

**FACTORS AFFECTING ADOPTION OF ORGANIC FARMING BY MAIZE
FARMERS IN MERU SOUTH DISTRICT**

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DECLARATION

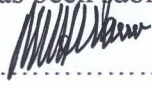
This project is my own original work and has not been presented for a degree in any other university.

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DEDICATION

To my beloved wife Rosemary and my son Eddy Thati.

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The views and interpretations in this paper are solely mine and not related in any way to the Department of Economics, Kenyatta University.

ABSTRACT

Organic farming of which Stover, trash and farm composite are components, offers considerable promise for increasing food production in Kenya. It nonetheless remains unclear whether, organic farming techniques lend themselves easily to adoption by small-scale farmers. And if so, why do some farmers adopt organic farming while others fail to adopt?

Using survey data collected from 119 households in Meru-South District, this study investigated factors that influence adoption of organic farming by small-scale maize farmers. A structured interview schedule was used to collect data on the socio-economic characteristics and the institutional factors affecting adoption of organic farming. The data collected was analyzed using econometric software known as Statistical Program for Social Scientists (SPSS). Both descriptive and regression results of the logit model are presented.

The farmers reported several constraints to adoption of organic farming, including inadequate knowledge, lack of market for organic products, inadequate market information, labour availability and expensive certification process. Conventional farmers reported uncertainty about the supply chain (market for organic product), strict certification procedure and reduced yield as the most important reasons for not converting to organic farming

Major factors associated with adoption included farm size, awareness, social capital proxied by membership to farmer association, household size, farmer experience and

ecological zones. These findings raise important questions as to whether organic farming techniques are really affordable to smallholders. To spur adoption, it is recommended that the government should come up with policy decisions and legislate organic laws that favour organic farming, while training activities should develop further into marketing, processing and certification of organic products. Extension messages should be focused on younger less experienced farmers and women who are more likely to adopt organic farming practices.

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ABBREVIATIONS AND ACRONYMS

BACs	Bio-Intensive Agricultural Clubs
CIMMYT	International Maize and Wheat Improvement Center
CBTF	Capacity Building Task Force
ERSWEC	Economic Recovery Strategy for Wealth and Employment Creation
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
IFOAM	International Federation of Organic Agriculture Movement
KOAN	Kenya Organic Agriculture Network
KOFA	Kenya Organic Farmers Association
KOPA	Kenya Organic Producers Association
MDG	Millennium Development Goals
NGO	Non-Governmental Organization
SPSS	Statistical Program for the Social Scientists
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UN	United Nation
WHO	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Adopter - a farmer who acquires and put into use organic farming techniques in his/her farm.

Adoption – is a decision to acquire and use an existing ideas or innovation (techniques) preferred course of improving performance.

Conventional farming /green revolution – farming where high yielding varieties are used together with synthetic chemical inputs (external inputs)

Disadoption- stopping practicing organic farming/dropping organic farming techniques after adoption.

Disadopter - a farmer who previously used organic farming practices, but does not use any of them currently.

Free rider – anyone who would like to have the benefits of the goods or services without Contributing or sharing the cost of its supply or provision.

Non-Adopter - a farmer who had never practiced organic farming on his/her plot.

Organic agriculture/ Organic farming - holistic production management system, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. (ie. Farm composite is used as a substitute of synthetic chemical inputs).

Productivity – increase in output without increase in inputs.

Stover → Corn stock used as fodder but can also be used to make composite which is the organic substitute of synthetic fertilizers.

Trash – Trimmings from plants, twigs, branches or leaves/grass that have fallen, slashed (grass) or been trimmed from trees and plant which are used to make composite

CHAPTER ONE

INTRODUCTION

1.1 Background

1.1.1 Role of Agriculture

According to International Federation of Organic Agriculture Movement (IFOAM), agriculture is the cornerstone of Kenya's economy employing over three quarters of the population. More than 50 percent of export earnings and 24 percent of Gross Domestic Product (GDP) are attributed to agricultural products. Tea, Horticulture, coffee, tobacco, cashew nuts, sisal and pyrethrum, create the largest export earnings for Kenya (Republic of Kenya, 2007).

Most Kenyan farmers are small-scale operators and the subsistence lifestyle they once depended on is no longer viable due to population pressure which has shrunk farm size. Today, all live in a market economy and subsidized goods and free services for rural people are a thing of the past. Kenya's growing population, too, will need to be fed and will continue to require more, safe and better quality food. So, how do rural people increase farm productivity and household farm incomes from less land?

With growing population and fixed agricultural land, there is need to embrace agricultural technologies that maximize output from diminishing land size per farmer and fertility. Food production will not keep pace with population growth, unless there is a much greater use of improved technologies. The view that a household's primary need is food has given way to a livelihood perspective that emphasizes secure, sustainable farming as a necessary condition for food security.

The role of agricultural technology in improving the well-being of rural farming households has been widely documented in Economic Recovery Strategy for Wealth and Employment Creation (ERSWEC), (Republic of Kenya, 2003) and in Sessional Paper No 1 of 1986. Among other strategies, agricultural research and extension services are the several key ingredients to poverty alleviation, employment creation, increased household farm incomes and improvement in food security.

According to Republic of Kenya (1986), Kenya's Export-orientation policy paper an outward looking strategy as opposed to Import Substitution strategy contained in Sessional Paper No.10 of 1965, which was inward looking strategy. Self-sufficiency in the production of agricultural products such as, maize, beans and vegetables is a key strategy for sound economic management and renewed growth for the country. For the agricultural sector to play this central role in a sustainable way, rapid growth in output and productivity is critical.

To respond to rapidly-rising food demand, farmers have extensively used "green revolution" technologies, i.e., use of chemical synthetic inputs, hybrid seeds (high yielding varieties), and improved farming techniques. Although green revolution techniques raise productivity significantly, the chemical inputs used have posed serious health risks, as well as threatening widespread ecological damage that render the sector's improvements unsustainable. It may help in the short to medium-run, but in the long-run farmers have second thoughts about it. More so, these chemical inputs are expensive for farmers.

1.1.2 Organic Farming and its Benefits

In response to rising concern about the sustainability of conventional agriculture, the government has collaborated with International assistance agencies to promote organic farming or “Bio-intensive agriculture”. The organic sector in Kenya is still relatively small. Only 182,000 hectares of land are under organic management, which accounts for only 0.69 % of the total agricultural area in Kenya (UNEP/UNCTAD, 2006). About 30,000 farms have changed over to organic cultivation methods so far (IFOAM & FiBL 2006). Many of the exporters of organic product are large-scale farmers who are already engaged in the export of agricultural and horticultural produce, and are diversifying into organic production to meet demand of their established customers (IFOAM 2003).

Small-scale organic farmers in Kenya have formed a national representative organization, the Kenya Organic Farmers Association (KOFA). Larger companies and commercial farmers who are already in the export market have organized themselves into the Kenya Organic Producers Association (KOPA). In 2004, organic agriculture stakeholders in Kenya, including KOPA and KOFA, formed the umbrella network known as Kenya Organic Agriculture Network (KOAN) to support the successful growth of the sector (UNEP/UNCTAD 2006).

The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people. It emphasizes the use of management practices in preference to the use of off-farm inputs. This is accomplished by using, where possible, agronomic, biological, and mechanical methods,

as opposed to using synthetic materials to fulfill any specific function within the system. It involves use of improved seeds along with fertilizers, pesticides and insecticides derived from the natural ingredients available in the local environment. It is the use of natural methods of fertilizing land such as stover, trash and farm composite. Since chemical inputs are expensive for peasant farmers, organic farming offers the prospect of lower production costs and higher profitability.

Organic farming techniques may also raise overall productivity, by encouraging more effective use of existing inputs. In developing countries, especially in low-input traditional systems, properly managed organic agriculture systems can increase agricultural productivity and restore the natural resources base (Scialabba, 2000a). Organic farming is environmental friendly and produce foodstuff that are more human-friendly in that they have less harmful side effects on the health of the consumers compared with those produced using conventional agriculture. It is also labour intensive and, therefore, capable of increasing employment opportunities in rural areas. The fact that in organic farming, where herbicides cannot be applied, weeding should be done manually and requires substantial labour for extended periods of time (Scialabba, 2000b). Weeds can also be allowed to grow then slashed or cut and be used to make composite. Adopters of the mulch, green manure, stover and trash lines some of the organic farming practices appear to be less exposed to production risks (Klonsky, K and Tourte, L. 1998). This is because they help to improve soil fertility and moisture retention and increase soil organic matters once they are incorporated into the soil (World Bank, 1999; FAO, 2004; Vanlauwe, 2004).

Diversification of crops typically found on organic farms, with their different planting and harvesting schedules, may distribute labour demand more evenly, which could help stabilize employment. As in all agricultural systems, diversity in production increases income-generating opportunities and can, as in the case of fruits, supply essential health-protecting minerals and vitamins for the family diet (FAO, 2001). It also spreads the risks of failure over a wide range of crops.

The demand for organic products has also created new export opportunities for the developing world. Many developing countries have started to tap lucrative export markets for organically grown products. Tropical fruit to the European baby food industry, Zimbabwe herbs to South Africa, African cotton to the European Community, Chinese tea to the Netherlands, and soybeans to Japan (FAO, 1999) are just but a few examples. Organic farming will also enable farmers and exporters to meet the zero pesticide residual regulation on horticultural exports.

Organic agriculture can also contribute to local food security in several ways. Organic farming avoids high cost inputs for poor farmers and saves the country's foreign exchange used to import synthetic fertilizers, herbicides and pesticide. Organic soil improvement may be the only economically sound system for resource-poor, small-scale farmers. This characteristic of the production process on organic farms means that organic farmers are less dependent on external inputs such as fertilizers and credit, over which they may have little control, thereby increasing local food security and self-

reliance. Organic agriculture also means that indigenous species and knowledge, so often discounted, are of great value.

1.1.3 Organic Farming Practices in Meru-South District.

Meru South District is characterized by complex farming systems dominated by perennial cash crops, food crops and livestock (Micheni *et al.*, 1999). The area is in the main coffee/dairy/maize Land Use Systems, with an altitude of approximately 1500 M above sea level, an annual mean temperature of 20⁰ C, and an annual rainfall varying from 1200 to 1500mm (Republic of Kenya 2000). Organic farming has been in Meru-South since year 2002 and has been growing though at slow rate. Thus, the need for a better understanding of the factors that encourage or discourage adoption of organic farming in the District.

1.2 The Statement of the Problem

Kenya, like many other developing countries, aims at achieving self-sufficiency in domestic food production and attainment of the Millennium Development Goals (MDGs). Goal number one which is to eradicate extreme poverty and hunger and goal number seven ensure environmental sustainability are examples. Poverty, food insecurity, coupled with increasing population, is the major development challenge Meru South District is facing. About 72 percent of the population in the District is considered to be in the poverty bracket and mostly depend on relief food (Republic of Kenya, 2002)

Although green revolution raises productivity significantly, the chemical inputs used have posed serious health risks as well as threatened ecological damage that renders the agricultural sector's improvements unsustainable in the long-run. More so, these chemical inputs are expensive for poor farmers, causing them to produce less since they cannot afford to buy the inputs.

