GENDER DISPARITIES IN ADOPTION OF CLIMATE SMART AGRICULTURE AMONG POTATO PRODUCERS IN OL-KALAU SUB COUNTY, NYANDARUA COUNTY, KENYA

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A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Master of Arts Degree in Gender and Development Studies of Egerton University

EGERTON UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented in this university or any other for the award of a degree.

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Recommendation

This thesis has been submitted with our approval as university supervisors;

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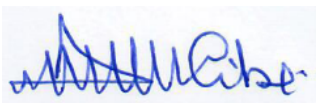
Signature  **Date 06/07/2022**

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DEDICATION

This thesis is dedicated to my parents Peter Thuo and Annastasia Wangari for their selfless love. Special dedication to my sister Racheal, brother Tirus and my nephew Andrian.

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First and foremost, I am grateful to the Almighty God for His provision, strength guidance, mercy and care, during the entire period of study. I extend my gratitude to Egerton University for granting me an opportunity to pursue my Master's degree. I would like to acknowledge Seed Potato Kenya Climate Smart Agricultural Project (KCSAP) for supporting me with research funds total amount 100,700 ksh. Special thanks go to my university supervisors, Dr. Lilian R. Chesikaw and Prof. Anthony M. Kibe for their tireless and invaluable efforts in guiding and supporting me during the entire study and research period. I would also want to thank Dr. Charles Wambu for the assistance he offered to me in proposal development and Thesis writing. I would like to thank all my respondents who dedicated their time and provided rich data that was used in this study.

ABSTRACT

This is a cross-sectional study on gender disparities in adoption of climate smart agriculture practices among potato producers in Nyandarua County, Kenya. The study specifically sought to investigate how gender disparities has led to non-adoption of women to climate smart technologies like the men. The study objectives were: to examine how men and women participate in decision making on choice of CSA technologies, to determine how men and women adopt CSA technologies, to analyze how men and women access to extension information and to determine how men and women participate in supply of labour in implementation of CSA technologies on seed potato production in Ol-kalau sub-county, Nyandarua county. A case study research design was used, data was collected using closed ended questionnaire and KII. Stratified random sampling was used to select sample size of 130 men and women respondents. The instrument was piloted in Njoro sub-county. A coefficient of 0.82 was obtained indicating the instrument was reliable as it was above the required threshold of 0.7. Data was analyzed using both descriptive and inferential statistics. The study findings indicated that male farmers dominated in decision making more than female farmers. This was because in Africa men are the head of households and thus, they make decisions more than women with mean difference of 0.918. There was a significant gender difference in the farmers adoption of CSA technologies with male farmers dominating in almost all activities. Male farmers sought extension information through the media more than their female farmers counterparts. Financial services are major reasons why most women farmers have not adopted CSA practices. Women farmers were significantly more involved in the supply of labor during planting, harvesting, sorting and grading. While male farmers dominated in the supply of labor during land preparation, pest and disease control, soil and water conservation, packaging and transportation. The study recommends that women farmers should be empowered to participate in decision making by supporting them access capital, knowledge and take part in CSA capacity building activities. Government, NGOs, should support both gender in adoption of CSA practices. Information on CSA should be made more accessible to both genders without bias through the mass media with consideration of women's triple gender roles. Women should be encouraged to contribute more in the provision of labor supply in CSA seed potato practices (i.e. use of mechanization).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYM

ASDS	-	Agricultural Sector Development Strategy.
CSA	-	Climate Smart Agriculture
CSAP	-	Climate-Smart Agricultural Practices
FAO	-	Food and Agriculture Organization
GAP	-	Good Agricultural Practices
GDP	-	Gross Domestic Product
GHI	-	Global Hunger Index
GoK	-	Government of Kenya
IPBO	-	International Plant Biotechnology Outreach
IRB	-	Institutional Review Board
KFSSG	-	Kenya Food Security Steering Group
NACOSTI	-	National Commission for Science, Technology and Innovation
NEMA	-	National Environment Management Authority
NGO	-	Non- Governmental Organization
SHG	-	Self-Help Groups
SPSS	-	Statistical Packages for Social Sciences
TIMPS	-	Technology, Innovation Management Practices

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

In Kenya, rural women provide the largest share of agricultural labor in most of the production activities. Women farmers remain much more dependent on agriculture for survival than male farmers, this is due to their lesser access to non-farm jobs like the white-collar jobs due to most of them being illiterate. They face a wide range of gendered constraints which affects their productive potential as agricultural workers specifically in Irish seed potato production. Most of these constitute women farmers who operate small farms are landless or own little land for themselves. Where a vast number of women farmers work as unpaid labor in family farms or work as manual laborers on field of others or in insecure tenure arrangements of land obtained through the family. Due to these reasons the Government of Kenya (GoK) has continued to give agriculture a high priority as an important tool for promoting national development goals.

Gender disparities in Irish seed potato production gaps exists in decision making power, adoption of CSA technologies, extension information that farmers sought on CSA technologies and farmers involvement in labour provision for CSA technologies. Although, women farmers share a significant contribution in the production process, their decision-making power is generally lower than men farmers. Men are considered as farmers and owners of farms thus dominate in making decisions in all farm activities and women are seen as helpers (Peterman *et al.,* 2014). Secondly, normative environment creates and shapes opportunities structures for men and women adoption of agricultural technologies (Fletschner *et al.,* 2014). Gender disparities such as illiteracy level, triple gender roles, lack of capital reduces women's farmers' adoption of CSA technologies in seed potato production. Feminization of poverty have led to more women farmers unable to adopt the CSA technologies like their men farmers counterparts. This is because financial services are major reasons why most women farmers have not adopted CSA technologies. Women farmers are poorer than men because they are unable to access credit facilities such as banks because they lack collateral such as land title deed to act as security in financial institutions thus they are unable to access credit facilities.

Extension officers' concentrate more on men since they are the land owners (Olorurifemia *et al.,* 2020). This leads to gender disparity between men and women farmers where women farmers are disadvantaged in acquiring extension information. Lemma *et al.* (2020) states that men farmers tend to attend agricultural community meetings forum such as

field days and research centres while women lack time to attend because of time constrain due to their triple gender roles. Therefore, access to extension information knowledge is an important resource for rural farmers, especially women farmers who have access to only 10% of agricultural extension programs (Cohen *et al.,* 2011).

Women play a key role in maintaining genetic diversity for Irish seed potatoes particularly in seed selection, varieties of seed, storage of seeds and utilization of those seeds (Puskur *et al.,* 2021). Although women, play these roles they still are not able to be involved in all the farm activities involving the Irish seed potato production thus creating a gap between them and their male farmers counterparts. This can be due to some of the farm activities like land preparation women prepare the land manually using *jembes* which is laborers (Okello *et al.,* 2010). On the other hand, men prepare land using mechanised tools such as tractor and animal like oxen which are less Laborers and less time spent in the farm. In most communities there are stereotypes that disadvantage women farmers not to do what they term as men's roles like managing diseases and pests through spraying (O'Dwyer, 2020). Soil and water conservation are mainly done by women by adding organic manure because they lack capital to buy fertilizer. While men farmers use fertilizers making them fetch high yields in their seed potato production unlike their women farmers counterparts. Lastly, harvesting is done by women manually using hands and hoes which is time consuming. While men farmers use harvesters spending very little time in the farm unlike the women farmers. All the factors discussed above on gender disparities between men and women Irish seed potato farmers prompted this study to be carried out so as to identify the gaps that exist between men and women farmers in Irish seed potato production.

The agricultural sector is the mainstay of the Kenya's economy. It directly contributes 24% of the Gross Domestic Product (GDP) and 27% of GDP indirectly through linkages with manufacturing, distribution and other services (GoK, 2012). Agricultural sector is the largest employer in the economy, accounting for 60% total employment. Over 80% of population living in rural areas derive their livelihoods mainly from agriculture (Mwaniki, 2016). The achievement of national food security is the key objective of Kenyan agricultural sector. Food security in this case is defined as ''a situation in which all individuals, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life'' (Kenya Food Security Steering Group, 2008). In the recent years, and especially starting from 2008, Kenya has been facing severe food insecurity problems depicted by high population having no access to food in right amounts and quality.

The estimates by Kenya Food Security Steering Group (KFSSG) indicate that over 10 million individuals are food insecure with majority of them living on food relief. Households are also incurring huge food bills due to the high food prices (Sabila, 2014). Currently food insecurity problems are attributed to several factors: climate change, frequent droughts, high cost of inputs especially fertilizer, low adoption level of Climate-smart Agricultural Practices (CSAP). Like any other climate change vulnerable country, Kenya has responded to the global call to mitigate and adapt to climate change effects by launching a CSA strategy; which was designed as part of its development programs that seek to achieve food security and sustainable development at the same time (GoK, 2017).

Irish Potato (*Solanum tuberosum*) is the world 's fourth most important food crop after wheat, rice and maize and the leading non-grain food commodity (FAO, 2015). Potato is the second most important staple food in Kenya and cash crop in the tropical highland regions of sub-Saharan Africa, where it is grown both as a horticultural crop due to its high value, and as a food security crop (Okello *et al.,* 2016). Irish potato is considered more significant to improving livelihoods of farmers because of its diverse uses as family food and in agro-processing industries (such as for potato fries, chips and crisps). Thus, the need to investigate how gender disparities has led to non-adoption of women farmers to climate smart technologies like the men do in Irish seed potato production.

1.2 Statement of the Problem

In Kenya, rural women provide the largest share of agricultural labor in most of the production activities which includes, land preparation, planting, weeding, seed selection, sorting and grading, harvesting among others. Despite all these roles women play in agricultural activities they still remain invisible partners in CSA practices. Women are normally side-lined especially in decision making in adoption of CSA technologies, access to extension information and supply of labor in Irish seed potato production. Gender disparities have not been considered with respect to CSA practices in Irish seed potato production. The differential needs of women and men with respect to adoption of CSA practices in seed potato production have not been studied and well documented in Ol-Kalau, Nyandarua, Kenya, hence the need for the study.

1.3 General Objective

The general objective of the study was to investigate how gender disparities affect adoption of climate-smart agriculture technologies in seed potato production in Ol-Kalau sub-County, Nyandarua County, Kenya.

1.3.1 Specific Objectives

i. To examine gender disparities that influence decision making on choice of Climate-smart Agriculture CSA technologies in seed potato production in Ol-Kalau sub-County.
ii. To determine gender disparities that influence the adoption of CSA technologies in seed potato production in Ol-Kalau sub-County.
iii. To analyse how gender disparities, affect access to extension information on CSA technologies in seed potato production in Ol-Kalau sub-County.
iv. To determine how gender disparities, affect supply of Labor in the implementation of CSA technologies in seed potato production in Ol-Kalau sub-County.

1.3.2 Research Questions

i. How do gender disparities influence decision making on choice of Climate-smart Agriculture (CSA) technologies in seed potato production in Ol-Kalau sub-County?
ii. In which ways do gender disparities influence adoption of CSA technologies in seed potato production in Ol-Kalau sub-County?
iii. How do gender disparities affect access to extension information on CSA technologies in seed potato production in Ol-Kalau sub-County?
iv. In which ways do gender disparities affect supply of Labor in the implementation of CSA technologies in seed potato production in Ol-Kalau sub-County?

1.4 Justification of the Study

This study was carried out to understand why men and women farmers are not starting at the same point when it comes to adoption of CSA practices. The knowledge gap of the study was, previous studies that have been carried out in the past have not specifically based their interest on gender disparities that affect women adoption of CSA practices in seed potato production. The new knowledge with respect to the study findings were; men and women farmers will learn modern and improved CSA technologies on seed potato production. Also, the study findings will inform the community on challenges women face in adopting the CSA technologies. This study purpose to create awareness of gender disparities in seed potato production as an economic activity in Ol-Kalau sub-County. This will be done publicly through presentation during conferences, seminars and online publication of the study results. This way, information will be disseminated to farmers and various potato stakeholders thus bringing about a notable change in the Irish seed potato production sector.

1.5 The Scope of the Study

This study was carried out in Ol-Kalau sub-County, Nyandarua County and covered Tumaini Mirangine and Dundori areas where seed potato production is practiced. It focused on men and women who were 18 years and above who practiced Irish seed potato farming in Ol-Kalau Sub-County in the areas listed above. The researcher chose these areas because of the following reasons; the county is the first leading in potato production in Kenya, some climate smart technologies have been scaled out in the area and it would offer the best sample to evaluate adoption and or non-adoption of CSA technologies for scaling to other counties i.e., Elgeyo Marakwet which was high in total production, but low in CSA adaptation. Moreover, different stakeholders and government agencies had over time introduced different technologies to improve the farmer's production level.

1.6 Limitations of the Study

The following factors posed some limitations in this study:

i. The study results may not be a representative of all seed potato growing areas of the County. The delimitation to this is that general notion of study results should be done with utmost care since the study focused on seed potato production.

ii. COVID-19 pandemic limited the movement and accessibility to the study area. Delimitation, the researcher carried masks and sanitizers while going to the field to collect data.

1.7 Assumptions of the Study

The following were the assumptions while conducting the study:

i. The information given by the respondents was true and accurate.

ii. The sample size was a good representation of the whole population.

1.8 Definition of Terms

Adopt:	Refers to the decisions that individuals make each time that they consider taking up an innovation or decision of an individual to make use of an innovation as the best course of action available
Climate-smart Agriculture practices:	In this study, it means context- specific practices. Where in one context, a practice may be climate-smart but not in another context depending on how where and why it is used.
Gender equality	In this study it referred to a situation where women and men had similar conditions and chance to participate in seed potato production.
Technology:	In this study, means how to cultivate a crop successful using innovation that ease work for humankind.
Agriculture:	Referred to any practice of tilling and cultivating the soil which included seed potato farming.
Decision making:	In this study, it means making important choices concerning seed potato production.
Gender participation:	In this study, it means both men and women farmers taking part in all activities of seed potato production.
Implementation :	It implies men and women farmers applying Climate-smart Agriculture technologies in seed potato production.
Gender :	In this study, referred to socially and culturally defined roles assigned to men and women farmers seed potato production.
Gender disparity:	In this study, referred to discrimination or differential treatment based on one's gender.
Gender roles :	Referred to the socially and culturally defined roles assigned to men and women farmers in seed potato production.
Women empowerment:	According to this study, meant women farmers being empowered through trainings to participate in decision making through capacity building and exercise control over seed potato production.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter covers literature review of work done by other authors in evaluating gender disparities in crop production (particularly Irish seed potato), using climate-smart technologies. It gives a highlight on gender disparities in potato production. Also, the following objectives are discussed; to determine gender disparities in decision making, adoption of CSA technologies, access to extension information and labor supply in implementation of climate-smart agricultural technologies in seed potato production. Similarly, it relates the theoretical framework of the study.

2.2 Gender Disparities in Potato Production

Gender issues have become main concern in the agricultural research field and activities mostly focusing on both sexes (men and women) especially in Irish seed potato production. Agricultural productivity disparities between men and women in the developing world are led by a number of possible factors; i.e., the quantity of inputs such as fertilizer, seeds or labor applied by men and women may differ between the two genders. Men and women may have different agricultural production aims, possibly because choice of crop differs by gender, whether influenced by cultural norms, lack of resources to cultivate specific crops and culturally appropriate division of labor (Peterman *et al.*, 2010). Cultural norms may hinder women involvement in physical farming practices for example in Ethiopia and Ghana where women farmers are forbidden to use plough because such work is perceived to be physically strenuous thus termed as men's role.

Potato originated from the Andean regions of Bolivia and Peru and was introduced into Spain from South America in mid-sixteenth century. From Spain, it was introduced to nearby countries and was being cultivated moderately in many European regions. By the seventeenth century, the potato was then distributed beyond Europe into India and China and by the eighteenth century to Japan (Lim, 2016). It became so extensively spread around the globe and it's important was introduced in Africa by Christian missionaries at the end of the 17^{th} century through the establishment of small plantations International Plant Biotechnology Outreach (IPBO, 2019). Potato is a crop of major economic importance worldwide. It provides reliable income, employment and food in most developing countries (FAO, 2008). It is a very versatile food crop and can be used in multivariate ways. It is eaten cooked and is cooked in different ways such as boiling, steaming, deep frying and roasting (Lim, 2016).

Globally potato provides food security to an estimated 800 million people (Hoffler & Ocheng, 2009). With the expected increase in population, agriculture will have to make noticeable adjustments to produce enough food (Otto *et al.,* 2017). However, this production is currently jeopardized by climate change. In case of inappropriate measures, agriculture and food systems will be at higher risk (Thornton *et al.,* 2014).

Irish potato production, being a realistic venture, which should be promoted not only for food security but also increase income for farmers. Adoption of improved agricultural technologies and modern method of farming among men and women farmers differs greatly. Women farmers are disadvantaged more than their men counterparts where they lack financial assets to help them adopt the CSA technologies. Thus, women lag behind and are not able to adopt the technologies as the men do. This creates a gap for this study indicating that previous studies that have been carried out in the past have not specifically based their interest on gender disparities that affect women adoption of CSA also it will provide up to date information.

In Africa, potato production through improved agricultural technologies and modern farming methods is important for increased output. However, Africa still lags behind in terms of production and yield levels, rates of modern input uses, adoption of technology and access to credit or insurance and markets which are often failing or incomplete (Dillon & Barret, 2014). Gender disparities in agriculture inhibits maximum potato production thus is a limiting constraint.

This is evidence because in sub-Saharan Africa, women account for almost 50% of the agricultural labor force but still suffer from low access to decision making, adoption of CSA technologies, extension information and supply of labor in potato production. Their labor productivity is rated as low due to lack of access of productive resources such as land, certified seeds, technology, extension services and credit as their male counterparts. Moreover, women do not have much control over their resources because are dependent on men's decision in all activities in potato production. Also, low adoption rates of modern inputs and technology adoption because they are disadvantaged in terms of finances which is a major hindrance to them adopting the CSA technologies.

In Kenya, the constraints of technology affect women's labor productivity in terms of efficiency and effectiveness. Women play an indispensable role in agriculture, innovativeness and improving the quality of life in rural areas. However, their contribution often remains concealed due to some social barriers and gender bias (Peterman *et al.,* 2014). The rapid development of agriculture sector which contributes about 27% of the Gross

Domestic Product (GDP) in Kenya and about 70% of the rural population depend on agriculture, the problem of failed agricultural innovations has become a major challenge (Masunzu, 2020). The government of Kenya in its big four agenda aims at ensuring food security. This is also supported by Sustainable Development Goals (SDGs) of ensuring food security. The adoption of improved agricultural technologies/innovations among farmers at any given time is as a result of the interaction with various factors including certain personal and institutional characteristics (Gkartzios *et al*., 2022).

The productivity of potato, the second most important staple food crop in Kenya is being lowered by climate change (Bolt *et al.,* 2019). The study by Hammond (2018) showed that climate-smart potato varieties can improve potato productivity in various environments from sea level to high mountain conditions where potato smallholder farmers predominate. In addition to temperature regimes and solar radiation, consideration of several factors that include soil characteristics, nutrient availability and water use efficiency is important for the success of this CSA practice. However, for better results, these resistant varieties may be accompanied with the use of Phyto sanitation and cultural practices, clean fields, biological control and disease-free tubers (Agutta, 2015). Crop rotation is also one of the CSA approaches that has been adopted by farmers in Kenya.

