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AN ASSESSMENT OF THE EFFECT OF GENDERED DECISION-MAKING AND ACCESS TO INSTITUTIONAL SUPPORT SERVICES ON MAIZE PRODUCTION EFFICIENCY IN KENYA

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Reg. No. A56/76210/2014

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DECLARATION

Declaration

I hereby declare that this thesis is my original work and has not been presented for any award in any other academic institution.

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Approval

This thesis has been submitted to the Graduate School with our approval as supervisors.

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DISSEMINATION

The following papers have been written from this thesis:

1. **Osanya, J.,** Adam, R., Otieno, D, and Nyikal, R. (2017). Characterization of Intra-household Gender Relations in Agriculture in Kenya: Access to Institutional Support Factors and Decision-Making. *Paper presented at the Egerton University 11th International Conference, Egerton University, Kenya, 29th - 31st March, 2017*

DEDICATION

This thesis is dedicated to my late father, Mr. Arthur Elphas Osanya-Nyyneque, who taught me how to read and write.

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ACRONYMS

AERC	African Economic Research Consortium
AGRA	Alliance for a Green Revolution in Africa
ASDS	Agricultural Sector Development Strategy
AU	African Union
CIMMYT	*Centro Internacional de Mejoramiento de Maiz y Trigo* (International Maize and Wheat Improvement Center)
FAO	Food and Agriculture Organization of the United Nations
GAD	Gender and Development
IFPRI	International Food Policy Research Institute
MDG	Millenium Development Goal
MLN	Maize Lethal Necrosis
SSA	Sub-Saharan Africa
SDG	Sustainable Development Goal
UN	United Nations
WID	Women in Development

ABSTRACT

The need to effectively integrate gender in agriculture is a topical issue in research and policy debates. Previous studies have shown that women in Sub-Saharan Africa (SSA) face challenges in accessing productive resources such as land, and this reduces their productivity compared to men. Most of these studies, however, have analyzed male-headed versus female-headed households, and this approach fails to take into account the women who are in male-headed households, for example. Moreover, the combined effect of gendered decision-making and access to institutional support services on agricultural productivity and efficiency has not received adequate focus in empirical work. The main objective of this study was to assess the effect of intra-household decision-making and access to institutional support services (group membership, credit, extension, agricultural training forums) on maize production efficiency in Kenya. Using primary data collected from Bungoma and Meru counties, a multivariate probit model was applied to analyze factors affecting men's and women's participation in decision-making, while stochastic frontier production functions were used to estimate technical efficiency. Findings indicate that men and women do not have equal roles in household decision-making and access to institutional support services. Women had higher group membership while men had higher education levels, access to agricultural training forums and were found to be more likely to contribute to decisions on input and labour use. Extension, mobile phone use and credit had a positive effect on efficiency. Based on these results, the study recommends implementation of gender-based interventions such as agricultural training forums for women, as well as providing incentives that encourage men to join and contribute productively to agricultural development groups. This will ensure fairness in access to resources and improved efficiency.

Key words: gender, decision-making, institutional services, maize, efficiency, Kenya.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Agriculture is a key sector for economic growth and development for many of the developing nations (FAO, 2015). In Sub-Saharan Africa (SSA), it accounts for about 65 percent of the labor force and is a source of livelihood to approximately 80 percent of the population (AGRA, 2014). Smallholder farmers, who provide 80 percent of the food supply in Africa, carry out most of the agricultural activities in SSA. The region, however, still experiences high levels of poverty and hence food insecurity, with an estimated 33 percent of its population (220 million people) being undernourished (FAO, 2015). High food insecurity levels are caused by situations such as civil strife, insecurity, rising global food prices, unfavorable climatic conditions, inefficiency in resource use in production and low agricultural productivity (AGRA, 2014). The majority of the food insecure in these countries live in rural areas where agriculture is the main source of livelihood (Mehra and Rojas, 2010; Ogunlela and Mukhtar, 2009).

Agricultural productivity in SSA remains low despite reforms such as fertilizer subsidies in some countries such as Malawi that are generally thought to have led to an increase in total production (Nin-Pratt, 2015). This calls for increased investment in agricultural research in order to come up with new technologies and provision of a favorable environment for farmers to adopt them. This in turn helps to increase the rate of technical change and improve food security levels (Wakhungu, 2010). Many of the farmers lack access to resources such as land, water, credit and extension services and this affects their farm productivity and efficiency (Fuglie and Rada, 2013).

Maize is the staple food in Kenya, accounting for about 40 percent of all crop area in the country with yields averaging about 1622 kilograms per hectare. Per capita consumption is estimated to be 103 kilograms per year (CIMMYT, 2015). Maize farming provides a source of livelihood to many smallholder farmers, who account for about 65 percent of the maize produced in the country. The grains are used for food as well as for sale, while the leaves and stalks provide animal fodder and alternatives to fuel wood for cooking. Maize yields in Kenya have been fluctuating over the years due to insufficient rainfall, pest and disease attacks and inefficiency in resource use (CIMMYT, 2015). For instance, an outbreak of maize lethal necrosis (MLN) disease resulted in yield losses of 126 000 metric tonnes in 2012, which was estimated to be equivalent to USD$52 million loss. About 58 percent of the loss was experienced in Western Kenya (Mahuku, *et al.* 2015).

Figure 1 below represents the average maize yield in Kenya for the years 2006 to 2018 in kilograms per hectare.

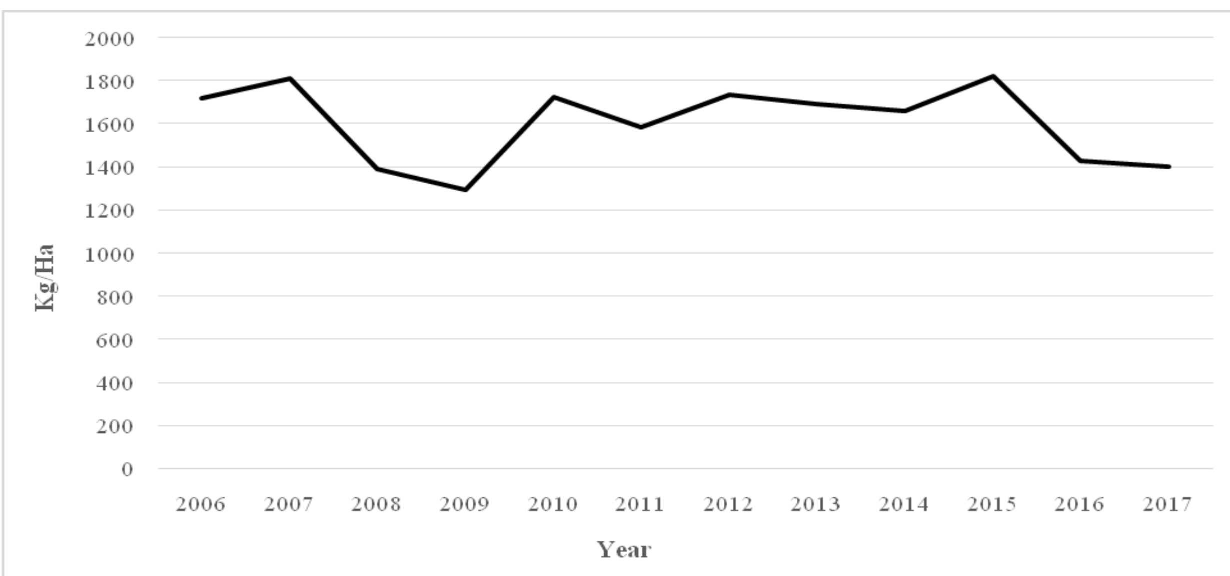

Figure 1: Average maize yield in Kenya in kilograms per hectare (2006-2018).

Source: FAO (2018).

From Figure 1 above, it can be seen that the average maize yield has remained at about 1500 kilograms per hectare overall with slight fluctuations over the years. Yields dropped sharply in 2008 and this can be attributed to the political crisis as well as depressed rainfall and consequently drought experienced in many parts of the country during that year (World Bank, 2009). Decreased yields in 2011 were caused by the outbreak of MLN disease. In 2016, the 22 per cent decline in average yield can be attributed to erratic rainfall (KIPPRA, 2016).

In 2013, CIMMYT, together with the Kenya Agricultural and Livestock Research Organization (KALRO) carried out the Adoption Pathways Project. Its aim was to improve the understanding of how socioeconomic factors such as gender, as well as institutional support services such as social capital, access to credit, extension services and group membership, affected the productivity of smallholder maize and legume farmers in Kenya (CIMMYT, 2012). Gender is increasingly becoming a key area of focus for agricultural research, purposely to enhance inclusivity and fairness in resource allocation and sharing of farm benefits. The term is commonly used interchangeably with sex, although they have different meanings. While sex refers to the biologically determined differences between men and women, gender refers to the socially established roles and responsibilities of men and women, which differ across cultures and over time as societies evolve (FAO, 2004; Catacutan and Naz, 2015). Gender differences are determined by the perceptions of a society, about the physical differences, tastes, tendencies and capabilities that exist between men and women (World Bank, 2009).

Gender relations are the ways in which societies assign specific roles to men and women. This determines the functions and responsibilities of either sex as well as their access to and control over resources, for instance, ownership of land and access to credit (FAO, 2004). This in turn affects division of labor, education, opportunities for professional advancement and participation in policy-making. These vary across societies and cultures and change over time.

In SSA, men and women traditionally assume different roles in agriculture. For instance, men are usually involved in clearing of land, slashing, burning and ploughing, while women mostly do weeding, harvesting and post-harvest work (FAO, 2011). Men were also associated with production of cash crops while women were involved mostly in production of food crops (Mehra and Rojas, 2010). These roles are, however, changing over time in some societies resulting in women performing tasks that were traditionally carried out by men (Van Eerdewijk and Danielsen, 2015).

In many rural societies, especially in SSA, men and women face unequal access to resources. Women are usually disadvantaged and encounter obstacles in accessing productive inputs such as land, seeds, fertilizer and credit. They also face challenges in accessing high value markets as well as other key services required in agricultural production such as extension and membership in cooperatives (Njuki *et al.* 2013; Ashby *et al.* 2008; World Bank, 2009). This causes them to register lower productivity and efficiency in agriculture than men, resulting in a gender gap in agricultural production. Closing this gap can lead to an increase in agricultural productivity by 20 to 30 percent in SSA. It can also result in additional benefits such as raising the incomes of female farmers, increasing the amount of food produced, reducing prices, improving nutrition and reducing poverty (FAO, 2011; UN, 2015).

Bridging the gender gap has been shown to contribute to considerable improvement in output. For instance, the UN (2015) estimated that for Tanzania and Malawi, enhanced gendered access to resources could improve annual crop output by 2 and 7 percent, respectively. This would translate to a potential gross increase in Gross Domestic Product (GDP) by about USD$105 million and USD$100 million in these countries respectively (UN, 2015). The main factors causing the gender gap in these countries were found to be lack of access to sufficient labor, fertilizer, seeds, extension services and child care and household responsibilities that reduce time available for farm work (World Bank, 2014). Unequal distribution of resources and decision-making along gender lines are prevalent in Kenya and require targeted interventions to enable sustained development.

1.2 Statement of the Research Problem

Gender inequality continues to exist in many parts of SSA. Several studies (Peterman *et al.* 2010; Githinji *et al.* 2011; Ngigi *et al.* 2016), have found that women do not have the same access to key resources and services required in production as men, causing them to have lower productivity. This gender gap in access to resources is caused by differences in gender relations across societies (Ashby *et al.* 2008; Seebens, 2011). For instance, inheritance and ownership laws in developing countries usually limit the resources that women are able to access. This is true especially for land (Mikkola and Miles, 2007; Kousar *et al.* 2015; Doss, 2018).

Gender relations in societies and within households, influence access to institutional support services such as group membership, credit, extension and access to agricultural training forums, as well as intra-household decision-making roles. This in turn affects productivity and efficiency (Quisumbing *et al.* 2014). Findings by Muriithi, (2015), showed that in Central Kenya, women were excluded from joining farmer groups, attending horticultural trainings and accessing credit, hence they had lower productivity than men.

As women have limited access to institutional support services and little control over resources, their roles in household decision-making regarding production and resource allocation are also limited (Mikkola and Miles, 2007; Farnworth, 2013; Ambler *et al.* 2017). For instance, Ngigi *et al.* (2016) found that men were the sole decision-makers on land use in majority of the households sampled in the eastern and western regions of Kenya. Intra-household decision-making is determined by the resource endowment of the parties. Men and women who have higher income have higher decision-making power in the household and better access to resources. According to the International Food Policy Research Institute (IFPRI, 2014), women who have higher decision-making power on crops to grow and inputs to use have higher productivity. This can be shown from studies such as Sneyers and Vandeplas (2013), which found a positive relationship between women's involvement in decision-making and dairy productivity in India. Dimova and Gang (2013), also found that households where women were the key decision-makers in cash crop production had greater efficiency than those where men were the key decision-makers, in Malawi.

Many studies have assessed access to resources and institutional support services by men and women in agriculture by using the sex of the household head or plot manager as the proxy for gender. This approach fails to take into account the contribution of the women who are in male-headed households for example, that is, the intra-household aspects. This study aimed to contribute to this gap in literature by analyzing intra-household access to institutional support services (group membership, access to credit, extension services, and attendance of agricultural training forums), as well as contribution to maize production decisions and how this affects efficiency. This is so as to provide useful insights into the potential contribution of men and women to farm production. This is important especially for maize because it is the basic staple food grown by many households in Kenya.

1.3 Objectives of the Study

The main objective of this study was to assess the effect of intra-household gendered decision-making and access to institutional support services on maize production efficiency.

The specific objectives were to:

- Characterize institutional support services and maize production decisions along gender perspectives.
- Assess the socio-economic and institutional support services that affect men and women's participation in household decision-making.
- Analyze the effect of gendered access to institutional support services and participation in household decision-making on maize production efficiency.

1.4 Research Hypotheses

The hypotheses tested in this study were:

- There is no statistical difference between men's and women's access to institutional support services and participation in maize production decision-making.
- Access to institutional support services and socio-economic characteristics of farmers do not significantly affect their participation in household decision-making.
- Access to institutional support services and participation in household decision-making does not have any significant effect on maize production efficiency.