It is against this background that the public agencies, NGO's and international donors have supported organic farming or bio-intensive agricultural development efforts (FAO, 2001). Organic agriculture ensures agricultural biodiversity, which is essential for food security, and sustainable agricultural development. It promotes environmentally, socially and economically sound production of food and fibres (UNEP/UNCTAD 2006). It also eliminates reliance on external farm inputs and any possibility of poisoning from powerful agro-chemicals for both humans and livestock. The adoption of organic farming is, therefore, an important part of combating poverty and food insecurity in Meru-South where farmers grow maize as the staple food.

But like many other promising agricultural technologies in the developing world the adoption of organic farming in Kenya has been disappointing (Nyangena, 2004). The limited overall success of organic farming inspite of its importance in the long-term sustainability of agricultural production is worrisome. The overall adoption of organic farming has not been fully understood and some aspects of technology adoption remains poorly researched. This necessitates effort for better understanding of the conditions and

constraints that encourage or discourage adoption of agricultural technologies. Therefore, the basic research questions answered in this study are:

- i. What socioeconomic factors influence adoption of organic farming by the small-scale maize farmers?
- ii. What are the institutional factors influencing adoption of organic farming by maize farmers?
- iii. Why do some farmers disadopt organic farming?
- iv. What incentives, institutional and agricultural policy interventions would most effectively encourage farmers to adopt and continue using organic farming technology?

1.3 The Objectives of the Study

The general objective of this study was to investigate factors that influence adoption of organic farming by maize farmers in Meru south district. The specific objectives were:

- i. To identify and assess socioeconomic factors influencing adoption of organic farming by small-scale maize farmers.
- ii. To investigate institutional factors influencing adoption of organic farming by the small-scale maize farmers.
- iii. To explore whether the household-level factors that encourage adoption of organic farming also discourage disadoption
- iv. To come up with specific institutional and agricultural policy interventions that could help accelerate adoption of organic farming by the small-scale maize farmers.

1.4 Justification and Significance of the Study

Without basic descriptive information on who are adopting, disadopting and not adopting productive agricultural technologies, it would be difficult to formulate policies aimed at improving agricultural productivity (Doss, 2003). This study aimed at generating insights that contributes to designing agricultural and institutional policies conducive to higher and more widespread adoption of organic farming, thereby increasing productivity, mitigating food insecurity, and reducing poverty and unemployment. Thus, this study offers valuable information to government, NGOs, international donors and other agencies involved in community development on the possibility of accelerating organic farming adoption. This study is also likely to set a pace for further studies in the area and as a result may prove to be of interest to researchers and scholars.

1.5 Scope of the Study

This study covered two Divisions randomly selected from the five Divisions of Meru-South District. Meru South District was chosen because it is representative of other Districts in the region where maize is a major food crop and its relative success in organic farming. The survey was conducted in the main maize growing areas of the two Divisions, classified as Upper Midland 2 (UM2) and Upper Midland 3 (UM3) (Jaetzold and Schmidt 1983), that together are dominated by the coffee/dairy land use systems.

1.6 Organization of the Study

This paper is organized in five chapters, including this introductory chapter. The next chapter reviewed both the theoretical and empirical literature on technology adoption that

was relevant to this study, and a brief overview of the literature. Chapter three provides a theoretical framework to the empirical model and the research methodology. It also presents a detailed specification of the model to be estimated. Chapter four presents research results and chapter five provides summary, conclusion and policy implications from the findings.

CHAPTER TWO LITERATURE REVIEW

2.1 Introduction

This chapter is divided into two parts. The first deals with theoretical literature on technology adoption models and the second deals with empirical literature. This chapter reviews the literature related to technology adoption models, and highlights factors that have been found to affect farmer's adoption of new agricultural technologies in order to gain insights regarding constraints to the adoption of organic farming.

2.2 Theoretical Literature

Qualitative response models such as binary-choice, discrete or dichotomous models can be used to evaluate the farmer's decision-making process concerning the adoption of agricultural technologies. Based on the assumption that households and farmers are faced with a choice between two alternatives (adoption or no adoption) and the choice depends upon identifiable characteristics (Pindyck and Rubinfeld, 1997). Assuming that the decision made by farmers regarding adoption of a particular technology is guided by a utility maximization objective, a new technology (t_2) is adopted if and only if the utility derived from new technology (t_2) is greater than the utility derived from the old technology (t_1) ie $U_{1i} < U_{2i}$. The utility function ranking the i^{th} farmers' preference for technologies is represented according to Rahm and Huffman (1984): as $U(R_{ij}, A_{ij})$

Where utility U depends on a vector R_{ij} , describing the distribution of net returns for technology t_j , and a vector A_{ij} , corresponding to other attributes associated with the technology t_j . The variables R_{ij} and A_{ij} are not observable, but a linear relationship is postulated for the i^{th} farmer between the utility derived from the t_j technology and a vector

of observed farm and farmer characteristics X_i and a zero mean random disturbance term μ_t :

$$U_{tji} = U(X_{tji}, \mu_{tj}) \text{ where } j=1, 2 \text{ and } i = 1, 2, \dots, n. \quad (1)$$

As mentioned previously, the i th farmer adopts t_2 if U_{t2} is greater than U_{t1} . A qualitative variable Y can represent the farmer's adoption decision.

$$Y = 1 \text{ if } U_{t2} > U_{t1} \text{ and new technology } t_2 \text{ is adopted replacing } t_1 \text{ and } Y = 0 \text{ otherwise} \quad (2)$$

The probability that Y_i is equal to one is expressed as a function of specific farm and farmer characteristics:

$$P_i = \Pr (Y = 1) = \Pr (U_{t1} < U_{t2}) \quad (3a)$$

$$\Pr [U_{t1}(X_i, \mu_{1i}) < U_{t2}(X_i, \mu_{2i})] \quad (3b)$$

$$\Pr (X_i\alpha_1 + \mu_{1i} < X_i\alpha_2 + \mu_{2i}) \quad (3c)$$

$$\Pr [\mu_{1i} - \mu_{2i} < X_i(\alpha_2 - \alpha_1)] \quad (3d)$$

$$\Pr (\gamma_i < X_i\beta) = F (X_i\beta) \quad (3e)$$

$\Pr (\cdot)$ is a probability function,

$\gamma_i = \mu_{1i} - \mu_{2i}$ is a random disturbance term

$\beta = \alpha_2 - \alpha_1$ is a coefficient vector and;

$F (X_i\beta)$ is a cumulative distribution function for γ_i evaluated at $X_i\beta$.

The marginal effect of a variable X_j on the probability of adopting new technology can be calculated by differentiating P_i with respect to X_i :

$$\partial P_i / \partial X_{ij} = f(X_i\beta) \cdot \beta_j, \quad (4)$$

Where $f(\cdot)$ is the marginal probability density function of γ_i and $j = 1, 2 \dots J$ is the number of explanatory variables. The general form of the univariate dichotomous choice model is expressed as:

$$P_i = P_i(Y_i = 1) = G(X_i, \theta) \text{ where } i = 1, 2, \dots, n. \quad (5)$$

Equation (5) states that the probability that the i^{th} farmer will adopt a specific technology is a function of the vector of explanatory variables X_i and the unknown parameter vector θ .

Three alternative functional relationships are commonly used by researchers to specify G : Linear Probability (LP), Probit, and Logit models. A Linear probability model ($Y_i = \alpha + \beta X_i + \mu_i$) has been used extensively in econometrics applications. However, its specification has caused estimation problems and the non-normality of the disturbance terms makes the use of traditional tests of significance (t-test and F-test) inadequate.

Koutsoyiannis (1977), and Pindyck and Rubinfeld, (1997) summarize the limitations of the LP functional form as follows: First, it gives a heteroscedastic regression model and its variance-covariance matrix varies systematically with the independent variables; Secondly, The predicted value of $X\beta$ is not restricted to lie between 0 and 1, which is inconsistent with the definition of Y_i as a conditional probability, and lastly some studies have revealed that adoption decision functions are curvilinear rather than linear. Thus, Ordinary Least-Squares (OLS) would produce inefficient parameter estimates.

Given the problems associated with the linear probability model, economists have developed alternative functions that confine the estimated probabilities between 0 and 1. The two most common functions used in econometric applications are the logistic and the

cumulative normal distributions, creating the logit and probit models, respectively. Thus, the probability that a farmer will adopt a new technology is expressed as:

$$P(Y = 1) = F(X\beta)$$

Using the logit model, the probability of an individual household (farmer) adopting a new technology t_2 , given a well-defined set of socio-economic and physical characteristics (X), is represented as:

$$P(t_2 | X) = 1 / [1 + \exp -(X\beta + \mu)] \text{ Cumulative logistic distribution}$$

Likewise, the probability of not adopting the new technology t_2 (continuing with technology t_1) is given by:

$$\begin{aligned} P(t_1 | X) &= 1 - P(t_2 | X) = 1 - \{1 / [1 + \exp -(X\beta + \mu)]\} \\ &= \exp -(X\beta + \mu) / [1 + \exp -(X\beta + \mu)] \end{aligned} \quad (6)$$

The relative odds of adopting versus not adopting a new technology are given by

$$\begin{aligned} P(t_2 | X) / P(t_1 | X) &= \{1 + \exp -(X\beta + \mu)\} / [\exp -(X\beta + \mu) [1 + \exp -(X\beta + \mu)]] \\ &= \exp (X\beta + \mu) \end{aligned} \quad (7)$$

$$\text{Taking the logarithm of both sides: } \ln [P(t_2 | X) / P(t_1 | X)] = X\beta + \mu \quad (8)$$

In a logit model, the parameter estimates are linear and, assuming a normally distributed disturbance term (μ), the logit maximum likelihood (LML) estimation procedure is used to get efficient, consistent, and asymptotically normal estimators. Those estimates will represent the effects and statistical significance of the explanatory variables on the adoption of a particular technology (Pindyck and Rubinfeld, 1997).

The probit model is also more appealing than the linear probability model, since it incorporates nonlinear maximum-likelihood estimation. Probit analysis accounts for heteroscedasticity of the error terms and restricts predictions to lie between 0 and 1 range. The probability of a farmer adopting or not adopting improved technology in the probit model is defined in terms of an index that may have any value between -∞ and +∞. This index is converted into probability values by using a standard cumulative normal distribution and this transformation guarantees that all corresponding probability values are confined between 0 and 1 (Pindyck and Rubinfeld, 1997, Maddala, 1988). The functional form is represented as follows:

$$P_i = F(Z_i) = \int_{-\infty}^{Z_i} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{\mu^2}{2}\right) d\mu \quad \mu \sim N(0,1)$$

Where $Z_i = X_i \beta + \mu_i$

Logit and probit models have been widely used in different adoption studies (for example, Yahanse *et al.* 1990; Polson and Spencer 1991; D'Souza, Cyphers, and Phipps 1993; Hussain, Byerlee, and Heisey 1994; Salalsya *et al.* 1998 and Akter and Rajah, 1992). These models not only help assess various factors that affect adoption of a given technology, but also provide predicted probabilities of adoption. They can be used for example to indicate how the likelihood of a farmer adopting a particular technology changes according to his or her level of education, keeping all other factors constant. Since logit and probit models yield similar results in the case of binary choice models (Maddala, 1983, and Amemiya, 1981), the choice of one over the other is a matter of convenience.