Nyandarua county's plan to increase potato yields to 15 tons/ha by 2022 opted for agroforestry, water harvesting and planting of the short cycle and drought-tolerant potato varieties as major CSA practices to achieve this (GoK, 2018). However, the study by Leal Filho *et al.* (2019) gives an overview of the bottlenecks that continue to hinder the registration of the expected success. He attributes low adaptation of CSA to the lack of information on appropriate CSA practices, resource insufficiencies and lack of incentives to the farmers (Nyasimi *et al.,* 2017). This has led to inappropriate and ineffective practices of CSA. This creates a research gap that prompts the need to evaluate why women are not able to participate in adoption of climate-smart agricultural practices in seed potato production in Nyandarua County, Kenya.

Despites the several studies conducted on productivity of potato production in Nigeria, there are limited comparative studies carried on Irish seed potato production which focuses on gender disparities/differences among men and women farmers in Ol Kalau sub-county, Kenya thus the need for this study. The following objectives were generated to determine gender disparities in decision making, adoption of CSA technologies, access to extension information and labor supply in implementation of climate-smart agricultural technologies in seed potato production.

2.3 Disparities between Men and Women in Decision Making on Choice of Climate Smart Agricultural Production

Most African countries are patriarchal in nature and men are the decision makers hindering women capacity to contribute in the adoption of the CSA objectives (Aryal *et al.,* 2020). Rural women, particularly women are trying to be on same level with men on decision making policies implementation should be made to curb gender imbalance. Women have limited rights in decision making power unlike their male counterparts endangering them to the implication of climate change since they have limited power to adapt to climate-smart technologies. Khoza *et al. (*2019) men and women farmers' climate change experiences impact on them differently. Where men farmers have the power to make decisions relating to changing agricultural practices while women may not have the same power as men (Nyasimi *et al.,* 2017). Sales of produce in all crops and the prices lies on men's decision. During the management of farm practices, men in most cases use machines in carrying out the maintenance practices. Women on the other hand lack money to purchase chemicals and equipment for weed and pest control. Therefore, women's yields will be lower than the male's because of carrying out of many management practices manually. Men are known to be the decision makers both in the family and community levels. This way, women's needs may not be addressed adequately or considered in programs (Sarapura, 2013). The decisions in adopting new technologies or new methods of cultivating native seed potatoes have to be approved by the males in the family. Their decision on whether to adopt or dismiss the adoption of technologies depends on them and is final to the family members no matter how good the technology may or may not be (Ali *et al.,* 2021).

Women have for a long-time experienced discrimination and non- inclusivity in decision making due to various customary practices that hinder them from engaging in decision making process (Makama, 2013). For instance, control over land and methods used in farming has for a very long time depended on men farmer decision while women just implement the decision that men have already made without consulting them. Rural women play a key role in supporting their households and communities in achieving food and nutrition security, generating income, and improving rural livelihoods and overall well-being. Women being an integral part of farming household provide 60% to 80% of all agricultural labor *(*Mulokozi *et al.,* 2020*).* According to Kidiga (2017) stated that women form the backbone of rural development and represent a major force that could boost rural economy, higher growth rate and increased food production. Over the years, reports across different societies of the world including those of Kenya clearly gave evidence to the productive

capability of women in national development in relation to their men folks (NEMA, 2017) Women actually constitute the bulk of the world's food producers by pre-dominating the agricultural sector in terms of numbers and tasks performed.

Men dominance in decision making affects the implementation of CSA practices and fulfilment of main goal in farming. Women adoption of CSA is affected by lack of involvement in the climate-smart practices and sustainability. This results to low yield compared to their male counter parts who have access to information on CSA. Women farmers in different countries are recording varying yields due to climate change and weather patterns caused by failure to implement long term CSA practices Waroga (2019). In this women farmers involvement in decision making process would ensure that they adopt practices that mitigate climate change by adopting CSA practices. Due to illiteracy level of women, they are not able to contribute to various CSA issues affecting its adoption. Westwood *et al.* (2018) men are literate and own land, farming equipment's and knowledge especially on weed management which are agricultural factors of production. On the other hand, various customary norms and practices have contributed into lowering status of women not to engage or participate in decision making process. Thus, men have a sole responsibility of making decisions on CSA while women only direct implement what men say. Both men and women farmers through equal involvement can have equal chances in decision making platforms.

In developing countries women farmers play a critical role globally in agriculture and productivity. However, women farmers have been discriminated by different stakeholders regarding communication of information inclusivity in decision making. Failure of women farmers been included in CSA has hindered them from participating and implementing sustainable farming practices. As a result, stakeholders should strive towards ensuring involvement of both men and women farmers' decision regarding CSA practices.

Women do not attend social gatherings because of too many roles that they have been assigned to them and men decides who should attend (Chuchird *et al.*, 2017). Culture has assigned many roles to women. Adagbonyin (2004) in his study found out that women are the gate-keepers of culture. Therefore, most women follow what culture dictates to which are men decisions especially on issues to do with assignment of gender roles and taboos. Ali *et al.* (2021) argued that various crucial decision-making processes have contributed significantly in affecting implementation of CSA by men and women in different parts of the world. As such, women involvement in decision making will bridge the gap that has continuously existed in development of CSA practices that many women are not conversant

with. There's need to bridge the gap that exist by ensuring women are actively involved in decision making process, control of production factors in agriculture. As a result, there will be involvement and fairness in decision making and not allow any instance where women are unfairly disadvantaged due to lack of platforms to speak out their voices and ideas.

2.4 Disparities of Men and women in Adopting Climate-smart Agriculture Technologies.

In many Africa developing countries, most bank account holders are men and women are constrained in accessing financial tools because they lack collateral such as land title deed to act as security in case they need to take loan from banks. Mugo *et al.* (2017) recorded that creating a bank account in formal financial institutions like banks is a crucial step towards ensuring financial involvement of both men and women farmers. In ability to access credit facilities is a global issue challenging woman. Njiraini *et al.* (2018) stated that lack of credit hinder women from procuring improved agricultural inputs such as certified seeds, fertilizers and other technologies for high yields. African rural set- up with male head of households are the main clientele (Fletschner *et al.,* 2014). Normative environment creates and shapes opportunities and structure for men and women. There exist some social factors that limit women's access to resources and information, which in turn influence adoption of new technologies and accessing the benefits of seed potato production. Mudege *et al.* (2016) reported that gender relations reveal the division of labor and allocation of resources between men and women as well as how value is given and power is mobilized during the production of seed potatoes. Gender inequalities which in most cases favor men and limit resources which women can access or do is a big barrier to women's adoption of new technologies since such resources are needed in order to practice what the technologies demand to be done by the farmers. Women provide agricultural labor which is lowly paid, work under deplorable condition with no protective gear, lack tools and equipment's which make work easier.

Farmers face risks caused by effects of CSA hazards and challenges of managing risks associated with new technologies adoption that are costly and only benefit them after many years of production (William *et al.,* 2015). Social demographic variables have focused more on gender relations and the normative environment including institutional focus along the potato value chain. Mudege *et al.* (2016) stated that institutional factors such as access to credit and market by men and women and their influence on adoption of improved varieties and productivity has influence the women's adoption of climate-smart agriculture technologies. Moreover, gender relations and norms have also influenced the way women

adopt new technologies when it comes to seed potato production (McGuire *et al.*, 2022). Men and women farmers who are not able to access finances may not be able to access resources nor adopt to CSA practices. According to Kristjanson *et al.* (2012) success of CSA is determined by implementation of sustainably practices on institutional behavioural change to influence different policies. Transformational CSA practices entail those activities that contribute to improved livelihood (Babugura, 2021). Farnworth *et al.* (2018) reported that women are capable as male partners but lack access to credit facilities making them harvest low yields in their farms. Access to credit also affects control of ownership of assets. Women face more bottlenecks while trying to access credit due to lack of collateral such as land to act as security in financial institutions to enable them access credit facilities. Thus, women have less access to man power, agricultural inputs, technologies that are required for CSA practices. Stakeholders should assess role of women in CSA and the hiccups they face while accessing credit. Implementation of different financial programs will allow women farmers to have access to credit facilities and break the barriers that existed while seeking financial services. Climate change related risks should be covered by insurance body to cater for needs of women farmers. Gender gap in access to resources such as capital, assets, land as well as knowledge and information has exacerbated the gender gap in productivity between men and women (Quisimbing *et al.*, 2014).

2.5 Men and women Disparities in Accessing Extension Information on Climate-smart Agriculture Technologies.

In most developing countries extension officers' positions are male dominated and discriminate against rural women farmers and only reach out to the men farmers because they are owners of the lands. Lack of adequate extension information to women farmers due to time poverty because of their triple gender roles make them have low or no knowledge on Irish seed potato farming. They use organic fertilizers instead of using enhanced fertilizers like their male counterparts Waaswa (2021). This leads to men farmers getting more yields in productivity compared to their women counterparts who get low yields because of their use of inferior quality products.

Extension officers concentrate more on men since they are the owners of land (Olorurifemia *et al.,* 2020). The mode of communication used by extension officers discriminate women because of their low level of education and are time limited due to their domestic chores such as taking care of children and elderly that take most of their time. Male heads tend to attend community meetings, forums, field days and research centers while

women lack time to attend because of time constrain (Lemma *et al.,* 2020). Therefore, Access to knowledge and information is an important resource for marginalized rural farmers, especially female farmers who have access to only 10% of agricultural extension programs (Cohen *et al.,* 2011).

2.5.1 Other Factors Influencing Access to Extension Officer Services Include:

Education Level; Most men have a higher education level thus access to different types of extension services while education level of women is low thus affecting their interaction rates with extension officers (Ragasa *et al.,* 2012). Lack of Funds**;** In developing countries, public domain undertakes extension services that are often underfunded. This extension officers are not able to reach out to a large number of farmers due to lack of resources. Involvement of both men and women will ensure equality and development of both men and women leading to a positive impact and will be recorded on CSA implementation due to extension services offered to both genders. Knowledge Power; Lack of adoption of technology CSA practices can be blamed at lack of know-how and can be powered through extension officers. Policies**;** Gendered policies should be formulated to bring about gender equality between men and women farmers but are contradicted on how CSA concepts are understood in practices that pave way for adaptation between researcher, practitioners, farmers and policy makers (Williams *et al.,* 2015). Few Extensions Officer's; In developing countries, agricultural extension services are rare to get thus women farmers encounter challenge before they get their services. Due to that extension officer's look down on small scale farmers who are mostly women despite them producing bulk food consumed in the country and put more attention to commercial farmers who are male dominate leaving out women.

Access to credit is a challenge to many women especially those living in rural areas. Most micro-finance institutions are located in cities and big towns, far from farming communities where women due to their restricted mobility and time constraints cannot access them easily. Moreover, the interest rates of the credits are too high. Some women in the rural areas are not aware of the existence of these microfinance credit schemes that can raise incomes and therefore cannot borrow their loans to improve their farming enterprises (Cai *et al.,* 2020).

2.6 Gender Disparities in Supply of Labor in Implementation of Climate-smart Agriculture Technologies

Rural women provide most labor both in small- and large-scale potato production. They carry out activities starting from conservation of seeds, to seed selection to planting, weeding, harvesting, storing and marketing (Mudege *et al.,* 2020). Gender division of labor along the potato chain exists since both men and women are involved in the main potato production activities (Tarjem *et al.*, 2021). Some specific activities such as manual weeding, cooking of seed potatoes and storage have been exclusively left for women. According to Mudege (2020) some researchers have conducted sex disaggregated analysis of Labor distribution in seed potato production activities but have not disaggregated when it comes to constraint because of the focus on technical issues like pest and disease control which is male dominated.

In seed potato production, women play a key role in maintaining genetic diversity for seed potatoes particularly in seed selection and varieties, storage of seeds and utilization of those seeds (Puskur *et al.,* 2021). Women are directly involved in selecting and preserving different native potato varieties to meet different social rituals and obligations. Managing of genetic diversity through management of combination of varieties enables communities to manage risks particularly where climate stress is more frequent and intense. Women adaptive capability to maintain, manage and preserve the native potatoes knows how to adapt native to different climatic conditions, pathogens and plagues (Mudege *et al.,* 2020).

Women have also taken part in researches that work to improve crop varieties. In the contemporary society, men and women have different preferences that is of an advantage when it comes to crop improvement (Polar *et al.,* 2021). This results to the generation of breeds of crops with better yields as well as better resistance to drought, pests and diseases. Women prefer crop varieties that lessen their burden and time in food preparation (Mudege, 2020). For instance, some women do not like the deep-eyed varieties of potatoes because they are difficult to peel. They also prefer potatoes which are regarded to be more nutritious for pregnant women. Women in research area will advocate for the production of such improved varieties.

During the management of farm practices, men in most cases use machines in carrying out the maintenance practices. Women on the other hand lack money to purchase chemicals and equipment for weed and pest control. Therefore, women's yields will be lower than the male's because of carrying out of many management practices manually.

In marketing and post harvesting process women are exploited by middlemen (Bonabana *et al.,* 2013). In male-headed households, the men are given the payment even if the women submitted the potatoes for sale. Some women have formed marketing groups to enable them have a better collective bargaining power but these collective marketing schemes reinforce existing gender inequalities too. Some women's mobility has been restricted by their husbands who become suspicious when their wives go to meet their customers. Lack of knowledge on good markets also affect women's adoption to new agricultural technologies (Mudege *et al.,* 2015).

2.7 Theoretical Framework

The researcher used two theories the liberal feminism theory and diffusion of Innovation theory.

2.7.1 Liberal Feminism Theory

Liberal feminists emphasize equal individual rights and liberties for men and women downplaying sexual differences, it emphasizes the importance of structuring sexual roles in ways that promote women autonomous self-fulfilment. Liberal feminists argue that society holds the false belief that women are, by nature, less intellectually and physically capable than men. They argue that men are more privileged than women and thus fight for the extension of those rights and privileges to women. Liberal feminists did not regard men as the main problem but believed that men and women can work together to bring about change. The relevance of Liberal Feminism theory can be seen where women are discriminated against in the adoption of climate-smart technologies in terms of decision making, financial services, agricultural inputs and technologies, and access to extension information. Thus, it advocates for equal rights of men and women in all sectors including seed potato production in climate change technologies. If women are given equal rights with men, then they will be able to take part in economic activities including seed potato production. In this study, rural women are rarely considered as clientele for improved technology, technical training, and extension programs are almost exclusively targeted at men thereby denying women opportunities to improve their skills affecting their ability to benefit from the change. Women should work with men in seed potato production farming to gain more knowledge and reap more profits.

2.7.2 Diffusion of Innovation Theory

Rodgers (2003) defined the adopter categories as "the classification of members of a social system on the basis of innovativeness". For Rodgers innovativeness helped in understanding the desired and main behaviour in the innovation-decision process. Thus, he categorized the adopters based on innovation classified into five: innovators- are first individuals to adopt innovation and are willing to adopt new ideas and are the gate keepers bringing innovation from outside the system, early adopters- is the second fastest category adopting innovation members in this category are more likely to hold leadership roles in social system and other members come to get advice or information about innovation , early majority- adopt an innovation after a varying degree of time and their innovation decision takes more time than it takes innovators and early adopters, late majority-adopt an innovation after average member of society wait until most of their peers adopt the innovation then they feel -it is safe to adopt it and lastly laggards- are last individuals to adopt an innovation because of limited resources and lack of awareness-knowledge of innovation they first want to make sure that an innovation works before they adopt. Rodgers (2003) further describes his five categories of adopters in two main groups the earlier adopters and late adopters. Earlier adopters consist of innovators, early adopters and early majority, while late majority and laggards comprise late adopters. Rodgers identified difference between the two groups in terms of socio-economic status, personality variables and communication behaviours, which are positively related to innovativeness.

The relevance of adoption theory to this study can be seen where women fall at the last stage of laggards who are the last individuals to adopt an innovation because of limited resources, lack of decision-making power, lack access to extension information, awareness-knowledge of innovation they first want to make sure an innovation works before they adopt. Women use manual technologies to carry out their farm activities thus take most of their time leaving them with limited time to concentrate on other issues like training, seminar and workshop on climate-smart agricultural technologies. The productive assets hinder them from adopting new agricultural technologies because they are illiterate and less economically stable thus are generally the last to adopt an innovation. While lack of credit facilities limits women ability to participate in new climate-smart technologies.

2.8 Conceptual Framework

The conceptual framework is important in illustrating the relationship between independent, dependent and intervening variables. The independent variables influence or

affect outcomes which in this study are the gender disparities such as decision making, financial services, access to extension officers. The dependent variables are those that depend on the independent variables they are the outcome/results of the influence or are affected by the dependent variables which in this study include degree of adoption rates, position women hold in decision making of CSA practices. Intervening variables on the other hand, stand between the independent and dependent variables and they mediate the effect of the independent variable on the dependent variable. In this study they could be the government policies in agriculture, Trainings and access to credit facilities. The above factors influence seed potato practice either positively or negatively. This is illustrated in Figure 1 below

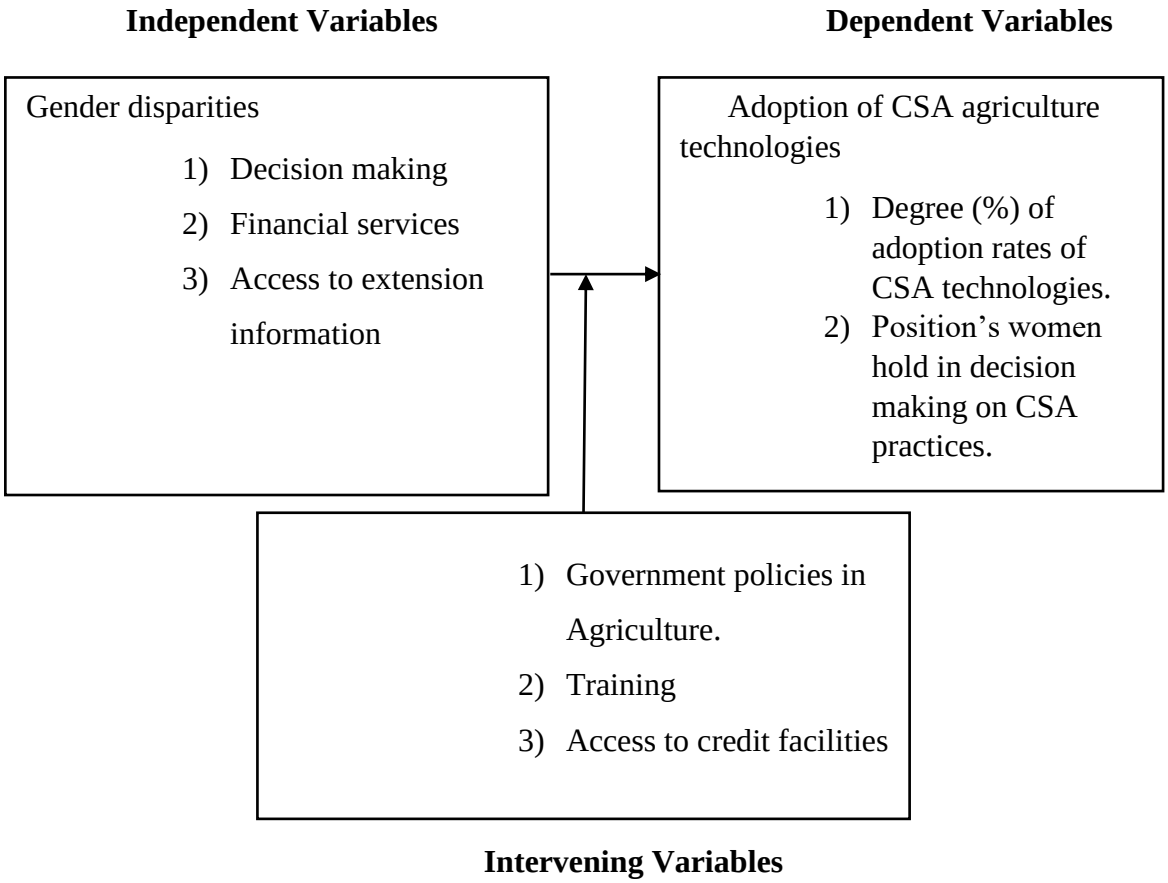

Figure 2.1: Relationship between Independent, Dependent and Intervening Variables

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter describes the research methodology which was used in carrying out the study. It details various processes that were carried in the entire research period. It covers the research design, the study area, study population sample size and sampling procedures, the data collection instruments, data collection procedures, Ethical consideration, and data analysis process.