1.5 Justification of the Study

The results from this study will inform policy on gendered approaches in agricultural development in order to ensure equitable access to resources by both men and women. This is in line with the fifth Sustainable Development Goal (SDG) which aims to achieve gender equality and empower all women and girls (UN, 2015). The second and third objectives of this study contribute to this goal as they assessed men and women’s decision-making in maize production, and how it affects efficiency.

Part III of the Malabo Declaration echoes a commitment towards ending hunger and halving poverty in Africa by the year 2025 by doubling the current agricultural productivity levels. This is to be achieved through creating appropriate conditions to facilitate access to quality inputs as well as knowledge, information and skills (AU, 2014). One of the strategies indicated to achieve this is by supporting and facilitating the entry and participation of women and youth in gainful agribusiness opportunities. The results from the first, second and third objectives will be used to provide information on gender relations and farmers’ efficiency levels, which can then be used to guide the formulation of policies that are geared towards achieving these targets.

The Bill of Rights (Chapter Four) in the Constitution of Kenya advocates for equal treatment of men and women in political, economic, social and cultural capacities. This is found in Article 27 (Republic of Kenya, 2010a). The first and second objectives from this study will provide information on men and women’s roles in decision-making in agriculture as well as access to various resources. This will then provide information that will guide design of policies that aim towards achieving equality among men and women across various aspects.

The overall goal for Kenya’s Agricultural Sector and Development Strategy (ASDS) is to achieve a growth rate of 7 percent per year for the agricultural sector. This is to be achieved through increasing productivity of agricultural enterprises. The third objective of this study will provide information on efficiency, which will help in designing strategies for achieving this growth rate. The ASDS also aims to develop a gender policy for the agricultural sector. This will be in order to ensure women empowerment as well as integrate the needs of both men and women so that they can equally benefit (Republic of Kenya, 2010b). The first and second objectives of this study will provide information that will assist in designing and revising the gender policy for the sector.

Chapter 2, section 2.3.6.2 of the Kenya Youth Agribusiness Strategy, 2017-2021, cites gender disparities as one of the cross-cutting challenges affecting youth involvement in agribusiness. It states that: "The main constraints inhibiting gender equality in agriculture include low empowerment of young women to take up decision making roles." As a result one of the strategic interventions given is to build youth capacity in order to curb gender inequality issues. The results from the first and second objectives will provide information on intra-household gendered decision-making roles as well as access to institutional support factors, which will help to address this goal.

The County Integrated Development Plans for Bungoma and Meru prioritize improving productivity, output and value of the agricultural sector by conducting relevant research in order to improve food security and reduce poverty. This is to be achieved through a multi-sectoral approach, where stakeholders such as training and research institutions are to contribute by conducting relevant research on agriculture in the region (Republic of Kenya, 2013). The third objective of this study provides information gender decision-making on maize productivity for the two counties, which can then be used as a guide towards achieving the goal of improving agricultural productivity.

1.6 Organization of the Thesis

The rest of this thesis is organized as follows: Chapter 2 provides an overview of gender concepts and dimensions in agricultural development and empirical studies that have been conducted on access to institutional factors, gender roles in decision-making and farm production efficiency. Chapter 3 outlines the methods used in the study, while Chapter 4 presents the results and discussion. Finally, Chapter 5 provides the summary, conclusions from the study and recommendations for policy action based on the results obtained.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 An Overview of Gender Concepts and Dimensions in Agricultural Development

Gender refers to the social attributes and opportunities associated with being a man or a woman (FAO, 2004). These attributes are determined by various cultural, religious, ethnic, ideological and economic factors, and they change over time as societies evolve (World Bank, 2009; FAO, 2011). Gender determines what is expected or allowed from a man or woman in a specific context, such as the sharing of responsibilities and resources.

Research on gender in development began as early as 1970, with the publication of the book: *Women's Role in Economic Development,* by Esther Boserup. The book highlighted the plight of women in developing countries. It pointed out that women were neglected in development efforts, and were being denied their customary rights, roles and access to resources (Tiruneh *et al.* 2001; Okali, 2011; Mehra and Rojas, 2010). This led to an increased interest in activities such as conferences, projects and international agreements geared towards improving the welfare of women by giving them equal access to education and employment opportunities as well as representation in political spheres. As a result, the term gender is often associated with the empowerment of women. These activities were known as Women in Development (WID) initiatives. Boserup's work was later critiqued and found to be biased as it focused solely on addressing women's issues yet men continued to dominate most of the decision-making processes (Okali, 2011).

From 1995, development efforts switched from WID to Gender and Development (GAD) (UN 2014). These initiatives took into account the relationships between men and women in development processes. Development efforts therefore shifted from women to gender relations.

Commonly known as gender mainstreaming, this refers to instances where any planned action such as policies, programs and projects, assess the outcomes for both men and women. (Catacutan and Naz, 2015). The concerns of both men and women are a key component in the design and implementation of policies and programs across all spheres. This is in order to achieve gender equality, which occurs when men and women have equal opportunity to realize their potential and contribute to development and enjoy its benefits (Mikkola and Miles, 2007).

Gender mainstreaming has led to the integration of gender in many of the development agendas, such as the Millennium Development Goals (MDGs), in the year 2000. These have since been replaced by the Sustainable Development Goals (SDGs). The fifth SDG aims to achieve gender equality and empower all women and girls by ending all forms of discrimination and ensuring their participation in leadership and other levels of decision-making (UN, 2015).

The GAD agenda was included in agricultural and food security policies (FAO, 2011). Research on gender in agriculture has since been carried out on various aspects such as markets, intra-household dynamics, differences in productivity and efficiency and dynamics in value chains. Most of this research has revealed that due to the existing structures in most societies, women lack adequate access to productive resources and opportunities (Quisumbing, *et al.* 2014). According to the World Bank (2009), gender equality in agriculture is important for a number of reasons. For instance, higher economic growth is achieved when access to resources is equal for both men and women. It also leads to improved food security and overall household welfare.

Women are increasingly getting involved in agriculture either as waged workers, unremunerated family workers or independent producers (Lastarria-Cornhiel, 2006). This has happened due to a number of factors such as economic policies like trade liberalization that have promoted growth of agri-businesses and agricultural exports. Gender dynamics such as migration to urban areas in search of better jobs have also left women in charge of farming to provide food for their households (Doss, 2011b; Seebens, 2011).

Increased number of women in agriculture does not necessarily translate into their empowerment. Empowerment refers to a situation where people are enabled to live their lives to their full potential based on their own choices in respect of their rights as human beings (Catacutan and Naz, 2015). Men and women who have higher decision-making power are more empowered. Studies have shown that people who earn wages and own resources such as land have higher decision-making power than those who are resource-poor (Lastarria-Cornhiel, 2006; Doss, 2011a).

Agricultural value chains are also embedded in social contexts, hence are affected by social and cultural factors including gender. The organizational arrangements and bargaining strengths of the actors from input supply, production, processing, storage, wholesale and retail to consumption are influenced by social, cultural and economic factors (Coles and Mitchell, 2011; Rubin and Manfre, 2014). The development of value chains affects gender relations in households as men and women take up more responsibilities along the value chain.

Participation in value chains is affected by access to factors of production such as land, labour and capital. Women mostly participate in value chains as employees, while men assume management roles. Women tend to dominate lower levels where there are fewer barriers to entry, simple tasks and low cost equipment. This is due to unequal access to resources, gender power relations and land tenure arrangements that exclude women (Coles and Mitchell, 2011).

Gender in agriculture cuts across all aspects from decision-making in accessing resources to participation in other value chain activities. It is therefore imperative that research on gender in agriculture take on a comprehensive analysis, with the various roles, preferences, needs and resources accessible by both men and women, taken into account. *Ex-post* impact assessments and evaluations need to be integrated in gender research (Quisumbing *et al.* 2014).

2.2 Review of Empirical Studies on Gender Roles in Decision-Making, Access to Institutional Support Services and Production Efficiency

2.2.1 Gender Roles in Decision-Making

Perceptions by societies about the functions and responsibilities of either sex result in different gender roles. In many traditional African societies, women are considered the primary care givers of children and as such they carry out most of the domestic tasks while men are usually perceived to undertake paid work outside the home (Sikod, 2007; FAO, 2011). Women are also traditionally known to cultivate food crops, for home subsistence, while men farm the cash crops which are sold to generate income for the household (Dimova and Gang, 2013).

Intra-household decision making is as a result of a bargaining process, which depends on an individual's resource endowment (Udry, 1995). Consequently, men and women who have greater access to resources such as land and institutional support like factors like extension, social capital and technology, have higher bargaining power and hence more input in decision-making (Angel-Urdinola and Wodon, 2010; Ambler *et al.*2017).

Several studies have characterized patterns of gender roles in farm decision-making. A qualitative study based on focus group discussions with the respondents by Van Eerdewijk and Danielsen (2015), on gender matters in agriculture in Ethiopia and Kenya, found that in Ethiopia, men were the sole decision-makers in most of the farm activities such as allocation of labour, output utilization and farm expenses incurred. In Kenya, it was noted that more women participated in decisions by being consulted or informed, but men had higher decision making power and control over resources. This was, however, not the case for households where women had their own resources, for instance income from formal employment. The study did not analyze quantitatively the responses, which is the gap that was filled by this study.

Enete and Amusa (2010a) found that men and women contributed almost equally to most of the farm decisions in cocoa production in Nigeria. Ajewole *et al.* (2015) found that men dominated decision-making in rice production in Nigeria, with more than 80 percent of men undertaking rice production decisions alone. Meijer *et al.* (2015) found that joint decision-making between husband and wife was common in Malawi, for most agricultural activities such as decisions on what crops to plant, weeding, fertilizer application and selling farm produce. Some decisions were mostly undertaken by the men, such as decisions regarding tree planting and management. Ngigi *et al.* (2016) found that, in Kenya, about 77 percent of men reported making decisions on land use without consulting their wives. These studies did not assess the effect of the observed decision-making patterns on farm productivity or efficiency; hence this is a gap that this study attempted to fill.

Other studies have looked at how participation in decision-making affects affect productivity and efficiency and have had mixed results. Sneyers and Vandeplas (2013) found that households where women contributed to dairy production decisions had about 20 percent higher productivity than households where women did not contribute to decisions. Dimova and Gang (2013) assessed the effect of female decision-making in household cash crop production on efficiency in Malawi. The results of the study showed that households where women were the key decision makers in cash crop production had greater efficiency than households where men were the key decision makers. Ngenzebuke (2014) found that in Tanzania, plots owned by women were 6 percent less productive than male-owned plots, but could be 9 percent more productive when the female is involved in decision making in production. These studies used male-headed versus female-headed household categorization in their analysis, and as such did not assess the intra-household gender dynamics, which is the gap filled by this study.

Some of these studies have assessed the determinants of participation in various household decisions by both men and women. Sneyers and Vandeplas (2013) found that ownership of assets, access to technology and the number of hours spent on labour in the farm had a positive effect on women's decision-making in the household with regards to dairy farming in India. A study by Enete and Amusa (2010b), found that education level, number of hours spent doing farm labour, farm size and financial contribution all positively influenced women's decision-making power on cocoa farming activities in Nigeria. The gap identified from these studies is that their focus was on women while the current study incorporated both men and women in the analysis. The literature on factors affecting contribution to decision-making in households for Kenya still remains scarce and this study helps to add to the knowledge in this area.

2.2.2 Gender and Access to Institutional Support Services

Differences in social and cultural aspects across societies determine access to resources and institutional support services by men and women. Many of the studies that have been done on gender in agriculture (see for example Kinkingninhoun-Medagbe *et al.* 2008; Peterman *et al.*2010; Van Eerdewijk and Danielsen, 2015; Muriithi 2015; Ajewole *et al.* 2015), have found that men and women do not have equal access to productive resources such as land, labour, machinery, credit, training and extension services and membership in social and agricultural development groups. For example, Alene *et al.* (2008) found that women cultivated smaller portions of land than men in western Kenya. Ngigi *et al.* (2016) found that men owned and controlled a larger percentage of draft livestock such as oxen and donkeys, while women mainly controlled smaller animals such as poultry. Husbands were also found to own most of the household assets. Gebreselassie *et al.* (2013), found that in Ethiopia, 95 percent of male-headed households that were sampled owned oxen for ploughing compared to 75 percent of female-headed households. Fisher and Kandiwa (2014), found that female-headed households were more labour-constrained, especially with regards to adult male labour compared to the male-headed households, and therefore had to rely on children and the elderly to provide labour for agricultural activities in Malawi.

Membership in agricultural development groups is important for agricultural activities as it can lead to benefits such as subsidized credit, collective marketing and input acquisition. Results of a study by Muriithi (2015), showed that in Central Kenya, women's membership in horticultural production and marketing groups was very low; about 20 percent. Van Eerdewijk and Danielsen (2015), found that in Ethiopia, women group membership was low and was mainly reserved for those who sold produce or used purchased farm inputs, which was mainly done by men. The same study, however, found that in Kenya, the majority of women interviewed belonged to various types of groups. This was because of the need to assist each other in running their households and developing their communities. Ngigi *et al.* (2016) also found that women had higher membership in social groups, compared to men.

Access to extension or agricultural advisory services is a vital service for farmers because it is through this that they are able to gain knowledge on different farming aspects. Women generally have less access to extension and training services. A study in Ethiopia by Gebreselassie *et al.* (2013), found that female-headed households received half as many extension visits as the male-headed households and women did not participate in agricultural training events that took place outside the farm. Muriithi (2015), also found that majority of women did not participate in horticultural training activities. About 34 percent of the women attended a training event compared to 62 percent of men. According to Ragasa (2012), fewer women are likely to participate in training services because their mobility is hindered by their greater time burdens owing to their domestic responsibilities, social and cultural norms and lack of funds for travel. Furthermore, lack of capacity due to their lower education levels makes their opportunities for participating in these activities limited (Farnworth and Colverson, 2015).

Access to financial services, for instance through credit services or insurance is important for farmers' productivity and for overall agricultural development. This ensures that farmers can make the necessary investments for optimal production and also withstand negative occurrences such as droughts and disease outbreaks that would otherwise lead to huge losses (Fletschner and Kenney, 2014). According to FAO (2011), women are less likely to access credit because they do not own most of the household assets and also because of social norms that limit the kind of economic activities they can engage in. A study by Awotide *et al.* (2015), among smallholder cocoa farmers in Nigeria, found that male-headed households received up to 30 percent higher loan amounts than female-headed households. Muriithi (2015), found that 54 percent of men compared to 44 percent of women reported to receiving agricultural credit, among smallholder vegetable farmers in Kenya. Some studies have found the reverse whereby more women than men are found to be able to obtain loans for agricultural activities. For instance, Anang *et al.* (2015), found that being female increased the likelihood of receiving credit in Ghana. This is because women were found to be more trust-worthy and had higher repayment rates than men. An increase in the number of organizations providing credit facilities that are targeting women is another reason for more women than men being able to access credit (World Bank, 2009). Their access to credit is further enhanced by groups such as merry-go-rounds and savings associations, which offer them easier access to loans without many requirements such as the ones that exist in formal lending organizations.

2.2.3 Production Efficiency and Gender

As women have generally been found to have less access to and control over resources, it would be expected that their productivity and efficiency would be lower than that of men. A number of studies have included variables to represent gender in their analyses of farm production efficiency (see for example: Alene *et al.* 2008; Liu and Myers, 2009; Dadzie and Dasmani, 2011; Simonyan *et al.* 2011; Nyanjong' and Lagat, 2012; Karki, *et al.* 2015), and have obtained mixed results.

Koirala *et al.* (2015), found that female-headed households were less efficient than male-headed households in the Philippines. Dadzie and Dasmani (2011) found that, in Ghana, farms that were managed by men were more technically efficient than farms that were managed by women. This was because the men had better access to and control over resources compared to the women. Liu and Myers (2009), found that having a female as the household head decreased efficiency of maize farmers in Kenya by about 5 percent.

Simonyan *et al.* (2011), analyzed gender differences in technical efficiency among maize farmers in Nigeria and found that female farmers had higher technical efficiency scores as compared to their male counterparts. Nyanjong' and Lagat (2012), observed higher technical and allocative efficiency scores for sugarcane plots that were managed by women compared to those that were managed by men, in western Kenya.

Other studies have found no significant differences between gender and efficiency. Alene *et al.* (2008), found that there were no significant differences in technical and allocative efficiencies between male-headed and female-headed households in western Kenya. Similar results were obtained by Karki, *et al*. (2015), who found that gender did not have any effect on technical efficiency of African indigenous vegetable farmers in Kenya. Nyagaka*et al.*, (2010), also found sex of the household head to have no influence on farm technical efficiency in Kenya.

These studies have all used the sex of the household head or farm manager as the variable for gender. The current study, however, delved deeper into the gender dynamics within the households and assessed men and women's access to institutional support services and roles in decision-making and how these affect efficiency.

2.2.4 Production Efficiency and Access to Institutional Support Services

Many of the studies that have analyzed farm production efficiency have included variables such as group membership, access to credit and extension services, access to markets for input and output, and access to information and technology.

Membership in agricultural development and other social groups is generally expected to have a positive effect on farm production efficiency. According to the FAO (2011), groups such as self-help groups, community-based organizations and savings groups can help in pooling of resources, building social capital and therefore increase access to information which is helpful in farm production activities. Several studies have assessed the effect of group membership on efficiency. For instance, Tchale (2009), found that farmer membership in a club or organization had a positive effect on efficiency of smallholder farmers in Malawi. Similarly, Obare *et al.* (2010), found that membership in a farmers' association had a positive effect on allocative efficiency of Irish potato farmers in Kenya. Conversely, Simonyan *et al.* (2011), found that membership in a cooperative union negatively affected efficiency of male farmers. This was because the men were found not to utilize their membership in these groups for discussing production issues. Addai *et al.* (2014), however, found that membership in a farmer's organization had no significant effect on technical efficiency of maize farmers in Ghana.

Farmers' access to financial services such as credit, savings and insurance also has an effect on agricultural output and hence farm production efficiency. When farmers are able to obtain money, for instance through credit loans, they can meet their costs for resources such as inputs and even invest in technology such as farm machinery, which helps improve their productivity (FAO, 2011).

Several studies on efficiency have included variables that represent access to financial services such as credit, savings and off-farm income. Nyagaka *et al.* (2010), found that credit access positively affected technical efficiency of Irish potato farmers in Kenya. Dadzie and Dasmani (2011), also found that access to credit had a positive effect on efficiency of farms in Ghana. Other studies that have found credit access to have a positive effect on farm technical efficiency include: Awotide *et al.* (2015), which found that access to credit had a positive effect on technical efficiency of smallholder cocoa farmers in Nigeria. Liu and Myers (2009), found that farmers who had other sources of income apart from farming had greater technical efficiency scores for maize production than those who did not. Likewise, Otieno *et al.* (2014), found that non-farm income positively influenced efficiency of beef cattle farmers in Kenya. This was because the extra earnings enabled the farmers to invest in various resources required for farm production purposes.

Access to extension services and training is another institutional support factor that has an effect on farm production efficiency as it enables farmers to obtain information on various technologies available such as new production methods and management practices (Ragasa, 2012). This has been analyzed in several studies. For instance, Addai *et al.* (2014), found that contact with an extension agent reduced technical inefficiency of maize farmers in Ghana by about 40 percent. Other studies with similar results include Nyanjong and Lagat (2012), which found that sugarcane farmers in western Kenya who had received extension services were more economically efficient than those who had not and Kavoi *et al.* (2010), which found that dairy farmers who received more extension service visits were more cost efficient. This was because they acquired knowledge on new technologies and production methods. Alene *et al.* (2008), found that access to extension services increased maize production for women farmers in Kenya by about 14 percent compared to 10 percent for men. Essilfie *et al*. (2011), however, found that contact with an extension agent had no effect on efficiency of maize production in Ghana. These studies did not assess the intra-household patterns of men and women's access to institutional support factors and its effect on efficiency. This is the gap that this study sought to fill.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Conceptual Framework

Figure 2 below illustrates the conceptual framework for the study.

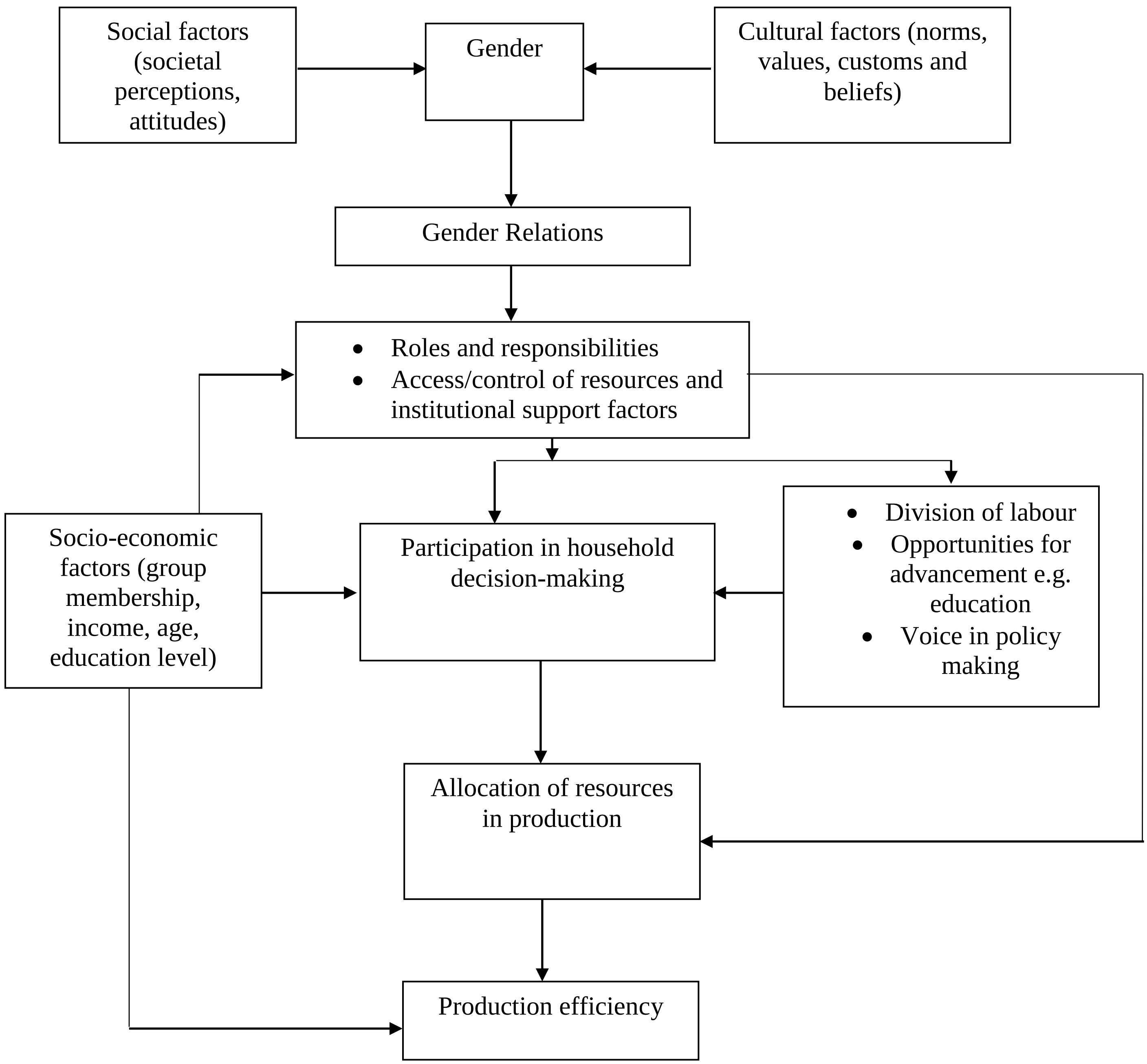

Figure 2: Conceptual framework for the study

Source: Adapted from FAO (2011) and World Bank (2009).

Gender is determined by different social and cultural factors that differ by society. It is the social definition of being either a man or a woman. It is determined by a particular society's perceptions and attitudes about the physical differences and capabilities of either sex (FAO, 2004). Cultural factors such as norms, values, beliefs and customs also influence gender. These are social rules and assumptions that define who does what, how, the status of people and their relative value in society (Van Eerdewijk and Danielsen, 2015). Gender influences gender relations, which refers to the way a specific society assigns roles to men and women. This determines their various functions and responsibilities in society and their access to and control over resources and institutional support factors, including land, farm equipment, inputs such as seed, fertilizer, labour, credit and extension services. Income obtained from crop sale is also an important resource to consider in gender analysis. Access to resources and services also determines allocation of resources which affects efficiency in production.

Roles and responsibilities and access to and control of resources affect division of labour in production, opportunities for professional advancement such as education voice in policy making as well as intra-household decision-making roles. In farming, these could be decisions on which food and cash crops to grow, the varieties, seeds to use, fertilizer to use, purchase of farm equipment, when to sell crops, how to utilize the income obtained from crop sale and how to use credit obtained from financial institutions. The participation of men and women household farm decisions in turn determines how resources are allocated in production, which then affects farm production efficiency.

3.2 Theoretical Framework

This study is based on the transformation concept in producer theory. A producer, thus a firm, farm, household or individual, takes a set of inputs and transforms them into outputs. These inputs are also called factors of production, for instance land, labour, seed and fertilizer. A production function defines the relationship that transforms inputs into outputs and is expressed as:

$$Y = f(x_1, x_{2.............}x_n) \qquad (1)$$

Yrepresents the output, f is the functional relationship and x_i represents the quantities of inputs. The value of Y depends on the quantities of input that are used up in the production process (Debertin, 2012).

Production functions assume various functional forms, for instance Cobb-Douglas, transcendental logarithmic (translog), and quadratic and are used in empirical analyses of growth and productivity. Productivity refers to the output generated per unit of input. In efficiency analysis the most commonly used production functions are the Cobb-Douglas and the translog production functions because they are linear in parameters and therefore can be estimated by simple linear regression methods (Czekaj and Henningsen, 2011).

The Cobb-Douglas production function is specified as follows:

$$Y = Ax_1^{\alpha}x_2^{\beta} \qquad (2)$$

Where Y represents the output, $x_1$and x_2 are inputs, α and β are parameters to be estimated and A represents the combined impact of the other factors of production (Debertin, 2012). As this function expresses the inputs and output as a non-linear relationship, it has to be linearized in order for the estimates of A, α and β to be obtained. This is done by taking the natural logarithm of both sides of the equation in (2), hence:

$$InY = InA + \alpha Inx_1 + \beta Inx_2 \qquad (3)$$

The initial specification of the Cobb-Douglas production function had only two inputs. This can be generalized to include more inputs, for instance:

$$Y = Ax_1^{\beta 1} x_2^{\beta 2} x_3^{\beta 3} x_4^{\beta 4} \quad (4)$$

The returns to scale for a Cobb-Douglas production function are given by the sum of the parameters, for instance in equation (2), it is given by $\alpha + \beta$. When the sum is less than 1, it signifies decreasing returns to scale, when it is equal to 1, it means constant returns to scale and increasing returns to scale when it is greater than one. The values α and β represent the partial elasticities of production for the respective inputs. The Cobb-Douglas production function produces isoquants that are negatively sloped and convex to the origin (Debertin, 2012). It is mainly applied due to its simplicity and its assumptions of homogeneity and unitary elasticity of substitution between inputs.

The translog production function does not assume constant elasticity of substitution between inputs. It is said to be a flexible functional form because it has a second order approximation property. It does, however, have some limitations in that it does not provide a good approximation for a wide range of observations and it involves estimation of more parameters than the Cobb-Douglas production function (Lyu, *et al.,* 1984). A two-input translog production function can be expressed as:

$$InQ = \alpha + \beta_1 Inx_{1i} + \beta_2 (Inx_{1i})^2 + \theta_1 Inx_{2i} + \theta_2 (Inx_{2i})^2 + \delta (Inx_{1i})(Inx_{2i}) + \varepsilon_i \quad (5)$$

Where:

InQ is the natural logarithm of the output (*Q*)

Inx_{1i} is the natural logarithm of the first input (x_1) for observation *i*

Inx_{2i} is the natural logarithm of the second input (x_2) for observation *i*

α, β_1, β_2, θ_1, θ_2 and δ are regression parameters to be estimated

ε_i is the error term for the i^{th} observation

According to Farrell (1957), there are two types of efficiency - technical and allocative. Technical efficiency refers to firms' ability to produce maximum output from a given set of inputs. Allocative efficiency, also known as price efficiency, is the ability of firms to use inputs optimally given their prices (Chavas and Aliber, 1993).Technical efficiency denotes the relationship between some observed production and an ideal production level. Calculation of technical efficiency involves estimation of a frontier production function. This can be done through either parametric or non-parametric approaches.

Non-parametric approaches assume a production function producing maximum output given a set of inputs. This is specified as:

$$y_i = f(x_i;\beta), i = 1, 2 \dots . N \tag{6}$$

wherey_i is output, x_i represents a vector of inputs and β is a parameter to be estimated. This was then estimated using mathematical programming. These methods however, posed some problems as they are sensitive to outliers and they produce estimates with no known statistical properties (Aigner *et al.*, 1976). Aigner *et al.*, (1976) proposed the addition of a two-sided error term to the model. This is in order to account for firms' inability to optimize, which is represented by a one-sided error term, as well as measurement errors in y_i, which is represented by a symmetric error term. The error term is given as:

$$\varepsilon_i = v_i + u_i \tag{7}$$

The component v_i is symmetric and independently and identically distributed with $N(0, \sigma_v^2)$, while the component u_i is distributed independently of v_i and satisfies $u_i \leq 0$. When σ_v^2=0, the model collapses to a deterministic frontier. The error term is specified with two different components because it is assumed that the production process is faced with two different random disturbances. The non-positive disturbance, u_i arises due to technical inefficiency while the random disturbance v_i arises due to shocks such as poor weather and differences in agro-climatic conditions. A firm's production frontier is therefore given by:

$$y_i = f(x_i ; \beta) + v_i \quad (8)$$

with the error term making it stochastic, hence the name stochastic frontier analysis (Aigner *et al.*, 1976). The other part of the error term, u_i shows that the firm's output should lie below or on its frontier. Stochastic frontier analysis is a parametric approach commonly used in estimation of production frontiers and calculation of technical efficiency scores because it incorporates the two-sided error term that distinguishes between noise and inefficiency effects (Battese and Coelli, 1995).

3.3 Study Area

The initial survey which was conducted by CIMMYT in 2013 covered five counties: Bungoma and Siaya in Western Kenya and Meru, Embu and Tharaka Nithi in Eastern Kenya. For this study, two counties out of the five were selected, that is, Bungoma and Meru counties. Bungoma County was selected because it is one of the main maize growing areas in Kenya and maize is a major subsistence as well as cash crop in the area. Meru County was selected because it has a higher level of commercialization and lower poverty levels compared to the other counties, where maize is a minor crop compared to Bungoma, and is not a major staple food there. The variation in the economic conditions of the two regions provide an overview of differences in intra-household gender roles and access to resources in maize production efficiency across the eastern and western regions of Kenya.

Bungoma County covers an area of 3 123 km^2 has a population of about 1,630 934 people (KIPPRA, 2016). It is one of the four counties that were carved out of the former Western Province of Kenya. It borders Trans Nzoia County to the North and North East, the Republic of

Uganda to the North-West, Kakamega County to the East and South East and Busia County to the South-West. It lies within latitude 00° 33’48.60”N and longitude 34° 33’37.98”E. It comprises mainly upper and lower highland as well as upper midland areas which are all conducive for the growth of maize. The altitude ranges from 1200m in the lower areas to about 4000m in the higher areas – around Mount Elgon. The climate is mainly warm and wet, with two rainy seasons, one running from March to July, and the other running from August to October. Annual rainfall averages 400-1800mm, while the annual temperature varies from 0 to 32°C (Republic of Kenya, 2013).

The economy of Bungoma is largely dependent on agriculture owing to its rich and diverse ecological conditions and fertile soils. Maize, sugarcane, beans and sunflower, are some of the main crops grown in the county. Maize yields in Bungoma average 1.6 million tonnes per year, most of which is grown for subsistence. Yields fluctuate annually due to over-reliance on rain-fed production, use of uncertified seeds and deterioration of soil quality due to overuse of fertilizers (Republic of Kenya, 2013). According to KIPPRA (2016), Bungoma has an average poverty level of 55 percent. Figure 3 below is a map showing the location of Bungoma County.

Figure 3: Map of Bungoma County

Source: Republic of Kenya (2013).

Meru County is found in the upper eastern region of Kenya and covers an area of 6 936 $km^{2.}$ It has an estimated population of about 1.5 million persons (Republic of Kenya, 2014). It borders Tharaka Nithi County to the South, Isiolo County to the North and East, Laikipia County to the West and Nyeri County to the South West. It lies within latitude 00° 03’00”N and longitude 37° 37’559.99”E.

The county has a wide range of agro-ecological zones, and is covered mainly by highland areas. Altitudes range from 300 to 5199 metres above sea level. The climate also varies but is cool and wet in most areas. Rainfall averages 300mm to 2500mm per year and temperatures are between 8 and 32°C (Republic of Kenya, 2014).

More than 80 percent of the population in Meru relies on agriculture to sustain their livelihoods. The main cash crops grown are tea, coffee, bananas and flowers. Maize is grown mainly on small-scale, with bananas being the staple crop in the region. Meru County is estimated to have a poverty level of about 28 percent, which is among the lowest in Kenya, after Kajiado, Nairobi and Kiambu counties (KIPPRA, 2016; Republic of Kenya, 2014).

The map of Meru County is shown in Figure 4 below, with the main agricultural areas indicated.

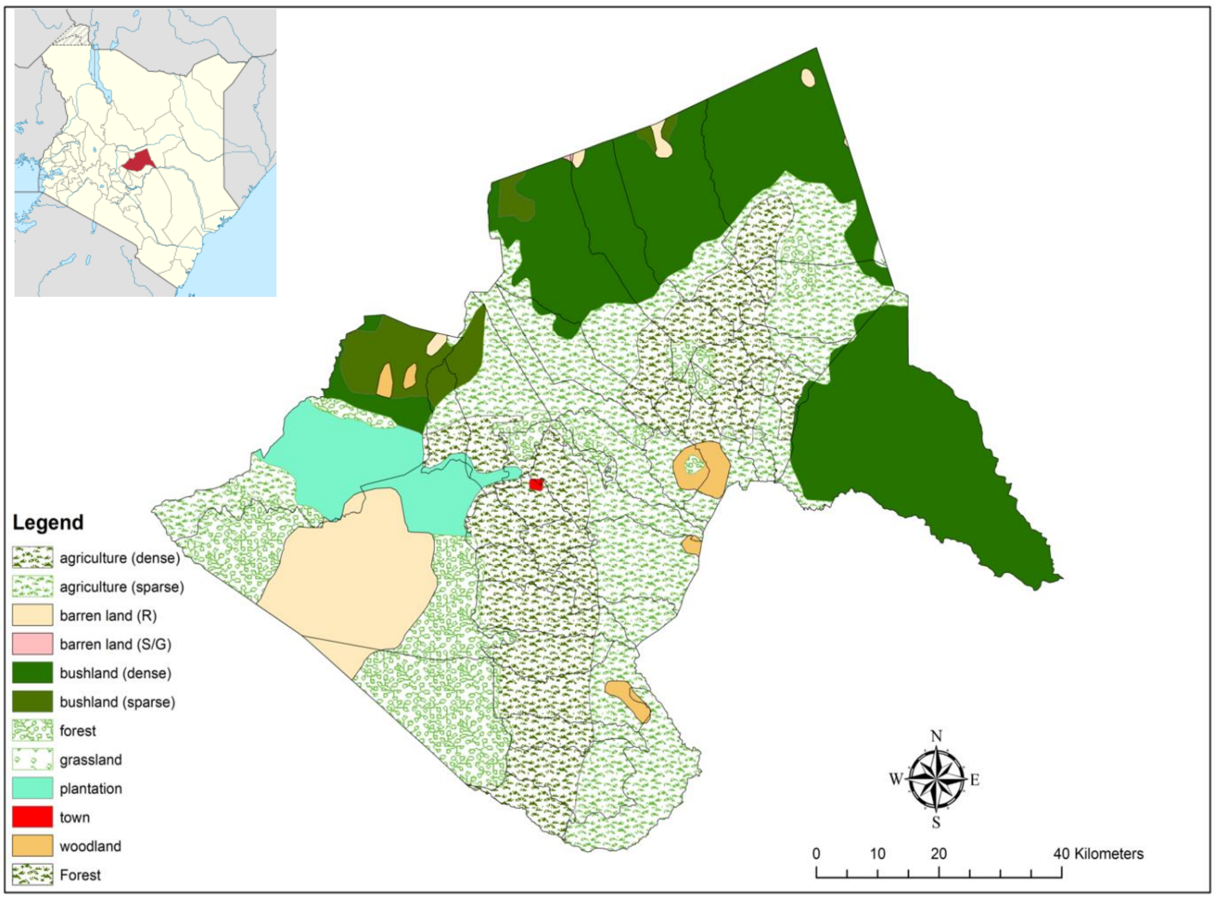

Figure 4: Map of Meru County

Source: Republic of Kenya, 2013

3.4 Sampling and Sample Size Determination

The study used purposive sampling method to obtain the respondents for the study. This is a non-probability sampling technique which is used when there are a limited number of primary data sources who can contribute to the objectives of the study (Mugenda and Mugenda, 2003). The criterion for selecting the subjects for the study in this case was the respondents who had been surveyed in the initial study. Following Cochran (1977), calculating the sample size when the population size is known can be done using the formulae in the steps outlined below:

$$\frac{z^2pq}{e^2} = n_0 \qquad (9)$$

Where, n_0 is the sample size, z^2 is the critical value for the desired confidence level, p is the estimated proportion of attribute that is present in the population, q is 1- p, and e is the desired level of precision.

For the current study, the desired level of precision was 5%, with 95% confidence level whose critical value, z, is 1.96. Using an estimated proportion of attributes of 50% in the population, the ideal sample size would be:

$$\frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 384 \qquad (10)$$

Since the population from which the farmers were sampled was known, the formula in (9) was modified, according to (Cochran, 1977) to be:

$$\frac{n_0}{1 + \frac{(n_0 - 1)}{N}} = n \qquad (11)$$

Where n_0 is the sample size obtained from equation (9), and N is the population size, which in this case was 536, that is, the number of households sampled in the initial survey.

For this study, this is given as:

$$\frac{384}{1+\frac{384-1}{536}} = 224 \qquad (12)$$

The desired sample size for the study was 224 households, however it was only possible to sample 162 households (81 from each county), because the rest could not be reached.

Similar studies that have conducted gender analyses in household decision-making, for instance Ngigi *et al.* (2016), used a sample size of 156 households. Others include Ajewole *et al.* (2015), Meijer *et al.* (2015) and Van Eerdewijk and Danielsen, (2015), which have used sample sizes of between 111 and 300. The formula outlined above generated a sample size for this study which falls within the range used by these studies with a similar context, thus deeming its use here appropriate.

3.5 Data Needs and Sources

The study used primary data which was collected in October and November 2016 by the use of semi-structured questionnaires and face-to-face interviews. The study used the same respondents who were interviewed by CIMMYT in 2013 for the Adoption Pathways Project. This was as a form of triangulation in order to validate the data and increase its credibility, by obtaining current data on gender dynamics. The enumerators who collected the data were trained on how to interview the respondents prior to beginning the data collection exercise. Data was collected on both the head and spouse in each household. Variables were included on the socio-economic characteristics of the respondents, institutional support services and maize production. Specifically, some of the variables on which data was collected were: age of the respondents, education level, household income level, access to credit and extension services, group membership and maize plot data such as inputs used and yield obtained.

3.6 Empirical Data Analysis

3.6.1 Characterization of Maize Production Decisions and Institutional Support Services by Gender

The first objective on characterization of maize production decisions and institutional support factors along gender perspectives was done using descriptive methods. This was by calculation of frequencies and percentages for the categorical variables and means for the continuous variables, which were then presented in tables and graphs. In order to test for a significant difference for the categorical variables between genders and between counties the Pearson's Chi-square was estimated. The resultant χ^2 statistic as shown in Tables 3, 4 and 5 shows how much difference exists between the observed results and expected results if there was no relationship between the variables. A large enough statistic indicates that there is a relationship between the variables and hence the *p-value* is significant. The independent samples t-test was used to test for any significant differences between the continuous variables. This was done in Statistical Package for Social Sciences (SPSS) version 22.

3.6.2 Analysis of Factors Affecting Participation in Maize Production Decision-Making

The second objective on analysis of the socio-economic factors affecting participation in farm decision-making was analyzed using a multivariate probit model. This is a generalization of the probit model which allows the estimation of several equations jointly, where the dependent variables are binary and their occurrences are correlated (Greene, 2002). A model with two equations (bivariate) is specified as:

$$y_1^* = \boldsymbol{x}_1'\beta_1 + \varepsilon_1 , \quad y_1 = 1 \; if \; y_1^* > 0, 0 \; otherwise, \qquad (13)$$

$$y_2^* = \boldsymbol{x}_2'\beta_2 + \varepsilon_2 , \quad y_2 = 1 \; if \; y_2^* > 0, 0 \; otherwise, \qquad (14)$$

$$E\{\varepsilon_1|x_1,x_2\} = E\{\varepsilon_2|x_1,x_2\} = 0, \quad (15)$$

$$Var\{\varepsilon_1|x_1,x_2\} = Var\{\varepsilon_2|x_1,x_2\} = 1, \quad (16)$$

$$Cov\{\varepsilon_1,\varepsilon_2|x_1,x_2\} = \rho. \quad (17)$$

Where y_i represents binary outcomes of the dependent variable, $\boldsymbol{x}_i'$ represents a vector of explanatory variables, β_i represents coefficients to be estimated and ε_i are the error terms. The error terms follow a multivariate normal distribution, with mean zero and a variance-covariance matrix V, with values of 1 in the leading diagonals.

The model is estimated using the maximum likelihood method. For a bivariate model, the normal cumulative density function is given as:

$$Prob(X_1 < x_1, X_2 < x_2) = \int_{-\infty}^{x_2}\int_{-\infty}^{x_1} \phi_2\,(z_1, z_2, \rho)dz_1, dz_2 \quad (18)$$

This is denoted as:

$$\Phi_2(z_1, z_2, \rho) \quad (19)$$

The density is given as:

$$\phi_2(z_1, z_2, \rho) = \frac{e^{-\left(\frac{1}{2}\right)\left(x_1^2 + x_2^2 - 2\rho x_1 x_2\right)/\left(1-\rho^2\right)}}{2\pi(1-\rho^2)^{1/2}}.49 \quad (20)$$

To construct the log likelihood, let $q_{i1} = 2_{yi1} - 1$ and $q_{i2} = 2_{yi2} - 1$. Hence, q_{ij}=1 when y_{ij}=1 and -1 when $y_{ij} = 0$ for j = 1 and 2. Let:

$$z_{ij} = x_{ij}'\beta_j \text{ and } w_{ij} = q_{ij}z_{ij}j = 1,2 \quad (21)$$

and

$$\rho_{i^*} = q_{i1}q_{i2}\rho \quad (22)$$

In the density, ϕ_2, and cumulative density function, Φ_2, the subscript 2 indicates the bivariate normal distribution. Otherwise it indicates the explanatory variables in the model (Greene, 2002).

The probabilities that enter the log likelihood function are:

$$Prob\{Y_i = y_{i1}, Y_2 = y_{i2} | x_1, x_2\} = \phi_2(w_{i1}, w_{i2}, \rho_{t^*}) \quad (23)$$

The empirical model for this study is given as:

$$\begin{Bmatrix} DECINPUT \\ DECLABOUR \\ DECCREDIT \\ DECOUTPUT \\ DECINCOME \end{Bmatrix} = \beta_0 + \beta_1 Sex + \beta_2 Group + \beta_3 Extvisits + \beta_4 County + \beta_5 Educyrs + \beta_6 Landsize + \beta_7 Credit + \beta_8 Friendldr + \beta_9 Phoneuse + \varepsilon_{1-5} \quad (24)$$

Where the dependent variables are:

$DECINPUT$ = Participation in decision- making on inputs (seed and fertilizer) to use, which is a binary variable, 1, when the person participates in that decision and 0 when they do not.

$DECLABOUR$ = Participation in decision- making on labour to be hired, which is a binary variable, 1, when the person participates in that decision and 0 when they do not.

$DECCREDIT$ = Participation in decision- making on sourcing and use of credit, which is a binary variable, 1, when the person participates in that decision and 0 when they do not.

$DECOUTPUT$ = Participation in decision- making on output utilization, which is a binary variable, 1, when the person participates in that decision and 0 when they do not.

$DECINCOME$ = Participation in decision- making on use of income from sale of maize, which is a binary variable, 1, when the person participates in that decision and 0 when they do not.

And the explanatory variables are:

Sex = The sex of the respondent, 1 when male and 0 when female.

$Group$ = Group membership, 1 when the person is a member and 0 when they are not.

$Extvisits$ = The number of extension visits received in the past year.

$County$ = The county; 1 for Bungoma and 2 for Meru.

$Educyrs$ = The number of years of formal education a person has obtained.

$Landsize$ = Size of land owned in acres.

$Credit$ = Whether or not a person received credit, 0 = no, 1 = yes.

$Friendldr$ = Whether or not a person has friends or relatives who are in leadership positions in governmental organizations; 0 = no, 1 = yes.

$Phoneuse$ = Whether or not the household utilizes mobile phones to access agricultural services, 0 = no, 1 = yes.

$\varepsilon_1 - \varepsilon_5$ − Represent the error terms for each of the equations.

The expected signs of the variables included in this model are indicated in Table 1 as shown below:

Table 1: A Summary of the expected signs of the variables

VARIABLE	DESCRIPTION	EXPECTED SIGN
Age	Age in years	±

Education Level	Number of years of formal education	+
Farm size	Size of farm in acres	+
Access to credit	1 when credit was obtained, 0 when no credit was obtained	+
Access to extension services	1 when extension services were obtained, 0 otherwise	+
Group membership	1 when person is a member, 0 otherwise	+

Umeh and Chukwu (2014), and Sneyers and Vandeplas (2013), found a negative relationship between age and participation in farm decision-making. Kelechi and Chinasa (2015), found that older women participated more in household decision-making. This study hypothesized that age can influence participation in decision-making either positively or negatively as previous studies have produced mixed results.

Education level was expected to positively affect participation in farm decisions. Enete and Amusa (2010b), and Umeh and Chukwu (2014), found that women who had more years of formal education participated more in farm decisions. This is because they had more opportunities, including for earning income.

Obinna and Ifenkwe (2013), found that women participated more in farm decision-making in households that had larger farm sizes. This study expected that farm size would have a positive influence on participation in farm decision-making.

Access to credit and extension services were expected to positively influence participation in farm decision-making. This conforms to Ochieng *et al.* (2014), who found that people who had access to credit and extension services, participated more in farm decisions.

Group membership was expected to positively influence participation in farm decision-making. Pal (2014), found that decision-making levels were higher for women who belonged to self-help groups. Nyanjong' and Lagat (2012) found that farmers who were members of sugarcane out-grower groups had higher economic efficiency in production.

This model was estimated using STATA software, version 11.

3.6.3 Analysis of the Effect of Participation in Decision-Making and Access to Institutional Support Services on Maize Production Efficiency

The third objective on the analysis of the effect of participation and access to institutional factors on efficiency was analyzed using the stochastic frontier analysis. Technical efficiencies were estimated. Following Battese and Coelli (1995), the general specification is as follows:

$$y_i = f(x_i;\beta)\exp(V_i - U_i) \quad i=1, 2, \ldots\ldots N \qquad (25)$$

where y_i is the output of the i^{th} firm, x_i is a vector of inputs, β is a vector of parameters to be estimated and $(V_i - U_i)$ is the composite error term consisting of V_i, a random error term and U_i, a non-negative component representing inefficiencies.

Technical efficiency (TE) of the individual firm can be given as the ration of the mean output and the inputs used, given the technical inefficiency (Coelli *et al.*, 2005). This can be expressed as:

$$TE = \frac{E(y_i|u_i,x_i)}{E(y_i|u_i=0,x_i)} = exp(-u_i) \qquad (26)$$

Where TE lies between 0 and 1. When TE = 1, it means the firm is fully efficient, while a TE of 0 means the firm is fully inefficient.

A likelihood ratio test was done in order to test whether the Cobb-Douglas or the Translog production function was suitable for estimation of the data. The results are given in Section 3.7.4, under model diagnostics. The results showed that the Cobb-Douglas production function would provide a better fit than the translog production function.

The Cobb-Douglas production function used for this estimation was specified as follows:

$$In\ (y_i) = \beta_0 + \beta_1 InLand + \beta_2 InFert + \beta_3 InSeed + \beta_4 InLab + \ (V_i - U_i) \qquad (27)$$

where:

y_i is the quantity of maize produced in kg

$Land$ is the area of land in acres used in production of maize

$Fert$ is the quantity of fertilizer used in production of maize (kg)

$Seed$ is the quantity of seed used in planting maize (kg)

Lab is the total labor days required in production of maize

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ are parameters to be estimated

$(V_i - U_i)$ is the composite error term.

The inefficiency effects were estimated by the equation:

$$m_i = \delta_0 + \delta_1 Z_1 \qquad (28)$$

where:

δ_0, δ_1 are parameters to be estimated

$Z_1$is the variable representing participation in decision-making and access to institutional support factors

The efficiency model was analyzed using STATA software, version 11.

3.7 Model Diagnostics

3.7.1 Multicollinearity

In order to test for multicollinearity among the variables included in the multivariate probit model as well as the stochastic frontier model, the Variance Inflation Factors (VIFs) were calculated. According to Gujarati and Porter (2009), the VIF scores can be obtained by regressing one explanatory variable against the other explanatory variables and then using the formula below to calculate:

$$\frac{1}{1-R_i^2} \qquad (29)$$

Where R_i^2 is the coefficient of determination of the explanatory variable that was used as the regressand. The VIF scores are shown in Appendix 1.

3.7.2 Heteroskedasticity

The Breush-Pagan/Cook Weisberg test for heteroskedasticity was applied to ascertain that the variance between the error terms in the multivariate probit models were constant. The result was as shown: χ^2 (1) = 0.16; $Prob > \chi2 =$ 0.6909

It is not significant hence the study failed to reject the null hypothesis, implying constant variance.

3.7.3 Likelihood Ratio Tests

In order to test whether a pooled or separate multivariate probit models for men and women should be run, a poolability test was conducted. This was done by computing a Likelihood Ratio (LR) statistic, which is based on the difference in the log-likelihood functions for the different models (Wooldridge, 2012). In this case, the null hypothesis stated that there is no significant difference.

The result of the test is given as: $LR\ \chi^2(45) = 39.02$; $Prob > \chi 2 = 0.7221$

Given that the result is not significant, this study failed to reject the null hypothesis and thus the pooled model would be a better fit for the data.

The same procedure was carried out for the stochastic frontier analysis in order to determine whether there were any significant technological differences in maize production between the two counties. The result of this test is given as: $LR\ \chi^2(7) = 34.49$; $Prob > \chi 2 = 0.000$

Seeing as the result is significant, in this case, the null hypothesis is rejected meaning that a pooled stochastic frontier model would not provide a good fit as the difference in technologies used in the different counties is significant.

3.7.4 Model Choice for Stochastic Frontier Analysis

This test was conducted in order to determine which production function (Cobb-Douglas or Translog), would provide the best fit for the data. The results of this test are given in Table 2 below:

Table 2: Test Results for Model Fit for Stochastic Frontier Analysis

Production Function	Degrees of Freedom	Log likelihood	χ^2 measure	Prob ($>\chi^2$)
Cobb-Douglas	7	-74.443	1.857	0.395
Translog	17	-49.589	47.708	0.049**

***: Denotes significance at 5%*
Source: Survey Data (2016).

The results show that the null hypothesis which stated that the Cobb-Douglas production function would be best suited for analyzing the data compared to the Translog production function, is not rejected, hence it was the production function of choice for this study.

CHAPTER FOUR

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4.0 RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of the Households

Table 3 below shows the socio-economic characteristics for the households in the two counties that were sampled in the study.

Table 3: Socio-economic profiles of the households

Variable	**Bungoma (n=81)**	**Meru (n=81)**	**Total (n=162)**	**χ^2 statistic**	**Significance level (*p-value*)**
Received extension (% of households)	56.8	44.4	50.6	2.470	0.116
Received credit (% of households)	19.8	12.3	16.0	1.649	0.119
Income level in KES* (% of households)					
≤ 10 000	79.0	77.8	78.4	0.036	0.849
>10 000	21.0	22.2	21.6		
Receive remittances (% of households)	39.5	28.4	34.0	2.230	0.135
Received seed/fertilizer subsidy (% of households)	17.3	3.7	10.5	7.952	0.005**
Attended agricultural workshop or forum in past year (% of households)	55.6	37.0	46.3	5.586	0.018**
Grow maize for sale (% of households)	37.0	71.6	54.3	19.504	0.000**
Use of mobile phone for agricultural services	55.6	59.3	57.4	0.227	0.634
Average household size	7.6	4.2	5.8		0.000**
Average number of extension visits in the past year	8.3	1.8	5.1		0.000**
Average distance from farm to nearest market (km)	3.8	4.0	3.9		0.808
Average land size (acres)	3.1	2.6	2.8		0.845
Average land under maize (acres)	1.8	1.5	1.6		0.087*
Average maize yield (kgs)	1995.7	1475.2	1735.5		0.030**
Average monthly household maize consumption (kgs)	80.4	51.5	65.9		0.000**
Average number of months without own produced maize for consumption	2.5	0.5	1.5		0.000**

(**): Denotes significance at 5%; (*): Denotes significance at 10%; 1USD = KES 100 at the time of survey
Source: Survey Data (2016).

Half of the households overall received extension services in the past year. This is slightly higher for Bungoma (57 percent) than Meru (44 percent). The households in Bungoma also had a higher number of extension visits. This could be because of the presence of the One Acre Fund project in the area, which is a non-profit organization that assists farmers with subsidized inputs and credit for agricultural use. Figure 5 below shows the sources of extension for both counties and it shows that more farmers in Bungoma County receive extension service from the One Acre Fund than from government extension agents.

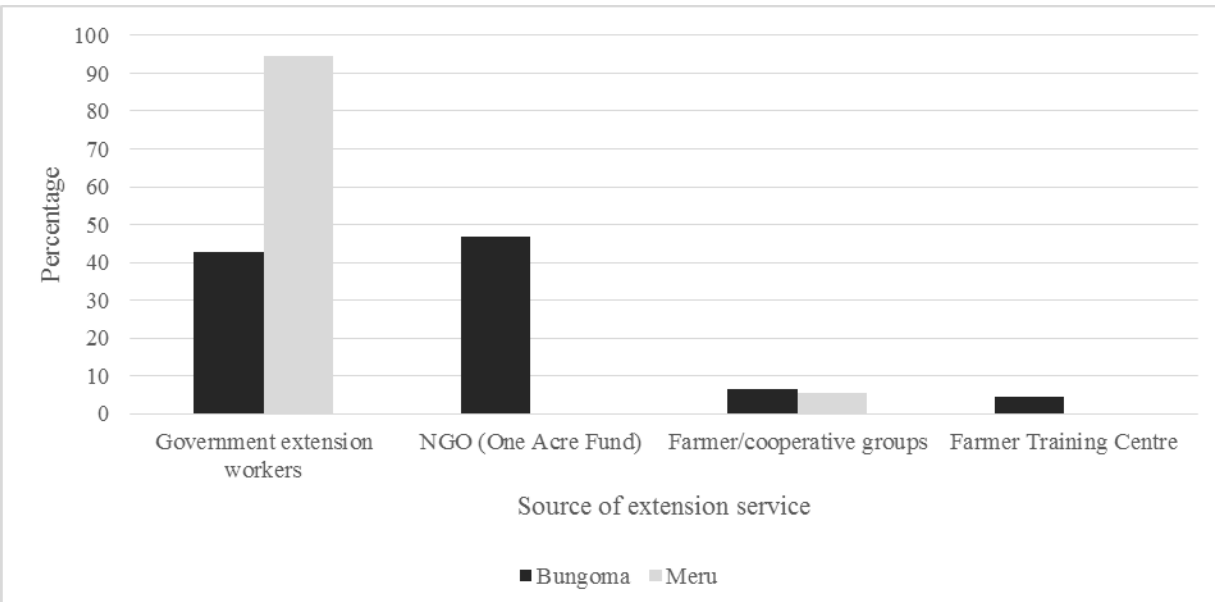

Figure 5: Extension service sources by county

Source: Survey Data (2016).

About 16 percent of households were able to access credit services in form of cash loans. This low figure could be due to the constraints faced in accessing credit such as lack of collateral for obtaining loans. Most of the households are low income households, with an average monthly income of less than 10,000 KES. Some of the respondents also cited fear of crop failure and hence not being able to repay the loans and high interest rates as other reasons for not taking out loans.

About 11 percent of the households received seed and fertilizer subsidies overall, with more households in Bungoma (17 percent) than in Meru (4 percent) receiving the subsidies. Long procedures for applying for and receiving subsidized inputs could be one of the reasons for this result. In some cases, some of the respondents said that the subsidies are set aside for disadvantaged groups in society such as widows and those with disabilities.

About 56 percent of households in Bungoma compared to 37 percent of households in Meru had members who attended an agricultural training workshop or forum in the past year. This shows that the farmers in Bungoma have greater access to agricultural information and training services. This could also be due to the presence of the One Acre Fund organization and farmer training centers in the area which conduct regular farmer trainings and workshops.

More than half of the households (57 percent) in both counties use mobile phones for agricultural services, for instance to access mobile money, check prices of produce and access markets. This is to be expected given the proliferation of mobile phone technology in Kenya which has made it easier to access various services.

On average, maize is grown mostly on small scale - less than 2 acres- in both areas, with slightly bigger areas under maize in Bungoma, hence higher yields than in Meru. In Bungoma, maize is grown mostly for subsistence and as such the households there have a higher average household monthly consumption, while in Meru, maize is grown mostly for sale.

Although there are higher maize yields in Bungoma than in Meru, most of which is grown for subsistence, the households in the area experience more months of scarcity of own produced maize, compared to Meru. This could be attributed to the larger household sizes as well as the maize eating culture that is prominent in Bungoma. Additionally, in Meru, there is a wider food base because of greater enterprise diversification undertaken by the farmers causing them to have other food options apart from maize (Republic of Kenya, 2014).

Table 4 below shows the gender disaggregated profiles for the household members (head and spouse).

Table 4: Gender-disaggregated socio-economic profiles of the household members (head and spouse)

	Bungoma (n=164)		Meru (n=162)		Total (n=326)			
Variable	**Men (n=81)**	**Women (n=83)**	**Men (n=81)**	**Women (n=81)**	**Men (n=162)**	**Women (n=164)**	**χ^2 statistic**	**Significance level (*p-value*)**
Average age (years)	52.7	44.6	50.8	44.7	51.8	44.6		0.000**
Average number of years lived in village	40.7	23.7	43.5	25.7	41.9	24.6		0.000**
Education level (% of respondents)								
None	7.5	6.0	5.4	5.1	6.5	5.6	15.293	0.002**
Primary	30.0	54.2	56.8	69.2	42.9	61.5		
Secondary	55.0	38.6	33.8	25.6	44.8	32.3		
Post-secondary	7.6	1.2	4.1	0.0	5.8	0.6		
Group membership (% of respondents)	38.8	68.7	36.5	71.8	37.7	70.2	33.551	0.000**
Received credit (% of those who received credit)	75.0	25.0	23.1	76.9	49.1	51.0	0.034	0.853
Received extension (% of those who received extension)	63.0	58.7	52.8	69.4	57.9	64.1	0.254	0.614
Have friends or relatives in leadership positions in organizations within and outside the village (%)	40.0	38.6	17.6	16.7	29.2	28.0	0.062	0.803
Attended agricultural workshop or forum in the past year (% of those who attended)	68.9	35.6	63.3	36.7	66.1	36.2	4.494	0.034**

(**) represents significance at 5%.; For Bungoma County there are more women than men because two households were polygamous
Source: Survey Data (2016).

The average age of men and women is about the same for both counties. The women are on average about 7 years younger than the men. Majority of the men and women have primary education as their highest level of education. However, about 50 percent of men have studied beyond primary level compared to 32 percent of women. This indicates that men have, on average, more years of formal schooling than women. This could be due to social and cultural factors that discriminate against women's access to productive resources, including education (FAO, 2011). This is similar to results by Ngigi *et al.* (2016), in Kenya, who found that men had, on average, two more years of schooling than their wives.

About 70 percent of women compared to 38 percent of men are members of agricultural development groups. This is similar to the results by Van Eerdewijk and Danielsen (2015), who found that there were more women than men in community based organizations and self-help groups in Bungoma and Laikipia in Kenya. This was due to the need to support each other and bring development to their communities. Group membership helps build social capital, which in turn improves sharing of information and resources and can sometimes provide sources of subsidized credit for the members (Seebens, 2011; FAO, 2011). Group membership can also improve the bargaining capacity of members, which can lead to them to have greater voice in decision-making (World Bank, 2009).

Figure 6 below shows the types of groups to which the men and women belong.

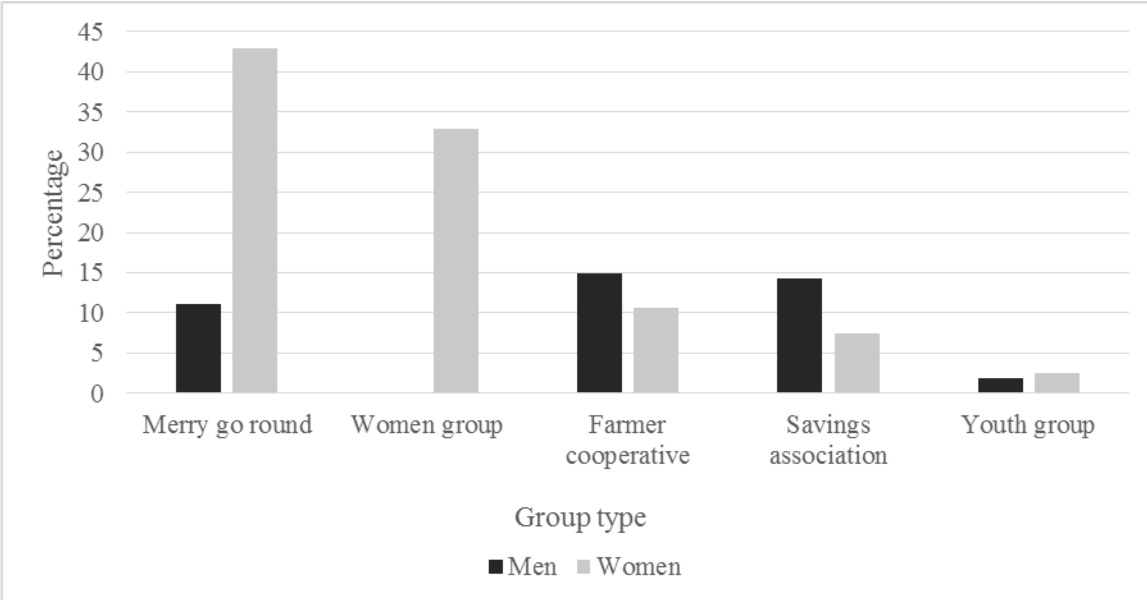

Figure 6: Type of group membership by men and women

Merry-go-rounds and women groups are the main groups of which women are members, while men mostly belong to farmer cooperatives and savings groups. Similarly, Ngigi *et al.* (2016), found that men belonged mostly to farmer associations and welfare associations, while women were mainly members of women groups and microfinance groups.

Apart from group membership, social capital can also be influenced by the number of years a person has lived in the particular area. In this study, men have lived in their villages longer than the women probably because when women get married they leave their homes and join their husbands' homes. About 30 per cent of both men and women have friends or relatives who have leadership positions in organizations within and outside of their villages. This is also part of social capital and networking; people with wider networks are expected to have greater access to information that could be useful in agricultural activities.

Out of the households that received credit, over 70 percent was received by men in Bungoma. In Meru, however, it is mostly the women who applied for and received credit in the household.

This could be due to the presence of the higher number of women in groups – merry go rounds and women groups- that offer subsidized credit as well as microfinance institutions that have loan features that are targeted to women.

A significantly higher number of men than women in both counties reported having attended an agricultural training or workshop in the past year. This is similar to results obtained by Muriithi, (2015) who found that, in Central Kenya, very few women compared to men had access to horticultural trainings and therefore had to rely on informal sources of information such as friends, neighbours and community women groups. According to World Bank (2009), women are less likely to participate in agricultural trainings such as meetings, workshops or demonstration plots due to lack of resources such as funds, greater time burdens owing to their domestic responsibilities and lower education levels (Ragasa, 2012).

4.2 Participation in Decision-making in Maize Production

Table 5 below shows the percentage of men and women who contribute to maize production decisions

Table 5: Percentage of men and women who contribute to maize production decisions

	Percentage who participate			
Decision	**Men (n=162)**	**Women (n=164)**	**χ^2 statistic**	**Significance level (*p-value*)**
Maize variety to grow	87.7	80.7	2.820	0.093*
Time of planting	87.0	82.6	1.182	0.277
Seed to buy	87.0	83.2	0.887	0.346
Fertilizer to buy	85.7	80.1	1.801	0.406
Labour to be hired	83.8	77.0	2.267	0.132
Sourcing of credit	61.7	59.0	0.237	0.627
Use of credit obtained	62.3	60.2	0.145	0.704
Output utilization	83.1	82.6	0.104	0.949
Maize sale	54.5	56.5	0.125	0.724
Use of income from maize sale	58.4	56.5	0.119	0.730
General farm management	87.0	78.3	4.184	0.041**

(**) represents significance at 5%; (*) represents significance at 10%
The number of men and women is not equal because two households had polygamous marriages
Source: Survey Data (2016).

About 80 percent of men and women contribute to the main decisions on maize production such as selecting of varieties to grow, time of planting, inputs to use and utilization of output. This is similar to results by Meijer *et al.* (2015), who found that more than three-quarters of both men and women in Malawi contributed to decisions on crop planting, weeding and fertilizer use. For decisions on general farm management, more men than women contribute and this result is significant at 5 percent level. Similar results were obtained by Angel-Urdinola and Wodon, (2010), who found that most decisions on the use of productive assets, such as land, were undertaken by men, especially among the poor households in Nigeria. Slightly over half of both men and women contribute to decisions on sourcing and use of credit, sale of maize and use of income from maize sale.

Table 6 below shows the results of a multivariate probit regression of participation in various maize decisions against socio-economic and institutional factors.

Table 6: Multivariate probit regression results on determinants of household decision-making

Decision	**Inputs (seed and fertilizer) to use**		**Labour use**		**Credit use and sourcing**		**Output Utilization**		**Income use**	
Variable	**Coefficient**	**Sig.** ***(p- value)***	**Coefficient**	**Sig.** ***(p- value)***	**Coefficient**	**Sig.** ***(p- value)***	**Coefficient**	**Sig.** ***(p- value)***	**Coeff.**	**Sig.** ***(p- value)***
Sex (Male)	0.401 (0.195)	0.041**	0.419 (0.176)	0.018**	0.236 (0.167)	0.157	0.113 (0.173)	0.511	0.225 (0.159)	0.159
County (Bungoma)	0.466 (0.211)	0.027**	0.558 (0.186)	0.003**	1.560 (0.190)	0.000**	0.515 (0.197)	0.009**	0.891 (0.169)	0.000**
Extension visits	0.005 (0.008)	0.508	-0.008 (0.006)	0.167	0.003 (0.006)	0.576	-0.016 (0.005)	0.002**	0.000 (0.005)	1.000
Education years	0.016 (0.026)	0.543	0.046 (0.025)	0.068*	0.035 (0.028)	0.205	0.053 (0.026)	0.042**	0.060 (0.024)	0.013**
Land size	0.002 (0.028)	0.945	0.080 (0.033)	0.015**	0.027 (0.025)	0.285	0.030 (0.024)	0.207	0.066 (0.023)	0.005**
Group membership	0.431 (0.201)	0.032**	0.241 (0.185)	0.192	0.431 (0.173)	0.013**	0.195 (0.186)	0.295	0.378 (0.165)	0.022**
Friends/Relatives in leadership positions	-0.210 (0.202)	0.299	-0.373 (0.187)	0.046**	0.131 (0.187)	0.482	-0.458 (0.188)	0.015**	0.342 (0.182)	0.068*
Phone use	0.013 (0.191)	0.947	-0.037 (0.176)	0.833	0.260 (0.158)	0.127	-0.206 (0.181)	0.256	0.230 (0.161)	0.154
Credit access	0.066	0.836	0.021	0.938	0.392	0.109	0.343	0.216	-0.458	0.041**

	(0.319)		(0.268)		(0.245)		(0.277)		(0.224)	
Constant	-0.188	0.635	-0.732	0.051	-2.906	0.000	-0.205	0.591	-2.300	0.000
	(0.396)		(0.375)		(0.442)		(0.382)		(0.385)	
n = 326										
Log likelihood : -536.172										
Wald χ^2 (45): 164.03										
Prob>χ^2 = 0.000										
Likelihood ratio test of rho21=rho31=rho41=rho51=rho32=rho42=rho52=rho43=rho53=rho54=0; χ^2 (10) = 435.54; Prob>χ^2=0.000										

*** denotes significance at 5% level; * denotes significance at 10% level; Values in parentheses are the standard errors*
Source: Survey data (2016).

The *Chi square* value at the end of the table (χ^2 =435.54; *p*=0.000) is significant and this shows that participation in each of the maize production decisions is not independent from each other and therefore if each equation was estimated separately, it would produce biased results. That is to say, we reject the null hypothesis that participation in each of these decisions is independent. In addition, participation in each of these decisions is positively and significantly correlated.

Men are more likely than women to contribute to decisions on inputs (seed and fertilizer), as well as labour to be used in maize production. This is analogous to the findings by Gebreselassie *et al.* (2013), where 55 percent of women reported that selection of seed varieties to plant was undertaken solely by men in Ethiopia. Further, 94 percent of the women said that men were responsible for purchase of fertilizer, while 64 percent reported paying of casual labour to be exclusively the is to be expected given that in many African societies, men are regarded as the head of households and hence undertake most of the household decisions.

Group membership increases the likelihood of participation in decisions on input use, credit use and sourcing and income use. This is plausible given that according to the World Bank (2009), group membership helps increases members' bargaining power and hence build their experience in decision-making. Additionally, being a member of a group can lead to benefits such as collective marketing, input supply and easy access to credit facilities. It would thus be expected that an individual who has easier access to inputs and credit through group membership has higher decision-making power on the same.

The variable for the county is positive and significant for all the decisions. This can be interpreted to mean that persons in Bungoma County are more likely to contribute to decisions on maize production as compared to those in Meru County. This could because of the higher maize yields in the area compared to in Meru as well as the higher consumption amounts because it is a staple food in the area.

The more the number of years of formal education a person has, the more likely they are to contribute to decisions on labour use, output utilization and use of income from sale of maize. This is because people who have more education are more informed hence they have a better awareness about their responsibilities in the households and are in a better position to make decisions.

People with larger land sizes are more likely to contribute to decisions on labour to be used as well as decisions on use of income from maize sale. This could be because larger land sizes require hiring of external labour and hence decisions have to be made on such, as opposed to people with smaller land sizes who probably just utilize family labour. Furthermore, men and women with larger land sizes are more likely to sell their maize output and hence participate in decisions regarding the use of income obtained. Similar results were obtained by Enete and

Amusa (2010b), who found that women with larger land sizes were more likely to contribute to cocoa farming decisions in Nigeria.

Having friends or relatives who have leadership positions within governmental organizations increases the probability of contributing to decisions on the use of income from sale of maize. This could be due to increased social capital which increases the flow of information hence these people are more informed. This same variable reduces the probability contributing to decisions on labour use and output utilization. This could be due to most households utilizing family labour.

Receipt of credit lowers the likelihood of contributing to decisions on income use. This is probably because households that receive credit repay it from their income obtained from maize sale, hence the need to make decisions on that is relatively lower.

4.3 Stochastic Frontier Analysis of Technical Efficiency

Table 7 below shows the results of a stochastic frontier estimation of inputs against maize yield for the households in Bungoma and Meru counties.

Table 7: Stochastic frontier production input parameters

	Bungoma (n=81)		Meru (n=81)	
Variable	**Coefficient**	**Sig. *(p-value)***	**Coefficient**	**Sig. *(p-value)***
Land Area on maize	530.056 (146.557)	0.000**	1025.186 (174.173)	0.000**
Seed	-7.144 (3.810)	0.061*	5.726 (30.686)	0.852
Fertilizer	1.955 (0.660)	0.003**	5.325 (2.486)	0.032**
Labour (people)	47.849 (2.573)	0.000**	13.720 (7.645)	0.073*
Constant	78.691 (125.936)	0.532	-761.436 (184.446)	0.000**
Gamma (γ)	95.160		94.894	
Maximum TE	1.000		1.000	
Minimum TE	0.062		0.025	
Mean TE	0.925		0.854	
Log likelihood function	-647.815		-660.436	

*** denotes significance at 5% level;* denotes significance at 10% level; Figures in parentheses are the standard errors; TE is technical efficiency*
Source: Survey data, (2016)

Households in Bungoma have an average technical efficiency of 93 percent while in Meru the average is 85 percent. From the table above, the coefficients for the inputs for both counties add up to more than one. This means that if the quantities of the indicated inputs were to be doubled, the maize yield would increase by more than double; that is the production function exhibits increasing returns to scale. For both counties, approximately 95 percent of the differences in yield are caused by technical inefficiencies.

The area under maize has a positive effect on output for both counties. Increasing the acreage under maize leads to higher yields. Fertilizer use has a positive effect on output, and this is significant for both counties. More fertilizer use leads to higher yields because it supplies nutrients to the crop which boost growth. The use of more people to provide labour during production activities leads to higher maize yields. When there are more people they can specialize in different activities for optimum productivity. This is significant for both counties. Seed use has a negative effect on yield in Bungoma. This could be because many of the households reported obtaining poor yields in that particular cropping season due to insufficient rainfall, as well as obtaining poor quality subsidized seed. For Meru County, seed has an insignificant effect on yield and this could also be due to the use of poor quality seed. The inefficiency effects for the households in both counties are given in Table 8 below.

Table 8: Inefficiency effects from the production function estimation

	Bungoma (n=81)		**Meru (n=81)**	
Variable	**Coefficient**	**Sig. (*p-value*)**	**Coefficient**	**Sig. (*p-value*)**
Household size	0.070 (0.015)	0.000**	0.529 (0.042)	0.000**
Credit access	-2.163 (0.185)	0.000**	4.180 (0.093)	0.000**
Extension visits	0.006 (0.002)	0.010**	-0.030 (0.007)	0.000**
Phone use	0.145 (0.087)	0.096	-1.293 (0.193)	0.000**
Land size	0.580 (0.029)	0.000**	-0.079 (0.095)	0.030**
Attendance of agricultural workshop/forum	-0.516 (0.100)	0.000**	3.524 (0.169)	0.000**
Land tenure (own land)	-0.416 (0.336)	0.215	1.641 (0.090)	0.000**
Sell maize	-15.176 (0.793)	0.000**	12.727 (0.154)	0.110
Constant	10.816 (0.418)	0.000**	-7.665 (0.256)	0.000**

*** denotes significance at 5% level; Figures in parentheses are the standard errors*
Source: Survey data, (2016)

Household size has a negative effect on efficiency for both counties. With larger household sizes, more resources are required for their sustenance and this competes with resources required for maize production. Addai *et al.* (2014) also found household size to have a negative effect on technical efficiency of maize farmers in Ghana.

The more extension visits a household receives, the more efficient they are. This is observed for Meru County. Extension services enable farmers to obtain useful information that can help improve their production. Similarly, Dadzie and Dasmani, (2011), found that contact with an extension agent had a positive effect on efficiency of food crop farmers in Ghana. For Bungoma, however, this is not the case perhaps because they receive extension visits and learn skills that are not applicable to maize production.

Access to credit by the household reduces inefficiency in maize production in Bungoma County. This is because the funds obtained enable acquisition of inputs and other resources for use in production. Studies that have obtained similar results include Awotide *et al.* (2015) and Nyagaka *et al.* (2010), who found that access to credit had a positive effect on technical efficiency of cocoa farmers in Nigeria and Irish potato farmers Kenya respectively. For Meru County, however, obtaining credit does not help reduce inefficiency perhaps because cash loans obtained are utilized for purposes other than maize production. This can also be explained by the collapse of many of the industries in Bungoma County, such as the sugar companies and the Webuye paper mill. As a result most of the credit obtained is directed towards investment purposes.

Use of mobile phones to access various agricultural services such as checking prices of produce and sourcing for buyers has a positive effect on efficiency for Meru County. This is because mobile phones have made it easier and even cheaper for farmers to obtain services and information on proper production practices. For Bungoma County, this is not the case perhaps because maize is mostly grown for subsistence hence the farmers do not need to access these mobile-based agricultural services.

Households with larger land sizes are more efficient in Meru. This is because households with larger land sizes have higher yields and hence more resources which enable them to access services such as extension in order to optimize production. Similarly, Karki *et al.* (2015), found that vegetable farmers in Kenya who had larger land sizes were more efficient than those with smaller land sizes. For Bungoma, households with larger land sizes are less efficient. This could be because larger farms require more resources for maintenance compared to smaller farms.

Attendance of an agricultural workshop or training forum by men and women in the household helps to reduce inefficiency. This is significant for Bungoma. This is because the training services enable the farmers to obtain information on best production practices. For Meru, however, this is not the case perhaps because the workshops they attended were not on maize production.

Households that sell maize in Bungoma are more efficient than those that do not. This is plausible given that since the maize production is a source of income, the farmers are more likely to invest more resources into optimum productivity in order to ensure high returns.

Table 9 below shows the intra-household inefficiency effects for the pooled men and women in the households for both counties.

Table 9: Intra-household gendered inefficiency effects

	Pooled Men (n=162)		**Pooled Women (n=164)**	
Variable	**Coefficient**	**Sig. (*p-value*)**	**Coefficient**	**Sig. (*p-value*)**
Education level	-76.166 (0.078)	0.000**	-7.565 (0.112)	0.000**
Group Membership	-24.037 (0.369)	0.000**	10.217 (0.265)	0.000**
Land size	10.441 (0.091)	0.000**	2.294 (0.018)	0.000**
Received credit	4.905 (607.714)	0.994	-5.073 (0.503)	0.000**
Attended agricultural workshop/forum	-2.081 (607.712)	0.997	-3.588 (0.235)	0.000**
Contributed to decision-making on:				
Credit use and sourcing	-10.698 (0.871)	0.000**	-8.437 (0.353)	0.000**
Income use	1.286 (0.002)	0.000**	0.525 (0.002)	0.000**
Constant	-55.010 (0.842)	0.000**	-38.634 (0.552)	0.010**

*** denotes significance at 5% level; figures in parentheses are the standard errors*
The number of men and women is not equal because two households had polygamous marriages
Source: Survey Data (2016).

From Table 9 above, the constants are significant indicating that there are other variables that have a positive effect on efficiency which have not been included here. Education level of both men and women has a positive effect on maize production efficiency. This is reasonable because educated people are more likely to make better and informed choices on production practices which lead to greater efficiency. Similar results were obtained by Liu and Myers (2009), who found education level to have a positive effect on maize production efficiency in Kenya and

Simonyan *et al.* (2011), who found education level of men to have a positive influence on efficiency of maize production in Nigeria.

Membership in social and agricultural development groups by men has a positive effect on efficiency. For women, however, the reverse is observed with their group membership having an efficiency-reducing effect. This suggests that men utilize their membership in groups for agricultural development benefits, while women mostly use it for socializing purposes.

Men and women with larger land sizes are less efficient. This is perhaps because they have more resources and are thus not motivated to utilize them optimally in production, as compared to those who have smaller land parcels of land. Larger land sizes also require greater resources to manage, making it difficult to achieve greater efficiency.

Access to credit by women has a positive effect on efficiency. This indicates that women are more likely than men to utilize funds obtained as agricultural credit for agricultural purposes. According to Fletschner and Kenney, (2014), women are more prudent in managing of resources, compared to men because they are risk-averse.

Attendance of agricultural forums or training workshops by both men and women has a positive effect on efficiency. This is because the agricultural training forums equip farmers with skills and knowledge which is useful for maize production and therefore they are able to achieve greater efficiency.

Men and women who contribute to decision-making on credit sourcing and use have greater efficiency. Credit access enables farmers to obtain resources for use in production. Additionally, credit which is obtained has to be repaid and therefore it is managed well in production purposes. Contribution to decision-making on income use, however does not have a positive effect on efficiency perhaps because majority of the households grow maize for subsistence.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of this study was to conduct an intra-household gender analysis with respect to decision-making in maize farming on inputs to use, labour use, credit sourcing and use, output utilization and income use, as well as access to institutional support services. The study also sought to find out if this had an effect on maize production efficiency in Kenya. Using data collected from Bungoma and Meru counties, the results show that there are differences between access to institutional support services and decision-making patterns between men and women within households. Men were found have higher education levels than women and had better access to agricultural training programs that enhance efficiency. More women than men were found to be members of agricultural development groups overall. Within the counties there were also observed differences in access to resources, for instance more men than women accessed credit within the households in Bungoma, while the reverse is true for Meru County. Sex, education level, group membership and land size were the main factors that were found to have a positive influence on contribution to decision-making within the household. Access to credit, extension services, mobile phone use and access to agricultural training programs were found to enhance efficiency while household size was found to have a negative effect on maize production efficiency.

5.2 Conclusions

The big picture message resulting from this study reinforces what is already in the literature and that is there exists a gender gap between men and with regard to access to various resources for agricultural production. This means that mean and women do not have equal access to institutional support services (group membership, access to credit, extension and access to agricultural training forums. Additionally, men and women do not have equal voice in decision-making within the household.

Education level was found to have a significant effect on participation in decision-making as well as increasing efficiency. Women were found to have lower education levels than men, and as such, they are at a disadvantage. For instance, men were found to be more likely to contribute to decisions on inputs and labor, compared to women. Women were also found to participate less in activities for increasing knowledge such as training programs or workshops. These were also found to significantly improve efficiency.

A significantly larger percentage of women than men were found to belong to agricultural development groups. Group membership had a significant effect on decision-making within the household. This is because it helps to build social capital and hence provide an avenue for obtaining information and other resources that help improve productivity and efficiency.

This study contributes to existing knowledge on maize production efficiency by disintegrating the gender variable through assessing the dynamics within the household, rather than going the conventional route of comparing male-headed and female-headed households.

5.3 Recommendations for Policy Action

Based on the finding that education level increases the likelihood of contribution to decision-making and also has a positive effect on maize production efficiency, the study recommends improving women's access to resources such as extension services that are specifically targeted to them. This can help improve their bargaining power and hence decision-making power in the household. This will in turn help to improve intra-household harmony. Farm productivity and efficiency will also be increased as well.

Policies can also be designed that help to improve women's access to agricultural training workshops and forums, as they were found to be disadvantaged in this area. This will help them to increase their skills and knowledge which will then enable them to access productive resources as well as improve their decision-making regarding production and resource allocation. Women's decision making on resources has been linked to improved children's nutrition, education levels and overall household welfare. These policies can help to contribute to these outcomes.

Encouraging men to join and contribute productively to groups such as farmer cooperatives and savings associations through provision of incentives such as subsidized inputs to group members can help improve men's membership in groups. This will in turn improve social capital and exchange of information and resources which will help improve productivity and efficiency.

As the use of mobile phones to access agricultural services was found to have a positive effect on maize efficiency, farmers need to be sensitized on the use of this technology in their agricultural production practices as it makes it easier and cheaper to access agricultural information. Policies that encourage farmers to utilize mobile phones and improve their access to internet can be designed and implemented in order to help them realize greater efficiency from their production.

Less than twenty percent of households were able to access credit in form of cash loans. From this result the recommendation given is that policies should be designed that improve farmers' access to credit through creation of flexible repayment terms in order to cater for the eventuality of crop failure.

5.4 Contributions to Knowledge

The study found that even within households there exist gender differences in access to various resources and roles in decision-making. This is, however, not solely biased towards men as is painted in most of the literature on gender. For instance, the study demonstrated that in Western Kenya, it is mainly the men who received agricultural credit for the households, but in Eastern Kenya, it was mostly the women. For both regions, it was mainly women who were found to be members of agricultural development and social groups.

The study showed that membership in agricultural development groups (savings associations, women groups, farmers cooperatives, youth groups), sex and education level were the main determinants of gendered intra-household decision-making. The literature on determinants of decision-making in agriculture for Kenya is scarce, and this study contributes to knowledge in this area. Additionally, the study used sex-disaggregated data which is a contribution to knowledge as many of the previous studies have only assessed male-headed versus female-headed households.

5.5 Areas for Further Research

This study assessed participation in decision-making as a binary variable, which was coded as yes or no, when an individual contributed to a decision or not. There are, however, various levels of participation, ranging from no input or input in few decisions to input in most or all decisions. Contribution to decision-making can be analyzed at these different levels to provide more in-depth insights on intra-household gender dynamics. Other studies can be done to compare the perceptions of men and women regarding household decision making, in cases where they were interviewed separately. This could help to reduce bias from only one respondent, as men and women have different perceptions on household issues

Intra-household gender relations encompass a wide range of aspects, and decision-making and access to resources are only part of it. Further research can be done on division of labour or time allocation by both men and women to various household activities. This will provide greater insights into intra-household gender dynamics and therefore help in the design of gender policies for agricultural development.

This study assessed contribution to maize production decisions by the household head and the spouse in each household. Further analysis can be done to include the contribution of other household members for instance children or other relatives who make production decisions. This will provide a more in-depth analysis of intra-household contribution to agricultural production by gender.

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APPENDICES

APPENDIX 1: Variance Inflation Factors (VIFs) for Multivariate Probit Model

Variable	VIF
Sex	1.14
County	1.16
Group Membership	1.22
Land size	1.14
Credit	1.30
Extension visits	1.39
Education years	1.21
Phone use	1.20
Friends in leadership positions	1.24
Mean VIF	**1.22**

The VIFs are all less than 10, this indicates multicollinearity is not a problem (Gujarati and Porter, 2009)

APPENDIX 2: Variance Inflation Factors (VIFs) for Stochastic Frontier Model

Variable	VIF
Household size	1.10
Received credit	1.45
Extension visits	1.42
Phone use	1.26
Attended agricultural forum	1.06
Decision-making on income use	1.14
Decision-making on credit use	1.29
Mean VIF	**1.25**

The VIFs are all less than 10, this indicates multicollinearity is not a problem (Gujarati and Porter, 2009)

APPENDIX 3: QUESTIONNAIRE USED FOR THE SURVEY

HOUSEHOLD SURVEY QUESTIONNAIRE FOR MASTER'S RESEARCH THESIS ON THE EFFECT OF GENDER ROLES AND INSTITUTIONAL FACTORS ON MAIZE PRODUCTION EFFICIENCY

Dear Madam / Sir, my name is ______ and I am a student at the University of Nairobi. I am conducting a follow-up survey on gender and maize production efficiency among the farmers who were interviewed for the SIMLESA project by CIMMYT in 2013. I am requesting for 30 minutes of your time for your participation in this survey. Participation in this exercise is voluntary and all information collected will be kept confidential.

Does your household grow maize? 0. No _______ 1. Yes _______. If NO, terminate interview.

Household ID ……………..…. Date of Interview ……………..

Enumerator Code…………….

PART 1: HOUSEHOLD AND VILLAGE IDENTIFICATION

1. Region: 1. Western _____2. Eastern __________

2. County: __________________________________

3. Sub-County: ______________________________

4. Location: ________________________________

5. Sub-location: ______________________________

6. Village: __________________________________

7. Is it rural or peri-urban? 1 = Rural 0 =peri-urban

PART 2: MAIZE PRODUCTION INFORMATION

1. Total area of land owned ________________ acres.2A: Maize plot and yield information

Season	Plot area (acres)	Plot tenure	Plot ownership	Maize variety grown	Intercropping on plot 0. No 1. Yes	Percentage area under maize	Maize yield (kgs)
1.Long rains April 2015							
2. Short rains Oct/Nov 2015							

Plot tenure codes 1. Owned 2. Rented in 3. Borrowed 4. Other (specify) _________________________

Plot ownership codes 1. Self 2. Spouse 3. Self and spouse jointly 4. Other (specify) ________________

Maize variety codes 1. H 622 2. H 515 3. H 513 4. DK 8031 5. SC627 6. Situka M-1 7. Staha 8. Kito-ST 9. TMV-1 10. Bora 11. Kilima 12. Lishe K1 13. Lishe H1 14. PAN 67 15. PAN 6549 16. Other (specify) ______________________

2B: Inputs used in maize production

	Quantity of seed used (kg)	Cost of seed/kg	Quantity of fertilizer used (kg)	Cost of fertilizer/kg	Quantity of pesticide used (kg or litre)	Cost of pesticide/kg or litre	Quantity of herbicide used (kg or litre)	Cost of herbicide/kg or litre
1.Long rains April 2015								
2.Short rains Oct/Nov 2015								

2C: LABOUR USE

Means of plowing used 1. Hand 2. Animal traction 3. Tractor 4. Other (specify) ____________

Activity	Family labour used (days)						Hired labour used (days)					
	Men	No.	Women	No.	Children (< 14 yrs.)	No.	Men	No.	Women	No.	Children (< 14 yrs.)	No.
1.Land preparation												
2.Planting												
3. Fertilizer application												
4.Weeding												
5.Pesticide application												
6.Harvesting												

3. Average household maize consumption per month _______ bags

4a. Quantity of maize sold per season ________________ bags 4b. Average price ____________

5. How many months in the past year did the household not have its own produced maize for consumption __________

6. Rank the following constraints faced in production from the greatest to the least 1.Insufficient credit 2. High prices of inputs 3. Access to output markets 4. Pests and diseases 5. Low price for produce 6. Lack of extension services

Ranking: _____ ________ _________ ________ ________ _________ Other constraints faced (specify) ______________________

PART 3: PARTICIATION IN DECISION-MAKING ON MAIZE PRODUCTION ACTIVITIES

	Who decides the following? 1. Self 2. Spouse 3. Self and spouse jointly 4. Other (specify)
Activity	
1. Maize variety to grow	
2.Time of planting	
3.Seeds to buy	
4.Fertilizer to buy	
5.Labour to be hired	
6.Sourcing for credit	

7.Use of credit obtained	
8.Output utilization (for food or for sale)	
9.When to take crops to the market	
10.Use of income from sale of maize	
11.General farm management	

PART 4: INSTITUTIONAL FACTORS

4A: ACCESS TO EXTENSION SERVICES AND INFORMATION

Did the household require extension services? 0. No 1.Yes. If yes, fill table below.

	Did household seek extension on the following issues? 0. No 1.Yes.	Who in the household sought/applied for extension? 1 Self 2. Spouse 3. Jointly 4 Other (specify)	Did household receive extension on the following issues? 0. No 1. Yes	Who in the household received extension 1 Self 2 Spouse 3 Jointly 4 Other (specify)	Source of information	Number of extension visits last year
ISSUE						
1.Maize varieties to grow						
2.Pest and disease control						
3.Crop rotation						
4.Input markets and prices						
5.Output markets and prices						
6.Collective action/farmer						

organization						

Source of information codes: 1. Government extension workers 2. Farmer/cooperative groups 3. NGOs4. Farmer training center 4. Other (specify) ________________________________

	Do you obtain information on the above issues from the following sources? 0. No 1.Yes	Which member of the household uses this channel more often? 1. Self 2. Spouse 3. Jointly 4. Other (specify)
Radio/TV		
Newspaper		
Mobile phone		

11. Which is your most preferred source of information on the above issues? (Rank in order from most to least preferred) 1. Government extension workers 2. Farmer/cooperative groups 3. Radio/TV 4. Mobile phone 5. Newspaper

____

Ranking: _____ _______ ________ _______ _______ ________

4B: ACCESS TO CREDIT

Did the household need credit for maize production during the past year? 0. No 1. Yes

	Did the household apply for credit for the following purposes? 0. No 1. Yes If yes, for how much	Who applied for the credit? 1.Self 2. Spouse 3. Jointly 4.Other(specify)	Did the household receive credit for the following production activities? 0.No 1.Yes	Who in the household received the credit? 1.Self 2.Spouse 3.Jointly 4. Other (specify)	Amount of credit received	Amount repaid so far	If credit was received what was the source?	If no credit was received what was the reason?
1.Purchasing farm equipment								
2.Purchasing inputs (seed, fertilizer, pesticide)								

3.Paying land rent								

Source of credit codes: 1. Farmer group/cooperative 2. Microfinance institution 3. Bank 4. Merry go round 5. Mobile phone 6. Other (specify___________________

Reason for not receiving credit 1. Did not apply 2. Lack of collateral 3. High interest rates 4. Other (specify) ___________________

Who decides what to use the credit for? 1.Self 2.Spouse 3.Jointly 4.Other(specify)	What percentage/amount of the credit received was used for the following purposes?		
	Use	**Percentage/Amount**	
	Farm use		
	Education		
	Purchase food		
	Medical expenses		
	Other (specify)		

4C: GROUP MEMBERSHIP

	Are you a member of any of the following groups? 0.No 1.Yes	What benefits do you derive from this group?	What are the management challenges faced by the group?
1.Savings/credit association			
2.Merry-go-round			
3.Farmer cooperative union			
4.Women group			
5.Youth group			

Benefits derived from group 1. Subsidized credit 2. Extension services 3. Subsidized inputs 4. Market for produce 5. Other (specify__________________________

Management challenges faced by group 1. Conflict between members 2. Free riding 3. Poor leadership 4. Poor communication 5. Misuse of funds 6. Other (specify) _________________

4D: SOCIAL CAPITAL AND NETWORKING

1. Number of years you have lived in this village ________

Are any of your friends or relatives in leadership positions in governmental institutions within and outside this village? 0. No 1. Yes	If yes, which organization	Position held	Perceived advantages to the farmer

Perceived advantages codes: 1. Easy access to credit 2. Easy access to markets 3. Extension services 4. Other (specify) ____________________

4E: INPUT AND OUTPUT MARKETS

1. Source of maize seed: 1. Own saved seed 2. Government subsidy 3. Seed company 4. Farmer group 5. NGO 6. Other (specify) _____________________

2. Fertilizer/seed subsidies	Did the household require vouchers/subsidy for the following in 2015? 0.No 1.Yes	Did the household receive vouchers /subsidy for the following in 2015? 0.No 1.Yes	Who in the household received the vouchers/subsidy for seed and fertilizer? 1. Self 2. Spouse 3. Jointly 4.Other (specify)	Amount/quantity received	What are the advantages of the seed and fertilizer
a. Seed					
b. Fertilizer					

Advantages: 1. Low cost 2. Convenient 3. Time saving 4. Marketability 5. Packaging 6. Other (specify) _______________________

4. Distance from farm to market ______ km

5. How do you source for buyers for your produce? 1. Self 2. Brokers 3. Other (specify) ____________

6. To whom do you mainly sell your produce? 1. Small trader 2. Large trader 3. Farmer cooperatives 4.

7. How do you obtain information on the selling price of produce? 1. Physical visits to the market 2. Middle men 3. Radio 4. Mobile phone 5. Other (specify) _______________

8. Marketing channels:

Do you sell your produce to any of the following	Price at which produce is sold /kg	Perception on fairness of the channel	Reason why channel is preferred
Brokers			
Wholesalers			
Retailers			
Other (specify)			

Perception on fairness of the channel 1. Very fair 2. Somewhat fair 3. Not fair
Reason why channel is preferred 1. Fair price 2. Easy access from farm 3. Convenient 4. Other (specify) ______________________

4F: TECHNOLOGY
1. Does the household use mobile money transfer systems for farm transactions 0.No 1. Yes
2. If yes, who does the transactions? 1. Self 2. Spouse 3. Self and spouse jointly 4. Other household member (specify) _____________
3. Frequency of mobile money transactions for farm activities 1.Daily 2. 2-3 times a week 3. Once a week4. 2-3 times a month 5. Once a month
4. Use of ICT in agriculture:

	Do you use the following e-agriculture or ICT based services in agriculture?	If yes, who mostly makes use of the service? 1. Self 2. Spouse 3. Self and spouse jointly 4. Other (specify
Phone		
E-mail		
Facebook		
Twitter		
Whatsapp		
Other (specify)		

Do you use any e-agriculture or ICT based services for the following activities?	0. No 1. Yes	If yes, who in the household makes use of this service? 1. Self 2. Spouse 3. Self and spouse jointly 4. Other (specify)
a.Check for prices of produce (e.g. Mfarm, NAFIS)		
b. Source for buyers (e.g. Mfarm,)		
c. Source for credit (e.g. Mshwari, Airtel Kopa Cash, Equitel)		
d. Agricultural Insurance (e.g. KilimoSalama)		
e. Sourcing for inputs (e.g. Mfarm)		
f. Extension service(e.g. NAFIS, E-extension)		
g. Collective action/farmer organization(e. g. WhatsApp groups)		
i. Other (specify)		

5. In the past year, has any household member attended any agricultural workshop or forum? 0. No 1.Yes

6. If yes, who attended? 1. Self 2. Spouse 3. Both self and spouse 4. Other household member (specify) ________________

PART 5: HOUSEHOLD ASSET OWNERSHIP

1. Does the household own the following assets?	0. No 1. Yes	Number owned	Who decides its use? 1. Self 2.Spouse 3.Jointly 4. Other (specify)	Who makes decisions regarding a new purchase or construction of the asset? 1. Self 2.Spouse 3.Jointly 4. Other (specify)
a.Hoe/Jembe				
b. Slasher				
c. Knapsack sprayer				
d. Wheelbarrow				
e. Ox-plough				
f. Tractor				
g. Bicycle				
h. Motorbike				

i. Donkey				
j. Car				
k. Charcoal stove				
l. Kerosene stove				
m. Radio				
n. Mobile phone				
o. Smartphone				
p.TV				
q. House				

2. Are there any remittances to the household from members who are working away from home? 0. No 1.Yes
3. If yes, which household member? 1. Spouse 2 Son 3. Daughter 4. Brother 5. Sister 6. Other (specify) ________________
4. Amount remitted per month _____________ Kshs

PART 6: HOUSEHOLD COMPOSITION AND CHARACTERISTICS

Household member	Relationship to household head	Sex 0.Female 1.Male	Age (years)	Education level		Marital status	Primary occupation	Religion
				Level	Years			
Respondent								
HH member #2								
HH member #3								
HH member #4								
HH member #5								
HH member #6								
HH member #7								
HH member #8								
HH member #9								
HH member #10								
Total/HH size								

Relationship to household head: 1. Household head 2. Spouse 3. Son/Daughter 4. Mother/Father 5. Brother/Sister 6. Nephew/Niece 7.Cousin 8. Grandson/Granddaughter 9. Son/Daughter-in-law 10.Mother/Father-in-law 11. Domestic worker 12. Other ___________
Education level: 1. None 2. Primary level 3. Secondary level 4. College 5. Bachelor's Degree 6. Master's Degree 7. PhD
Marital Status: 1. Married 2. Widow/Widower 3. Divorced or separated 4. Single
Primary Occupation: 1. Farmer 2. Teacher Businessman/woman Student Other (specify) ___________________
Religion: 1. Christian 2. Muslim 3. Other (specify) ________________
Household monthly income (KES):

Range		Amount
< 10 000		
10001 - 20 000		
20 001 – 30 000		
30 001 – 40 000		
40 001 –50 000		
>50 000		

THANK YOU!