2.3 Empirical Literature

Many studies have sought to explain farmer adoption of new technologies, including specific traits of improved varieties. Byerlee (1996) study on adoption analysis of the early phase of Green Revolution (1965-75) found that endowment, good market network, availability of credit, and risk bearing significantly explained their adoption.

Rogers (1962) popularized a diffusion model of adoption of innovations that posited that innovations were adopted at differential rates by groups of consumers or decision-makers, differentiated by their status in the society and their orientation to novelty and to risk. The study categorized population differentiates into five as regards their orientation to, and the rate of adoption of new products or ideas: the innovators, the early adopters, the early majority, the late majority and laggards. Innovators have a natural proclivity towards novelty. Furthermore, because they tend to have more resources, they can afford the risk associated with an unproven product or idea. According to Rogers (1995), early adopters are well integrated into their social systems and are often leaders in their communities. They follow the lead of the innovators. This might also hypothesize that they would tend to be less risk averse than the rest of the population.

The third category, early majority, comes next in the line of adopters, followed by the late majority and laggards, who whether because of lack of access to information, products or resources, or their orientation to risk, are the last groups to adopt new products or systems. Rogers (1995) posited the notion that innovators and early adopters differ from late adopters in significant ways according to demographic, psychographic and economic

factors. Organic production methods in agricultural systems are still in the innovation and early adoption stage that is organic production is still dominantly the purview of innovators and early adopters. It would be instructive, therefore, to identify and analyze those key demographic and behavioral variables that differentiate these innovators and early adopters from their peers who have not yet adopted organic production methods.

A study by Maredia and Minde (2002), which explored the relationship between profitability of agricultural technologies and its adoption by farmers in Eastern Africa, identified three groups of technologies: First, some profitable technologies were widely adopted, such as improved cassava varieties in Uganda and improved coffee varieties in Kenya. Second, some technologies were profitable under researcher-controlled environments, including technologies that were not as fully adopted as expected, and/or had been restricted to on-farm demonstration plots (for example, wheat variety and hybrid maize in Ethiopia and the application of inorganic fertilizer on maize in Kenya). Third, some technologies were unprofitable under specific circumstances, such as animal draught power technology for weed control when applied on farms that are less than two hectares.

In these studies, profitability was estimated using partial budget analysis, gross margin analysis, net present values, and value cost ratios. Furthermore, the authors drew two major conclusions: i) the productivity gap in Africa was heavily determined by non-technological constraints such as infrastructure, policies, input/output markets, and adverse climatic conditions, which reduced profitability and adoption of new

technologies, and ii) there was a need for continuous efforts to supply technologies that are adapted to the prevailing environmental conditions in order to make them profitable for farmers.

A study of the key factors associated with the adoption of hybrid maize in Latin America and the Caribbean region by Kosarek *et al.* (2001), reported that farmers' decision to adopt hybrid maize was determined by the expected returns of the technology, the availability of hybrid seed, and risks associated with uncertainty regarding the expected outcomes of the new technology. Moreover, they found that the structure of the seed market, the organization of the seed industry, and the cost of technology generation and development were key determinants of the profitability of supplying hybrid maize seed. One of the major conclusions of this study was that public research plays a vital role in insuring that the needs of small-scale and subsistence oriented farmers are met in zones where the welfare of the population is entirely dependent on maize production. Foster and Rosezweig (1995) found that the farmer's own experience and that of the neighbour with the high yielding varieties (HYVs) significantly influenced adoption.

Exploring the key determinants of the adoption of technologies by farmers growing upland rice and soybeans in Central-West Brazil, Strauss *et al.*, (1991), reported that farmer adoption of technology is an economic decision based upon discounted expected marginal benefits and costs. Furthermore, the major findings of this study included: farmer's education level contributed positively to the probability of soybean farmers performing soil sample analysis to determine the quantity of fertilizer that they should

apply on their rice fields; and time of residence in the region was positively related to rice growers' adoption of blast control and to the probability of adopting certain planting techniques for soybeans. Similarly, a study by Rahm and Huffman (1984) designed to evaluate the role of human capital and factors that affected the adoption of reduced tillage in corn production, found that farmers' education and experience play a crucial role in enhancing the efficiency of the adoption decision. Moreover, they concluded that the probability of a farmer adopting reduced tillage practices was strongly depended on soil characteristics, the cropping systems, and farm size.

Various studies have reported that risk aversion is likely to be negatively associated with adoption. For any level of farmer's risk aversion, the likelihood of technology adoption is positively correlated with the availability and accuracy of information about the performance of the specific new technology (Feder and Slade, 1984; Feder, 1982; Feder *et al.*, 1985; and Kristjanson, 1987). Besley and Case (1993) used a model of learning where profitability of adopting the new technology is uncertain and exogenous. Looking at a village in India, they found that farmer's adoption behaviour changed significantly once they discovered the true profits of adopting the new technology.

Recent studies conducted in Eastern Africa, designed to better understand key determinants of farm-level technology adoption, revealed that the major reasons for technology non-adoption were: farmer's unawareness of the improved technologies or lack of information regarding potential benefits accruing from them; the unavailability of improved technologies; and unprofitable technologies, given the farmer's agro ecological

conditions and the complex set of constraints faced by farmers in allocating land and labor resources across farm and off-farm activities (Doss, 2003). Ghadim *et.al*, (2005) found financial performance, scale of relevance, risks perception, information from training on each of the technology components statistically significant in explaining the adoption behaviour.

In recognition of two decades of on-going market reforms in Sub-Saharan Africa, Kelly *et al.*, (2003) suggested the need to assess the profitability of input use and potential explanations of non-profitability before drawing any conclusion regarding market failure or the limited impact of government intervention, such as input distribution programs oriented towards smallholders. Profitability studies carried out in Mozambique and Ethiopia revealed that after adjusting for the effects of market distortions (i.e., taxes, subsidies and currency overvaluation), application of fertilizers on cereals was unprofitable, given existing input and output marketing costs. Notwithstanding the limited availability of empirical data on the potential role played by farmer associations in absorbing some of the transaction's costs of input procurement, Kelly *et al.*, (2003) reported that farmer associations in the irrigated rice zone of Mali had reduced costs for their members by using transparent bidding procedures for sourcing inputs and by securing bank loans to guarantee timely repayment to suppliers.

A study by Adesina and Sanders (1991) designed to evaluate the adoption and farm-level effects of cereal technologies in Niger documented the ability of peasant farmers to adapt their cropping strategies to the low and erratic rainfall patterns by: (i) growing a mix of

varieties with different maturity lengths; and (ii) making appropriate and sequential decisions based on rainfall expectations, such as applying several different planting densities, planting in different dates, and/or applying fertilizers when the rains are early. They concluded that, in general, small farmers in Sub-Saharan Africa (SSA) were more likely to adopt labor intensive technologies, as they used relatively more family labor, which had a low opportunity cost. Furthermore, Kristjanson (1987) using an econometric model to determine the relationship between rainfall variables and crop yields, found similar farmer behavior in Burkina Faso. A study designed to estimate the effect of key exogenous socio-economic characteristics on the adoption of animal traction technology in Maseru, Lesotho showed that while two-thirds of female farmers adopted animal traction, only a low percentage of male farmers did so (Mbata, 2001).

Smallholder agriculture in much of the low-income tropics is nonetheless characterized by widespread failure to make sufficient soil fertility replenishment and soil conservation investments in order to sustain the quality of farmland (Sanchez *et al.*, 2001; Reardon *et al.*, 2001; Barrett *et al.*, 2002 and World Bank, 2003). A substantial literature based on cross-sectional analysis has explored the adoption of organic farming in order to understand the failure to adopt (Green, 2002; Fernandez-Cornejo *et al.*, 1998; Halweil, 2001; Harper, 1990; Klonsky, 2000; Schulze *et al.*, 1994; Burton *et al.*, 1999; Drake *et al.*, 1999; Kirner and Schneeberger, 2000; Schneeberger and Kirner, 2001; Schneider, 2001; Hollenberg *et al.*, 1999; and Schneeberger *et al.*, 2002). But there has been little accompanying exploration of the reasons for disadoption (i.e. abandonment after

experimentation of these techniques). Since organic farming requires ongoing practice, it is essential to understand both initial adoption and continued application of the methods.

Feder *et al.*, (1985) argued that off-farm income might affect adoption by providing a source of cash flow to buffer the risk associated with the introduction of new crop management practices. Moreover, the existence of effective extension services, adequate provision of inputs, timely credit availability, transportation, distance to the nearest market and functional marketing channels are of paramount importance to foster the adoption of new technologies (Feder *et al.*, 1985, Mbata, 2001; Abdulai and Huffman, 2005; Rauniyar and Goode, 1992).

Rauniyar and Goode (1992) found that market access and population density are significant in explaining adoption patterns for the improved dual multi-purpose cowpeas in the dry savannas of Nigeria. Conley and Udry (2000) found that learning costs associated with the new technologies significantly determines both the adoption rate and the depth of use of the new technologies. The existence of learning implies that the values of outputs to which these technologies are applied are also significant in determining the adoption behavior. Conley and Udry (2000) found that the new technology adoption depends on social learning. Farmers were found to have relied significantly on their neighbor's farms output due to the earlier adoptions to make their adoption decisions.

The use of longitudinal data to study dynamic patterns of organic farming practice adoption is novel in the broader literature. Papers on adoption (for example, Phiri *et al.*,

2003; Sheikh *et al.*, 2003; Franzel *et al.*, 2001; Pfister *et al.* 2005), focused on various socioeconomic factors that affect adoption using longitudinal data in their work. Pfister *et al.* (2005) focused on interseasonal labor constraints that curtailed the adoption of resource management practices. White and Laberta (2004) focused on measurement of the true opportunity cost of labor as a more accurate reflection of the labor constraints that face farmers in the adoption of technologies among resource-poor farmers. Sheikh *et al.* (2003) emphasized the importance of resource endowment variables compared to personal characteristics in shaping the adoption of 'no-tillage' technologies. Phiri *et al.*, (2003) find that land constraints reflected in the opportunity costs of land loom large in the adoption of tree fallows.

Okwell (1991) found that farmers in the semi-arid areas of eastern Kenya did not adopt a complete package of a new technology but components. The components which were non-cash using had the best adoption rate followed low-risk cash using components. The high-risk cash using components had the least adoption rate, indicating that the availability of cash and risks averse behaviour of farmers were significant in predicting adoption behaviour of a new technology package. The cost of the new technology, costs associated with adoption, availability of the technology and profit, influence the adoption of precision farming practices (Hannington *et al.*, 2003; Micheal, 2001).