3.2 Research Design

A research design is a blueprint for the collection, measurement and analysis of data (Kothari & Gaurav, 2011). This study adopted a cross-sectional design. This is a non-experimental method that gathers data through questionnaires and interviews (Orodho, 2004). It was used to gather information from individuals, groups with unique characteristics from the whole population. It had several advantages which included the following: It was cost-effective and enabled the researcher to collect information from a large population using a relatively little amount of money compared to other research designs.

It was also an excellent way of gathering information from wide range of people. For instance, the researcher gathered information from several areas of Ol-kalau sub-county and this design allowed saving of time since a large group could be dealt with at a go. This study therefore used cross-sectional design, to investigate on gender disparities in decision making, adoption of CSA technologies, access to extension information, and supply of labor in the implementation of Climate Smart Agriculture technologies on seed potato production in Ol-Kalau sub-county, Nyandarua County.

3.3 Study Area

This study was conducted in Tumaini, Mirangine, and Dundori in Ol-Kalau, Nyandarua County. The researcher chose these areas because of conducive climate for seed potato production and existence of inequalities in terms of gender representation between men and women farmers. Feminization of poverty together with financial constraints, values and ideologies forced women to leave seed potato farming for men. Women had also left the decision-making roles in the seed potato farming sector for men thus widening the gap between men and women in terms of the number of men and women in the Irish seed potato farming sector.

3.4 Study Population

The common observable characteristic of men and women farmers in Ol-Kalau Sub-County was that they practiced seed potato production. The accessible population of the study was all men and women farmers above 18 years practicing seed potato production in Ol-kalau sub-County. Men and women estimated to be seed potato producers were about 760 in number. The study sample framework was drawn from the accessible population. The extension officers and chairs of Self-Help groups were included in this study.

Table 3.1: Accessible Population and Sample Size

Administrative wards	Accessible population of farmers	Sample size
Dundori	300	61
Mirangine	235	40
Tumaini	225	29
Totals	760	130

Source: Ministry of Agriculture Livestock & Fisheries Nyandarua County.

3.5 Sampling Size and Sampling Procedure

Purposive sampling procedure was used to determine the accessible population of farmers because it allowed the researcher to use cases that had the required information with respect to the objective of the study. Therefore, the participants were selected only if they practice seed potato farming as well as the fact that they are adults (18 years and above). A total number of 760 men and women Irish seed potato farmers were used. Simple random sampling ensured equal chances to all men and women farmers in representation of sample size.

Creswell (2007) formula was used to determine the sample size

$$n=\frac{NC^2}{C^2+(N-1)e^2}$$

Where n=sample size

N=population (accessible population of 760)

C=coefficients of variation 25% as accepted by Creswell (2007)

e=standard error (0.02)

$$n = \frac{760\times0.25^2}{0.25^2+(70-60-1)0.02^2} = 129.745$$

n= 130

From the above calculation, 130 men and women participants were selected in all the areas of Ol-Kalau sub-County Nyandarua County.

From the list of 760 participants, a stratified random sampling was used to select 130 respondents. Individuals were categorized into sub-groups of two or more groups with distinct characteristic where men and women were categorized differently. They were picked randomly from each sub-group to form the sample size. Which ensured that the sample selection was independent of human judgment Creswell *et al.* (2007) whereby each number had equal chance of being selected. The extension officers and chairperson of Self-Help Groups in charge of seed potato production were also included in the study.

3.6 Research Instrumentation

Data was collected using a closed-ended questionnaire administered to the selected 130 men and women farmers respondents who practiced seed potato production in Ol-Kalau sub-County, Nyandarua County. The questionnaire was appropriate to the respondents as time was saved and cost of administering. According to Creswell *et al.* (2007) a questionnaire is a self-report instrument used for collecting information needed. The questionnaire comprised (20) closed ended question which assisted the researcher gather information appropriately. The questionnaire that the researcher generated was structured according to sections. Section A; demographic information, Section B; Gender disparities in Decision Making on seed potato production using CSA practices, Section C; Gender disparities in the adoption of CSA technologies in seed Potato Production, Section D; To analyse gender differences that affect access to extension information on CSA technologies in seed potato production, Section E; Gender Disparities in Supply of Labor in implementation of CSA technologies in seed Potato Production.

Interview schedules for the key informants included extension officers & chairpersons of Self- help groups in charge of seed potato production in the selected areas of study. The purpose of the interview in the study was to give the key informants an opportunity to explain issues concerning seed potato production in depth. The chairs of Self-Help Groups were very conversant with the group and were in a better position to discuss them well. The extension officers explained how each group took CSA trainings they offered to them (men and women farmers) and whether there was any positive change being realized. The interview schedule contained open ended questions. This enabled the researcher to collect in depth information from the respondents who were well versed with matters to do with seed potato farming.

Also, enhanced a deeper understanding on Irish seed potato farming and the challenges that the respondents faced.

3.7 Pre-testing

Before the actual data collection, the researcher conducted a pre-testing in Njoro sub-county, Njoro sub-county had the same characteristics as Ol-Kalau Sub-County and seed potato farming was also practiced in the area. The researcher used ten percent (10%) of the sample. Stratified random sampling was used to select thirteen (13) men and women seed producers who participated and ensured equal representation. The sample was not part of the final population. The purpose of pre-testing was to assure on validity and reliability of the instrument.

3.8 Validity

Validity is concerned with whether the findings are really about what it appears to be Creswell (2009). It refers to the extent to which data collection method accurately measured what it was supposed to measure (Bryman, 2004). According to Mugenda and Mugenda (2003) stated that internal validity is concerned with the extent the study establishes the factor that causes an effect. Content validity was used to establish whether the questionnaire accurately measured what was in the objectives. Validity is established by the expert judgment (Orodho, 2004). The researcher used relevant items that captured all the objectives in order to ensure that valid data was obtained. To ensure the instruments were valid and appropriate for the research, the researcher gave the supervisors and experts from the department of Gender and Development studies, Crops Horticulture & soil sciences of Egerton University. Validation of instruments improved effectiveness of collecting relevant data.

3.9 Reliability

A measuring instrument is reliable if it produces the same results or data after repeated trials (Mugenda & Mugenda, 2003). An instrument is reliable when it can measure a variable accurately and consistently obtain the same results under the same conditions over time (Orodho, 2003). Kothari and Gaurav (2014) states that each response to an instrument can have some random error. Therefore, an instrument should minimize the measurement error to ensure that the relationship between the true score and the observed score is strong. The researcher carried out a pre-test which enabled to assess the test items so as to judge

whether the instrument used was reliable or not. Pre-testing therefore helped to access the reliability of the test items by measuring the adequacy or vagueness of the instruments. This enabled the researcher to modify and improve the quality of the research instruments to increase their reliability. After the pre-test, reliability of the instruments was estimated using Cronbach's alpha formula. A reliability coefficient of 0.82 was found which was above the threshold of 0.7 and therefore considered good and reliable measure for the research.

3.10 Ethical Consideration

Ethics is a branch of philosophy which deals with one's conduct and serves as a guide to one's behaviour (Mugenda & Mugenda, 2003). This is because research deals with human beings to provide information needed by the researcher. According to guidelines for conducting research using human subjects, it is important to ensure that participants' protection is guaranteed. The researcher sought for an introductory letter from the University's graduate school which facilitated the issuance of research permit license from the National Commission for Science, Technology and Innovation (NACOSTI) and ethical clearance approval.

For this study, the required authorization letter was sort from Egerton University ethical committee prior to conducting the research. Ethical consideration was important in this research because it dealt with men and women seed potato farmers who were expected to give information to the best of their knowledge. This enhanced the privacy and the safety of the respondents. The researcher encouraged voluntary participation and assured the respondents on confidentiality in all the activities of the research. The researcher also explained clearly to the respondents on their protection, minimal risk for participating in the study and the fact that all the information was to be kept with confidentiality. To enhance privacy, the researcher did not require the participants' names on the research instruments.

The researcher approached the county director of education and sub- county director of education and sought authorization research letters and informed them of the intent to carry out research in Nyandarua County. The researcher visited the extension officers and agricultural departments that deals with seed potato production to familiarize herself with the study area and explain to them the purpose of the study. Modalities for collecting the required data were discussed and agreed before the researcher embarked on the study. A set of closed ended questionnaires, interviews schedules were administered to the respondents.

In order to ensure high level of response, the researcher visited all the respondents and the instruments were administered by the researcher personally. The researcher explained

how to fill the questionnaires and interview schedules to the respondents. The purpose of administering the questionnaires and the interview schedules personally was to avoid chances of misinterpretation of the items due to illiteracy as well as to solve problems of time and cost of travelling back to collect them. The instruments were then organized and then scored ready for analysis. Respondents were assured of confidentiality of their participation. The raw data, information and the statistical analysis were kept in a safe custody with strict passwords on the Statistical Packages for Social Sciences (SPSS) templates and were burned in a disc and kept safely by the researcher.

3.11 Data Analysis

Before the actual data analysis, questionnaires were checked to ensure their completeness. Confirmed the instruments were well coded, serialized and double checked to ensure quality control. The specific objectives stated in chapter one called for different statistical analysis. Qualitative data formed by KII (extension officers and chairs of Self-Help Groups) used content analysis and results were presented in form of quotes and narratives. Quantitative data formed by men and women Irish seed potato farmers was analyzed using descriptive and inferential statistics with the help of the Statistical Packages for Social Sciences (SPSS) computer programme version 27. Data was presented using frequency tables. This provided an opportunity to increase the understanding of the Gender disparities in decision making, adoption, access and utilization of extension information and labor supply in climate-smart agriculture technologies on seed potato production in Ol-Kalau sub-County, Nyandarua County.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

The study investigated the gender disparities in adoption of climate smart agriculture (CSA) among potato producers in Ol-Kalau Sub County, Nyandarua County, Kenya. This chapter presents results and discussions on the themes driven from the four objectives of the study. The responses from the respondents were analyzed using descriptive and inferential statistics. A total of 124 out of 130 questionnaires were administered. As far as the gender of the respondents was concerned, this study found that majority were female as represented by 54.0% of the total responses, on the other hand, about 46.0% of the respondents were male. 9 out of 10 Key informants were interviewed by the researcher thus bringing the response rate for key informant to 90%. This is because one who was missing was not present at the time the researcher was conducting the interviews.

4.2 Demographic Characteristics of the Respondents

The respondents of the study were Male and female seed potato farmers in Ol-Kalau Sub-County. The study gathered information on the respondents' demographic characteristics which included: age, marital status, level of education, current occupation. Other agricultural practices ventured in included; the number of years they had practiced seed potato farming, land acreage owned by each respondent and varieties they grew. The analyzed results are summarized here below.

4.2.1 Gender of Respondents

From the study results women were the majority of the respondents as represented by 54.0% of the total responses. This was because women were available during the study period also in Africa women are the ones who have been assigned the role of primary land cultivation and planting. On the other hand, about 46.0% of the respondents were men. This study was contrary with other studies that advocate for 2/3 gender representation in all sectors.

In a number of agricultural and development studies, the sex of a farmers (often discussed in terms of gender) has been a prominent characteristic of analysis in gender differentials farm productivity (Udry *et al.,* 1995). Most of these studies identify and discuss gender inequalities, such as differences in rates of participation in agricultural production activities; unequal access to land, credit, labor and inputs.

The results of gender distribution of the sampled farmers in Ol Kalau, Nyandarua County are summarized in Table 4.1.

Table 4.1: Gender of Respondents

Gender	Frequency	Percent %
Male	57	46.0
Female	67	54.0

4.2.2 Age of the Respondents

From the study results, males and females' respondents older than 47 years were 52.7% and 49.3% respectively. Majority of the respondents were aged above 37 years as represented by 66.7% males and 73.2% females of the total responses. Respondents aged 58 years and above comprised 28.1% males while females comprised 22.4%. About 31.6% males were aged 28 -37 years while females in the same age group stood at 14.9%. (Table 4.2).

The age of a farmers has sometimes been a contentious discussion in agricultural sector, in particular the Irish seed potato farming. There is concern that most farmers are getting older and could become unproductive because of their poor health conditions (associated with ageing) that limit their active participation in Irish seed potato production. The age of a farmers is predicted to have a negative impact on adoption because, as the age increases, physical strength tends to reduce and this is assumed to impact negatively on adoption of the CSA technologies (Abegunde *et al.,* 2019). There are significant differences in productivity by age of farmers, with older farmers producing lower yields per acre than younger farmers. According to one of the extension officers, a key informant, "*older farmers' tend to have more experience in Seed potato enabling them to appreciate and practice good cropping practices that increase production".* Older farmers are the owners of land and family properties and therefore tend to make production decisions.

This affirmed Kising'u (2016) who stated that currently Kenya's farming population is aging because agriculture remains unattractive to youths. The findings concurred with past studies showing that Irish seed potato farmers tend to be older in age.

Table 4.2: Age of the Respondents

Gender	Age group	Frequency	Percent %
Male	18 - 27 years	1	1.8
	28 -37 years	18	31.6
	38 -47 years	8	14.0
	48 -57years	14	24.6
	58 years & above	16	28.1
Female	18 - 27 years	8	11.9
	28 -37 years	10	14.9
	38 -47 years	16	23.9
	48 -57years	18	26.9
	58 years & above	15	22.4

4.2.3 Marital Status of Respondents

According to this study results, males' respondents were married as represented by 91.2% while females were represented by 74.6%. This was due to provision of labor, access and control of land, access to capital and division of labour in a family set-up. This was followed by respondents who were single comprising 8.8% males and 13.4% females. While females' respondents who were divorced comprised 4.5% and widowed 7.5%. According to key informant extension officer stated *"A woman could easily access land while in a marriage set-up unlike when she was single this can be attributed by cultural issues to access and control land among women in the study area"*. Culture affected utility of land in the study area. Some married women confessed to the researcher that they got part of their capital from their husbands who occasionally boosted their production capital.

Land is accessed by women in marriage (Shire *et al.,* 2016). Once a woman gets married, the land that is owned by her husband automatically becomes a matrimonial property and can be accessed by the woman too. The role of marital status in Irish seed potato producing households is investigated to a lesser extent. However, a number of researchers attest that marital status is a relevant indicator in agricultural value chain development (Higgins & Fenrich, 2012; Waarts *et al.,* 2013). From one of the key Informant, i.e., the Chair of Mkulima Bora Self-Help Group (S.H.G) stated that "*marriage gives women access to land and men access to labour*".

The results are summarized in Table 4.3.

Table 4.3: Marital Status of Seed Potato Producers

Gender	Marital status	Frequency	Percent %
Male	Single	5	8.8
	Married	52	91.2
	Single	9	13.4
Female	Married	50	74.6
	Divorced	3	4.5
	Widowed	5	7.5

4.2.4 Level of Education of Respondents

From the study results, majority of the respondents had primary as their highest level of education as represented by males 29.8% while females 50.7%. Respondents level of secondary education comprised 47.4% males and 32.8% females. About 14.0% males and 6.0% females in the tertiary college. While those with university education comprised 8.8% males and 3.0% females and only males had the non-formal education represented by 7.5%. New technologies and training on Irish seed potato farming, are not taught below the tertiary level of education. Majority of the respondents attended the primary and the secondary level of education and few attended tertiary colleges or universities. Women were more in the primary level and few in the secondary tertiary and university level, this can be attributed to many challenges such as early marriages, early pregnancy, peer influence to getting married early, poverty that forces many women to give up on their studies, boy-child preferences and too many gender roles at home among other challenges. Those who had attended institutions of higher learning were fewer in the field of Irish seed potato because of time constrain. Most of them were learning from institutions far from their homes and on completion, they found employment in different counties far from their home county. Moreover, those who had just finished tertiary institutions were mobile and were busy looking for formal employment thus giving less attention to Irish seed potato. The level of education of the household head influences the kind of decision made on behalf of the entire household with regard to Irish seed potato production. Educated farmers are likely to make better decisions as well as quickly adopt new technologies in farming as compared to their less educated counterparts (Mwangi *et al.,* 2015). Improved education translates to better decision making due to the acquisition of more knowledge which increases one's intellectual capability on matters to do

with Irish seed potato production (Abebe *et al.,* 2013). Younger and more educated farmers are on average more productive than older farmers and more likely to adopt new farming technologies (Mwangi *et al.,* 2015). Therefore, the age and level of education of a farmer is an important characteristic in adoption of technologies, innovations and management practices such as climate smart agricultural practices.

In this study, respondents were asked about their level of completed education. The results are summarized in Table 4.4.

Table 4.4: Level of Education of Respondents

Gender	Level	Frequency	Percent %
Male	Primary	17	29.8
	Secondary	27	47.4
	Tertiary college	8	14.0
	University	5	8.8
	Non-formal	5	7.5
Female	Primary	34	50.7
	Secondary	22	32.8
	Tertiary college	4	6.0
	University	2	3.0
	Non-formal	0	0

4.2.5 Respondents' Main Occupation

In this study results, about 7.0% males and 4.5% females were engaged in non-farm self-employment. Other's occupation in the study area included formal employment males 1.8% and females 1.5%, casual laborer 1.5% represented by females only. This shows that majority of the respondents were crop farmers as represented by males 59.6% and females 67.2% of the total responses. This is probably because of the conducive climatic condition and availability of fertile lands that favor crop farming in Ol-Kalau sub-county. A few men and women Irish seed potato farmers were employed because they had primary and secondary school education only. For one to be employed in white collar jobs, they need to have gone through a tertiary education where they specialize in a particular task.

Table 4.5: Respondents' Main Occupation

Gender	Occupation	Frequency	Percent %
Male	Crop farming	34	59.6
	Livestock farming	18	31.6
	Formal employment	1	1.8
	Non-farm self-employment	4	7.0
Female	Crop farming	45	67.2
	Livestock farming	17	25.4
	Formal employment	1	1.5
	Casual labourer	1	1.5
	Non-farm self-employment	3	4.5

4.2.6 Types of livestock kept by Respondents

From the study results, majority of the respondents kept dairy cattle as represented by males 87.7%, females 70.1% of the total responses. Respondents who kept poultry comprised males 24.6% and females 28.4%. While beef comprised only 3.5% males and 3.0% females of total respondents. Dairy and poultry keeping was preferred by majority of the farmers in Ol-Kalau sub-county. This was attributed to Irish seed potato waste used as feeds to the dairy and poultry livestock in the study area while manure from the dairy and poultry livestock was used in organic farming of the Irish seed potato in the farm. Also, men and women Irish seed potato farmers opted to keep both dairy and poultry for supplementing their diet. (Table 4.6).

Table 4.6: Types of Livestock Kept by the Respondents

Types of Livestock	Gender	Response	Frequency	Percent %
Dairy	Male	Yes	50	87.7
		No	7	12.3
	Female	Yes	47	70.1
		No	20	29.9
Beef	Male	Yes	2	3.5
		No	55	96.5
	Female	Yes	2	3.0
		No	65	97.0
Poultry	Male	Yes	14	24.6
		No	43	75.4
	Female	Yes	19	28.4
		No	48	71.6

4.2.7 Respondents Farm Sizes

According to the study results, majority of respondents were having farm size of approximately 2-3 acres as represented by 35.1% males and 25.4% of females of the total responses. This was closely followed by respondents who were having farm size of approximately 4 acres and above comprising 35.1% males and females 20.9% of the total responses. Respondents who were having farm sizes ranging between 0 - 1 acres included 17.5% males and females 26.9%. Those with farm size of between 1 - 2 acres comprised males 12.3% and females 26.9%. This affirmed the continued fragmentation of land into smaller units as a result of high population that has hindered agricultural mechanization which is one of the CSA practices.

Due to continued sub-division of land (triggered by increased human population), the farm size in Nyandarua county was lower than the range of 4.5 - 8 Ha previously reported for this area by Baltenweck *et al.* (1998); Romney *et al.* (2004); Schreiber (2000).

Table 4.7: Respondents Farm Sizes

Gender	Farm Size (acres)	Frequency	Percent %
Male	0 - 1 acres	10	17.5
	1 - 2 acres	7	12.3
	2 - 3 acres	20	35.1
	4 acres and above	20	35.1
Female	0 - 1 acres	18	26.9
	1 - 2 acres	18	26.9
	2 - 3 acres	17	25.4
	4 acres and above	14	20.9

4.2.8 Irish Seed Potatoes Production Scale During the Previous (Oct-Dec 2021) Season

The study results indicate that, respondents were all smallholder farmers whose farm scale under seed potato was not more than 5 acres of land. Majority of the respondents were growing seed potato on farm scale of approximately of 0-1 acres as represented by 43.9% males and 65.7% females of the total responses. This was followed by respondents who grew potato on a farm scale of 1-2 acres comprising males 28.1% and females 22.4% of the total responses. It was only males 21.1% and females 9.0% of the respondents whose scale of seed potato production was 2 - 3 acres. While 4 acres and above males comprised 7.0% and 3.0% for the females. This was because seed potato production requires a lot of money and due to feminization of poverty women farmers were constrained by finances and only grew in small acreage which they can manage.

The results are summarized in Table 4.8.

Table 4.8: Irish Seed Potatoes Production Scale during the (Oct-Dec 2021) Season

Gender	Scale of Production (acres)	Frequency	Percent %
Male	0 - 1 acres	25	43.9
	1 - 2 acres	16	28.1
	2 - 3 acres	12	21.1
	4 acres and above	4	7.0
Female	0 - 1 acres	44	65.7
	1 - 2 acres	15	22.4
	2 - 3 acres	6	9.0
	4 acres and above	2	3.0

4.2.9 Method of land Acquisition

From the study results, the land that had been put under Irish seed potato farming in the previous season had been acquired mainly through inheritance for males 42.1% while females 47.8% This was because according to the African culture, children inherit land from their fathers thus resulting in a majority of land being inherited. Followed by leasing males represented 15.8% whereas females represented 17.9% lease annually by paying some amount of money as agreed by owner of the farm. Purchasing males comprised 19.3% and 19.4% for the females due to high economic hardship farmers are not able to buy land.
This is summarized in Table 4.9.

Table 4.9: Method of land Acquisition

Gender	Method of Land Acquisition	Frequency	Percent%
Male	1	9	15.8
	1 2	1	1.8
	1 2 3	1	1.8
	1 3	5	8.8
	2	11	19.3
	2 1	2	3.5
	2 3	2	3.5
	3	24	42.1
	3 1	2	3.5
Female	1	12	17.9
	1 2	4	6.0
	1 3	2	3.0
	2	13	19.4
	2 1 3	1	1.5
	3	32	47.8
	3 1	2	3.0
	4	1	1.5

[1]Leasing, [2]Purchasing, [3]Inheritance

4.2.10 Seasons (months) Irish Seed Potato was produced in 2021

From the results, majority of the respondents had produced Irish seed potatoes in the season tallying with the months of March-June as represented by males 75.6% and females 71.7% of the total responses. This was because of the rain patterns where the long rains were experienced leading to high yields. This was followed by respondents whose seasonal production of Irish seed potato was in Nov-Feb comprising 15.8% males and 22.4% females of the total farmers. Those who produced during the July-Oct season comprised males 7.0% and females 4.5%. Males represented 1.8% who produced seed potato in other seasons, notably August – December and October – December seasons. It is apparent that potato can be produced in Ol-kalau Sub-County, almost throughout the whole year. However, farmers realized low yields when poor rains are normally received between Jan and March. As a

CSA practice, it is important that men and women farmers be trained on the best time for planting Irish seed potato, in order to realize high yields.

Respondents were requested to indicate which seasons (months) they produced Irish seed potato in the previous cropping year of 2021.

The results are summarized in Table 4.10.

Table 4.10: Seasons (months) Irish Seed Potato Production Produced

Gender	Season	Frequency	Percent%
Male	1	22	38.6
	1 2	5	8.8
	1 2 3	3	5.3
	1 3 2	1	1.8
	1 4	12	21.1
	2	4	7.0
	3	9	15.8
	4	1	1.8
Female	1	21	31.3
	1 2	5	7.5
	1 2 3	2	3.0
	1 3	2	3.0
	1 4	17	25.4
	1 4 2	1	1.5
	2	3	4.5
	3	15	22.4
	3 2	1	1.5

Others included: August – December and October – December

4.2.11 Experience in Irish Seed Potato Farming

According to results, experience was measured by the number of years household head had spent producing seed potato. Respondents were having farming experience of 16 years and above as represented by 36.8% and 31.3% males and females respectively. This was because most of them were aged 48years and above thus had the chance to practice seed potato farming for longer years. About 31.6% males and 35.8% females had farming

experience of about 1 - 5 years. While those with 6- 10 years comprised 22.8 % and 23.9% males and females respectively. About 8.8% males and 9.0% females of the remaining farmers had farming experience of about 11 - 15 years. From the results above, shows that male farmers got high experience than their female farmers counterparts making them adopt CSA technologies more creating a gap between them.

Farming experience has had a significant impact on allocative and economic efficiency among seed potato producing farmers (Nyagaka, 2009). Household heads with more years of experience in producing Irish seed potatoes are more allocatively and economically efficient than their counterparts. Similarly, Amara *et al.* (1999) found a positive and significant influence of experience on efficiency of potato farmers in Quebec. Experience comes with years in practicing farming and consequently age of farmer. Therefore, it's likely that older farmers had more experience than their younger counterparts' and were better skilled in adoption of CSA practices in Irish seed potato production.

Table 4.11 shows the frequency distribution of the years of experience in production of Irish seed potato among the sampled household heads.

Table 4.11: Experience in Irish Seed Potato Farming

Gender	Year of Farming Potato	Frequency	Percent%
Male	1 - 5 years	18	31.6
	6 - 10 years	13	22.8
	11 - 15 years	5	8.8
	16 years and above	21	36.8
Female	1 - 5 years	24	35.8
	6 - 10 years	16	23.9
	11 - 15 years	6	9.0
	16 years and above	21	31.3

4.2.12 Potato Yield in the Last 2021 Season

From the study results, respondents produced about 1 - 10 bags/acre (50kg) during their last cropping season as represented by 17.5% males and 35.8% females of the total responses. About 12.3% males and 25.4% females produced about 11 - 20 bags (50kgs) of seed potato during the previous cropping cycle. Those who produced 51 bags/acre (50kgs) and above comprised males 35.1% and females 13.4%. The low yields were attributed to the

use of poor-quality seed, lack of Climate Smart technology skills and climate change that affected the yields. These results concur with those of Nyagaka (2009) who found that the mean yield of Irish ware potatoes obtained by farmers in Nyandarua county (Nyandarua North District) was approximately 21.93 of 100 kg bags per acre (5.48 t/ha). These results suggest that there is considerable room for improving average Irish potato yields (to the national targeted of 20 t/ha) in the study area by adopting CSA technologies.

This study sought to know how many 50kg bags of potato respondents produced in the last season.

Results are summarized in Table 4.12.

Table 4.12: Potato Yield in the Last Season

Gender	Number of Bags (50kg)	Frequency	Percent%
Male	1 - 10 bags	10	17.5
	11 - 20 bags	7	12.3
	21 - 30 bags	3	5.3
	31 - 40 bags	8	14.0
	41 - 50 bags	9	15.8
	51 bags and above	20	35.1
Female	1 - 10 bags	24	35.8
	11 - 20 bags	17	25.4
	21 - 30 bags	8	11.9
	31 - 40 bags	5	7.5
	41 - 50 bags	4	6.0
	51 bags and above	9	13.4

4.3 Gender Disparities in Decision Making on Choice of Climate-Smart Agriculture (CSA) Technologies in Seed Potato Production

The first objective in this study sought to examine gender disparities that influence decision making on choice of Climate-smart Agriculture (CSA) technologies in seed potato production in Ol-Kalau sub-county. Descriptive and inferential statistics were used to analyze this objective.

4.3.1 Farmers' level of Importance in Decision Making on CSA Potato Production Activities

This study was interested on the farmers' level of involvement (i.e., degree of importance) in decision making in CSA practices in potato production. The results are summarized in Table 4.13.

Table 4.13: Farmers' Level of Importance in Decision Making on CSA Potato Production Activities

Activities	Very much	Much	Moderate	Low	Very low	Total	Mean	Std. dev
Land acquisition	31 (25%)	25 (20.2%)	45 (36.3%)	16 (12.9%)	7 (5.6%)	124 (100%)	3.46	1.17
Land preparation	28 (22.6%)	41 (33.1%)	40 (32.3%)	12 (9.7%)	3 (2.4%)	124 (100%)	3.64	1.02
Acquisition of farm inputs	46 (37.1%)	26 (21%)	26 (21%)	10 (8.1%)	16 (12.9%)	124 (100%)	3.62	1.39
Planting (time; tillage, etc)	22 (17.7%)	44 (35.5%)	47 (37.9%)	10 (8.1%)	1 (0.8%)	124 (100%)	3.61	0.90
Weed control	20 (16.1%)	51 (41.1%)	31 (25%)	18 (14.5%)	4 (3.2%)	124 (100%)	3.52	1.03
Harvesting	21 (16.9%)	37 (29.8%)	58 (46.8%)	5 (4%)	3 (2.4%)	124 (100%)	3.55	0.91
Packaging	24 (19.4%)	38 (30.6%)	32 (25.8%)	26 (21%)	4 (3.2%)	124 (100%)	3.42	1.12
Transport	46 (37.1%)	13 (10.5%)	21 (16.9%)	8 (6.5%)	36 (29%)	124 (100%)	3.20	1.67

From the study results, farmer respondents who considered involvement in land acquisition activities for Irish seed potato production comprised a cumulative of 45.2% (for both much and very much). Specifically, those who indicated their involvement in land acquisition activities to be much and very much comprised 20.2% and 25%, respectively. Those who described their involvement in land acquisition activities to be low (both low and very low) comprised 18.5%. Irish seed potato farmers involved to a 'much' extent as far as

land preparation activities was concerned in their potato production comprised of 55.7%. Those who indicated their involvement in land preparation activities to be much and very much comprised 33.1% and 22.6%, respectively. Those who described their involvement in land preparation activities to be low (both low and very low) comprised 12.1%. This implies that there is need for training farmers who were categorized as moderate and below on the importance of land selection and acquisition for seed potato production. There was flooding due to impervious soils and high rainfall that has resulted in rotting of tubers and lowering of yield and thus, reduction in total produce.

The level of involvement of most respondents 58.1% on acquisition of farm inputs for Irish potato production was described as ‘much'. Those who indicated their involvement in acquisition of farm inputs activities to be much and very much comprised 21% and 37.1%, respectively. Those who described their involvement in acquisition of farm inputs activities to be low (both low and very low) comprised 21%.

Most of the respondents (53.2%) described they were involved in a ‘much' extent as far as planting activities (i.e., tillage, furrow making, etc) was concerned in their potato production. Those who indicated their involvement in planting activities to be much and very much comprised of 35.5% and 17.7%, respectively. Those who described their involvement in planting activities to be low (both low and very low) comprised 8.9%. Seed potato yields are influenced by time of planting, land preparation methods that produce the correct tilth and planting depth. Considering that many farmers (over 46%) considered these practices as of moderate, low and very low importance, there is a great need to validate these CSA practices to show case their great importance in increasing yields. This will result in them getting more involved in adopting of the said CSA practices.

In this study results, most of the respondents (57.2%) described they were involved to a ‘much' extent as far as weed control activities were concerned in Irish potato production. Those who indicated their involvement in weed control activities to be much and very much comprised 41.1% and 16.1%, respectively. Those who described their involvement in weed control activities to be low (both low and very low) comprised a cumulative of 17.7%. Similarly, there is a significant number of Irish potato farmers in Ol kalua Sub-County, who deemed it of moderate importance, low and very low importance in controlling weeds. However, weeds cause over 50 % loss in potato productivity (Fried *et al.,* 2017). This shows the importance of demonstrating the degree of gain if good weed management in Irish seed potato production is practiced in Nyandarua County.

Irish seed potato farmers were involved to a ‘much' extent as far as harvesting activities were concerned in their Irish seed potato production by (46.7%) described being involved. Those who indicated their involvement in harvesting activities to be of much and very much (importance) comprised 29.8% and 16.9%, respectively. Those who described their involvement in harvesting activities to be low (both low and very low) comprised 6.4%. Correct timing to dehaulming Irish seed potato plants influences the seed potato size and thus grade. The use of certain tools (e.g., jembes) can result in over 15 to 20% damage of tubers at harvesting time. Resulting in high perishability at transportation and storage times and thereafter lowering of selling price. Unfortunately, over 53% farmers in Ol kalau sub county considered it as of moderate importance (46.8%). There is great need for training and demonstrating good harvesting practices.

Respondents (50%) described they were involved to a ‘much' level of extent as far as packaging activities were concerned in their Irish seed potato production. Those who indicated their involvement in packaging activities to be of much and very much importance comprised 30.6% and 19.4%, respectively. Those who described their involvement in packaging activities to be low (both low and very low) comprised 24.2%. Moderate were 25.8%. Packaging regulations are prescribed in the Irish Potato 2019 regulations. They inform farmers of the importance of packaging potatoes to a maximum of 50 kg only. The bags must be well perforated to allow proper aeration and weight enable ease of transportation and minimal damage. These need to be taught to those (50%) farmers that don’t consider packaging as being important. Appreciation of these CSA practices would minimize their post-harvest losses and increase the marketing value of their produce. Most of the respondents (47.6%) described they were involved in a ‘much' extent as far as transport activities was concerned in their potato production. Those who indicated their involvement in transport activities to be much and very much comprised 10.5% and 37.1%, respectively. Those who described their involvement in transport activities to be low (both low and very low) comprised 35.5%.

The transport of seed and ware potato is also regulated by county governments. Transportation of potatoes is done through licensed vehicles and operators. This helps to monitor movement and even enforce the Irish potato 2019 regulations. Training of these regulations will enable (the over 52.4% farmers’ that considered transport of being moderate to low in importance) to appreciate and adopt good transportation practices that will protect his/her produce and enable it reach the market safely, in good quality and at a profitable

price. Further studies are recommended to determine the impact of transportation choice on quality of marketed seed and ware potatoes.

4.3.2 Analyses of gender differences in the level of decision making on various potato production activities.

Independent t-test analysis was used to determine if there was significant difference in extent of decision making on various Irish seed potato production activities by gender. The results were summarized in Table 4.14.

Male Irish seed potato farmers significantly dominated in decision making of all the potato farming activities. Specifically male farmers were more involved in the following decision-making domains in potato farming: land acquisition (t-value = 4.648; $p<0.005$); land preparation (t-value = 4.306; $p<0.05$); acquisition of farm inputs (t-value = 6.241; $p<0.05$); planting (t-value = 2.015; $p<0.05$); weed control (t-value = 2.519; $p<0.05$); harvesting (t-value = 2.145; $p<0.05$); packaging (t-value = 6.048; $p<0.05$) and transportation (t-value = 11.924; $p<0.05$). Overall male farmers were more involved than their female counterparts with a mean difference of 0.918 (t-value = 6.654; $p<0.05$). This was because, in African cultures men are the heads of household and thus they contribute significantly more than women on various crucial decision-making processes affecting implementation of CSA practices.

These results agree with Aryal *et al.* (2020) who found that most African countries are patriarchal in nature with men dominating the decision-making process including those in agricultural sector. This minimizes and many times even hinders the capacity of women in contributing to the adoption of the CSA technologies. Land acquisition, time and types of land preparation inform the types of CSA practices. The onset of rains determines the time to begin land preparation. Knowledge of rainfall patterns, amounts and even frequency informs on the varieties to grow, as well as direction of furrows, which depends on the type of soil and direction of the slope of land. Type of land preparation (on various loose soils) can lead to extensive soil erosion of sloppy land that is exposed to high intensity rainfall. Training on these good agricultural practices (GAP) that are climate smart to both genders will help improve on potato yields and sustain them too. The results are consistent with Nyasimi *et al.* (2017) who found out that women have limited rights in decision making power unlike their male counterparts endangering them to the negative consequences of climate change since they have limited power to adapt to climate-smart technologies. According to Waroga (2019) women farmers in different countries record lower yields than their male counterparts due to

climate change and weather patterns caused by failure to implement long term CSA practices. Women farmers involvement in decision making process could ensure that they adopt CSA practices that mitigate or help adopt to climate change. Empowering both men and women in collection of weather (rainfall, temperature, etc) data, analyses and interpretation will help in making good decisions that are climate smart. Men dominate in the use of machinery in agriculture. Women mostly lack money to purchase chemicals and equipment for weed and pest control. Consequently, women produce less yield than men because of carrying out of many management practices manually.

According to Sarapura (2013) men are the key decision makers both in the family and community levels. Consequently, women's needs may not be addressed adequately or considered in climate smart agricultural practices related programs, that include training. Likewise, Ali *et al.* (2021) noted that most decisions in adopting climate smart agricultural technologies in Irish potatoes have to be approved by the males in the family. Their decision on whether to adopt or dismiss the adoption of technologies depends on them and is final to the family members no matter how good the technology may or may not be.

This study also agrees with Makama (2013) who states that women have for a long-time experienced discrimination and non- inclusivity in decision making due to various customary practices that hinder them from engaging in decision making process. Women in most communities are disadvantaged from control of land and deciding on methods to be used in farming. Women just implement the decision that men have already made without consulting them making them vulnerable to low production outcomes that might result. According to Westwood *et al.* (2018) men are more literate than their female counterparts and own land, farming equipment's and knowledge which are agricultural factors of production. Due to illiteracy level of women, they are not able to contribute to various CSA issues affecting its adoption as well as men do.

Table 4.14: T-Test Results for the Gender Difference in Level of Decision Making on Potato Production Related Activities

Production activities	Gender	N	Mean	Std. Dev.	t-value	df	p-value	Mean Diff.
Land acquisition	Male	57	3.95	.934	4.648	122	0.000	0.903
	Female	67	3.04	1.186				
Land preparation	Male	57	4.04	.706	4.306	122	0.000	0.737
	Female	67	3.30	1.115				
Acquisition of farm	Male	57	4.35	.790	6.241	122	0.000	1.366
inputs	Female	67	2.99	1.482				
Planting	Male	57	3.70	.801	2.015	122	0.012	0.164
	Female	67	3.54	.974				
Weed control	Male	57	3.77	.655	2.519	122	0.013	0.458
	Female	67	3.31	1.233				
Harvesting	Male	57	3.65	.719	2.145	122	0.025	0.186
	Female	67	3.46	1.035				
Packaging	Male	57	4.00	.756	6.048	122	0.000	1.075
	Female	67	2.93	1.146				
Transport	Male	57	4.53	.826	11.924	122	0.000	2.452
	Female	67	2.07	1.352				
Overall	Male	57	3.9978	.54970	6.654	122	0.000	0.918
	Female	67	3.0802	.90889				

4.4 Gender Disparities in the Adoption of CSA Technologies in Seed Potato Production in Ol-Kalau Sub-County

The second objective in this study sought to determine gender disparities in the adoption of CSA technologies in seed potato production in Ol-Kalau sub-County. This objective was analyzed using descriptive statistics (frequencies and percentages) as well as inferential statistics (t-test).

4.4.1 CSA Technologies Practiced by Respondents in their Potato Farming During the Last Season

Climate smart agriculture (CSA) is an integrative approach to address the challenges of food security and climate change by sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change and reducing and/or removing

greenhouse gas emissions, where possible Intergovernmental Panel on Climate Change, 2012. The various climate smart agricultural practices adopted by the respondents are discussed below:

4.4.2 Agronomic Practices

There are several agronomic practices implemented to mitigate climate change. These include: application of organic farming, conservation agriculture and resource conservation technologies (RCTs) and cover cropping.

Organic farming is one of the major CSA agronomic practices that respondents in the study area had implemented in the last cropping season (Oct-Jan 2021). The proportion of respondents who had adopted various aspects of organic farming practices are summarized in Table 4.15.

Table 4.15: Degree of Organic Farming Practices Adopted

CSA Practice	Gender	Response	Percent%
Did you ensure that there was minimal biodiversity loss and sustainability of potato production system?	Male	Yes	15.8
		No	84.2
	Female	Yes	16.4
		No	83.6
Did you use alternative sources of nutrients for crop (crop rotation, residue management, organic manures and biological inputs)?	Male	Yes	93.0
		No	7.0
	Female	Yes	95.5
		No	4.5
Did you implement chemical free weeds and pest's management practices (physical, cultural and biological)?	Male	Yes	52.6
		No	47.4
	Female	Yes	59.7
		No	40.3
Did you maintain livestock in tandem with potato farming?	Male	Yes	91.2
		No	8.8
	Female	Yes	83.6
		No	16.4

Some of the agronomic practices to do with organic farming that respondents in the study area had implemented included provision of alternative sources of nutrients to crops; i.e., through crop rotation, residue management, organic manures and biological inputs. Where males were represented by 93.0% and females 95.5%. These practices are known to help improve the soil fertility by increasing the soil organic matter and water holding capacity, leading to high yields. Maintenance of livestock in tandem with potato farming is practiced by 91.2% males and 83.6% females. Chemical free weeding and pest management practices through physical, cultural and biological practices was represented by 52.6% males and 59.7% females which ensures minimal biodiversity loss and sustainability of potato production system. Women were more involved in these activities because they did not require finances.

Conservation agriculture and resource conservation technologies were some of the agronomic practices that respondents had implemented in their previous potato cropping season as shown in Table 4.16.

Table 4.16: Conservation Agriculture and Resource Conservation Technologies (RCTs)

Technologies	Gender	Response	Frequency	Percent%
Crop rotations or sequencing and	Male	Yes	52	91.2
associations of crops (for		No	5	8.8
nitrogen-fixation)	Female	Yes	59	88.1
		No	8	11.9
Minimal mechanical soil	Male	Yes	27	47.4
disturbance (zero-tillage and		No	30	52.6
direct seeding)	Female	Yes	30	44.8
		No	37	55.2
Mulching (for soil cover and	Male	Yes	12	21.1
nutrient enhancement)?		No	45	78.9
	Female	Yes	13	19.4
		No	54	80.6

In the study results, some of the conservation agriculture and resource conservation technologies (RCTs) implemented by the respondents included: crop rotations or sequencing and associations of crops for nitrogen-fixation where 91.2% males and 88.1% females

practiced it where they grew peas for crop rotation. Minimal mechanical soil disturbance through zero-tillage and direct seeding males comprised 47.4% and 44.8% represented females. Males were majority in mulching with 21.1% and 19.4% for females as this task required more energy and because of masculine body of men they dominated for soil cover and nutrient enhancement. These CSA practices help to conserve soil moisture from getting lost through evaporation as well as increase the water use efficiency.

Cover cropping was a CSA practice that had been adopted in the previous Irish potato cropping season as summarized in Table 4.17.

Table 4.17: Farmers who Practiced Cover Cropping

Cover cropping CSAPs	Gender	Response	Frequency	Percent%
Farmers that grew leguminous cover crops	Male	Yes	27	47.4
		No	30	52.6
	Female	Yes	34	50.7
		No	33	49.3
Farmers that grew vegetative cover between successive agricultural crops	Male	Yes	14	24.6
		No	43	75.4
	Female	Yes	15	22.4
		No	52	77.6

Male farmers grew leguminous cover crops as represented by 47.4% and 50.7% for the women. Women were the majority as they preferred such crops because they took short time to be cooked. While males who grew vegetative covers comprised 24.6% and 22.4% for females this was because men used vegetative crops to feed to their livestock as noted earlier men keep livestock more than their female counterparts.

4.4.3 Characteristics of Potato Varieties Grown

Farmers in the study area, had adopted types of potato varieties grown as a climate smart agricultural practice. Some of the crop varieties planted by farmers in their previous cropping season was drought, disease resistant, salinity and flooding resistant as summarized in Table 4.18.

Table 4.18: Climate Smart Seed Potato Characteristics Preferred in Varieties Grown in Ol Kalau

Varieties Grown	Gender	Response	Frequency	Percent%
Did you grow potato variety	Male	Yes	49	86.0
that was resistant to diseases?		No	8	14.0
	Female	Yes	50	74.6
		No	17	25.4
Did you grow potato variety	Male	Yes	43	75.4
that was resistant to drought?		No	14	24.6
	Female	Yes	50	74.6
		No	17	25.4
Did you grow potato variety	Male	Yes	19	33.3
that was resistant to flooding?		No	38	66.7
	Female	Yes	21	31.3
		No	46	68.7
Did you grow potato variety	Male	Yes	10	17.5
that was resistant to salinity?		No	47	82.5
	Female	Yes	15	22.4
		No	52	77.6

According to results, some of the climate smart agricultural practices related with seed potato varieties that were grown by the respondents included growing of potato variety that were disease tolerant. Diseases such as late blight, bacterial wilt and potato cyst nematodes are some of the major diseases that devastate seed potato production in Nyandarua county and the world as a whole. Soils infested by bacterial wilt and or PCN are normally disqualified from growing seed potato. This is the reason why varieties that can tolerate these diseases are high sought for. Males comprised 86.0% and females 74.6% thus creating the gender disparity between men and women in the varieties grown and women farmers lagging behind in adoption of climate smart practice, drought tolerant males represented 75.4% while females 74.6%, flooding tolerant males and females comprised 33.3% and 31.3% and salinity tolerant males represented 17.5% and females 22.4%. This study noted that some of the crop varieties that were grown by farmers in the previous potato crop season were yield and maturity enhanced. The results are summarized in Table 4.19.

Table 4.19: Yield and Maturity Enhanced Seed Potato Crop Varieties

Yield and Maturity	Gender	Response	Frequency	Percent%
Did you grow potato	Male	Yes	57	100.0
variety that was high	Female	Yes	64	95.5
yielding?		No	3	4.5
Did you grow potato	Male	Yes	57	100.0
variety that was fast	Female	Yes	63	94.0
maturing?		No	4	6.0

Climate smart agricultural practices that had been adopted by respondents in Ol Kalau Sub-County were related to yield levels and rates of maturity. Males had grown high yielding and fast maturing varieties (i.e., *shangi)* comprised 100% and 100%, respectively. This is because men are capable of accessing credit facilities that make them harvest high yields in their farms. Whereas, women are disadvantaged whereby they face bottlenecks while trying to access credit due to lack of collateral such as land title deed which they can use to get loans from banks.

4.4.4 Integrated Soil, Water and Nutrient Management

Table 4.20: Soil Management Practices

Soil Management	Gender	Response	Frequency	Percent %
Did you apply fertilizer to your most recent potato crop?	Male	Yes	56	98.2
		No	1	1.8
	Female	Yes	66	98.5
		No	1	1.5
Did you apply manure to your most recent potato crop?	Male	Yes	39	68.4
		No	18	31.6
	Female	Yes	41	61.2
		No	26	38.8
Did you test your soil before embarking on potato farming?	Male	Yes	27	47.4
		No	30	52.6
	Female	Yes	14	20.9
		No	53	79.1
Did you implement any additional measure to ensure good soils for your recent potato crop?	Male	Yes	10	17.5
		No	47	82.5
	Female	Yes	5	7.5
		No	62	92.5

Others: ash application, mulching, rabbit urine application, crop rotation and liming

From the study results, some of the soil management climate smart agricultural practices implemented by the respondents included fertilizer application by males 98.2% and 98.5% females, manure application 68.4% and 61.2% males and females respectively. Males dominated in soil testing 47.4% while females 20.9% because males can afford the cost incurred in soil testing while females due to feminization of poverty are not able to meet the costs because of poverty. Other soil management CSAPs were implemented by males comprised 17.5% and 7.5% for females of the total respondents. These included ash application, mulching, rabbit urine application, crop rotation and liming. Because of the need for healthy growth of crops, high yields and fast maturity.

Table 4.21: CSA Water Management Practices

On-farm water harvesting	Gender	Response	Frequency	Percent
Did you harvest water (in your farm) for use in potato crop farming?	Male	1	12	21.1
		2	45	78.9
	Female	1	12	17.9
		2	55	82.1
Did you practice drip irrigation in your potato crop farming?	Male	1	2	3.5
		2	55	96.5
	Female	2	67	100.0
Did you use other soil management CSAPs in potato farming?	Male	2	57	100.0
	Female	2	67	100.0

Others include: mulching; cover cropping; sprinkler irrigation

According to results, some of the water management CSA practices adopted in the recent past included on-farm water harvesting where 21.1% males and 17.9% females practiced. Low level of resources affects females as they do not have money to purchase tanks for storing water. Pumping of water using generators driven by solar technology (e.g., sun culture and water pumps. Drip irrigation ensured that water flows in the fields. Other CSA water conservation technologies practices include mulching, cover cropping and sprinkler irrigation where both men and women farmers agreed to have practiced any of them.

The nutrient management practices that respondents in Ol kalua sub -county had adopted included fertilizer application males 94.7% and females 97.0%, manure application males 64.9% and females 61.2%. Respondents who did soil testing included males represented by 36.8% and females 13.4%. Males and females' farmers represented by 14.0% and 11.9% respectively were involved in other nutrient management practices which included ash application, mulching, rabbit urine application, crop rotation, booster application and liming. Fertilizer and manure application in Ol Kalau Sub-County are well adopted CSA technologies for increasing growth and yields of clean Irish seed potato.

Table 4.22: Nutrient Management Practices

Nutrient management CSAPs	Gender	Response	Frequency	Percent%
Did you apply fertilizer to your most recent potato crop?	Male	1	54	94.7
		2	3	5.3
	Female	1	65	97.0
		2	2	3.0
Did you apply manure to your most recent potato crop?	Male	1	37	64.9
		2	20	35.1
	Female	1	41	61.2
		2	26	38.8
Did you test your soil before embarking on potato farming?	Male	1	21	36.8
		2	36	63.2
	Female	1	9	13.4
		2	58	86.6
Did you implement any additional measure to ensure nutrient availability in the soil for your recent potato crop?	Male	1	8	14.0
		2	49	86.0
	Female	1	8	11.9
		2	59	88.1

Others: ash application, mulching, rabbit urine application, crop rotation, booster application and liming

4.4.5 Integrated Pest and Disease Control and Management

Table 4.23: Pest Control Management Practices

Pest control Management Practices	Gender	Response	Frequency	Percent%
Did you plant clean/certified potato seeds?	Male	1	53	93.0
		2	4	7.0
	Female	1	62	92.5
		2	5	7.5
Did you plant pest resistant potato varieties?	Male	1	34	59.6
		2	23	40.4
	Female	1	38	56.7
		2	29	43.3
Did you implement any additional measure to ensure pest control in your recent potato crop?	Male	1	8	14.0
		2	49	86.0
	Female	1	8	11.9
		2	59	88.1

Others include: ash application, tithonia water application, rabbit urine application, biological pest control, crop rotation, mulching and use of pesticide

Planting of clean/certified seeds and pest resistant varieties were the most popular pest control management practices that were implemented by the respondents as cited by males 93.0% and 92.5% females of the total respondents. Male famers 59.6% and 56.7% used pest resistant's potato varieties while 14.0% males and 88.1% females used other measures to ensure pest control which included ash application, tithonia water application, rabbit urine application, biological pest control, crop rotation, mulching and use of pesticide. Most common pests in seed are aphid, which flies (in field) and tuber moths in storage. The field pests are vectors of fungal diseases, i.e., late blight, and therefore need to be controlled early in order to protect the crop from yield losses.

Table 4.24: Disease Control Management Practices

Disease control management	Gender	Response	Frequency	Percent%
Did you plant disease resistant potato varieties?	Male	1	39	68.4
		2	18	31.6
	Female	1	49	73.1
		2	18	26.9
Did you implement any additional measure to ensure disease control in your recent potato crop?	Male	1	9	15.8
		2	48	84.2
	Female	1	8	11.9
		2	59	88.1

Others include: Crop rotation, early land preparation, rabbit urine application, timely harvesting, proper storage and crop rotation

Respondents planted disease resistant potato varieties such as *shangi* males represented by 68.4% and females 73.1%. Males 15.85 and females 11.9% practiced other disease control management practices such as crop rotation, early land preparation, rabbit urine application, timely harvesting, proper storage and crop rotation.

4.4.6 Other CSA Technologies

Table 4.25: Weeding, Greenhouse and Seeding Technologies

Weeding, greenhouse and Seedling technologies	Gender	Response	Frequency	Percent%
Did you use apical rooted cuttings for your recent potato crop?	Male	1	15	26.3
		2	42	73.7
	Female	1	13	19.4
		2	54	80.6
Have you grown your potato in Greenhouse?	Male	1	1	1.8
		2	56	98.2
	Female	2	67	100.0
Do you practice biological weed control?	Male	1	5	8.8
		2	52	91.2
	Female	1	8	11.9
		2	59	88.1

Some of the other climate smart agricultural technologies that relate to weeding, greenhouse and seeding that were practiced by the sampled respondents included use of apical rooted cuttings represented by males 26.3% and females 19.4%. Male farmers dominated because they had finances to buy the apical rooted cuttings unlike women farmers who are depended on males. Males 1.8% and females 100% responded that they had grown potato in green house while biological weed control men 8.8% and females 11.9% agreed they had practiced. Women were more in the biological weed control because it did not involve money and resources so women were able to practice.

Table 4.26: Information Use and Acquisition

Information Use and Acquisition	Gender	Response	Frequency	Percent%
Did you use mobile/internet information gathering for your most recent potato crop?	Male	Yes	35	61.4
		No	22	38.6
	Female	Yes	21	31.3
		No	46	68.7
Did you use weather forecast information on your most recent potato crop?	Male	Yes	32	56.1
		No	25	43.9
	Female	Yes	28	41.8
		No	39	58.2

Males represented by 61.4% and females 31.3% agreed that they acquired information using mobile/internet technologies. The low adoption in use of smart mobile (android) technology especially by females is attributed to the women farmers being elderly and thus unable to operate smart mobile based technologies. Males 56.1% and females 41.8% used weather forecast information to predict on timing of different potato production activities. This means that both genders and especially women farmers will need to be informed and trained on the advantages of using modern remote sensing weather forecast and mobile based technologies. According to key Informant extension officer stated that "*farmers rely mostly on local and traditional sources of information to make their farming decisions"* which might not be accurate nor reliable making them delay in planting time and harvesting affecting the yields.

4.4.5 T-Test Results for the Differences in the Level of Adoption of Selected CSA Practices

This study was interested in gender parity with respect to adoption of selected climate smart agricultural practices. Difference in the adoption of selected CSA practices was analyzed using independent samples t-test.

Table 4.27: T-test Results for the Differences in Adoption of Selected CSA Practices

	Gender	Mean	Std. Dev.	T	p-value	Mean Diff.
Organic farming	Male	2.526	0.826	-0.184	0.855	-0.026
	Female	2.552	0.744			
Conservation agriculture	Male	1.597	0.842	0.526	0.600	0.074
	Female	1.522	0.725			
Cover cropping	Male	0.719	0.818	-0.087	0.931	-0.012
	Female	0.731	0.730			
Drought, disease, salinity and flooding resistant crop varieties	Male	2.123	1.053	0.425	0.672	0.093
	Female	2.030	1.337			
Yield and maturity enhanced crop varieties	Male	2.000	0.000	2.828	0.040	0.104
	Female	1.896	0.431			
Integrated soil management	Male	2.316	0.869	2.994	0.003	0.435
	Female	1.881	0.749			
Integrated water management	Male	0.491	0.947	0.871	0.386	0.133
	Female	0.358	0.753			
Integrated nutrient management	Male	2.105	0.880	2.818	0.042	0.269
	Female	1.836	0.771			
Integrated pest control management	Male	1.667	0.664	0.446	0.656	0.055
	Female	1.612	0.695			
Integrated disease control management	Male	0.842	0.676	-0.075	0.940	-0.009
	Female	0.851	0.609			
Weeding, greenhouse and seeding technologies	Male	0.368	0.522	0.619	0.537	0.055
	Female	0.313	0.467			
Information use and acquisition through internet/phone and weather forecast	Male	1.175	0.909	2.879	0.005	0.444
	Female	0.731	0.809			

There was significant gender difference in adoption of CSA technologies relating to crop varieties selected for higher seed yields and early maturity (mean difference = 0.104; t-value = 2.828; $p<0.05$); with greater adoption reported among the male farmers compared to their female counterparts.

There was significant difference in gender disparities for the adoption of integrated soil management practices (mean difference = 0.435; t-value = 2.994; $p<0.05$); with greater adoption reported among the male farmers compared to their female counterparts. There was a significant difference in gender disparities in the adoption of integrated nutrient management practices (mean difference = 0.269; t-value = 2.818; $p<0.05$), with greater adoption reported among the male farmers compared to their female counterparts.

There was a significant difference in the farmers adoption of CSA technologies relating to information use and acquisition through internet/phone and weather forecast (mean difference = 0.444; t-value = 2.879; $p<0.05$); with greater adoption reported among the male farmers compared to their female counterparts.

Male seed potato farmers have significant access to information and use of technology more than their female counterparts. This is particularly so, in CSA technologies related to selection of varieties that bare higher yields and tolerant to diseases as well as implementation integrated soil and nutrient management practices.

Acquisition and use of knowledge have largely been a priority and preserve given to the male farmer in Africa. Capacity building opportunities provided by NGOs' and other training organizations have largely been biased towards favoring the male farmers. Because the females are normally left home to care for children and conduct domestic labour. It is recommended that females be given opportunities to acquire and use knowledge to enable them supplement the development and income generating production activities needed in the seed potato value chain.

4.4.6 Effect of Selected set of Factors on Farmers Adoption of CSA Technologies

This study was interested on how selected set of factors affected farmers adoption of CSA technologies. The reselected factors included: level of education, available technology, access to knowledge on CSA, access to finances, cultural norms and values, attitude of farmers, nature of technology, access to land and lack of CSA skills. The results are summarized in Table 4.28.

Most of the respondents (75%) stated that their level of education had low (little) and very low effect on their adoption of CSA technologies associated with seed potato

production. Those who perceived the extent of education level as having low and very low effects in adoption of CSA technologies comprised of 48.4% and 26.6%, respectively. Those who described the extent of education as having much and very much effect comprised a cumulative of 14.5%. About 10.5% felt that level of education affected their adoption of CSA technologies moderately. This is an interesting finding because many studies claim that a higher level of education affects adoption of technologies, as it influences levels of understanding and skills development positively. This is possible because Nyandarua farmers have been growing potatoes since independence. Therefore, they probably feel that there is no difficulty in adopting the CSA technologies they have been exposed to in recent times.

Majority of the respondents (65.3%) described that available technology affected the extent of their adoption of CSA technologies in a low extent. Those who perceived the extent of effect that available technology had on their adoption of CSA technologies as low and very low comprised 38.7% and 26.6%, respectively. Those who described the extent of effect as much and very much comprised a cumulative of 16.9%. About 17.7% felt that available technology affected their adoption of CSA technologies moderately.

Similar to level of education, the majority (65.3%) of farmers were not challenged by the level of CSA technologies being introduced with regard to seed potato production. This is probably due to the fact that (field) seed and ware potato production did not differ much, apart from the period prior to harvesting where dehaulming is required. Possible differences are in storage, which was not covered in this study.

Access to knowledge on CSA had affected farmers' adoption of CSA technologies in a low extent as confirmed by most of the respondents (64.5%). Those who perceived the extent of effect that access to knowledge on CSA had on their adoption of CSA technologies as low and very low comprised 42.7% and 21.8%, respectively. Those who described the extent of effect as much and very much comprised a cumulative of 20.1%. About 15.3% felt that access to knowledge on CSA affected their adoption of CSA technologies moderately. Access to finances was considered to have "very much" (61.3%) and "much" (17.7%) effect on adoption of CSA technologies by 79% of the respondents. Those who described the extent of effect as low and very low comprised a cumulative of 17.7%. About 3.2% felt that access to finances affected their adoption of CSA technologies moderately. Access to finance is a critical factor for adoption of technologies in field crop production.

Cultural norms and values were considered to have a low effect on adoption of CSA technologies by 66.1% of the respondents. Those who perceived the extent of effect that

cultural norms and values had on their adoption of CSA technologies as low and very low comprised 36.3% and 29.8%, respectively. This was because most of them had attended trainings and capacity building workshops that had reduced their belief in stereotypes and norms that added little value to their current livelihoods. Those who described the extent of effect as much and very much comprised a cumulative of 18.5%. About 15.3% felt that cultural norms and values affected their adoption of CSA technologies moderately.

Table 4.28: Effect of Selected Set of Factors on Farmers Adoption of CSA Technologies

Selected factors	Very much	Much	Moderate	Low	Very low	Total
Level of education	3 (2.4%)	15 (12.1%)	13 (10.5%)	60 (48.4%)	33 (26.6%)	124 (100%)
Available technology	5 (4%)	16 (12.9%)	22 (17.7%)	48 (38.7%)	33 (26.6%)	124 (100%)
Access to knowledge on CSA	7 (5.6%)	18 (14.5%)	19 (15.3%)	53 (42.7%)	27 (21.8%)	124 (100%)
Access to finances	76 (61.3%)	22 (17.7%)	4 (3.2%)	15 (12.1%)	7 (5.6%)	124 (100%)
Cultural norms and values	6 (4.8%)	17 (13.7%)	19 (15.3%)	45 (36.3%)	37 (29.8%)	124 (100%)
Attitude of farmers	3 (2.4%)	3 (2.4%)	5 (4%)	44 (35.5%)	69 (55.6%)	124 (100%)
Nature of technology	5 (4%)	14 (11.3%)	27 (21.8%)	60 (48.4%)	18 (14.5%)	124 (100%)
Access to land	14 (11.3%)	33 (26.6%)	19 (15.3%)	37 (29.8%)	21 (16.9%)	124 (100%)
Lack of CSA skills	3 (2.4%)	20 (16.1%)	27 (21.8%)	54 (43.5%)	20 (16.1%)	124 (100%)

Expression of negative attitudes (by some in the community) that discourage farmers from growing seed potato was described as having very little (low) effect on their adoption of CSA technologies by an overwhelming majority of 91.1% respondents. Those who perceived the extent of effect that attitude of farmers had on their adoption of CSA technologies as low

and very low comprised 35.5% and 55.6%, respectively. Those who described the extent of effect as much and very much comprised a cumulative of 4.8%. About 4% felt that attitude of farmers affected their adoption of CSA technologies moderately.

Therefore, Ol Kalau farmers are convinced of the importance of seed potato production. This implies that no amount of negativity will deter them in venturing into seed potato production, once given the chance.

The extent of effect that nature of technology had on farmers' adoption of CSA technologies was mainly low as explained by 62.9% of the total respondents. Those who perceived the extent of effect that nature of technology had on their adoption of CSA technologies as low and very low comprised 48.4% and 14.5%, respectively. Those who described the extent of effect as much and very much comprised a cumulative of 15.3%. About 21.8% felt that nature of technology affected their adoption of CSA technologies moderately.

Most of the respondents (46.7%) described the extent of effect that access to land had on their adoption of CSA technologies as low. Those who perceived the extent of effect that access to land had on their adoption of CSA technologies as low and very low comprised 29.8% and 16.9%, respectively. Those who described the extent of effect as much and very much comprised a cumulative of 37.9%. About 15.3% felt that access to land affected their adoption of CSA technologies moderately.

About 59.6% of the respondents described the extent of effect that lack of CSA skills had on their adoption of CSA technologies as low. Those who perceived the extent of effect that lack of CSA skills had on their adoption of CSA technologies as low and very low comprised 43.5% and 16.1%, respectively. Those who described the extent of effect as much and very much comprised a cumulative of 18.5%. About 21.8% felt that lack of CSA skills affected their adoption of CSA technologies moderately.

4.4.7 T-Test Results for the Effect of Selected Factors on Adoption of CSA Technologies in Potato Farming by Gender

The use of independent samples t-test was employed in order to determine if the selected factors had unequal effect on male and female farmers. The results are summarized in Table 4.29.

Results in Table 4.29 reveal that both male and female seed potato farmers were negatively affected by lack of access to all the social-economic factors (namely, level of education, seed production technology, knowledge and skills on CSA, finances and land). Generally, the overall t-test analyses show that women were more affected (t-value = -3.854;

p<0.05) than their male counterparts in all the social economic factors in adoption of CSA technologies. Attitude of farmers did not significantly affect any gender more than the other gender. However, the level of education (t-value = -2.835; p<0.05), available technology (t-value = -2.05; p<0.05), access to knowledge on CSA (t-value = -2.157; p<0.05), access to finances (t-value = -2.661; p<0.05), cultural norms and values (t-value = -4.584; p<0.05), nature of technology (t-value = -2.742; p<0.05), access to land (t-value = -2.638; p<0.05) and lack of CSA skills (t-value = -2.097; p<0.05) significantly affected female farmers more than their male counterparts.

Table 4.29: Gender Differences on Adoption of CSA Technologies as Affected by Socio-Economic Factors

Selected factors	Gender	N	Mean	Std Dev.	t-value	Df	p-value	Mean Diff.
Level of education	Male	57	1.88	.825	-2.835	122	0.005	-0.511
	Female	67	2.39	1.128				
Available technology	Male	57	2.07	.923	-2.05	122	0.043	-0.407
	Female	67	2.48	1.235				
Access to knowledge on CSA	Male	57	2.16	.978	-2.157	122	0.033	-0.439
	Female	67	2.60	1.244				
Access to finances	Male	57	3.96	1.439	-2.661	122	0.009	-0.378
	Female	67	4.34	1.095				
Cultural norms and values	Male	57	1.79	.901	-4.584	122	0.000	-0.897
	Female	67	2.69	1.221				
Attitude of farmers	Male	57	1.49	.805	-1.342	122	0.182	-0.210
	Female	67	1.70	.921				
Nature of technology	Male	57	2.16	.862	-2.742	122	0.007	-0.484
	Female	67	2.64	1.069				
Access to land	Male	57	2.65	1.302	-2.638	122	0.004	-0.381
	Female	67	3.03	1.279				
Lack of CSA skills	Male	57	2.25	.931	-2.097	122	0.038	-0.381
	Female	67	2.63	1.071				
Overall	Male	57	2.2671	.52699	-3.854	122	0.000	-0.454
	Female	67	2.7214	.74545				

The results of this study are consistent with UN women (2017) report that identified challenges relating to financial services as a major reason why most women have not adopted climate smart agricultural practices in Nigeria. In many Africa developing countries, most bank account holders are men and women are constrained in accessing financial tools. Inability to access credit facilities is a global issue challenging woman in gainful agricultural production. Njiraini *et al.* (2018) argues that lack of credit hinders women from procuring improved agricultural inputs such as certified seeds, fertilizers and other technologies for high yields. According to Fletschner *et al.* (2014) normative environment creates and shapes opportunities and structures for men and women for adoption of agricultural technologies. Numerous social factors limit women's access to resources and information, which in turn influence adoption of new technologies and access to benefits of seed potato production. Therefore, to increase investments in seed potato production, both women and men should be supported to have access to finance, land that's suitable for seed production, access to technologies and skills in using them. Mudege *et al.* (2016) further noted that, gender relations reveal the division of labor and allocation of resources between men and women as well as how value is given and power is mobilized during the production of seed potatoes. In these study men significantly dominated over women in access to finances, land and therefore they had more power in mobilizing of resources for production of seed potato. Gender inequalities in social economic factors tend to favor men than women in most cases. This limit women access to resources causing a big barrier to women's adoption of new technologies, which are needed in order to practice what the technologies demand to be done by the farmers. For these reasons, it's recommended that women be prioritized in access to knowledge and training on CSA skills, access to finance that will enable them access new technology necessary for seed potato production. These will empower women to efficiently practice the CSA technologies in seed potato production, leading to higher yields and incomes in rural households.

Mudege *et al.* (2016) stated that institutional factors such as access to credit, market by men and women affect their influence on adoption of improved varieties and productivity. This disadvantage the women's adoption of climate-smart agriculture technologies. Moreover, Men and women farmers who are not able to access finances may not be able to access resources nor adopt the CSA practices. According to key informant chairperson of Kiriundu Self Help Group stated that "*Cultural norms affected female farmers in some areas where they were not allowed to make furrows as it was believed if they put their legs apart in the furrows the seed potato will not grow"* Findings of this study agrees with McGuire *et al.*

(2022) Who stated that cultural norms and value affects women negatively more than their male counterparts. Gender relations and norms have also influenced the way women adopt new technologies when it comes to Seed potato production.

4.5 Gender Disparities in Access to Extension Information on CSA Technologies in Seed Potato Production

The third objective in this study analyzed how gender disparities affect access to extension information on CSA technologies in Seed potato production in Ol-Kalau sub-County. The data collected was analyzed using descriptive (frequencies and percentages) & inferential statistics (independent samples t-test)

4.5.1 Extension Information that Farmers Sought on CSA Technologies

Results summarized in Table 4.31 below depicts that most (75.8%) men and women seed potato farmers sought extension information for selection of planting materials. Those who agreed and strongly agreed comprised (62.9%) and (12.9%) respectively. Those who disagreed on seeking extension information for the sake of enhancing their selection of planting materials comprised a cumulative of (20.9%) About (3.2%) were undecide.

About (60.4%) of the respondents agreed that they used to seek extension information on land preparation. Those who agreed and strongly agreed comprised (55.6%) and (4.8%), respectively. Most (41.1%) of the respondents had only primary level of education with little formal education on potato farming. Therefore, extension information for them was the only source of training they could access. This gave them the confident that they are preparing the land in the right way to avoid losses.

Farmers who sought extension information on pest and disease control comprised about (87.1%) of the total respondents. Those who agreed and strongly agreed comprised (58.1%) and (29%), respectively. Those who disagreed comprised a cumulative of (7.2%) About (5.6%) were undecided. Seed Potato respondents in Ol kalau sub-county (62.9%) agreed that they used to seek extension information on managing post- harvest loses. Those who agreed and strongly agreed comprised (51.6%) and (11.3%), respectively. Those who disagreed comprised a cumulative of (25%) About (12.1%) were undecided. A cumulative of (58.0%) of the total respondents agreed that they sought extension information on management of soil erosion. Those who agreed and strongly agreed comprised (52.4%) and (5.6%), respectively. Those who disagreed comprised a cumulative of (20.9%) About (21%) were undecided. Knowledge and skill acquisition for disease, pest, post-harvest and soil

management is of paramount importance needed for successful seed potato production. According to Upadhyay (2021) Poor disease and pest control can result in 80 to 100% losses, while post-harvest management losses average 30-40%. Continued awareness creation and training for the balance number of farmers that disagreed with consulting agriculture extension will be necessary in our efforts to increase food production.

Table 4.30: Farmers Respondent Rating on the Extent to which they Sought Extension Information on CSA Technologies

Extension information	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Selection of planting materials	16 (12.9%)	78 (62.9%)	4 (3.2%)	20 (16.1%)	6 (4.8%)	124 (100%)
Land preparation	6 (4.8%)	69 (55.6%)	12 (9.7%)	28 (22.6%)	9 (7.3%)	124 (100%)
Pest and disease control	36 (29%)	72 (58.1%)	7 (5.6%)	7 (5.6%)	2 (1.6%)	124 (100%)
Managing post- harvest loses	14 (11.3%)	64 (51.6%)	15 (12.1%)	20 (16.1%)	11 (8.9%)	124 (100%)
Soil Erosion	7 (5.6%)	65 (52.4%)	26 (21%)	21 (16.9%)	5 (4%)	124 (100%)

4.5.2 T-Test Results for Differences in Seeking of Extension Information on Selected Key Activities in Potato Farming by Gender

This section provides analyzed information on gender differences in the extent of seeking extension information on selected key activities in potato farming (i.e.,) selection of planting materials, land preparation, pest and disease control, managing post- harvest loses and controlling soil erosion). The results are summarized in Table 4.31.

Table 4.31: Gender Difference in Seeking of Extension Information on Selected Key Activities in Potato Farming

Production activities	Gender	N	Mean	Std. Dev.	T	Df	*P*-value	Mean Diff.
Selection of planting materials	Male	57	3.77	1.035	1.396	122	0.165	0.264
	Female	67	3.51	1.064				
Timely Land preparation	Male	57	3.26	1.142	-0.179	122	0.858	-0.035
	Female	67	3.30	1.059				
Pest and disease control	Male	57	4.12	.867	0.607	122	0.545	0.093
	Female	67	4.03	.834				
Managing post- harvest loses	Male	57	3.39	1.192	-0.153	122	0.879	-0.032
	Female	67	3.42	1.130				
Soil Erosion	Male	57	3.28	1.065	-1.129	122	0.261	-0.197
	Female	67	3.48	.877				
Overall	Male	57	3.5649	.65260	0.155	122	0.877	0.019
	Female	67	3.5463	.67920				

The results in table 4.31 shows that there were no significant differences in the extent of seeking extension information on seed/planting materials selection, land preparation, pest and disease control, post- harvest loses management and control of soil erosion. This could mean that both genders equally have adequate knowledge of these seed potato production activities as not to seek extension advice or; they are not aware of their importance and therefore content of the normal practices; or, there is no new knowledge for dissemination on seed potato production. Conservation tillage is however being introduced for potato cropping systems in Nyandarua. It is however yet to be fully appreciated as a necessary practice, as the technology has not been validated.

4.5.3 Extension Information Sources

Respondents were asked to rate the extent to which they got extension information from; (sub county extension officers, private extension officers, successful farmers, field visits and mass media). The results are summarized in Table 4.32.

Table 4.32: Extent which Farmers Sought Extension Information from Various Sources

Extension information sources	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Sub county extension officers	20 (16.1%)	74 (59.7%)	4 (3.2%)	18 (14.5%)	8 (6.5%)	124 (100%)
Private extension officers	28 (22.6%)	40 (32.3%)	36 (29%)	13 (10.5%)	7 (5.6%)	124 (100%)
Successful farmers	33 (26.6%)	47 (37.9%)	13 (10.5 %)	13 (10.5%)	18 (14.5%)	124 (100%)
Field visits	49 (39.5%)	55 (44.4%)	4 (3.2%)	10 (8.1%)	6 (4.8%)	124 (100%)
Mass Media	73 (58.9%)	36 (29%)	2 (1.6%)	8 (6.5%)	5 (4%)	124 (100%)

Most of the respondents (75.8%) agreed that they got extension information on potato production from sub county extension officers. Those who agreed and strongly agreed comprised (59.7%) and (16.1%), respectively. Those who disagreed on seeking extension information from sub county extension officers comprised a cumulative of (21%) About (3.2%) were undecided.

About (54.9%) of the respondents agreed that they got extension information from private extension officers. This was because such farmers had first-hand experience and the farmers did not require a lot of processes and appointments to see them.

Those who agreed and strongly agreed comprised (32.3%) and (22.6%), respectively. Those who disagreed on seeking extension information from private officers comprised a cumulative of (16.1%) About (29%) were undecided. Seed potato respondents (64.5%) forming the majority agreed that they got extension information from successful farmers. This was because these farmers were living around their area and could easily be reached

unlike travelling to the county offices which was a bit far. Those who agreed and strongly agreed comprised (37.9%) and (26.6%), respectively. Those who disagreed on seeking extension information from sub county extension officers comprised a cumulative of (25%) About (10.5%) were undecided.

Majority of the respondents agreed that they got extension information from field visits as represented by (83.9%) of the total responses. Respondents who agreed and strongly agreed comprised (44.4%) and (39.5%), respectively. Those who disagreed on seeking extension information from sub county extension officers comprised a cumulative of (12.9%) About (3.2%) were undecided. Most of the respondents (87.9%) agreed that they got extension information from Mass Media. Those who agreed and strongly agreed comprised (29%) and (58.9%), respectively. Those who disagreed on seeking extension information from sub county extension officers comprised a cumulative of (10.5%) About (1.6%) were undecided.

Awareness creation, information dissemination and training on seed potato production through mass media had the greatest (87.9% for both agree and strongly agreed) impact on farmers in Ol Kalau followed by field visits (83.9%), sub-County extension officers (75.8%). More use of these methods will prove to be more effective in knowledge dissemination, training and adoption of CSA practices that will lead to agricultural development. This study findings agree with Mwalukasa (2013) that there is a positive relationship between the increased flow of information and agricultural development.

4.5.4 T-Test Results for Gender Differences in the Extent which Farmers Sought Extension Information from Various Sources.

This study was interested in knowing if there was a significant difference in the extent to which farmers sought extension information from various sources as influenced by gender. An independent sample t-test was conducted. The results are summarized in Table 4.33 below.

There was no significant difference in farmers' acquisition of extension information through sub-county extension officers, private extension officers, successful farmers and field visits. However, more male farmers sought extension information through the mass media than their female counterparts (mean difference = 0.442; t-value = 2.349; $p<0.05$). Possible causes for women not being able to take advantage of mass media as observed by men is: They have less time to listen to media because of their triple gender roles of nurturing of children (reproductive roles) being primary food producers (productive role); participating in

community activities (community roles) that make them less exposed to the ongoing within the community.

Enabling them to engage differently in these triple roles has been seen as a threat to male gender roles. This has led to conflicts within the households and any drastic changes is likely to jeopardize the unity of the home. Careful discussions between the gender needs to be allowed so that diversion from the norms does not result in disharmony, acrimony and separation of homes.

Table 4.33: T-Test Results for Differences in the Extent Which Farmers Sought Extension Information from Various Sources by Gender

Extension sources	Gender	Mean	Std. Dev.	t	df	p-value	Mean Diff.
Sub county extension officers	Male	3.67	1.091	0.198	122	0.844	0.040
	Female	3.63	1.139				
Private extension officers	Male	3.54	1.087	-0.115	122	0.909	-0.023
	Female	3.57	1.158				
Successful farmers	Male	3.40	1.534	-0.843	122	0.401	-0.208
	Female	3.61	1.218				
Field visits	Male	4.11	1.012	0.458	122	0.648	0.090
	Female	4.01	1.161				
Mass Media	Male	4.56	.756	2.349	122	0.020	0.442
	Female	4.12	1.237				
Overall	Male	3.8561	.56030	0.605	122	0.547	0.068
	Female	3.7881	.67499				

4.5.5 Factors that Affect Farmers Access to CSA Extension Information

This study was interested in knowing the factors that affect farmers' access of CSA extension information. Respondents were therefore asked to rate how selected set of factors affected them as they sought CSA extension information. The results are summarized in Table 4.34.

Table 4.34: Effect of Social Factors on Farmers' Access to CSA Extension Information

Selected factors	Very much	Much	Moderate	Low	Very low	Total
Low literacy level	2(1.6%)	13(10.5%)	14(11.3%)	72(58.1%)	23(18.5%)	124(100%)
Few extension Officers	14(11.3%)	42(33.9%)	34(27.4%)	28(22.6%)	6(4.8%)	124(100%)
Gender roles	28(22.6%)	8(6.5%)	29(23.4%)	22(17.7%)	37(29.8%)	124(100%)
Knowledge power	3(2.4%)	14(11.3%)	29(23.4%)	61(49.2%)	17(13.7%)	124(100%)
Language barrier	1(0.8%)	2(1.6%)	15(12.1%)	58(46.8%)	48(38.7%)	124(100%)

Most of the respondents (76.6%) described the extent of effect that low literacy levels had on them accessing the CSA extension information as low. Those who perceived the extent of effect that low literacy levels had on accessing CSA extension information as low and very low comprised (58.1%) and (18.5%), respectively. Those who described the extent of effect as much and very much comprised a cumulative of (12.1%). About (11.3%) felt that low literacy levels affected their accessing the CSA extension information moderately. It is interesting to note that most (76.6%) Ol Kalau farmers believed that the level of literacy had little influence on seed potato farming. The probable reason is that they had a vast range of experience (of over 16 years) in seed potato farming giving them confidence in seed potato production. However, this has not helped increase the productivity, which have remained low. Effort should be directed towards exposure to the vices causing low productivity, i.e, PCN, Bacterial diseases and use of farmer saved seeds instead of certified seed. These vices

come with continuous long-term challenges in seed potato production, without careful consideration of the environmental problems it causes, i.e., poor soil health.

About (45.2%) of the respondents described that few extension officers affected their access to CSA extension information in a 'much' extent. Those who perceived the extent of effect that few extension officers had on their accessing the CSA extension information as much and very much comprised (33.9%) and (11.3%), respectively. Those who described the extent of effect as low and very low comprised a cumulative of (27.4%). About (27.4%) felt that few extension officers affected their access to CSA extension information moderately. Majority of the respondents (47.5%) described that gender roles affected their access to CSA extension information in a low extent. Those who perceived the extent of effect that gender roles had on their accessing the CSA extension information as low and very low comprised (17.7%) and (29.8%), respectively. Those who described the extent of effect as much and very much comprised a cumulative of (29.1%) About (23.4%) felt that gender roles affected their access to CSA extension information moderately. Most of the respondents (62.9%) described the extent of effect that knowledge power had on their accessing the CSA extension information as low. Those who perceived the extent of effect that knowledge power had on their accessing the CSA extension information as low and very low comprised (49.2%) and (13.7%), respectively. Those who described the extent of effect as much and very much comprised a cumulative of (13.7%) About (23.4%) felt that knowledge power affected their accessing the CSA extension information moderately. Therefore, Access to knowledge and information is an important resource for marginalized rural farmers, especially female farmers who have access to only 10% of agricultural extension programs (World Bank, (1998).

An overwhelming majority of the respondents (85.5%) described the extent of effect that language barrier had on their accessing of CSA extension information as low. Those who perceived the extent of effect that language barrier had on their accessing the CSA extension information as low and very low comprised (46.8%) and (38.7%), respectively. Those who described the extent of effect as much and very much comprised a cumulative of (2.4%) About (12.1%) felt that language barrier affected their accessing the CSA extension information moderately. Majority of farmers speak in Kikuyu and Swahili languages, with a good control of English. Therefore, they had no difficulty in communication.

4.5.6 T-test Results for the Gender Difference in the Effect of Selected Factors on Farmers' Access to CSA Extension Information

Independent samples t-test was conducted to analyze gender difference in the effect of selected factors on farmers' access to CSA extension information. The results are summarized in Table 4.35.

Table 4.35: T-test Results for the Gender Difference in the Effect of Selected Factors on Farmers' Access to CSA Extension Information

Gender	N	Mean	Std. Deviation	Std. Error Mean
Male	57	2.1088	.49291	.06529
Female	67	2.7672	.72580	.08867

Mean difference = -.65839; Calculated t-value = -5.803; df=122; p-value = .000

The results in Table 4.35 shows that female farmers were more affected by low literacy levels, few extension officers, gender roles, knowledge power and language barrier) than their male counterparts (t-value = -5.803; p-value = .000).

This study results agrees with Bernier *et al.* (2016) who found that most developing countries extension officers' positions are male dominated and discriminate against women and mainly reach out to the men who are the heads of their homes. According to Olorurifemia *et al.* (2020) extension officers concentrate more on men since they are the owners of land. The mode of communication used by extension officers discriminate women because of their low level of education and are time limited due to their domestic roles such as taking care of children and elderly that take most of their time.

Consequently, lack of adequate extension services accessed by women has led to women lack of knowledge on certified seeds production; the long-term advantages of using organic fertilizers as compared to their male counterparts. According to Akrofi-Atitianti *et al.* (2018) noted that involvement of both men and women can ensure equality and development of both men and women leading to a positive impact and will be recorded on CSA implementation due to extension services offered to both genders. In order to increase seed potato production, it may be important to also enable the female farmers to have access to extension officers to boost household knowledge and skills in seed potato production, so as to supplement household incomes (productive). Lack of adoption of CSA technology can be blamed at lack of know-how and can be powered through extension officers (Williams *et al.*, 2015). According to Key informant extension officer stated that "gender *responsive policies*

should be formulated to bring about gender equality between men and women farmers". Women are also likely to become useful contributors to community roles. This study agrees with Lemma *et al.* (2020) who found that male heads tend to dominate community meetings, forums, field days and research centers. On the other hand, women lack time to attend because of time constrain. Most men have a higher education level and thus able to access different types of extension services. Education levels of women is often low thus affecting their interaction rates with extension officers.

This however may lead to conflicts of interest that are biased to males particularly in traditional settings. The total independence of the female resulting from a shift in income generating status can result in household disruptions. A consideration of proposed changes (in access to knowledge, skills, access to finances, land and other socio-economic factors) that will empower (seed potato) women farmers should be carefully consider in view with the consequences' that would result in the mid to long term traditional marital values that give stability to rural household. Studies to evaluate the effects of women empowerment on marital household stability are recommended. This will help us discuss the pros-and-cons of the degree to which gender roles ought to be changed or evolved, *viz-a-vis* (against) the disruption they may cause to household incomes, actualization (marital happiness) and thus household stability of both genders.

4.6 Gender Disparities in the Supply of Labour for the Implementation of CSA Technologies in Seed Potato Production

The fourth objective in this study sought to determine how gender disparities affect supply of Labor in the implementation of CSA technologies in Seed potato production in Ol-Kalau sub-County. Data collected was analyzed using descriptive and inferential statistics. Descriptive statistics (frequencies and percentages) were used to describe the respondents' extent of involvement in provision of labour for practicing CSA. The t-test was conducted to analyze gender differences in provision of labour in various CSA practices.

4.6.1 Farmer Respondents in Provision of Labour for CSA Practices During Seed Potato Production

Most of the respondents (61.3%) described their extent of labour-provision for Seed potato land preparation as "much". Those who perceived their extent of labour-provision in land preparation as much and very much comprised (21.8%) and (39.5%), respectively. Those who described their extent of involvement as Low and Very low comprised a

cumulative of (25.8%) About (12.9%) felt that their involvement in land preparation through their provision of labor was moderate. About (57.2%) of the respondents described their extent of involvement in providing labour during Seed potato planting as much. Those who perceived their extent of involvement in planting as much and very much comprised (41.1%) and (16.1%), respectively. Those who claimed low and very low involvement in potato planting comprised a cumulative of (6.4%) About (36.3%) felt that their involvement in planting was moderate.

An overwhelming majority of the respondents (80.6%) argued to be much involved (through labour provision) in crop rotation in Seed potato production. Those who perceived their extent of involvement in crop rotation as 'Much and Very much comprised' (63.7%) and (16.9%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (4.8%) About (14.5%) felt that their involvement in crop rotation through their provision of labor in Seed potato production was moderate.

Most of the respondents (56.5%) described their extent of involvement in pest and disease control through provision of labor as being much. Those who perceived their extent of providing labour in pest and disease control as Much and Very much comprised (21.8%) and (34.7%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (33.9%) About (9.7%) felt that their involvement in pest and disease control through their provision of labor in Seed potato production was moderate.

About (54%) of the respondents described that they were involved in weeding (in form of provision of labor) in Seed potato production in a much extent. Those who perceived their extent of involvement in weeding as Much and Very much comprised (37.1%) and (16.9%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (27.4%) About (18.5%) felt that their involvement in weeding through their provision of labor in Seed potato production was moderate.

Most of the respondents (47.6%) described their extent of involvement in soil and water conservation in form of provision of labor in Seed potato production as much. Those who perceived their extent of involvement in soil and water conservation as Much and Very much comprised (40.3%) and (7.3%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (25%) About (27.4%) felt that their involvement in soil and water conservation through their provision of labor in seed potato production was moderate.

Those who claimed to be involved in provision of labour for harvesting of Seed potato in a "much" extent comprised a cumulative of (80.7%). Those who perceived their extent of

involvement in harvesting as Much and Very much comprised (48.4%) and (32.3%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (6.4%). About (12.9%) felt that their involvement in harvesting through their provision of labor in Seed potato production was moderate. Most of the respondents (49.2%) described their extent of involvement in sorting and grading in form of provision of labor in Seed potato production as much. Those who perceived their extent of involvement in sorting and grading as Much and Very much comprised (10.5%) and (38.7%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (37.1%). About (13.7%) felt that their involvement in sorting and grading through their provision of labor in Seed potato production was moderate.

About half of the respondents (50%) described their extent of involvement in packaging in form of provision of labor in Seed potato production as much. Those who perceived their extent of involvement in packaging as Much and Very much comprised (35.5%) and (14.5%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (23.3%). About (26.6%) felt that their involvement in packaging through their provision of labor in Seed potato production was moderate. Most of the respondents (51.6%) described their extent of involvement in transporting (from field to the household store) in form of provision of labor in Seed potato production as much. Those who perceived their extent of involvement in transporting as Much and Very much comprised (12.1%) and (39.5%), respectively. Those who described their extent of involvement as Low and Very low comprised a cumulative of (37.9%). About (10.5%) felt that their involvement in transporting through their provision of labor in Seed potato production was moderate.

In summary, it is evident that for all CSA field production activities involved in seed potato production, less than (57.3) % of the farmers provided labour for planting (57.2%), pest and disease control (56.5%), weeding (54%), transportation from the fields (51.6%), packaging (50%), sorting and grading (49.2%), soil and water conservation (47.6%) except during land preparation (61.3%), harvesting (80.7%) and crop rotation (80.6%) practices. This was so because, farmers tended to engage external labour for many of these operations as they were labour intensive (and tedious) and time consuming. Mechanization of seed potato farming is strongly recommended to help ease the labour challenges in provision of labour and improve on time efficiency.

The results are summarized in Table 4.36.

Table 4.36: Farmers' Provision of Labour in CSA Practices During Seed Potato Production

CSA practices	Very much	Much	Moderate	Low	Very low	Total
Land preparation	49(39.5%)	27(21.8%)	16(12.9%)	21(16.9%)	11(8.9%)	124(100%)
Planting	20(16.1%)	51(41.1%)	45(36.3%)	5(4%)	3(2.4%)	124(100%)
Crop rotation	21(16.9%)	79(63.7%)	18(14.5%)	4(3.2%)	2(1.6%)	124(100%)
Pest and disease control	43(34.7%)	27(21.8%)	12(9.7%)	31(25%)	11(8.9%)	124(100%)
Weeding	21(16.9%)	46(37.1%)	23(18.5%)	27(21.8%)	7(5.6%)	124(100%)
Soil and water conservation	9(7.3%)	50(40.3%)	34(27.4%)	25(20.2%)	6(4.8%)	124(100%)
Harvesting	60(48.4%)	40(32.3%)	16(12.9%)	5(4%)	3(2.4%)	124(100%)
Sorting and grading	48(38.7%)	13(10.5%)	17(13.7%)	14(11.3%)	32(25.8%)	124(100%)
Packaging	18(14.5%)	44(35.5%)	33(26.6%)	23(18.5%)	6(4.8%)	124(100%)
Transporting	49(39.5%)	15(12.1%)	13(10.5%)	12(9.7%)	35(28.2%)	124(100%)

4.6.2 Gender Differences in Farmers' Involvement in Labour Provision for CSA practices

This study results helped to determine if there were significant difference in farmers' involvement in labour provision for CSA practices. The results are summarized in Table 4.37.

Table 4.37: Gender Differences in Farmers' Involvement in Labour Provision for CSA practices

CSA practices	gender	N	Mean	Std. Dev.	T	Df	p-value	Mean Diff.
Land preparation	Male	57	4.56	.732	8.385	122	0.000	1.666
	Female	67	2.90	1.339				
Planting	Male	57	3.47	.804	-2.491	122	0.014	-0.362
	Female	67	3.84	.809				
Crop rotation	Male	57	3.93	.678	0.035	122	0.972	0.004
	Female	67	3.93	.745				
Pest and disease control	Male	57	4.58	.680	11.414	122	0.000	2.027
	Female	67	2.55	1.184				
Weeding	Male	57	3.54	.888	1.459	122	0.147	0.305
	Female	67	3.24	1.349				
Soil and water conservation	Male	57	3.61	.881	3.88	122	0.000	0.674
	Female	67	2.94	1.028				
Harvesting	Male	57	3.35	.834	-2.149	122	0.034	-0.306
	Female	67	3.66	.750				
Sorting and grading	Male	57	1.82	1.071	-14.47	122	0.000	-2.638
	Female	67	4.46	.959				
Packaging	Male	57	3.89	.859	5.582	122	0.000	0.984
	Female	67	2.91	1.069				
Transporting	Male	57	4.67	.636	13.415	122	0.000	2.622
	Female	67	2.04	1.353				

Female farmers were significantly more involved in the supply of labour during planting (Mean difference = -0.362; Calculated t-value = -2.491; df=122; p-value = 0.014), harvesting (Mean difference = -0.306; Calculated t-value = -2.149; df=122; p-value = 0.034), sorting and grading (Mean difference = -2.638; Calculated t-value = -14.47; df=122; p-value = 0.000) activities in the implementation of CSA technologies in Seed potato production.

On the other hand, male farmers were significantly more involved in the supply of labour during land preparation (Mean difference = 1.666; Calculated t-value = 8.385; df=122; p-value = 0.000), pest and disease control (Mean difference = 2.027; Calculated t-value = 11.414; df=122; p-value = 0.000), soil and water conservation (Mean difference = 0.674; Calculated t-value = 3.88; df=122; p-value = 0.000), packaging (Mean difference = 0.984; Calculated t-value = 5.582; df=122; p-value = 0.000) and transportation (Mean difference = 2.622; Calculated t-value = 13.415; df=122; p-value = 0.000) activities in the implementation of CSA technologies in Seed potato production.

There were no significant gender disparities in the supply of Labor in the implementation of CSA technologies in Seed potato production during crop rotation (Mean difference = 0.004; Calculated t-value = 0.035; df=122; p-value = 0.972) and weeding (Mean difference = 0.305; Calculated t-value = 1.459; df=122; p-value = 0.147) activities.

It is evident that men provide the bulk of the labour during seed potato production in Ol Kalau Sub-County of Nyandarua County. The practice that takes most of the household labour is in crop rotations, where other crops are grown, i.e., garden peas, carrots, cabbages for cash crops, oats for forage and a little maize for subsistence. Methods to ease the burden of seed potato field production labour is necessary if we are to encourage the youth to venture into seed potato production. Mechanization for land preparation, motorized spraying, transportation, soil and water conservation practices need to be implemented for increased productivity and efficiency.

4.6.3 Challenges Faced by Farmers in the Provision of Labor in Seed Potato Production

This study sought to know how selected set of factors affected their provision of labour for Seed potato production. The selected factors included low education level, cost of labor, nature of work, labor mobility and long distance to the farm. The results are summarized in Table 4.38.

Table 4.38: Challenges Faced by Farmers in the Provision of Labor in Seed Potato Production

Challenges	Very much	Much	Moderate	Low	Very low	Total
Low education level	2 (1.6%)	12 (9.7%)	13 (10.5%)	67 (54%)	30 (24.2%)	124 (100%)
Cost of labor	79 (63.7%)	21 (16.9%)	16 (12.9%)	7 (5.6%)	1 (0.8%)	124 (100%)
Nature of work	5 (4%)	33 (26.6%)	47 (37.9%)	32 (25.8%)	7 (5.6%)	124 (100%)
Labor mobility	7 (5.6%)	20 (16.1%)	23 (18.5%)	57 (46%)	17 (13.7%)	124 (100%)
Long distance to the farm	13 (10.5%)	14 (11.3%)	9 (7.3%)	31 (25%)	57 (46%)	124 (100%)

Majority of the respondents (78.2%) described the extent of effect that low education level had on their provision of labor in Seed potato production as low. Those who perceived the extent of effect that low education level had on their provision of labor in seed potato production as low and very low comprised (54%) and (24.2%), respectively. Those who described the extent of effect as much and very much comprised a cumulative of (11.3%). About (10.5%) felt that low education level affected their provision of labor in Seed potato production moderately.

An overwhelming majority of the respondents (80.6%) described the extent of effect that cost of labor had on their provision of labor in seed potato production as much. About (16.9%) and (63.7%), of the respondents perceived the extent of effect that cost of labor had on their provision of labor in seed potato production as much and very much, respectively. Those who described the extent of effect as low and very low comprised a cumulative of (6.4%). About (12.9%) felt that cost of labor affected their provision of labor in Seed potato production moderately.

About (31.4%) of the respondents described the extent of effect that nature of work had on their provision of labor in Seed potato production as low. Those who perceived the extent of effect that nature of work had on their provision of labor in seed potato production as low and very low comprised (25.8%) and (5.6%), respectively. Those who described the extent of effect as much and very much comprised a cumulative of (30.6%). About (37.9%)

felt that nature of work affected their provision of labor in Seed potato production moderately. Those who described the extent of effect that labor mobility had on their provision of labor in Seed potato production as low comprised (59.7%) of the total respondents. About (46%) and (13.7%) perceived the extent of effect that labor mobility had on their provision of labor in Seed potato production as low and very low, respectively. Those who described the extent of effect as much and very much comprised a cumulative of (21.7%). About (18.5%) felt that labor mobility affected their provision of labor in Seed potato production moderately. Most of the respondents (71%) described the extent of effect that long distance to the farm had on their provision of labor in seed potato production as low. Those who perceived the extent of effect that long distance to the farm had on their provision of labor in Seed potato production as low and very low comprised (25%) and (46%), respectively. Those who described the extent of effect as much and very much comprised a cumulative of (21.8%). About (7.3%) felt that long distance to the farm affected their provision of labor in Seed potato production moderately.

It is evident from Table 4.39 above that the cost of labour (80.6 %) in field operations affected seed potato production (negatively). This was due to the laborious nature of work being scored as very much and much difficulty by 30.6%. Long distances between farms and household stores were considered as being difficult by 21% of the farmers. Potato tubers are bulky, heavy and easily gets damaged if handled poorly (roughly). Handling during planting and harvesting requires strength which in many times only men can provide because of their masculine body. High post-harvest losses can be incurred if packaging and sorting are done carelessly. Due to these, the right sized packaging (50kg bags), provision of transportation vehicles (including tractors), provision of tillage equipment, sowing / planting and moulding machines as well as harvesters and motorized sprayers will greatly encourage seed potato farming as it will ease labour demands. It will also improve the quality of land preparation for proper sprouting, tuber and plant growth as well as quality (less damaged) of harvested tubers. In this manner, the productivity will increase tremendously and incomes too. It is therefore recommended that farmers be provided with easy access to these resources for enhanced potato production and food security.

4.6.4 T-Test Results for the Differences in the Effect of Challenges Faced by Farmers in the Provision of Labor in Seed Potato Production by Gender

Independent samples t-test was conducted with an aim of assessing gender differences in the effect of selected challenges in the provision of labor in Seed potato production. The results are summarized in Table 4.39.

Table 4.39: Gender differences in the Effect of Challenges Faced by Farmers in the Provision of Labor in Seed Potato Production by Gender

Gender	N	Mean	Std. Deviation	Std. Error Mean
Male	57	2.7789	.45148	.05980
Female	67	2.8716	.66670	.08145

Mean difference = -.09269; Calculated t-value = -.890; df=122; p-value = .375

The results in Table 4.40 shows that none of the gender was more disadvantaged in the provision of labour in Seed potato production farmers as far as the selected set of factors (low education level, cost of labor, nature of work, labor mobility and long distance to the farm) was concerned (t-value = -.890; p-value = .375).

Findings of the results disagree with Mudege *et al.* (2020) who reported that rural women provide most labor in agricultural production than their male counterparts. This may be due to differences in cultural norms and beliefs. In Ol Kalau seed potato production, men provide most of the farm operations. Reason being because of the masculine nature of work involved that demands heavy lifting, movement of tubers and making of furrows. Most reports provide information on ware potato as opposed to seed potato. According to Tarjem *et al.* (2021) observed that gender division of labor along the Irish potato chain agreed that both men and women are involved in the main Irish potato production activities, which included weeding, however men dominated weeding in Kenya.

Women play a key role in maintaining genetic diversity for Irish potatoes particularly in seed selection and varieties, storage of seeds and utilization of those seeds in Irish potato production (Puskur *et al.,* 2021). The current study concurs that women are directly involved in selecting seed potatoes, but did not evaluate their preservation activities to meet different social rituals and obligations. Managing of genetic diversity through management of combination of varieties enables communities to manage risks particularly where climate stress is more frequent and intense. In the contemporary society, men and women have different preferences that is of an advantage when it comes to crop improvement (Polar *et al.,* 2021).

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study investigated the gender disparities in adoption of climate smart agriculture among potato producers in Ol-Kalau Sub County, Nyandarua County, Kenya. This section presents summary of key study findings as well as conclusions and recommendations which are logically arranged in line with the objectives of the study. Some areas of further research have also been suggested.

5.2 Summary of Findings

The following were the key findings of this study:

Male farmers were more involved in decision-making in the following domains in Irish seed potato farming; land acquisition, land preparation, acquisition of farm inputs, planting, weed control, harvesting, packaging and transportation. Overall male farmers were more involved than their female counterparts. This was because, in African cultures men are the heads of household and thus they contribute significantly more than women on various crucial decision-making processes affecting implementation of CSA practices. These results agree with Aryal *et al.* (2020) who found that most African countries are patriarchal in nature with men dominating the decision-making process including those in agricultural sector. This minimizes and many times even hinders the capacity of women in contributing to the adoption of the CSA technologies.

Gender disparities (illiteracy level, triple gender roles, lack of capital) reduced women's adoption of CSA technologies in Irish seed potato production. Financial services are major reasons why most women have not adopted CSA practices. Findings of this study agrees with McGuire *et al.* (2022) who stated that cultural norms and value affects women negatively more than their male counterparts. This have influenced the way women adopt new technologies when it comes to Irish seed potato production.

Most of the males and females' respondents in Irish seed potato production agreed that they sought extension information from the sub-county agricultural officers. Though, male farmers had more access to information through the mass media much more than their female farmers counterparts this was because male farmers owned android mobile phones which they can use to google information in the website concerning CSA technologies in Irish seed potato production.

Male farmers provided most of the labor for farm operations, i.e., land preparation, pest and disease control, soil and water conservation, packaging and transportation activities. While female farmers were significantly more involved in the supply of labour during planting, harvesting, sorting and grading. in the implementation of CSA technologies in Irish seed potato production. There were no significant gender disparities in the supply of Labor in the implementation of CSA technologies in Irish seed potato production during crop rotation and weeding activities. In Ol Kalau, men provide most of the farm operations activities. Reason being because of the masculine nature of work involved that demands heavy lifting, movement of tubers and making of furrows

5.3 Conclusions

From the study results, the following conclusions have been drawn:

i. Men are the heads of household and they contribute significantly more than women on various decision-making processes affecting implementation of CSA practices. Gender disparities (illiteracy level, triple gender roles, lack of capital) reduce women's adoption of CSA technologies in seed potato production.
ii. Financial services are major reasons why most women have not adopted CSA practices. This have influenced the way women adopt new technologies when it comes to Seed potato production. Adoption of CSA practices is significantly affected by gender disparities with regard to access to capital, knowledge, skills and time to effectively participate in seed potato production.
iii. Male farmers sought extension information through the mass media than their female counterparts.
iv. Men provide most of labour in the farm operations activities.

5.4 Recommendations

This study makes the following recommendations:

i. Women should be empowered to participate in decision making by supporting them to access capital, knowledge, skills and make time to take part in CSA capacity building activities.
ii. Government, NGOs, Development partners and various potato sector stakeholders should support both gender in adoption of CSA practices in seed potato production.
iii. Information on CSA should be made more accessible to both genders without bias through the mass media and ICT with consideration of womens' triple gender roles.

iv. Women should be encouraged to contribute more in the provision of labour supply in CSA seed potato practices (i.e. use of mechanization)

5.5 Suggestions for Further Research

The findings of this study would act as a base for more research on the gender disparities in adoption of climate smart agriculture among potato producers in Ol-Kalau Sub County, Nyandarua County, Kenya. However, this study was not exhaustive recommends further research on:

i. A similar study in other counties in Kenya and Africa.
ii. To evaluate factors that affect women's' participation in decision making in CSA seed potato production.
iii. To determine how potato sector actors can support adoption of CSA practices from a gender perspective.
iv. To examine the influence of information communication and extension on the adoption of CSA practices by potato farmers.
v. To determine the effect of skilled and unskilled labour on seed potato production from a gender lens.

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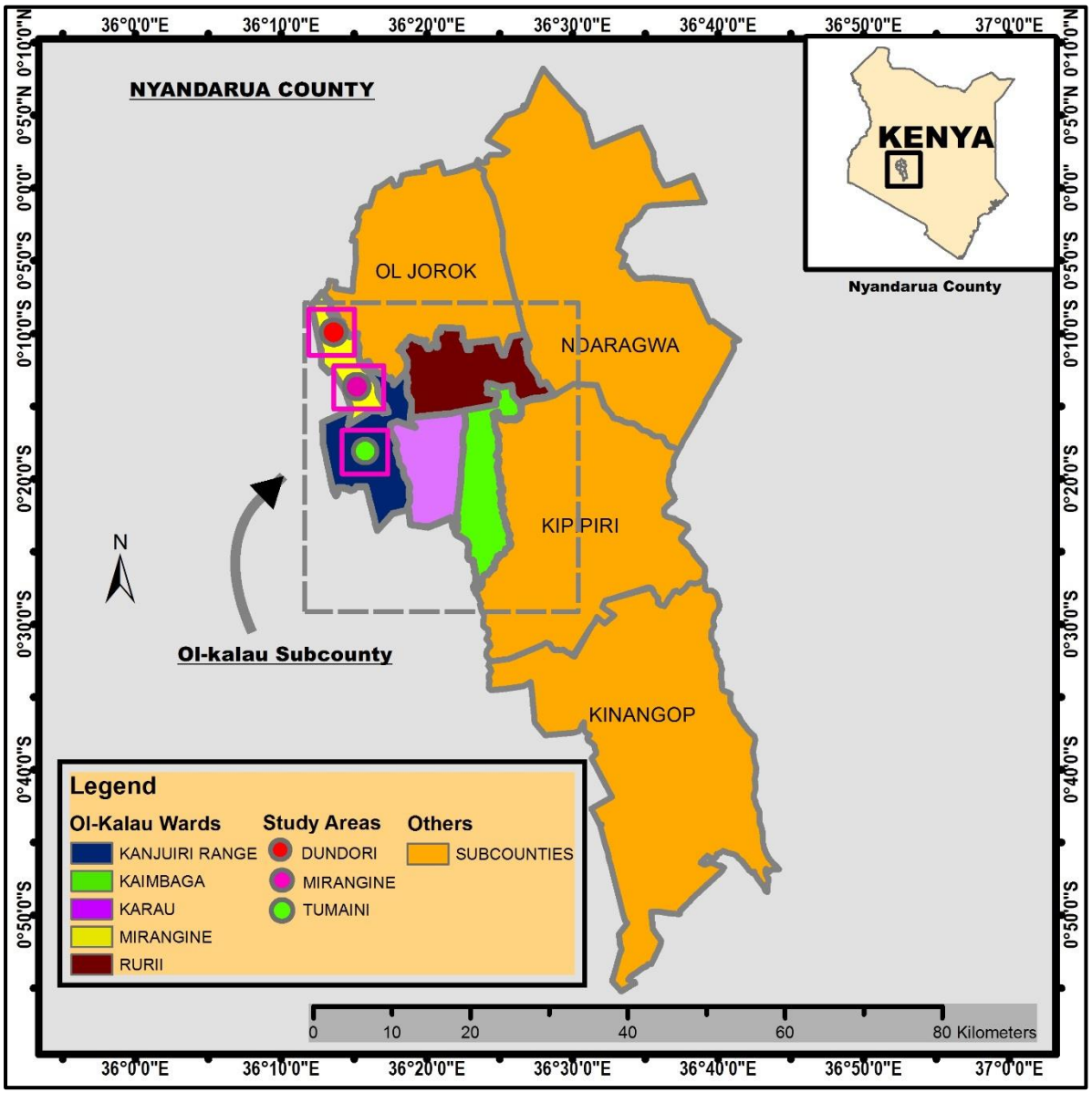
APPENDICES

APPENDIX A: Map of Nyandarua County



Source: *Egerton University Geography Department*

APPENDIX B. Questionnaire for the Men and Women Respondent

Dear Respondent,

I'm a Master's of Arts in Gender and Development studies student of Egerton University carrying out research on Gender disparities in adoption of climate smart agriculture among potato producers in Ol-kalau sub county, Nyandarua county, Kenya. The study aims at evaluating the use (i.e.; adoption level) of Climate Smart Agricultural (CSA) practices by female and male seed potato farmers; Evaluate how adoption is influenced by Gender disparities in decision making, adoption, access to extension information and labour supply. Any additional volunteer information is highly welcomed. Note that the information given shall purely be used for academic research and its confidentiality is guaranteed. This is to kindly request you to take a few minutes to reflect and answer the following questions.

Thank you for your cooperation.

Thuo Wamaitha Betty

Instructions

- **Please respond to all questions**

Section A: Background Information

1. What is your gender?

(1) Male ( ) (2) Female ( ) (3) Others ( ) please specify ……

2. What is your age bracket?

(1) 18 years-27years ( ) (2) 28years-37years ( ) (3) 38years-47 years ( )

(4) 48years-57years ( ) (5) 58years & above ( )

3. What is your marital status?

(1) Single ( ) (2) Married ( ) (3) Divorced ( ) (4) Widowed ( ) (5) Widower ( )

4. What is your highest level of education?

(1) Non-formal ( ) (2) Primary ( ) (3) Secondary ( ) (4) Tertiary college ( )

(5) university ( )

5. What is your main occupation?

(a) Crop farming ( )

(b) Livestock farming ( )

(c) Formal employment ( )

(d) Casual labourer ( )

(e) Non-farm self-employment ( )

6. What is the size of your farm?

(1) 0-1 acre ( ) (2) 1-2 acres ( ) (3) 2-3 acres ( ) (4) 4 & above ( )

7. Do you produce seed potato? (1) Yes ( ) (2) No ( )

8. Under what scale did you produce seed potatoes during the last season?

(1) 0-1 acre ( ) (2) 1-2 acres ( ) (3) 2-3 acres ( ) (4) 4 acres & above ( )

9. How have you acquired the land?

(1) Leasing ( ) (2) Purchasing ( ) (3) Inheritance ( ) (4) Gift ( )

10. Which seasons (months) do you produce seed potato in a year?

(1) March-June ( ) (2) July-Oct ( ) (3) Nov-Feb ( ) (4) Others ( ) Please specify……

11. How long have you practiced seed potato farming?

(1) 1-5years ( ) (2) 6-10 years ( ) (3) 11-15 years ( ) (4) 16 & above ( )

12. How many bags of potato did you produce in the last season?

++\Z

SECTION B Gender disparities in decision making on seed potato production using Climate Smart Agricultural practices.

13. Indicate the level of importance to which you make decisions on the following activities?

Activities	Very much	Much	Moderate	Low	Very low
Land acquisition					
Land preparation					
Acquisition of farm inputs					
Planting					
Weed control					
Harvesting					
Packaging					
Transport					

SECTION C Gender disparities in the adoption of CSA technologies in seed Potato production.

14. Which of the following CSA practices did you adopt in your potato farming during the last season?

CSA technologies	**Specific CSA technologies**	**Description**
Agronomic practices	Organic farming	☐ Ensuring biodiversity and sustainability of the system ☐ Use of alternative sources of nutrients for crop (crop rotation, residue management, organic manures and biological inputs) ☐ Chemical free weeds and pests' management practices (physical, cultural and biological) ☐ Maintenance of livestock in tandem with crop farming.
	Conservation agriculture and resource conservation technologies (RCTs)	☐ Minimal mechanical soil disturbance (zero-tillage and direct seeding) ☐ Mulching (for soil cover and nutrient enhancement) ☐ Crop rotations or sequencing and associations of crops (for nitrogen-fixation).
	Cover cropping	☐ Growing leguminous cover crops ☐ Growing vegetative cover between successive agricultural crops
Crop Varieties	Drought, disease, salinity and flooding resistance	☐ Resistance to drought ☐ Resistance to salinity ☐ Resistance to flooding ☐ Resistance to diseases
	Yield and maturity enhanced varieties	☐ High yielding ☐ Fast maturing

Integrated soil, water and nutrient management	Soil management	☐ Soil Testing ☐ Fertilizer application ☐ Manure application ☐ Others
	Water management	☐ Solar pump ☐ Drip irrigation ☐ On Farm Water Harvesting ☐ Super Absorbent Polymers ☐ Other
	Nutrient management	☐ Soil Testing ☐ Fertilizer application ☐ Manure application ☐ Others
Integrated pest and disease control and management	Pest control management	☐ Pest resistant varieties ☐ Use of clean seeds ☐ Other
	Disease control management	☐ Disease resistant varieties ☐ Other
Other CSA technologies	Weeding, greenhouse and seeding technologies	☐ Biological weed control ☐ Greenhouse technology ☐ Use of apical rooted cuttings ☐ Weather forecast information ☐ Use of mobile information gathering
	Information use and acquisition	☐ Weather forecast information ☐ Use of mobile information gathering

15. In your opinion how do the following set of factors affect your adoption of CSA technologies?

Selected factors	Very much	Much	Moderate	Low	Very low
1. Level of education					
2. Available technology					
3. Access to knowledge on CSA					
4. Access to finances					
5. Cultural norms and values					
6. Attitude of farmers					
7. Nature of technology					
8. Access to land					
9. Lack of CSA skills					

SECTION D. To analyse gender differences that affect access to extension information on CSA technologies in seed Potato production

16. Which kind of extension information do you require on CSA technologies?
Tick appropriately (where SA= Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree)

Information required	**Ratings**				
	(1) SA	**(2) A**	**(3) U**	**(4) D**	**(5) SD**
1. Selection of planting materials					
2. Land preparation					
3. Pest and disease control					
4. Managing post- harvest loses					
5. Soil Erosion					

17. Where do you source extension information from?

where (SA= Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree)

Source of extension information	**Ratings**				
	(1) SA	**(2) A**	**(3) U**	**(4) D**	**(5) SD**
1. Sub county extension officers					
2. Private extension officers					
3. Successful farmers					
4. Field visits					
5. Mass Media					

18. How does the following set of factors affect you in accessing the CSA extension information?

where (SA= Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree)

Factors	**(1) SA**	**(2) A**	**(3) U**	**(4) D**	**(5) SD**
1. Low literacy levels					
2. Few extensions officer's					
3. Gender roles					
4. Knowledge power					
5. Language barrier					

Section E. Gender disparities in Supply of Labor in Implementation of Climate Smart Agricultural technologies in seed Potato Production.

19. How are you involved in the following CSA practices (in form of labor) during seed potato production?

where (SA= Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree)

CSA practices	**Level of involvement**				
	(1) SA	**(2) A**	**(3) U**	**(4) D**	**(5) SD**
1. Land preparation					
2. Planting					
3. Crop rotation					
4. Pest and disease control					
5. Weeding					
6. Soil and water conservation					
7. Harvesting					
8. Sorting and grading					
9. Packaging					
10. Transporting					

20. How does the following set of challenges affect you in the provision of labor in seed potato production?

where (SA= Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree)

Challenges faced	**(1) SA**	**(2) A**	**(3) U**	**(4) D**	**(5) SD**
1. Low education level					
2. Cost of labor					
3. Nature of work					
4. Labor mobility					
5. Long distance to the farm					

APPENDIX C: An Interview Guide for the Key Informants (Extension Officers and Chairs of SHG)

Dear Respondent,

I'm a Master's of Arts in Gender and Development studies student of Egerton University carrying out research on effects of Gender disparities on adoption of potato production climate-smart agriculture technologies in Ol-kalau, