures in crop production systems by urban farmers in Migori municipality.

## 1.4 Significance of the study

This study provides basic information on the use of organic manures by urban producers in the growing of vegetables in Migori municipality. The findings are useful in the defining the important factors that explain difference in adoption of organic manures in vegetable production. The findings are very useful as they provide a basis for formulation of policies to increase use of organic manures in urban crop production systems. All the institutions and organizations that would want to organize activities to promote use of organic manures in vegetable production in Migori municipality will find the results useful in designing and implementing their strategies.

## 1.5 Scope and limitations of the study

The findings from adoption studies reveal that the factors influencing adoption of farm technologies are those related to the technology's attributes and those associated with farm and farmer's attributes (Mussei et al, 2001), and that their modeling depend on the type of study being conducted, that is, whether it focuses on adoption as a discrete (choice) variable, or on level of adoption as a continuous variable (Doss, 2003). This study assessed adoption of organic manures in urban vegetable production, as a discrete choice (binary), across different socio-economic groups of farmers. The aspects of the technology were not included in the model for estimation. The study only probed farmers to find out on their general views on; important benefits of organic manures in vegetable production and difficulties experienced when using the manures in crop production.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

This chapter gives a summary and critique of works by scholars that are relevant to this study. It is divided into three sections. The first section reviews literature on studies done in other countries, the second, those conducted in Kenya, and the last is a brief overview of the literature.

## 2.2 Literature relating to other countries

Although the practice of urban solid waste composting for use in crop production is increasing, GTZ (1999) in a case study report on organic waste utilization noted that there are factors limiting widespread production and application of the compost. These factors include; insufficient knowledge by end users about the value and use of waste derived compost, consumers perception of compost to contain pollutants of urban waste, lack of government interventions to promote compost in agriculture, high transport costs due to long distances between compost market and farms, and availability of competing products to the end users. For such initiatives to succeed, it was concluded that the marketing aspects relating to acceptability of compost, competing products, marketing infrastructure, ascertaining quality and demand for compost, relevant knowledge of potential end users, price formation, promotional activity and publicity be considered. The assessment done by GTZ focused on marketing of compost rather than on adoption

of use. On the contrary, this study focuses on farmyard manure and compost prepared and used on the farm by the farmers rather than those purchased from commercial sources.

Bodnar and Graaff (2003) in a study to identify the major factors influencing adoption of soil and water conservation (SWC) measures in southern Mali analyzed five factors: land pressure, cotton growing area, possession of ploughing equipment, possession of a donkey cart and farmer training in SWC. Correlation, regression and factor analysis led to the conclusions that; farmers in high land pressure areas and in possession of ploughing equipments and donkey carts adopt more SWC measures. Those trained were also indicated to adopt more soil erosion control measures, while those in cotton growing areas adopted less SWC measures. It was also noted that there are strong correlation between adoption of erosion control and soil fertility measures that could not be explained by the five factors only. The study therefore suggested that there are additional factors that trigger the adoption of SWC measures.

A study conducted by Tenge et al (2004) in the West Usambara highlands, Tanzania order to determine the social and economic factors that influence adoption of soil and water conservation (SWC) measures, revealed that involvement in off farm activities, insecure land tenure, location of fields and lack of short term benefits from SWC were among the major factors that negatively influenced adoption of SWC measures. Membership in farmer groups, level of education, contact hours with extension agents and SWC programs were found to positively influence adoption of SWC measures. The study recommended the integration of social and economic factors into SWC plans, the

creation of more awareness among farmers of soil erosion effects and long term benefits of SWC, development of flexible SWC measures to cater for different farm patterns and a participatory approach to SWC at catchment level rather than at individual farmer's fields, as primary to facilitating adoption of different SWC measures.

Though the studies by Bodnar and Graaff (2003) and that by Tenge et al (2004) provide directions on factors that are likely to influence adoption of organic manures in crop production, they concentrated on use of physical structures and failed to isolate significance of each factor.

Hattam and Holloway (2004) suggested that effective policy design must take into consideration both economic and social complexities surrounding adoption decisions. This was motivated by findings of a study that was conducted to investigate adoption of certified organic production among Mexican farmers which indicated that adoption was positively influenced not only by management and economic factors such as production cost per hectare, but also by social factors such membership of a producers association. The study also indicated that experience in agriculture had a significant but negative effect. The study focused on adoption among avocado producers while study focuses on vegetable producers.

Karki and Bauer (2004) assessed the impact of foreign-aided project in technology adoption and food security. The study identified factors determining adoption of improved technology by smallholder peasants. It revealed that timely availability of

credit, years of schooling, off farm income, extension service, project intervention, farm size and experience of farmers significantly influenced their adoption decisions. The study concluded that if these determinants are properly addressed, there would be a tremendous influence of project in transferring technology, alleviation of food insecurity and increasing household economy. In this study, their was no knowledge of a project in the study area that particularly focused on enhancing use of organic manures, however it revealed additional factors that were included in the model.

Daramola (2005) studied the socio economic factors influencing the adoption of farm innovations in Oyo state of Nigeria. Using a multivariate probit analysis, it was demonstrated that infrastructural and economic factors played significant roles in adoption decisions. Inappropriateness of certain innovations to farmers' circumstances was also identified as militating against adoption. This study was not very specific on a particular innovation. It looked at how farmers generally put into use research recommendations. This study was specific to assessing use of organic manures, and used the logit model to estimate the relationship between adoption and the exogenous variables.

Okunade (2006) assessed the factors that influence adoption of improved farm practices among women farmers in three different agricultural zones of Osun state, Nigeria. The study identified technical skill, farmer's attitude towards change and risks, income level, level of education, religion, years of farming experience, land tenure systems, labour availability, cultural beliefs, norms and taboos as characteristics of farmers that would

largely influence adoption behaviour. It also revealed that cost, relative advantage, technical appropriateness and simplicity of application were aspects of technology that significantly determine whether farmers will choose to adopt or not. The study suggested that innovations that are taken to farmers should be relatively cheap, simple to use with less external assistance, and must conform to the norms, beliefs and should not run counter to the existing religion of the people. However, some of the factors it assessed such as attitudes of the farmer, religious and cultural norms and taboos have not been incorporated in the model in this study. This was done so as to avoid over specification.

## 2.3 Literature specific to Kenya

Allison et al (1998) in a review of the use of urban waste in peri-urban interface production systems indicated that farmers in Nairobi, Kenya were generally aware of the benefits of using compost in crop fields. Farmers reported use of compost on their farms in the hope that it would help them grow many crops, reduce chemical fertilizer requirement, soften (loosen) soil for easy cultivation, achieve long term soil fertility and to produce vegetables which would remain fresh for along time.

Mose et al (2000) conducted a study to analyze the factors that influence adoption of organic and inorganic fertilizers in maize and Kales in North Rift Valley Region. The study was motivated by a need to know the extent of adoption of these technologies, after the Soil Management Project (SMP), initiated and tried with the participation of farmers identified them as practical ways of addressing the problem of declining soil fertility and low crop yields in the region. The results indicated that SMP was a major source of

information about soil management technologies and that, farmers who had access to information and had large farm and household sizes tended to adopt most of the technological components. However, inadequate availability of organic manure and information limited fast adoption of the technologies.

The study also revealed that adoption of compost, one of the technology components, was influenced by age. Younger farmers tended to be involved more in compost preparation than the elderly. On the basis of the finding that the technologies required much labour, the study identified the need to explore more cost-effective ways of composting and farmyard manure preparation and applications, which should be preceded by an effective dissemination of information, in order to encourage their adoption.

Makokha, et al (2001) used a logistic regression to determine the socio- economic factors that influence the use of inorganic fertilizers and manures for maize production in Kiambu district. It was demonstrated that extension and off-farm income significantly affected adoption of manure use, and that age of household head, extension, membership in an organization and off farm income were the factors that significantly influenced the adoption of inorganic fertilizers. In order to increase use of manure and inorganic fertilizers so as to increase maize production in the district, the study recommended increased provision of extension services to farmers to provide advice on improved on-farm manure management and fertilizer recommendations, particularly in terms of crop suitability, timing and methods of application.

Sachs (2005), while visiting the United Nations (UN) Millennium project in Sauri sub location in Siaya district of Nyanza province, reported that in a meeting with about two hundred farmers, only two reported to have used fertilizers on their farms that season. The rest of them although admitted use of fertilizers in the past, were then not able to use the inputs because their prices had gone up out of reach. A scientific farming approach introduced by the International Centre for Research in Agro forestry (ICRAF) in the area, involved use of improved fallows with nitrogen fixing trees, planted alongside maize or other crops, to enable the farmer get a natural substitute for chemical nitrogen fertilizer. Only one fourth of the Sauri farmers had been able to adopt the new method. According to the report, it was observed that introducing the technique required money, use of some non nitrogen fertilizers such as potassium, and a loss of one planting season. The technique therefore was quite costly for the impoverished farmers.

## 2.4 Overview of literature

The literature that has been reviewed reveals that several factors influence the decisions made by farmers to adopt or not to adopt farming technologies. Some of these factors relate to the technology's attributes such as; cost of fertilizers, technical complexity, labour requirements, suitability of the technology, ability of the technology to yield short term benefits and availability of the technology's components. These aspects of technology and institutional arrangements that affect farmers decisions to adopt a farm technology will not be considered in this study.

All the studies recognize that decisions for adoption of any technology are influenced by the farmers' socio-economic characteristics. Those studies identified farmers' age, level of income, education, farm size, family size, access to credit, use of hired labour, training in aspects of technology, participation in technology development programs, level of off farm engagements and income, land tenure security, membership in farmer groups, and experience in farming, as the factors that significantly influenced adoption. For the other general technologies it was also noted that adoption varied with gender of household head. The variables used in this study are obtained from this set, by considering those that reflect the socio economic aspects of urban micro farmers and are quite relevant to this study.

The different studies have used either logit or probit models in analyzing the effects of the socio-economic factors on adoption of farm technologies. This study used of the logit model as described in chapter three.

# CHAPTER THREE

# CONCEPTUAL FRAMEWORK AND METHODOLOGY

## 3.1 Conceptual framework

This section discusses how adoption is conceptualized and modeled in this study. The theoretical model is discussed first then the empirical model presented.

### 3.1.1 Modeling technology adoption by farmers

In this study the farmer is conceptualized as a consumer of a technology. It is assumed that a farmer makes decisions to adopt a given technology in order to maximize expected utility. Guided by the utility maximization objective, a given technology ($t_1$) is adopted, if and only if, the utility derived from it is greater than the utility derived from the old technology ($t_0$). The $i^{th}$ farmer adopts the technology $t_1$ if;

$$Uit_1 > Uit_0 \quad \text{----------} \quad (1)$$

Where: i = 1, 2, 3... n denote the different farmers making decisions to adopt and $Uit_1$ and $Uit_0$ denote utility derived by farmer i from technology $t_1$ and $t_0$ respectively

The utility function ranking the $i^{th}$ farmer's preference for the technology $t_1$ is represented as;

$$Uit_1 = Uit_1(Rt_1, At_1) \quad \text{----------} \quad (2)$$

Where: - $R_{t1}$ describes the distribution of net returns from the technology $t_1$ and

-$A_{t1}$ is a vector that describes the other attributes associated with the technology.

Since the variables $R_{t1}$ and $A_{t1}$ are ideally non observable in this type of study, the utility derived from the technology $t_1$ by a farmer is postulated to have a relationship with a

vector of observable farm and farmer characteristics ($X_j$) and a random zero mean disturbance term ($u_i$)such that;

$$Uit_1 = Uit_1(X_j, u_i) \text{----------(3)}$$

$$Uit_0 = Uit_0(X_j, u_i) \text{----------(4)}$$

Where; $X_j = X_1, X_2 \ldots X_j$ represent the different farm and farmer characteristics (1 to j) that influence the decision to adopt a technology such as farmer's gender, age, level of education, experience in farming, training in the technology, level of off farm income among others.

In economic theory, utility functions are used only to represent ordinal indexes of preference, so that we are able to rank satisfaction derived from different consumption bundles. Utility itself is non observable, and difficult to measure (Nicholson, 1992). It can only be derived indirectly from observable variables so that shift parameters are determined that will explain how it varies with different situations. Use of probability models is, therefore, appropriate in undertaking an adoption study.

The farmer is faced with two options; to adopt or not adopt the technology in question. The general model is a binary choice model involving the estimation of the probability of adoption of the given technology, as a function of a vector of explanatory variables.
Taking Y to represent the farmer's adoption decision,

$Yi = 1$ if $t_1$ is adopted, implying $Uit_1 > Uit_0$ and $Yi = 0$ if otherwise, and we assume that the probability to adopt have a relationship with the observable farm and farmer characteristics. If the probability of adopt is given by;

$$P(Y = 1) = F(X, B) \text{----------} (5)$$

Then the probability of not adopt will be represented as:

$$P(Y = 0) = 1 - F(X, B) \text{----------} (6)$$

Where;

- P (.) is probability that a given decision is taken,
- $Y_i$ is the observed response, so that for the $i^{th}$ farmer $Y_i = 1$ if adoption and $Y_i = 0$ if otherwise,
- X is a vector of explanatory variables (farmer characteristics) that affect the probability of adoption of the given technology
- B is a vector of the coefficients of the explanatory variables that describes how changes in the variables influence probability of adoption of the technology
- The function F (.) may take the form of a normal, logistic, or any other probability function (Greene, 1990).

The three alternative functional relationships that can be used in estimation of the probability of adoption are; Linear Probability, Probit and Logit models. The probit and logit models are, however, preferred in estimation of probabilities because they help in overcoming some weaknesses inherent in linear probability models such as heteroskedasticity and linearity problems. Probit/logit models provide parameter

estimates that are efficient and consistent asymptotically. Although the two models yield similar results in the case of binary choice situations, different studies choose between the two on the basis of convenience (Greene, 1990).

The logit model is preferred for this study because it is computationally simpler. The model uses a logistic cumulative distribution function and estimates the probabilities as follows;

$$P(Yi = 1) = \left[ \frac{e^{XB+U)}}{1 + e^{XB+u}} \right] - - - - - - - - - - - (7)$$

$$P(Yi = 0) = 1 - \left[ \frac{e^{XB+U)}}{1 + e^{XB+u}} \right] = \left[ \frac{1}{1 + e^{XB+U}} \right] - - - (8)$$

Where e is the base of natural logarithms.

Taking $P(Y=1)=p$ and $P(Y=0)=1-p$, then

$$\frac{p}{1-p} = e^{XB+u} \text{ ----------} (9)$$

Taking natural logarithms from both sides gives;

$$\ln\left[\frac{p}{1-p}\right] = XB+u \text{ ----------} (10)$$

So that

$$\frac{\partial}{\partial X_j} \ln\left[\frac{p}{1-p}\right] = B \text{ ----------} (11)$$

The model is non linear and normal distribution is not guaranteed, hence the parameter estimates are obtained by use of maximum likelihood method and not Ordinary Least

Squares method which only gives efficient and consistent estimates when the distribution is normal (Greene, 1990).

The parameter estimate B, in this case is not interpreted as marginal value of change in probability. The marginal changes are computed according to the equation;

$$\frac{\partial p}{\partial X}=\left[\frac{e^{-XB+u}}{\left(1+e^{-XB+u}\right)^2}\right]B=\{F(X,B)[1-F(X,B)]\}\text{----------(12)}$$

### 3.1.2 The empirical model

The model used in the study was adopted from the preceding explanation based on the study by Karki and Bauer (2004), and was stated as;

$$\ln\left[\frac{p}{1-p}\right]=f(gend,age,educ,\exp,ext,train,temu,objec,off-c,lab,m/org,dist)$$

Expressed in linear form as;

$$\text{Ln}\left[\frac{P}{1-P}\right]=\beta_0+\beta_1 gend+\beta_2 age+\beta_3 Educ+\text{---------}+\beta_{12}dist+\varepsilon_i\text{----(13)}$$

Where: $p$ = Probability of adopting use of organic manures

$1-p$ = Probability of not adopting use of organic manure

Ln = natural logarithms (to base e)

$\beta_0 to \beta_{12}$ are the unknown parameters to be estimated

$\varepsilon$ = error term of the model

The explanatory variables included in the model were described, measured and categorized as in table 3.1

**Table 3.1 Description, categories and measurement of variables**

| Variable | description | category | measurement |
|---|---|---|---|
| Adoption | manure use in vegetable garden during the past 12 months | Adopter<br>Non adopter | 1<br>0 |
| Gender | Sex of the household head | Female<br>male | 1<br>0 |
| Age | Age of the household head in years | No category | Years |
| Education | Highest level of education attained by household head | Educ1 (Sec.)<br>Educ1(college)<br>Primary | 1 if sec; 0 otherwise.<br>1 if college; 0 otherwise.<br>the reference |
| Experience | number of years the household has grown vegetables while residing in Migori municipality | No category | years |
| Extension | access to professional information on farming practices in a year | Contact<br>No contact | 1<br>0 |
| Training | Any past participation in a training activity on composting or preparation of farmyard manure and their uses in crop production | Yes<br>No | 1<br>0 |
| Tenure | state of ownership of the land on which vegetables are grown in the current season | Individual ownership<br>others | 1<br>0 |
| Objective | Main reason for growing vegetables | Subsistence<br>sale | 1<br>0 |
| Member/org | Membership in a farming organization | Yes<br>No | 1<br>0 |
| Off farminc | The amount of income of household from off farm occupations | Not categorized | Kenya shillings |
| Distance | distance from household's residence to the main vegetable market | Not categorized | kilometers |

## 3.2 Methodology

This section discusses the methodology of the study. It presents a description of the sampling procedures, area of study, data type and collection procedures.

### 3.2.1 Sampling techniques and size

The sampling procedure adopted in this study was purposive, in that attempt was made to include only those farmers who were involved in production of vegetables during the time of study. This approach made identification of vegetable farmers easy. Those initially identified, helped in identification of other farms where vegetables were grown. Attempt was also made to ensure that the sample included farmers with varied off-farm occupations (formal employment, self employment in business activities, casual labour) and from different type of residence (own homes and rentals). A total of 89 farmers were interviewed and the information they provided was analyzed to answer the questions that were to be addressed by this study

### 3.2.2 Area of the study

This study was conducted in Migori municipality, a town that is located along the Kisii - Isibania highway. Migori municipality is in Migori district of Nyanza Province, Kenya. The municipality lies within the boundaries of two locations (Suna Central and Suna Ragana) of Suba East division. It hosts the Migori district's government departmental offices and facilities, and those of NGOs operating in the district. Other than those employed in the formal sectors, majority of the residents are traders. A good number of the households are also involved in crop and livestock production practices. Some of

them derive their livelihood mainly from the farming activities, while for others, it is a supplementary source of food and income.

Majority of the crop farmers produce for subsistence. Although there is enormous demand for farm produce, farming is not intensified since even commercial producers tend to seek alternatives in trading. There is less use of highly productive inputs. There is also heavy dependence on rain fed agriculture. During dry spells, production of crops, especially vegetables, falls below potential and insufficient to meet demand. This makes the residents to rely heavily on the neighbouring districts, such as Rongo and Kisii for its supply of vegetables.

Since crop production is one of the major economic activities of residents of the town, Migori municipality was chosen for this study because it would provides a good sample of urban crop producers from which the information required would be achieved.

### 3.2.3 Data type and collection procedures

This study used primary data, collected from 89 farmers from the study area. The farmers were interviewed, guided by a use of a structured questionnaire. Information was provided by the household head or the spouse (whoever was found on the farm at the time of visit).

# CHAPTER FOUR

# DATA ANALYSIS, INTERPRETATION AND DISCUSSIONS

## 4.1 Introduction

This chapter, reports the research findings, their interpretation and discussions. The data has been analyzed using descriptive and inferential procedures. Section 4.2 presents the descriptive summary of the data while in section 4.3 the output of the model's estimation is reported. Section 4.4 outlines the interpretations and discussions of the findings

## 4.2 Descriptive summary of the farmers by characteristics and adoption

The summary of data from the sampled farmers is presented in table 4.1. This summary enables the description of the pattern of adoption between farmers across different socio economic groups. From the results, out of the 89 farmers, 52 adopted use of the manures giving a rate of adoption of 58.4%. It also indicates that rate of adoption is relatively high among male headed households, where household heads have higher levels of education, those with access to extension services, are trained in use of manures, have more years of experience, have security of tenure, are members in farming organizations, who use family labour and produce for subsistence. This summary does not tell whether the impact of these factors is significant in explaining the difference in adoption. This is provided by the inferential estimation in section 4.3.

The mean of the characteristics can be used to describe the average farmer in Migori municipality. The distribution suggests that most of the farm households in the sample;

- are headed by males in middle age, with at least primary education.
- have low access to extension contact and training on use of manure
- lack security of tenure on land used for producing vegetable
- are not represented in farming organizations
- produce for subsistence
- use family labour
- have at least six years of experience in vegetable production
- reside within a walking distance to the main vegetable market

**Table 4.1: Summary on adoption by farmers by characteristic; means of the characteristics and percentage rates of adoption**

| FACTOR | Category | Adopters | Not adopt | Total | Rate of adoption | mean |
|---|---|---|---|---|---|---|
| Adoption | | 52 | 37 | 89 | 58.4 | |
| Gender | *males* | 45 | 28 | 73 | 61.6 | |
| | *females* | 7 | 9 | 16 | 43.8 | |
| Age | *<30yrs* | 12 | 12 | 24 | 50 | |
| | *30-50yrs* | 27 | 20 | 47 | 57.4 | |
| | *50-60yrs* | 13 | 5 | 18 | 72.2 | |
| | *> 60yrs* | 4 | 0 | 4 | 100 | 40.4382 |
| Education | *primary* | 18 | 16 | 34 | 52.9 | |
| | *secondary* | 15 | 9 | 24 | 62.5 | |
| | *college* | 19 | 12 | 31 | 61.3 | |
| experience | *<2yrs* | 8 | 14 | 22 | 36.4 | |
| | *2-5yrs* | 23 | 16 | 39 | 59 | |
| | *5-10ys* | 12 | 4 | 16 | 75 | |
| | *>10yrs* | 9 | 3 | 12 | 75 | 6.2023 |
| Extension | *contact* | 14 | 1 | 15 | 93.3 | |
| | *no contact* | 38 | 36 | 74 | 51.4 | |
| Training | *trained* | 20 | 2 | 22 | 90.9 | |
| | *not trained* | 32 | 35 | 67 | 47.8 | |
| Tenure | *secure* | 21 | 9 | 30 | 70 | |
| | *no security* | 31 | 28 | 59 | 52.5 | |
| Objective | *subsistence* | 42 | 28 | 70 | 60 | |
| | *sale* | 10 | 9 | 19 | 52.6 | |
| Member/org. | *Member* | 16 | 3 | 19 | 84.2 | |
| | *No* | 36 | 34 | 70 | 51.4 | |
| Off-farminc | *0-500* | 18 | 15 | 33 | 54.5 | |
| | *501-1000* | 6 | 6 | 12 | 50 | |
| | *1001-3000* | 16 | 9 | 25 | 64 | |
| | *>3000* | 12 | 7 | 19 | 63.3 | 2017.98 |
| Labour type | *family* | 47 | 32 | 79 | 59.5 | |
| | *hired* | 5 | 5 | 10 | 50 | |
| Distance | *<1km* | 11 | 12 | 23 | 47.8 | |
| | *1-2km* | 23 | 18 | 41 | 56.1 | |
| | *3-4km* | 11 | 5 | 16 | 68.8 | |
| | *>4km* | 7 | 2 | 9 | 77.8 | 1.9011 |

## 4.3 Model estimation output

Two models were estimated. In the first model, all the variables under investigation were included as exogenous variables, the results showing the marginal effects of changes in the explanatory variables on probability of adoption of organic manures in vegetable production are as indicated in table 4.2 a.

**Table 4.2 a: Marginal effects(at means) of the socio-economic factors on probability of Adoption**

| Variable | dy/dx | z | P>z |
|---|---|---|---|
| Age | 0 .0069975 | 1.14 | 0.254 |
| **Agesquared*** | -0.0001178 | -1.8 | 0.072* |
| Distance | -0.011481 | -0.21 | 0.835 |
| educ1 (secondary) | 0.1243717 | 0.94 | 0.346 |
| **educ2 (college) **** | 0.2683722 | 2.31 | 0.021** |
| Experience | 0.0150601 | 1.37 | 0.17 |
| Extension | 0.1614411 | 0.44 | 0.658 |
| Gender | -0.1812965 | -1.05 | 0.294 |
| Labour | -0.1310629 | -0.56 | 0.575 |
| Member/org | 0.1461124 | 0.60 | 0.550 |
| Objective | 0.1482078 | 0.83 | 0.405 |
| Off-farminc. | 0.0000327 | 1.03 | 0.304 |
| Tenure | 0.1602442 | 1.18 | 0.239 |
| **Training**** | 0.3632153 | 2.34 | 0.020** |

* Significant at $\alpha$ =10% and ** Significant at $\alpha$ =5%

A test on correlation between explanatory variables revealed high correlation between training and extension (r = 0.69), training and member/org (r = 0.57), between extension and member/org (r = 0.79). This created a problem of multicollinearity

An alternative model devoid of correlated variables was estimated. This involved dropping of extension and member/org. Labour and distance were also dropped since

descriptive statistics showed that majority of the town's residents stay within a walking distance to the main vegetable market, and that use of hired labour among the vegetable producers is minimal. Only 10 out of the 89 farmers interviewed employed hired labour. These could explain why the impacts of distance and hired labour turn out to be highly insignificant in explaining difference in adoption. The improved model was then estimated and the output is as in table 4.2 b.

**Table 4.2 b: Marginal effects (at means) of the socio-economic factors on probability of adoption in the improved model**

| Variable | dy/dx | z | P>z |
|---|---|---|---|
| Age | 0.0074387 | 1.25 | 0.211 |
| **Agesquared*** | -0.0001163 | -1.83 | 0.06* |
| Educ1 (secondary) | 0.1107788 | 0.82 | 0.410 |
| **Educ2 (college) **** | 0.2853616 | 2.51 | 0.012** |
| Experience | 0 .0140565 | 1.30 | 0.193 |
| Gender | -0.1627512 | -0.97 | 0.334 |
| Off-farminc | 0.000023 | 0.80 | 0.425 |
| Objective | 0.1710919 | 1.01 | 0.314 |
| Tenure | 0.142224 | 1.08 | 0.278 |
| **Training**** | 0.4581474 | 5.06 | 0.000** |

* Significant at $\alpha$ =10%, ** Significant at $\alpha$ = 5%

## 4.4 Interpretation and Discussions of the results

The marginal effect, (dy/dx), for a continuous variable gives the measure of change in probability due to a unit increase in the variable. However, for a dummy variable, dy/dx gives the likely change in probability due to discrete change of the variable from 0 to 1. Interpretation of these effects is on the basis of direction of the impact, and the significance of each variable, in explaining difference in adoption of organic manures in

vegetable production by farmers in Migori municipality. The effects of each of the factors are discussed below.

### 1. Training

The results indicate that the impact of training on aspects of organic manure use is the most significant in explaining the difference in adoption among urban vegetable farmers in Migori municipality. The positive coefficient of effect of change implies that the probability to adopt the technology increases with training. That is, farmers who are trained on the relevant aspects of use of organic manures such as; on benefits of the manures and on the preparation procedures are more likely to adopt their use, than those not trained.

Training enhances change of attitude towards different technologies as participants get exposed to the pros and cons of each technology. It also empowers the individuals with the ability of performing the required tasks in utilization of the technology. Because of these, trained individuals overcome the constraints of complexity of technology, hence are motivated to adopt as compared to those not trained.

### 2. Education

There is a significant difference in adoption between college education holders and primary education holders. The impact is positive, implying that college education raises the probability of adoption. On the other hand, the results indicate that there is no significant difference in adoption between secondary and primary education holders. This

finding implies that attainment of secondary education does make individuals better or worse adopters of use of organic manures in comparison to their counterparts who only attained primary education. In Kenya, agriculture education is not offered in all secondary schools. In the schools where Agriculture is taught, it is offered as an elective. It is therefore true that many individuals with secondary education may not have learnt any agriculture at that level, leaving them with the knowledge gained in primary. Many of the individuals who reported secondary education in the sample may have been in this category, hence the insignificance of the impact.

However, the positive coefficient means that a secondary education holder has a higher probability of adoption than a primary holder. The positive difference for college holders is larger than that of secondary holders in comparison to primary. The findings suggests that although individuals accumulate knowledge and exposure as they acquire higher levels of education, the thresh hold for adopting relevant technologies is not realized at the end of secondary education, but rather at college level. This is because at college level, individuals acquire more knowledge and much exposure, and the interest is in the usefulness of knowledge. They are also likely to have relevant interpretation of policies, and the risks of law breaking. They are therefore likely to make better decisions on what technologies to use in any form of production they choose to be involved in. This explains why the difference at this level becomes large and significant.

### 3. Age

The impact of age on adoption is significant at 10%. The positive sign on the effect of age, and the negative sign on that of agesquared, implies that the likelihood of adoption initially increases with age up to a given optimum age, after which the likelihood of adoption declines. This reveals that at some age probability of adoption increases with age, but at some other age, the probability of adoption declines as people get old.

### 4. Gender

Gender has no significant impact on adoption of the technology. It means that there is no important difference in adoption between male headed households and female headed households. The insignificance may be attributed to lack of variability in the sample since a large proportion of the sampled farm households were male headed. Although the impact is insignificant, the negative coefficient indicates that the likelihood of adoption is lower for female headed households than for male headed households.

### 5. Experience

The positive coefficient means that probability to adopt use of organic manures in vegetable production increases with years of experience in growing vegetables. The insignificant effect at the mean of six years, suggests that adoption is gradual, and activities to bring about significant change in adoption take effect over longer periods of time. In addition the variable experience may not have captured gaps on periods of use of this technology, or that of an alternative technology, or use of the technology in combination with another technology. Because these aspects, which define the quality of

experience were lacking, individuals with similar years of experience may have had differences in level of exposure to use of the technology

### 6. Extension

Access to professional information on farming practices increases the probability of adoption as indicated by the positive coefficient. However the effect in this case is insignificant. This may be attributed to the fact that an extension service is not limited to information on organic manures. It may also be due to inappropriateness of extension procedures. Some sources of information reported by the farmers such as, exhibitions at the district's annual Agricultural shows do not allow practical and intensive involvement of the farmers in technology development and transfer which would enhance adoption. However, some reported to have obtained information through their farming organizations. It is observed that a larger proportion of the farmers who receive information from their farming organizations adopted use of the technology. It is clear from this that sources of information and methods of extension should be effective in enhancing acquisition, retention and application of skills in farming.

### 7. Tenure

The insignificant coefficient of the effect of tenure means that there is no major difference in adoption by farmers due to difference in land ownership. This can be explained by the nature of vegetable production in Migori municipality. Many farmers in the area practice rain fed agriculture, implying that most vegetables are grown only over short time durations. It is possible that farmers may choose to use inorganic fertilizers

because these will yield immediate effects on yields during the short time the crops are grown.

The positive coefficient in this case means that tenure security raises probability of adoption, which suggests that farmers growing vegetables on own land are likely to adopt use of the manures more than those operating on rented and public land. This is possible because those operating on own land have incentives to land improvements because they demand long term productivity of their land.

**8. Objective**

The probability to adopt the technology is higher with subsistence production than with production for sale, but the effect is insignificant. Vegetable production in the municipality is more for subsistence than for sale. The lack of a large variance in objective may be the reason for the insignificance of the impact. Because of this objective of vegetable production is not an important factor in explaining difference in adoption by farmers in this area.

**9. Member/org**

The results indicate that membership in farming organization raises the probability of adopting the technology. Members of farming organization have continuous access to information of new innovations in farming. There is also a high likelihood of support and follow up for implementation of agreed practices. However, the impact is insignificant due to the high correlation between the variable and training, suggesting that many of the

farmers in Migori municipality who received training on aspects of use of organic manures were trained through their farming organization.

10. **Off-farm income**

Although the coefficient of marginal effect of a unit increase in off farm income is positive, the difference is almost zero. The effect is also insignificant. This implies that the difference between adopters and non adopters in this case cannot be explained on the basis of the different levels of off farm earning. Any interventions to enhance use of manure in Migori municipality should target all individuals irrespective of their levels of income.

**11. Labour**

The impact of hired labour on adoption is insignificant. This implies that those using hired labour are not specifically doing so in order to overcome labour constraints in use of manures, but rather just to have the routine husbandry practices done. The negative coefficient of effect means that probability of adoption is lower with use of hired labour than with family labour. This suggests that individuals providing hired labour are averse to manure handling.

**12. Distance**

The effect of change in likelihood of adoption decreases as the distance from residence to the main vegetable market increases. The effect is insignificant, implying that there is no serious difference in adoption by farmers on the basis of distance. The mean distance in

the sample is 1.90 kilometers, which is a walking distance. Also because of prevalence of vegetable selling points within urban estates, the difference in distance may not seriously influence decisions for adoption in urban set up, as it would in rural areas.

# CHAPTER FIVE

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Introduction

This chapter presents a brief summary of the findings of this study, the conclusions and recommendations on possible actions that can enhance adoption of organic manures in vegetable production in Migori municipality.

## 5.2 Summary and Conclusion

The estimation results of the logit model indicate that; age of household head, college education, and training in aspects of organic manure use, are significant in explaining the difference in adoption of organic manures in vegetable production by farmers in Migori municipality. Training is the most significant in enhancing adoption followed by college education at 5 %level. Age is found significant at 10%. Although the effect of the other factors are insignificant at both levels, the study reveals that years of experience in vegetable production, level of off farm income, subsistence production of vegetables, extension contact, membership in organization, and security of tenure have positive impacts, while gender, distance and hired labour have negative impacts on adoption.

These findings indicate that the most important variables for policies and strategies to enhance adoption of organic manures in Migori municipality are; age of household head, training and Education.

## 5.3 Recommendations

The following are recommendations for enhancing adoption of organic manures in urban vegetable production by farmers in Migori municipality.

- Farmers should be trained on important aspects of organic manures use in vegetable production using methods that effectively involve the farmers. The training programs should aim at increasing awareness on the importance of organic manures in urban crop production systems, and capacity building on preparation procedures and handling of manures. These can be achieved through workshops, seminars, and field days that critically address these needs.
- The municipal council and Ministry of Agriculture officials should utilize available avenues such as Chief *Barazas,* public open days, partnerships with religious institutions and farming organizations, to sensitize residents on the legal requirements on the practice of urban agriculture, hence use of manures rather than fertilizers in crop production practices.
- Establishment of a demonstration site where farmers can continually get exposed to various skills and procedures of preparation and use of the manures for growing different types of vegetables can be very useful.
- The training should be targeted at individuals within an optimal age group for adoption
- Activities undertaken to enhance adoption should be implemented over a period not less than six years to achieve reasonable impact.
- Activities that adequately expose student to choice of relevant technologies in production should be implemented in school programs. School debates, drama music,

essay contests and other club activities should be strengthened, and can be tailored to help impart important information to enhance adoption.

## 5.4 Recommendations for further research

This study did not include aspects of the technology in the model for estimation. It therefore recommends investigation on how aspects/ or the properties of the technology affects adoption. This is necessary as it can provide important information that would guide improvements in the technologies components to enhance adoption.

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APPENDIX A

**QUESTIONNAIRE 1** No._____

## Introduction

The person conducting this research (PEREZ AYIEKO ONONO) is a postgraduate student at Kenyatta University. The objective of the study is to identify and analyze the determinants of adoption of organic manures in urban vegetable production. The study's target population is farmers within Migori Municipality. You are hereby requested to provide information to facilitate the study. You are also assured that the information is required basically for academic purpose and will not be used to victimize you in any way. The findings of this study will be very useful in the formulation of policies and devising of strategies to promote use of organic manures in vegetable production so as to increase farm productivity.

1. **Name of Respondent**_____
   **Area of residence** _____

2. **Provide answers to the questions in the table below by ticking as appropriate in the third column.**

| | | |
|---|---|---|
| What is the Gender (sex) of the household head? | Female | |
| | Male | |
| In what Type of residence does the household live? | Own home | |
| | Rental | |
| What is The highest level of education attained by household head? | No formal education | |
| | Adult literacy | |
| | Primary | |
| | Secondary | |
| | College | |
| What is the state of ownership of the land on which the household has vegetables grown this season? | Individual registered | |
| | Family land | |
| | Rented | |
| | Public land | |
| What is the main type of labour used in the vegetable farm activities? | Family labour | |
| | Hired labour | |
| Does the household head belong to any farming organization? | Yes | |
| | No | |
| What is the main reason for the household's involvement in growing vegetables? | Family consumption | |
| | Sale | |
| | Both | |

3. **What is the Age of the household head in years?** _____

4. **How many people reside in your household?** _____

5. **For how many years has your household been engaged in vegetable production within Migori municipality?** _____

6. **Do you sometimes get information or advice on farming practices?**
   ☐ Yes ☐ No

**If yes**, from what sources? (Tick appropriate responses)

- ☐ Agricultural shows
- ☐ Ministry of Agriculture officers
- ☐ Farming organization
- ☐ Neighbor
- ☐ Any other (specify) _____

7. **Did you get any information or advice from the said sources any time during the last one year?** ☐ Yes ☐ No

8. **Have you ever been trained on the use of organic manures in crop production?** ☐ Yes ☐ No

**If yes**, on what particular aspects?

- ☐ How to prepare compost / farmyard manure
- ☐ The benefits of using organic manures in crop production
- ☐ Any other (specify) _____

**Name the institution/ organization that organized for the training**

_____

9. **What material(s) have you been using to improve soil fertility in your vegetable gardens during the last one year?**

- ☐ Fertilizers
- ☐ Organic manure (compost / farmyard manure)
- ☐ None

10. **If your answer for 9 is organic manures**
    a. Do you prepare the manure on your own farm or do you obtain it from another place?

☐ On-farm preparation
☐ From another place (specify) _____

- What specific benefits have you experienced with use of organic manures in vegetable production?

_____
_____
_____
_____
_____

- What problems or difficulties have you encountered with the use of organic manures in vegetables production?

_____
_____
_____
_____
_____

11. **Fill in the following table, the various off-farm income activities that members of your household are involved in, and for each the average earnings in Ksh. per week**

| | Off-farm occupation | Average earnings per week (Ksh.) |
|---|---|---|
| Household head | | |
| Spouse | | |
| Others 1. | | |
| 2. | | |
| 3. | | |
| **TOTAL** | | |

12. **What is the approximate distance from your residence to the nearest vegetable market in kilometers?** _____

13. **What major problems do you encounter as you engage in farming activities within this municipality?** _____

_____
_____
_____
_____
_____
_____
_____
_____

# APPENDIX B

## Table A.B: Coded research data

| adopt | gend | age | exp | off-inc | dist | ext | train | m/org | labor | object | tenu | educ1 | educ2 | agesq. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 42 | 1.5 | 2000 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 625 |
| 1 | 0 | 41 | 10 | 0 | 5 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 784 |
| 1 | 0 | 39 | 2 | 700 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 625 |
| 1 | 0 | 57 | 3 | 2000 | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1764 |
| 1 | 0 | 75 | 1 | 2200 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1681 |
| 1 | 0 | 67 | 4 | 300 | 4 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 625 |
| 1 | 0 | 50 | 2 | 0 | 4.3 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 784 |
| 1 | 0 | 45 | 1.5 | 1000 | 5 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1521 |
| 0 | 0 | 26 | 2 | 4000 | 1.5 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 484 |
| 1 | 0 | 34 | 2 | 1200 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3249 |
| 0 | 0 | 27 | 2 | 500 | 0.4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 5625 |
| 0 | 0 | 28 | 1 | 2000 | 0.3 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2704 |
| 0 | 0 | 35 | 5 | 10000 | 0.5 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 4489 |
| 1 | 0 | 27 | 4 | 2000 | 0.3 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 2500 |
| 0 | 0 | 50 | 15 | 3000 | 4 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 4096 |
| 0 | 0 | 25 | 1 | 500 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2025 |
| 0 | 0 | 42 | 1 | 2500 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 676 |
| 1 | 0 | 55 | 10 | 2500 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1849 |
| 1 | 0 | 48 | 1 | 6000 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1156 |
| 0 | 0 | 39 | 3 | 0 | 5 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2025 |
| 0 | 0 | 54 | 9 | 7500 | 4.5 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1024 |
| 1 | 0 | 69 | 7 | 1000 | 4.5 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 2025 |
| 0 | 0 | 60 | 1 | 500 | 0.3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 729 |
| 0 | 1 | 23 | 1 | 2500 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 2116 |
| 1 | 0 | 57 | 37 | 1000 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 784 |
| 1 | 0 | 54 | 4 | 450 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1225 |
| 0 | 1 | 55 | 20 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 729 |
| 0 | 0 | 34 | 10 | 700 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2704 |
| 0 | 0 | 30 | 2 | 500 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2025 |
| 1 | 1 | 33 | 2 | 3500 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2500 |
| 0 | 0 | 27 | 1 | 1300 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3025 |
| 1 | 1 | 48 | 10 | 1000 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 625 |
| 1 | 0 | 53 | 5 | 200 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 961 |
| 0 | 0 | 33 | 5 | 500 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1369 |
| 0 | 0 | 37 | 2 | 9000 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2500 |
| 1 | 1 | 40 | 7 | 3500 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1764 |
| 1 | 0 | 45 | 1 | 5000 | 0.5 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 3025 |
| 0 | 1 | 44 | 8 | 3000 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2304 |
| 1 | 1 | 41 | 4 | 1350 | 0.5 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1936 |
| 1 | 0 | 41 | 8 | 800 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1521 |
| 1 | 0 | 56 | 32 | 500 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 625 |
| 0 | 1 | 44 | 3 | 600 | 0.5 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2916 |
| 0 | 0 | 58 | 25 | 200 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4761 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 43 | 5 | 3500 | 1.5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 441 |
| 1 | 0 | 28 | 1 | 5250 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 441 |
| 1 | 0 | 28 | 8 | 2000 | 3 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1225 |
| 1 | 0 | 25 | 3 | 0 | 4 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 625 |
| 1 | 0 | 28 | 4 | 2700 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1936 |
| 0 | 0 | 43 | 2 | 2500 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 2209 |
| 1 | 0 | 45 | 18 | 2500 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 729 |
| 0 | 0 | 32 | 1 | 3000 | 0.8 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 784 |
| 1 | 0 | 52 | 36 | 1200 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 2500 |
| 0 | 0 | 25 | 3 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3600 |
| 0 | 0 | 35 | 1 | 1750 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 529 |
| 1 | 0 | 47 | 5 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1600 |
| 0 | 1 | 39 | 4 | 500 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 3249 |
| 0 | 1 | 35 | 2 | 150 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 729 |
| 1 | 0 | 25 | 2 | 500 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 576 |
| 1 | 0 | 25 | 6 | 4000 | 3.5 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 729 |
| 1 | 0 | 25 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1521 |
| 1 | 0 | 52 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2916 |
| 1 | 0 | 64 | 6 | 4000 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 3025 |
| 1 | 0 | 45 | 7 | 5000 | 1.5 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2401 |
| 1 | 0 | 46 | 5 | 3000 | 0.1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1521 |
| 0 | 0 | 55 | 10 | 700 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1156 |
| 0 | 0 | 31 | 5 | 300 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1225 |
| 1 | 0 | 37 | 4 | 4000 | 2.5 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1600 |
| 1 | 0 | 50 | 15 | 2500 | 0.5 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 900 |
| 1 | 0 | 44 | 20 | 0 | 5 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1089 |
| 0 | 0 | 21 | 1 | 350 | 3.5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 729 |
| 0 | 1 | 25 | 1 | 5000 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2304 |
| 0 | 0 | 27 | 1 | 750 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2809 |
| 0 | 0 | 28 | 1 | 1000 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1089 |
| 1 | 0 | 50 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1369 |
| 1 | 0 | 27 | 2 | 500 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 625 |
| 0 | 0 | 39 | 1 | 5000 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1681 |
| 1 | 0 | 41 | 3 | 10000 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1369 |
| 1 | 0 | 42 | 5 | 2700 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1600 |
| 1 | 0 | 22 | 2 | 200 | 5 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 3364 |
| 1 | 0 | 45 | 12 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2025 |
| 1 | 0 | 21 | 1 | 500 | 0.3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1936 |
| 0 | 1 | 44 | 1 | 500 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1681 |
| 1 | 0 | 40 | 2 | 2000 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1681 |
| 0 | 0 | 24 | 3 | 600 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1764 |
| 1 | 1 | 27 | 4 | 7500 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 3136 |
| 1 | 1 | 49 | 19 | 500 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1936 |
| 0 | 0 | 40 | 2 | 500 | 0.2 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 3364 |
| 1 | 0 | 37 | 17 | 3500 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1849 |
| 1 | 0 | 58 | 10 | 2450 | 0.5 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 784 |

# APPENDIX C

## Table A.C: Correlation Matrix

| | gend | Educ1 | Educ2 | age | exp | Off-inc | dist | ext | train | m/org | labor | tenu | object |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| gend | 1 | | | | | | | | | | | | |
| Educ1 | .05 | 1 | | | | | | | | | | | |
| Educ2 | .15 | -.44 | 1 | | | | | | | | | | |
| age | -.04 | -.22 | .15 | 1 | | | | | | | | | |
| exp | -.03 | .04 | -.15 | .4 | 1 | | | | | | | | |
| Off-inc | -.04 | -.15 | .6 | -.04 | -.13 | 1 | | | | | | | |
| dist | -.23 | 0 | -.13 | -.02 | 0 | -.19 | 1 | | | | | | |
| ext | -.05 | -.07 | -.01 | .03 | -.11 | -.12 | .27 | 1 | | | | | |
| train | -.06 | .05 | 0 | -.04 | -.13 | -.02 | .2 | .69 | 1 | | | | |
| m/org | -.1 | -.07 | -.04 | .03 | -.14 | -.12 | .16 | .79 | .57 | 1 | | | |
| labor | -.07 | .02 | -.11 | .02 | -.04 | -.07 | .07 | .03 | -.05 | -.01 | 1 | | |
| tenu | -.01 | .01 | .05 | -.09 | -.05 | -.09 | .08 | .01 | .03 | -.01 | .06 | 1 | |
| object | -.14 | .17 | -.01 | -.11 | -.11 | -.03 | -.13 | -.2 | -.23 | -.07 | -.1 | .23 | 1 |
| adoption | -.14 | .05 | .04 | .26 | .21 | .0024 | .16 | .20 | .19 | .16 | -.06 | .10 | -.05 |