Asambu (1993), using the logit model and other statistical techniques to study the adoption of HYV maize seeds in Eastern province in Kenya, found that extension contacts, availability of inputs and incomes were significant to decision making in new

technology adoption. Ongaro (1988) used Tobit model to analyze the adoptions of HYV maize seeds in Kisii and Nandi districts in western part of Kenya. The study found that access to extension contacts, perception of risk and uncertainty had a significant effect in the adoption of the HYV seeds. Formal education and farmers' level of technical skills also influenced adoption.

Nyangena (2004) used a learning model incorporating social capital as a fixed input to investigate the effect of social capital on adoption of soil and water conservation technologies in Machakos districts. The results indicated that trust, group activities and past adoption learning effects from other farmers significantly influenced the adoption behaviour.

Gamba and Mghenyi (2004) revealed that wheat farming experience and educational attainment enhanced the adoption of new wheat varieties. Other factors like agro ecological zones, gender, manure use, hiring of labour, and extension were statistically significant in explaining adoption of improved maize variety (Ouma *et.al*, 2002; Matiri *et.al*, 1996; Murithi *et.al*, 1994).

2.4 Overview of the Literature

Studies have identified many socioeconomic and policy related factors that affect farmers' technology adoption decisions, including access to farm labour, farm machinery, storage and distribution facilities, inputs and output markets, credit availability, farm size, level of education, land tenure, profitability of technology, farmer's awareness of existing

technologies, and government policies. However, the effects of these explanatory variables and interactions among them on farmer's technology adoption varies from region to region. Thus, extrapolation of results from one farming system to a completely different one should be avoided. Rather, country-specific studies need to be carried out to understand factors associated with farmer adoption of a specific technology in a specific location. Although, substantial studies have explored the adoption of agricultural technologies in order to understand the failure to adopt, there has been little accompanying exploration of the reasons for disadoption.

This study attempted to improve upon these past studies by assessing the factors influencing adoption and disadoption of organic farming, which has not been done before in Kenya. No known study has been done on Meru-South to show why there is slow adoption of organic farming

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the theoretical and empirical model used to analyze farmers' adoption decision and describes the sampling approach and data collection methods used in this study.

3.2 Theoretical Model

This study used the logit model to evaluate factors associated with adoption of organic farming following the study of Rahm and Huffman (1984). The probability that a farmer will adopt a new technology is expressed as a function of:

$$P(Y = 1) = F(\mathbf{X}\beta) \quad (1)$$

Using the logit model, the probability of an individual household (farmer) adopting a new technology t_2 , given a well-defined set of socio-economic and physical characteristics (X), is represented as:

$$P(t_2 | X) = 1 / [1 + \exp -(\mathbf{X}\beta + \mu)] \text{ Cumulative logistic distribution}$$

Likewise, the probability of not adopting the new technology t_2 (continuing with technology t_1) is given by:

$$\begin{aligned} P(t_1 | X) &= 1 - P(t_2 | X) = 1 - \{1 / [1 + \exp -(\mathbf{X}\beta + \mu)]\} \\ &= \exp -(\mathbf{X}\beta + \mu) / [1 + \exp -(\mathbf{X}\beta + \mu)] \end{aligned} \quad (2)$$

The relative odds of adopting versus not adopting a new technology are given by

$$\begin{aligned} P(t_2 | X) / P(t_1 | X) &= \{1 + \exp -(\mathbf{X}\beta + \mu)\} / [\exp -(\mathbf{X}\beta + \mu)] [1 + \exp -(\mathbf{X}\beta + \mu)] \\ &= \exp (\mathbf{X}\beta + \mu) \end{aligned} \quad (3)$$

$$\text{Taking natural logarithms of equation (3): } \ln [P(t_2 | X) / P(t_1 | X)] = \mathbf{X}\beta + \mu \quad (4)$$

$$L_i = X \beta + \mu \quad (5)$$

This is the Logit model. L_i , the logit is the logarithm of the odds ratio, and is linear in X . The logit was the dependent variable and is the logarithm of the odds that a particular choice will be made.

3.3 Model Specification

Generally, adoption studies consider many factors to explain farmers' adoption decisions. It was hypothesized that a farmer's decision to use or not to use a given technology is influenced by the characteristics of the household head (gender, age, and formal education), farm size, Land tenure, use of credit, extension advice, labour, off-farm income and farmer group membership. Data gathered regarding household farming practice was used to define three categories of farmers: Adopter, disadopter and Non-adopter.

The empirical model for estimating key determinants of organic farming adoption was specified as follows:

$$L_i = \beta_0 + \beta_1 X_{1i} + \beta_{2E1} X_{2E1i} + \beta_{2E2} X_{2E2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \beta_8 X_{8i} + \beta_9 X_{9i} + \beta_{10} X_{10i} + \beta_{11} X_{11i} + \beta_{12} X_{12i} + \beta_{13} X_{13i} + \beta_{14} X_{14i} + \beta_{15} X_{15i} + \beta_{16} X_{16i} + \epsilon_i$$

Where:

L_i = logarithm of the odds ratio i.e. $\ln(P_i/1 - P_i)$

$i = 1, 2, 3 \dots \dots \dots n$ are individuals

X_{mi} = the m th explanatory variable for the i th individual

$m = 0, 1, 2, \dots$, Where $m < n$

β_m = an unknown parameter; $m = 0, 1, \dots, m$

ε_i = error term

The explanatory and dependent variables used in the econometric model are defined in the next section.

3.4 Operational Definition and Measure of the Variables

Age of the household head (X_1): is measured in years. It was hypothesized that younger farmers may have greater access to information because they have greater access to education, and thus will be more aware of technologies.

Level of formal education of the household head: A higher level of education increases a farmer's ability to obtain, process, and use adoption information and improved technologies. Education thus increases the probability of adopting technology. Measured as two dummies i.e.

Maximum of primary formal education (X_2): Dummy variable, =1 if household head had at least but no more than primary level of education, = 0 otherwise.

Minimum of secondary education (X_3): Dummy variable, =1 if household head had secondary level (or higher) of formal education, = 0 otherwise.

Land Tenure system (X_4): This is the type of land ownership. Owners may perceive greater long-run gains from adoption. It was measured as a dummy, = 1 if owner of the farm (have security of tenure), and 0 otherwise.

Sex of the household head (X_5): A Dummy =1 if female, and 0 otherwise since food

production is dominated by women it was hypothesized that women are more likely to adopt organic farming practices than men.

Farming experience (X₆): The years the household head has been farming his/her own plot. Farmers with long experience in conventional farming may resist new approaches.

Profession of the household head (X₇): dummy variable = 1 if fulltime farmer, and 0 otherwise.

Awareness (X₈): This took a dummy variable (1= if the farmer is aware of organic farming, 0 otherwise).

Prior Training (X₉): This is prior training in organic farming practices. Measured as the number of days (duration) one was trained.

Household size (X₁₀): Number of adults resident in household. It was hypothesized that a larger household is likely to adopt organic farming due to high family labour availability.

Farm size (X₁₁): Farm size (Acres) was an indicator of wealth (and perhaps a proxy for social status and influence within a community) and expected to be positively associated with the decision to adopt agricultural technologies..

Contact with extension agent (X₁₂): Agricultural extension services are a major source of information in the study area and contact with extension agents increases a farmer's likelihood of adopting improved maize technologies. This was measured as number of times an extension officer visited the farmer during the past two year

Credit (X₁₃): Access to credit increases the probability of adopting improved maize technologies. This was measured as amount of money received.

Membership in an organization (X₁₄): Members of organizations (farmer groups, non-governmental organizations (NGOs)) have better access to information on improved maize technologies. Being a member of an organization was hypothesized to be positively associated with adoption of organic farming practices. This was a dummy variable (1=farmer is a member, 0 otherwise).

Non-farm income (X₁₅): Monthly average non-seasonal income from non-agricultural formal and informal employment, in Kenya shillings per month.

Livestock ownership (X₁₆): proxy for wealth. Wealthier farmers have greater access to resources and may be more able to assume risk (Doss, 2003). Measured as number of cows in a household.

Agro ecological Zones (X₁₇): Measured as dummy variable (1= highland areas, 0 otherwise).

3.5 Meru South District Profile.

The study was conducted in Meru South District, which is one of the thirteen (13) Districts in Eastern Province. The total area of the district is 1,092.9 KM², including 360 KM² of Mount Kenya Forest with a population size of 212,982 persons (Republic of Kenya, 2002). The district is divided into two Agro-ecological Zones i.e. the highland areas with temperatures ranging between 14⁰c to 17⁰c and lowland areas with temperatures ranging between 22⁰c to 27⁰c (Republic of Kenya, 2002). It is also divided

into five administrative Divisions Chuka, Igambang'ombe, Magumoni, Muthambi and Mwimbi.

The District is characterized by complex farming systems dominated by perennial cash crops, food crops and livestock (Micheni *et al.*, 1999). The area is in the main Coffee/Dairy/Maize Land Use Systems with an altitudes ranging from 5,200M at the peak of Mount Kenya, to the hot and dry low lands of Igambang'ombe at 400m above sea level, with several ridges and hills. The annual mean temperature of the area is 20⁰ C with an annual rainfall varying from 2200 to 500mm (Republic of Kenya, 2002; Jaetzold and Schemindt, 1983). The rainfall bimodal fall into two seasons; long rains lasting from March through June, and short rains from October through December.

Maize is a major food crop and dominates all national food security considerations in Kenya. Meru South District provides a very interesting case study where organic farming is showing some success with maize as the main food crop.

3.6 Sampling Technique and Sample size.

This study used multi-stage sampling procedure to select a sample of 119 households. First, Meru-South district was selected due to its fair success in organic farming practices. Second, two divisions Chuka and Magumoni Division were randomly selected from a total of five Divisions. A stratified sub-sample of 60 households comprising of 28 adopters and 32 non-adopters was purposively selected from Chuka Division and another sample of 59 households comprising of 28 adopters and 31 non-adopters was purposively selected from Magumoni division to form a total sample size of 119, which is large

enough to ensure accurate parameter estimates and to allow the data to be generalized to higher levels of aggregation (see table 1 in appendix A1).

3.7 Data type and source

This study used primary data collected directly from the identified household heads from a survey conducted in last year. Relevant secondary data was collected from the NGOs that promote Organic farming in the Region. A Pilot survey was conducted before data collection to pre-test the research instruments used in this study.

3.8 Data Collection Techniques

An interview schedule (see Appendix A2) with structured questions was used to collect data from the identified household heads by means of face to face interviews. Only the household heads were interviewed as it was assumed that they are key in household decision making. In addition the officials of the relevant NGOs promoting organic farming in Meru South were interviewed. Observation method was also used to collect supplementary data on farm practices and operation.

3.9 Data Analysis

The data collected was cleaned, refined, edited and coded before being analyzed using econometric software Statistical Program for Social Scientist (SPSS). Both descriptive statistics and regression results are presented.

CHAPTER FOUR EMPIRICAL FINDINGS

4.1 Introduction

This chapter presents descriptive statistics, regression results and discussion of the results.

4.2 Descriptive Statistics

(a) Socio-economic Characteristics

One of the objectives of this study was to identify and assess socioeconomic factors influencing adoption of organic farming by small scale maize farmers. In order to realize this objective various socio-economic characteristics of small-scale farmers were assessed and are presented below.

Education level, Age and Gender

Results for Educational level, age, and gender are as follows:

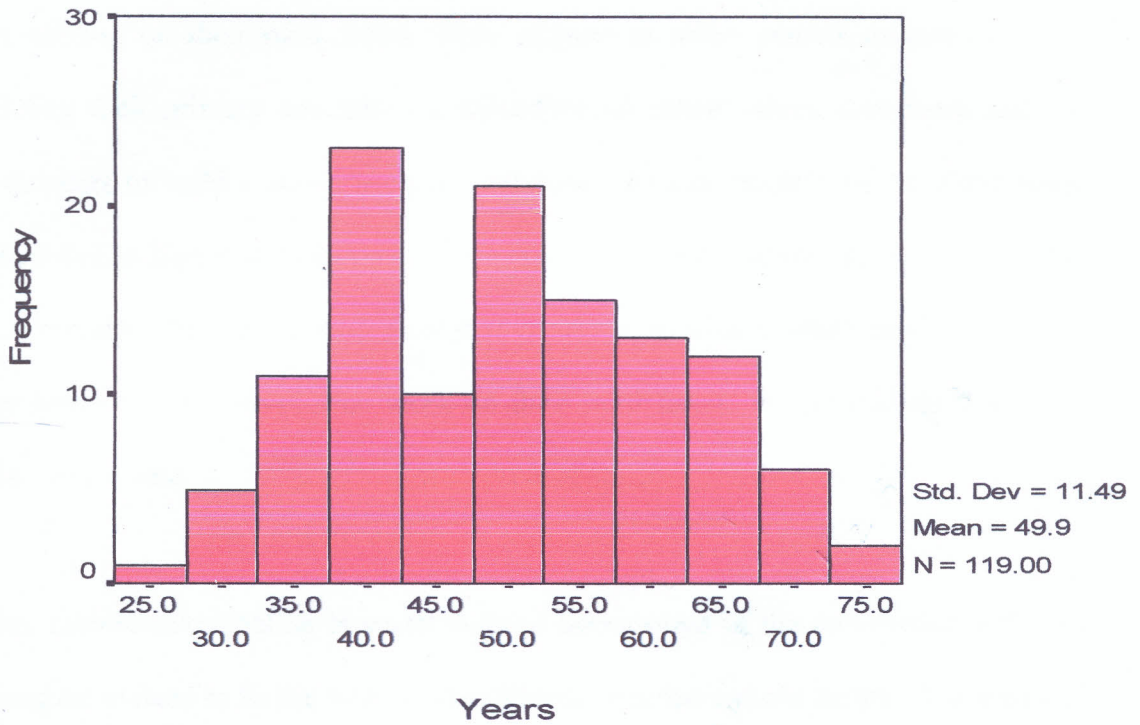
Table: 4.1 Education levels of the household head

	Frequency	Percent	Valid Percent	Cumulative Percent
None	4	3.4	3.4	3.4
Primary	67	56.3	56.3	59.7
Secondary	29	24.4	24.4	84.0
Post-secondary	19	16.0	16.0	100.0
Total	119	100.0	100.0	

Source: Survey 2007

54.3 percent of the respondents had primary education, 24.4 percent had at least secondary education, while 16 percent had post secondary education, and 3.4 percent were illiterate.

Figure 4.1: Respondents' age distribution



Source: Constructed from the Survey data, 2007

The average age of respondents was 49.9 years old, 37.8 percent were between 26 and 45 years old, 52.9 percent were between 46 and 65 years of age, and only 9 percent were over 66 years of age.

Table: 4.2 Sex of the farmer

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	77	64.7	64.7	64.7
Male	42	35.3	35.3	100.0
Total	119	100.0	100.0	

Source: Survey 2007

In terms of sex, of the 119 interviewed respondents, 77 were female (64.7percent). (see table 4.2 above). Only 14 or 18.18 percent of these female reported that they were household heads (either widowed or single mothers).

One explanation for this trend is that many young people prefer to establish themselves before settling on their rural farms. They migrate to urban centers as early as after completing their primary education or secondary education, where they work and use their earnings to build a house in their rural home. This is exacerbated by diminishing land size due to high population such that many would first buy land on which they can settle. Even after they get married, most men continue working in urban centers and remit money home to their wives who work on their rural farms. Others had their spouses working elsewhere.

Another possible explanation is the social cultural background of the community. Farming activities are viewed to be the work of the illiterate, women and old people. The men and the youth engage in other activities and others spend most of their time idling at the trading centers.

Household size defined as the total number of people living in the household at least nine (9) months per year averaged 4.1 (ranging from 1 to 9). Only 35.3 percent of respondents engaged in off-farm activities in 2006. It is important to note that this variable can also be used as an institutional factor to assess access to labour markets. The argument is that, where labour markets do not function effectively, households should supply their own labour for farm activities.

Apparently, in the study area, land tenure is not a major constraint. Over 77 percent of the respondents owned land title deed while others cultivated family owned land or rented

land. On average, household cultivated two (2) acres of land (see table 4.12). All of the respondents prepared their land manually using hand tools and engaged their children on farm activities. One of the major constraints farmers reported was a lack of draft-power for land preparation.

These descriptive statistics indicated that if smallholders' propensity to practice organic farming depends in large measure on farm size and household size, this would not seem to bode well for the future of spontaneous uptake of this technology.

(b) Institutional Factors

The second objective of this study was to investigate institutional factors influencing adoption of organic farming. Descriptive statistics of the institutional factors assessed are presented in this subsection.

Taking into account the importance of technical knowledge as a key determinant of technology adoption, questions were included in the questionnaire to determine the frequency, source and type of technical assistance that farmers had received during the last two year, with respect to organic farming. First, the respondents were asked whether they were aware of organic farming technology and who provided that information. The following table shows the responses.

Table 4.3: Awareness of technology

	Frequency	percent
Aware	101	84.9
Not aware	18	15.1

Source: Survey 2007

84.9 percent of the surveyed farmers were aware of organic farming techniques. Only 18 respondents which is 15.1 percent were not aware of organic farming despite its existence in the study area for more than five years. Source of information include media (Radio) 3.4 percent, field day and demonstration by NGOs 67.2 percent, early adopters 28 percent and public *Baraza* 7.6 percent. Ministry of Agriculture officials were biased to green revolution which made it difficult for farmers to convert to organic farming.

Secondly, they were asked whether they had participated in field days and/or on-farm demonstration events and to name the institution (s) that organized or funded those awareness activities (see table 4.4 below).

Table 4.4: Results of the Participation in field day or on-farm demonstration

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	32	26.9	26.9	26.9
yes	87	73.1	73.1	100.0
Total	119	100.0	100.0	

Source: Survey 2007

Approximately 73 percent of the respondents reported having participated in a field day and/ or off-farm demonstration event organized by NGOs 63.7 percent and Ministry of Agriculture (MOA) 21.3 percent.

Lastly, the respondents were asked how often any technician from public or NGO extension services had visited them during the last two years and what type of technological message was delivered (see tables 4.5).

Table 4.5: Number of times an extension officer visited the farmer

No. of times	Frequency	Percent	Valid Percent	Cumulative Percent
.00	60	50.4	50.4	50.4
1.00	37	31.1	31.1	81.5
2.00	20	16.8	16.8	98.3
3.00	2	1.7	1.7	100.0
Total	119	100.0	100.0	

Source: Survey 2007

Regarding the number of times extension officer visited farmers during the last two years, 50.4 percent were never visited, 31.1 percent reported having been visited once, while 16.8 percent received two visits and 1.7 received three visits table.

In recent years, development literature has highlighted the role of social capital in facilitating the exchange of information among farmers (Huysman, *et al.*, 2004). Considering farmers associations as a proxy for social capital, respondents were asked whether they and /or their spouses were members of any kind of farmer associations and to what extent they had benefited from membership. Table 4.6 below summarizes the answers to above question.

Table: 4.6 Memberships of Farmer Association(s)

A member	Frequency	Percent	Valid Percent	Cumulative Percent
No	41	34.5	34.5	34.5
Yes	78	65.5	65.5	100.0
Total	119	100.0	100.0	

Source: Survey 2007

Only 65.5 percent of the respondents were members of a farmer association. These farmers and/or their spouses belonged to seven different farmer associations in this study area. All the farmers associations were directly or indirectly supported by NGOs, through

Community Based Organization (CBOs), which assisted farmers by providing inputs and technical assistance or sponsored food-for-work projects. Five out of seven farmer associations mentioned were primarily engaged in food crop production, while two promoted animal husbandry on a rotational basis (the beneficiary of distributed cow/goat is obliged to give one calf to other member of the farmer association)

Respondents who were members of a Farmer Association identified the following benefits from their membership; access market for organic produces (42.1 percent), Agricultural products derived from collective production for household consumption (18.3 percent), access to farm inputs that are collectively owned such as animal traction for land preparation (20.7 percent), access to animals on a rotational basis 11 percent, and Access to credit (group lending) 7 percent.

It is clear that only half of the farmers were served by a Farmers Association. The sustainability of these Farmer Associations was questionable, since continued provision of NGO-supported technical assistance and inputs depends on continued access to funds from the international development community. Other bottlenecks threatening the functions and sustainability of these farmer associations include; the absence of crop marketing system and the non-availability of credit opportunities for farmers.

4.3 Reasons for disadoption.

The third objective of this study was to explore reasons for disadoption of organic farming. Farmers were first asked whether they had ever practiced organic farming on

their farm. Those who had done so were required to answer a filter question. The results of these questions are summarized in table 4.7 below.

Table 4.7: Disadoption

		Have you had atleast practiced organic farming in you farm?		Total
		No	Yes	
Are you currently practicing organic farming in your farm	No	38	25	63
	Yes		56	56
	Total	38	81	119

Source: Survey 2007

Out of 63 non-adopters/conventional farmers interviewed, 25 farmers had practiced /tried organic farming in their plots in the past. It is also true to say that 81 farmers out of 119 surveyed had atleast practiced organic farming but 25 of them stopped practicing.

Reasons for disadoption are shown in table 4.8 below.

Table 4.8: Farmers reasons for disadoption

Reason	Frequency	Percent
Labour intensive and time consuming	16	64
Expensive and time-consuming certification procedure	10	40
Uncertain about the market/price for organic products	10	40
Reduced output	4	16
Lack of Calliandra calothyrsus, Tithonia diversifolia	3	12
Insufficient fund to hire labour.	2	8

Source: Survey 2007

64 percent of the disadopters attributed their disadoption to labour and time spent on organic farming practices, 40 percent attributed it to expensive and time consuming certification procedures, 40 percent to uncertainty about the price and market for organic products, 16 percent to reduced output (yield) and income in short run particularly immediately after conversion. This is because of reduced synthetic inputs and also at this

early stage of adoption, a farmer is not yet certified as an organic farmer thus, he/she does not earn any premium over the conventional farmers as he/she has to sell his/her organic products as conventional products; and 12 percent attributed it to lack of Calliandra and Tithonia to provide green manure. These findings raise important questions as to whether organic farming and related techniques are really affordable to smallholders.

Among the surveyed organic farmers that is 56 farmers (currently practicing organic farming techniques), reported techniques include stover (30%) of the sample, trash (41%), farm composite (70%) and manure (86%).

Table 4.9: Organic farming techniques used

Technique	Frequency	percentage
Stover	17	30%
Trash	23	41%
Farm Composite	39	70%
Manure	48	86%

Source: Survey 2007

Manure and farm composite were mostly used techniques with 86 percent and 70 percent respectively, while trash scored 41 percent and stover 30 percent (may be due to scarcity of *Calliandra and Tithonia*).

The adopters were also asked what motivated them to adopt the organic farming techniques on their farms in order to gain insight on whether their expectations were being made. The results of the answers to above question are summarizes in table 4.10 in the next page.

Table 4.10: Primary motivating factors to adoption

Factor	Percent
High price/ increased income is an important reason for conversion	69.1
Recommendation by NGOs officials	58.9
Organic farming is environmental friendly	58.9
Improved health	49.0
High yields	41.3
Less expensive/cost savings from reduced synthetic chemical inputs use	33.7

Source: Survey data 2007

The adopters attributed their adoption of organic farming to, increased income because of high price (69.1 percent), NGO's recommendations 58.9 percent, environmental friendly (58.9 percent), improved health (49 percent) and less expensive/cost-savings from reduced synthetic chemical use (33.7 percent).

Some of the constraints cited by the adopters included; expensive and time consuming certification procedure, unstable market for organic product (For example, over 50 percent of the organic farmers reported that they had sold their products as conventional products) and lack of knowledge (see table 2 in appendix A1). Conventional farmers reported the same reasons as for why they have not converted to organic farming.

4.4 Econometric Results

Two diagnostics were carried out to test for multicollinearity. First, the correlation matrix (table 8 in Appendix A1) that showed that explanatory variables were not highly correlated. Secondly, Variance inflation factor (VIF) and tolerance statistics (1/VIF). As Menard (1995) suggested, a tolerance value of less than 0.1 almost certainly indicates serious collinearity problems, and for these data the values were greater than 0.1 for all

variables, therefore no serious multicollinearity. Myers (1990) also suggested that a VIF value greater than 10 is cause for concern. In this study the values were less than 10 for all variables (see table 4.11) below.

Table: 4.11 Collinearity diagnostics for adoption data Coefficients (a)

Model 1	Collinearity Statistics	
	Tolerance	VIF
Age	.289	3.458
Primary education	.127	7.883
Secondary education	.110	9.058
Land - tenure	.575	1.738
Sex	.766	1.306
Experience	.324	3.090
Occupation	.665	1.504
Awareness	.442	2.262
Prior training	.644	1.552
Household size	.495	2.020
Farm size	.439	2.276
Extension	.467	2.141
Access to credit	.680	1.470
Membership to any Farmer Association	.552	1.812
Off-farm income	.612	1.635
Livestock (cows)	.505	1.981
Ecological--zones	.305	3.278

Source: Survey 2007

Thus, it seems from these values that there is no serious multicollinearity problem.

4.3.2 Results of the logit model.

Based on the logit procedures, the maximum likelihood parameter estimates for the unrestricted model were computed (See table 7 in Appendix A1). First, the coefficients (β_i) of the explanatory variables in full (unrestricted) model were examined and assessed with respect to a priori expectations of the signs (according to adoption of technology theory) and the statistical significance of the coefficients. Second, a restricted model (Table 4.12 below) was estimated.

Table: 4.12 Maximum Likelihood Estimates of the Restricted Model

	β	t	Wald	df	Sig.	Exp(β)	95.0% C.I. for EXP(β)	
							Lower	Upper
Household head sex	1.625	1.395	1.945	1	.163	5.076	.518	49.768
Experience	-.067*	-.1.97	3.847	1	.050	.936	.875	1.000
Awareness	2.468*	1.732	2.999	1	.083	.085	.005	1.384
Household size	.709**	3.004	9.048	1	.003	2.032	1.280	3.224
Farm Size	.905**	2.678	7.149	1	.008	2.472	1.273	4.798
Extension	.682	1.287	1.659	1	.198	1.978	.701	5.584
Credit	.910	1.164	1.357	1	.244	2.485	.537	11.500
Membership	3.389**	3.579	12.796	1	.000	29.624	4.627	189.652
Off-farm	.874	1.269	1.609	1	.205	2.396	.621	9.247
Eco-zones	2.809**	2.570	6.598	1	.010	16.590	1.946	141.452
Constant	-9.896	4.149	17.218	1	.000	.000		

-2Log-likelihood = 76.1; $R^2 = .54$ (Hosmer & Lemeshow), .53 (Cox & Snell), .70 (Nagelkerke); Likelihood Ratio test $\chi^2(17) = 88.5$; * *Significant at 1%; * Significant at 5%.

Source: Survey 2007

The restricted model presented above excluded six variables from the full model, which had signs inconsistent with adoption theory and/or were not jointly significant likely due to the absence of variability among the respondents, including age, education, occupation of the household head, prior training, land tenure and livestock (cows) ownership.

In order to check whether the coefficients of the excluded explanatory variables were indeed zero a subsequent likelihood ratio statistic was computed. This likelihood ratio statistic had an asymptotic chi-square distribution with degrees of freedom equal to the number of restrictions being tested (Wooldridge, 2003). The test indicated that the restricted model performance was similar to the full (unrestricted) model.

Estimation results above (table 4.12) confirm prior expectations. All variables had the expected signs, and six variables were highly significant at 5 percent level of

significance. When farmers adopt organic farming techniques, the resulting improvements in productivity affects household welfare such as improved income and health, ability to educate children and invest on livestock and land assets. It is therefore possible that some household variables such as livestock and farm size are endogenous in this regression model. Large farm sizes, for example, may be an effect of adoption, not a cause. Therefore, readers are cautioned that the appropriate interpretation of these results is one of statistical association (correlation) between current technology use and the characteristics and not necessarily structural causality.

4.3.3 Discussion of Results

(a) Farm size, land tenure system and off-farm income

The probability of adopting organic farming practices was positively and statistically significantly influenced by the total farm size cultivated by a household. This may signal that these practices are not strictly scale neutral or, more likely, that the unobserved constraints and shadow prices facing households vary systematically with farm size. Farmers do perceive greater scale economies in organic farming than in conventional maize production. These results are consistent with those of Marenya and Barrett (2004) and Place *et al.* (2002).

Farm size can also be a proxy for wealth and social status. Thus, wealthier farmers are more likely to adopt organic farming techniques. Land ownership (see table 7 in appendix A1) though statistically insignificant, it had a positive sign indicating that it is highly unlikely that tenant farmers would invest the necessary labour without some guarantee of

access to the land in later years when the benefits of organic farming are attainable. Its insignificant implies that land ownership is not a constraint since almost all farmers own land title deed or cultivated family owned land but the existence of unsolved land tenure problems inhibits investment in soil fertility.

Off-farm activities had a positive sign though insignificant. This result was consistent with those of Feder *et al.* (1985). Non-farm income from informal and formal non-agricultural employment is quite important in fostering adopting of organic farming practices in that cash is essential to hire labour. Low income level hinders people from taking risks i.e. to access a new farming management system such as organic farming. At present productivity level and production scales, the population density and small farm system of Meru-South District might not be generating sufficient investible surplus to remain self-sustaining in the absence of non-farm income to invest in sustainable agricultural intensification.

The overall impression seems to confirm Shepherd and Soule's (1998) simulation results suggesting that wealthier farmers appear willing and able to invest in soil fertility such that they operate in a reasonably homeostatic system, while their poorer neighbours fail to make such investments, suffering soil fertility declines that further erode their wealth and reduce their propensity to undertake organic farming investments, in a vicious spiral of resource degradation and immiserization. The existence of these parallel systems suggests the presence of multiple dynamic equilibria, or resource degradation poverty traps, that merit further intensive investigation.

(b) Household labour availability (Family size)

The number of people who live in the household for at least nine months was statistically significant and positively associated with the adoption of organic farming. Phiri *et al.* (2003) and Pfister *et al.* (2005) reported the same results. Farmers who had little family labour available, a frequent situation among women farmers, were unlikely to adopt organic farming. This seem to reflect the important role that availability of family labour plays in the adoption of organic farming techniques. Family labour assumes greater importance given that low incomes constrain financial liquidity for hiring wage labourers, and given possible moral hazard problems associated with non-family labour calling for considerable supervision.

These problems raise the real cost of hired workers beyond the observed wage rate. Given that the bulk of labour for most farm operations in the study area is provided by the family rather than hired labour, lack of adequate family labour accompanied by inability to hire labour can seriously constrain adoption of organic farming.

Use of family labour could also imply rigidities in the labour market in that that when the wages are too expensive or labour scarce farmers may resort to use family labour. This raises questions about the access to labour market by the farmers since family labour is not sustainable and cannot be relied upon. Also interseasonal labour constraints hinder adoption.

© Gender, Age and Experience of Household Head

The sex of household head, though statistically insignificant, was positively associated with probability for adoption of organic farming. Same results were found by Mbata (2001) who found that while two-thirds of female farmers adopted animal traction, only a low percentage of male farmers did so.

The positive sign indicated that women were more likely to adopt organic farming. Women have fewer opportunities for earning off-farm cash incomes, making them less able than men to afford fertilizers and other synthetic chemicals. For more labour intensive practices such as stover lines, trash and composite manure, women fare better, perhaps due to superior social capacity to mobilize family or other reciprocal labour.

The experience of household head was statistically significant for adoption of organic farming and had a negative sign. The age of the household head though statistically insignificant had a negative sign. Since age and experience were correlated, (.736 see table 8 in appendix A1) age was excluded in the restricted model. Same results were found by Foster and Rosezweig (1995) who reported that the farmers's own experience and that of the neighbour with the high yielding varieties (HYVs) significantly influenced their adoption. Huffman (1984) also found that farmers' education and experience play a crucial role in enhancing the efficiency of the adoption decision.

The negative coefficient indicated that older farmers are less likely to adopt the organic farming techniques. As decision-makers age, their planning horizons shrink and so the

incentives for them to invest in the future productivity of their farms diminish. Moreover, younger farmers may incur lower switching costs in implementing new practices since they only have limited experience and the learning and adjustment costs involved in adopting organic farming practices may be lower for them.

Finally, since organic farming practices generally require more physical effort, the relatively healthier and stronger younger farmers are more likely to implement them than their older counterparts. This raises an important extension policy issue. Extension systems should differentiate their clientele based on critical demographic characteristics such as age and gender. If younger farmers are more likely to adopt new practices, perhaps extension messages should be focused on certain (younger) age cohorts, especially in the early stages of technology development and dissemination.

(d) Membership and awareness

Membership to a Farmer Association, a proxy for social capital was statistically significant at 1percent level of significance and had a positive sign. This indicated the important role played by social capital in technology adoption. Farmers who belonged to a farmers' association are more likely to adopt agricultural technology. These results were similar to Nyangena (2004) who found that trust, group activities and past adoption learning effects from other farmers significantly influenced the adoption behaviour. Same result were reported by Conley and Udry (2000) who found that new technology adoption depends on social learning.

Farmers Associations unite individual farmers in order to determine and set production standards and by-laws on organic farming. They also undertake collective off-farm investments such as packing and storage facilities for organic products. They sensitize consumers of organic products and they initiate the guarantee system. They encourage research institutions and other bodies to consider organic agriculture in their research endeavors. They influence donors to fund organic farming programmes. They also influence introduction of educational programmes at the lower levels of the education ladder. Thus, projects should make available financial resources to support investments in packing and storage facilities for Farmer Associations that are well organized and have prospects of success. In addition, funding should be secured so that the Associations can purchase the organic products from their members.

Awareness was also found to be statistical significant and positively associated with probability to adopt organic farming. Farmers who were aware of organic farming are more likely to adopt. Since 84 percent of the interviewed respondents were aware of organic farming, there is need to shift attention to economic, environmental and social benefits of organic farming by setting up training programmes and awareness raising and skills dissemination strategies among farmers extensionists and consumers. Awareness campaign should focus on distinguishing between organic farming and traditional farming methods.

(e) Ecological zones

Ecological zone variable was found to be statistically significant and positively associated with adoption. This indicated that a farmer from Chuka division was more likely to adopt organic farming. This could be due to ready market for organic product at Chuka town which is the District headquarter. It was also well served with good transport and communication network and many NGOs were operating from there. Climatic condition was also different from other parts in that it is on the highland zone next to Mt. Kenya Forest thus, material such as *Calliandra calothyrsus* and *Tithonia diversifolia* for composting were readily available.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

In order to explore factors and constraints affecting farmer adoption of organic farming practices in Meru-South District, a multi-stage sampling approach was used to select a sample of 119 farmers. A structured interview schedule was used to collect data on the socio-economic characteristics of the sampled household and assess institutional factors affecting adoption of organic farming.

The farmers reported several constraints to adoption of organic farming, including inadequate knowledge, lack of market for organic products caused by inadequate market information, labour availability and expensive certification process. Conventional farmers reported uncertainty about the supply chain, strict certification procedure and reduced yield as the most important reasons for not converting to organic farming.

A logit model was used to identify factors affecting farmer adoption of organic farming practices. Six factors were statistically significant which include awareness, household labour, farm size, social capital and eco-logical zones that were positively associated with adoption probability, while farmer experience was negatively associated with adoption probability. Households that have larger farms and enjoy greater availability of household labour and non-farm cash income were considerably and statistically significantly more likely to adopt organic farming practices.

5.2 Conclusion

Converting conventional agriculture to organic farming is a complex operation involving high risk and serious problems, both technical and economic. Organic farming could be more costly than conventional farming, mainly because labour input is high and yields are lower during transitional period.

The transitional period (the first two or three years after farmers start to produce organically) is the most difficult period for organic farmers. During this period, farmers have to carry out soil-conservation measures and pay for certification costs without being able to obtain premium prices. Farmers will probably experience some loss in yields when converting their operations to organic farming production. However, the degree of yield loss varies depending on factors such as the inherent biological attributes of the farm, farm expertise and the extent to which synthetic inputs were used under the previous management system. Thus, small farmers benefit greatly from the availability of short-term credit for hiring the necessary wage labour. This type of credit is especially necessary for women producers, who have fewer resources of their own to pay for wage labour. In addition, projects involved in promotion of organic farming could provide temporary and partial subsidies for these investments in soil-conservation measures and for covering certification costs during the transitional period.

Lowering the amount of off-farm inputs and enforcing strict certification procedures reveals a dilemma in promoting organic farming. During conversion period, farmers may experience loss due to reduced yield yet they cannot get premium enjoyed by organic

farmers since they are not certified organic farmer. The only solution for farmers is being able to receive a premium price for the organic products in a rather stable market structure. At the beginning, this could be realized by support policies as in the European Union (EU). It is well known that in the Union, there are some national support schemes such as conversion grants or aids besides Union-wide structural instruments and regulations. Because of lack of domestic market, this is achieved only through vertical coordination between producers and marketing or processing firms through contract farming. In short, development of organic farming is dependent on evolution in market structure and performance.

Organic farming is information intensive. Knowledge is not only necessary about the technical aspects of the production but also about the institutional environment and about the possible marketing strategies. Farmers who convert towards organic farming are confronted with economical and social consequences. Besides the direct cost of organic farming, some hidden cost or transaction costs due to uncertainty and specificity of organic farming also play a role. These hidden costs are mainly costs to gather information, negotiation costs and monitoring costs. Information about the market has to be gathered, distribution channels have to be organized, local trade partners have to be found.

Due to complexity of the management of organic farms, knowledge about the production process is important for all actors. Lack of knowledge and insufficient diffusion of knowledge are important problems during conversion.

For organic farmers, marketing the organic products seems to be a real problem. Often the organic farmers have to sell their products as conventional products. Certification procedure is expensive and time consuming. This discourages the adopter and the potential adopter thereby encouraging disadoption of organic farming. So a cost effective supply chain would stimulate the adoption of organic farming.

Households that have large farms, enjoy greater availability of family labour and non-farm cash income are more likely to implement organic farming techniques. Poorer smallholder farmers, most in need of natural asset protection and productivity enhancements, are least likely to adopt organic farming practices. This may contribute to the phenomenon of poverty traps where households with poor initial asset endowments are unable to acquire more remunerative livelihoods because they have very limited access to formal or informal finance necessary to build their farm assets through continuous investment and to protect them against negative shocks. The switchover of these poorer farmers to organic production would require specific measures to support more heavily the transition period and to solve problems of land tenure.

Moreover, given that the bulk of labour for most farm operations in this region is provided by the family rather than hired, lack of adequate family labour accompanied by inability to hire labour appears to seriously constrain adoption of organic farming practices. Thus, more emphasis should perhaps be devoted to developing and extending labour-saving techniques, especially with malaria, HIV/AIDS and family planning

programmness success which are draining poor families of prime-age adults' workers and family labour.

Lastly, local adoption of organic farming is a collective decision because farmers' synthetic chemical applications affect their neighbours' field as well. An organic farmer may be affected environmentally and health wise by the use of synthetic chemicals applied in the neighbouring plots. Thus the success of organic farming is on collective decision by all.

5.3 Recommendations

The findings of this study have various policy implications for Government, NGOs and International Donors.

(a) Government

The government should develop and expand organic curriculum at all levels of the education system from primary level to colleges and university education. This will provide information and awareness of organic farming and encourage young farmers to practice it and minimize the bias toward synthetic inputs. Establishment of Bio-Intensive Agricultural Clubs (BACs) at both primary and secondly schools will be a good beginning.

The government should enhance research in organic farming and support it with the necessary funding to facilitate dissemination of the findings to users

Offering subsidies such as conversion grants or aids to organic farmers during conversion period to compensate them since at this time farmers experience reduced yield and no premium as they are not yet certified.

Avail short term credit to young farmers and women producers, who are frequently alone and have fewer resources of their own to pay wage labour and soil-conservation measures yet they are more likely to adopt organic farming.

(b) NGOs and International Donors

The NGOs involved in various organic farming training activities should develop further into marketing, processing, inspection and certification of organic products. In this way, Kenya will have its own organic market regulatory organizations rather than relying on European Certification bodies that are too expensive.

Programmes and projects that promote the adoption of organic crops among small farmers should strongly support farmer organizations focused on farmers (especially women) who are more likely to adopt organic farming. This is far from an easy job, as organic production will pose great organizational demands on farmer associations: (a) organic agricultural products in developing countries are often sold in foreign markets; so the organization will have to deal with foreign buyers who demand quality and the timing of deliveries. Exporting is also much more demanding in terms of logistics and coordination and (b) the certification of production will require inspections, as well as certification costs, the establishment and running of a monitoring system and the

promotion of participation at the grass-roots level in order to avoid free riders. Thus, organizations working with small farmers that aim to support organic agriculture should target groups of farmers that show good prospects of succeeding in their collective action.

Organizations working with small producers should focus on strengthening associations that will play a role in the marketing of production, dissemination of organic technologies among their members and monitoring of their members' compliance with organic methods of production. Projects should provide solid support during the transition period for the certification of production, including temporary and partial subsidies to cover certification costs, intensive training among association members in the characteristics of organic production and the markets and problems of non-compliance, and for the organization of a well-functioning and participatory monitoring system.

In conjunction with government they should develop local markets in every part of Kenya and particularly urban areas; Kenya needs to have supermarkets stocking organic products and hotels and restaurants offering organic foods. They should initiate ways of home processing of organic products at farm level in order to add value and eliminate numerous middlemen who normally leave the producers with mere profits or sometimes non at all.

Help in building of social capital particularly in formation of self-help groups/farmers association and capacity build these associations to ensure their sustainability.

5.4 Limitations of the study and Areas for Further Research

First, the findings reported in this study strictly apply to the study area and should not be generalized to other regions with different agro climatic and socio-economic characteristics.

Second, the study used cross-sectional data to analyze the factors influencing adoption of organic farming in a certain point in time (July/August, 2007). However, the technology adoption process is inherently dynamic. Decisions made in one period are strongly dependent on the consequences of decisions made in previous periods. Thus, there is need to select and periodically survey a panel of organic farmers in order to monitor changing patterns in the use of organic farming practices including trends in area cultivated (farm size), behaviour of extension officers and the rate of adoption.

Additionally, these panel data could be used to assess the impact of organic farming on the well-being of farmers and whether or not the benefits of being an early adopter are preserved, even when many farmers have adopted technology.

As discussed in the previous chapter, a market is a major bottleneck to adoption of organic farming. Therefore, post-harvest research aimed at assessing ways to establish linkages between organic farmers and processors is vital for identifying potential markets, especially for farmers in remote and isolated zones that are disconnected from potential urban markets.

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APPENDICES

Appendix 1: General statistics

Table 1: Regional Distribution of the Sample

Division	Conventional farmers	Organic Farmers	Total
Chuka	32	28	60
Magumoni	31	28	59
Total	63	56	119

Source: Survey 2007

Table 2: Constraints/Problems facing organic farmers in Meru-South Districts

Constraint	percent
Expensive and time-consuming certification procedure	53.1
Uncertainty about market/price for organic products	52.7
Lack of knowledge/know-how	41.9
High production cost.	29.8

Source: Survey data 2007

Table 3: Reasons for not converting to organic farming by conventional farmers

Reason	Percent
Uncertainty about market/price for organic products	71.7
Expensive and time-consuming certification procedure	53.9
High production cost.	27.9
Lack of knowledge/know-how	17.6

Source: Survey data 2007

Table 4: Opinion of organic farmers

	Disagree percent	Agree percent
Often have problem with the marketing of my organic products	37	55
I regularly have to sell my organic products as conventional products	29	53
Organic farming benefits are greater than for conventional farming	21.8	47.1
Organic farming increased the numbers of workers/on farm hours	0	100
Organic farming has reduced the overall cost of production	41.2	55.6
Organic farming has improved environment	7	92.6
Organic farming has improved the crop yield	45.7	54.3
Organic farming has improved your health and that of your worker	44.4	55.6

Source: Survey data 2007

Table 5: Farmers suggestions on what need to be done to encourage adoption of organic farming

	percent
More education and training	47
Financial support	42.7
Ease certification procedure	39.5

Source: Survey data 2007

Table 6: Self-reported health

How often do you experience/experienced the following	Before Adoption			after adoption		
	Percent			Percent		
	Never	Rare	frequent	Never	Rare	frequent
Eye irritation/skin effect	23.3	45.2	31.5	38.7	30.7	30.6
Dizziness/headache	33.3	40.0	26.7	42.9	37.7	19.5
Vomitting	77.7	20.8	1.3	94.7	.4	1.3
Shortness of breath/convulsion	69.3	21.3	9.4	74.6	22.4	3.0

Source: Survey data 2007

Table 7: Maximum Likelihood Estimates of the unrestricted (full) Model

	β	t	Wald	df	Sig.	Exp(β)	95.0% C.I. for EXP(β)	
							Lower	Upper
AGE [°]	-.008	-0.1509	.021	1	.884	.992	.895	1.100
Educ ₁ [°]	-.341	-0.163	.027	1	.870	.711	.012	42.694
Educ ₂ [°]	-.723	-0.333	.111	1	.739	.485	.007	34.152
Land-ten [°]	.547	0.513	.263	1	.608	1.729	.214	13.983
HHSEX	1.390	1.040	1.082	1	.298	4.015	.293	55.109
EXP	-.059	-.1.135	1.281	1	.258	.943	.852	1.044
Occ-hold [°]	-.301	0.297	.088	1	.766	.740	.102	5.390
Wareness	2.533*	1.613	2.604	1	.107	12.593	.581	273.063
Train [°]	-.401	.538	.289	1	.591	.670	.155	2.888
HH	.731**	2.583	6.685	1	.010	2.076	1.193	3.612
FSIZE	.874*	2.076	4.308	1	.038	2.397	1.050	5.472
Extension	.571	.995	.989	1	.320	1.769	.575	5.447
Credit	1.025	1.223	1.496	1	.221	2.787	.539	14.404
Membership	3.132**	3.126	9.780	1	.002	22.921	3.219	163.200
Off-farm	.713	.961	.924	1	.337	2.040	.477	8.726
Cows [°]	.087	.218	.047	1	.828	1.091	.499	2.385
Eco-zone	2.537*	2.073	4.291	1	.038	12.637	1.146	139.282
Constant	-11.014	2.429	5.899	1	.015	.000		

-2Log-likelihood = 75.29; $R^2 = .54$ (Hosmer & Lemeshow), .53 (Cox & Snell), .70 (Nagelkerke); Likelihood Ratio test $\chi^2(17) = 89.27$; * *Significant at 1%; * Significant at 5%.

[°] Excluded in restricted model

Source: Survey 2007

Table 8: Correlation Matrix of Variables in the Logit Model

	age	Educ1	Educ2	LAND-TEN	hhsex	EX P	Occ-hold	Wareness	train	HH	FSIZE	Extension	Credit	Membership	off-farm	cows	Eco-zones
age	1																
Educ1	.006	1															
Educ2	-.030	-.915	1														
LAND-TEN	.346	-.235	.331	1													
hhsex	-.069	.059	-.200	-.238	1												
EXP	.736	.001	-.066	.288	-.063	1											
OCC-HOLD	.128	.366	-.393	-.103	.107	.143	1										
WARENES	.266	-.183	.163	.443	.009	.185	-.080	1									
TRAIN	.208	-.107	.107	.165	-.033	.105	-.129	.295	1								
HH	.599	-.139	.124	.313	-.187	.441	.085	.335	.099	1							
FSIZE	.323	-.274	.293	.321	-.183	.315	-.235	.201	.190	.455	1						
EXTENSIO	.076	-.289	.314	.220	.008	.224	.009	.249	-.004	.110	.060	1					
LOAN	.093	-.102	.126	.190	-.094	.173	-.133	.190	.021	.168	.246	.420	1				
MEMBERS	.186	-.282	.283	.283	-.119	.185	-.072	.533	.167	.341	.310	.255	.279	1			
OF-FARM	-.090	.013	-.046	.064	.003	.067	.080	.263	-.253	-.050	-.252	.190	-.003	.276	1		
cows	.220	-.340	.361	.312	-.211	.105	-.412	.231	.204	.273	.588	.130	.275	.276	-.172	1	
ECO-ZONES	.007	-.298	.283	.306	-.055	.220	-.083	.426	-.203	.123	-.018	.650	.401	.377	.416	.116	1

Source: survey 2007

A2: INTERVIEW SCHEDULE

Section 1

1.1 Name of enumerator.....

1.2 Location..... Date.....

Section 2 Farmer characteristics

2.1 Farmer's name (optional)

2.2 Sex; Male Female

2.3 Marital status: Married Single

2.4 Religion: Catholic Protestant Muslim Others

2.5 For how long have you been farming own farm produce? [.....Yrs]

2.6 How many people live in your household at least 9 months of the year? _____

Household composition (Those who live in the household for atleast 9 months a year)	Sex Male(0) Female(1)	Age (yrs)	Highest level of education attained None (0) Primary (1) Secondary (2) Post Secondary (3)	Main occupation None (0) Farming (1) Teacher (2) Business (3) Others(specify)	Average monthly income (Kshs)
Household head					

2.7 Do you have children or relatives working away from home (in town)? Yes No

If yes go to 2.6.1; if no go to 2.7

2.7.1 How many are they [.....]

2.7.2 Do they remit/send you any money? Yes No

If yes how much? [Kshs per month.....]

2.8 How many years have you lived in this village? [_____]

2.9 In 2006, did you work off farm? (1 =Yes 0 = No) _____

If yes how many days in a week do you work off-farm? [..... Days]

Approximately how much do you earn per day from off- farm activities? [Kshs.....]

2.10 Do you have any farmers groups or associations in this location? (1=Yes 0=No).....

2.10.1 If yes do you belong to any of the farmers group or association? (1= Yes 0=No).....

If no, why haven't joined any?.....

2.11 Do you engage your children on farm activities? (1=Yes 0=No).....

2.12 What is the total amount of hired labour force in the farm?.....

2.13 Do you suffer from any chronic disease? (1=Yes 0=No).....

2.14 If yes, specify.....

2.15 How many times have you missed work (unable to work) due to illness in the last three months?.....

SECTION 3 TECHNOLOGY ADOPTION AND CHARACTERISTICS

3.1 Have you ever practiced organic farming in any of your plots? (1=Yes 0=No).....

3.1.1 If yes are you currently practicing organic farming in your farm? (1=Yes 0=No).....

If yes go to 3.2, if No go to 3.3

3.2 In what year did you first practice organic farming? Year.....

3.2.1 What were the primary factors that motivated you to adopt organic farming?.....

.....
.....

3.2.2 For your farm, are the total benefits of organic farming greater than the previous/ conventional method? (a) Yes, the benefits are significantly greater

(b) Yes, benefits are slightly different

(c) Benefits are the same

(d) No, benefits are slightly lower

(e) No, benefits are significantly lower

3.2.3 Please rate the following statements about organic farming (1= strongly agree; 2=Agree; 3=Neutral; 4=Disagree; 5=strongly disagree)

(a) Organic farming has reduced the overall cost of production.....

(b) Organic farming has improved the environment.....

(c) Organic farming has improved the overall crop yield.....

(d) Organic farming has improved the value of farm produce.....

(e) Organic farming has improved your health and that of your workers.....

3.2.4 Did the adoption of organic farming lead to changes in the number of workers/on-farm hours? (i) Yes it led to an increase of workers (ii) Yes it led to a decrease (iii) No change

3.2.5 Was the decision to adopt organic farming made by (i) Farmer himself/herself (ii) A group/association (iii) Others (specify).....

3.3 Why did you drop/stop practicing organic farming?.....
.....

3.4 Please rate how often you experience/experienced the following (4= constantly; 3=frequently; 2=Sometimes; 1=rarely; 0=Never)

ADOPTERS	ADOPTERS		NON-
	BEFORE ADOPTION	AFTER ADOPTION	CURRENTLY
Eye irritation			
Dizziness			
Vomiting			
Skin effects			
Headaches			
Convulsion			

3.5 Had you ever received/attended any organic farming training? (1=Yes; 0=No).....

If, yes for how long.....days and who were the sponsors and what did you learn?.....

3.6 How did you come to know about the organic farming?

- i) Through the press (ii) Through attending an agricultural field day or an on-farm demonstration
- (iii) From early adopters (iv) Others (specify).....

SECTION 4 FARM CHARACTERISTICS

4.1 Farm size.....Acres

4.2 Farm tenure: (1=own title deed; 2=rented; 3=family land; 4=Hired land; 5= others (specify))

4.3 Farm preparation method: (1=manually; 0=Use animal traction)

4.4 What was the average maize output in the last season?.....bags

4.5 How long did the crops harvested last season sustain the family..... (in months)

If it did not take you to the next harvesting season, how did you meet the deficit?

4.6 Do you currently have livestock? (1= Yes 0 = No) _____ If Yes: Go to the table below.

Type _____ Cows _____ Oxen _____ Pigs _____ Goats _____

Sheep _____

Number _____

4.7 Do you own any assets? (1=Yes 0=No)...

4.7.1 If yes, indicate the number and rough estimate of the cost and whether they are in good working condition or not

Asset	Number owned	Acquisition cost	Working Condition (bad/good)
Panga			
Jembe			
Axe			
Rake			
Spraying pump			
Fork Jembe			
Bicycle			
Radio			
Television			
Motorcycle			
Car			
Spade/shovel			
Wheel barrow			
Ox-cart			
Others (specify)			

5.0 Institutional factors

5.1 During the past one years, have you attended an agricultural field day or an on-farm demonstration (0 =No 1 =Yes) _____ If yes:

Who sponsored the event

What did

you learn

5.2 During the past two years, how many times has an extension officer assisted /visited you?

_____ if at least once,

5.3 During the past one year, have you participated in an agricultural training course? (0 =No 1 =Yes) _____ If Yes:

Who was the sponsor	what did you learn

5.4 Are you or your spouse, a member of any association? (0= No 1 = Yes) _____ If Yes:

Name of the Association	How does the association benefit you or your spouse?

5.5 Have you ever had an agricultural loan since you started farming? (1=Yes 0=No).....

5.5.1 If yes what was the source and in which form?

Source	Year	Loan in cash	Loan in form of farm inputs	
			Equipment	Estimated value
Bank				
Co-operative society				
NGO				
Others (specify)				

5.5.2 What were the conditions for qualifying to borrow the loan?.....

.....

.....

5.6 Have you ever tried and was unable to sell your farm produce? 1=Yes 0=No.....

5.6.1 If yes, indicate the reasons in the table below by ticking appropriately.

1	2	3	4
Lack of buyers/market	Low prices	Lack of transport	Others(specify)

5.7 What are the major barriers to adoption of organic farming?.....

.....
.....
5.8 What is your general opinion on the organic farming practice?.....

.....
.....
5.9 Do you have any suggestion about what needs to be done to help farmers increase their organic maize production?.....

Thank you very much for your participation.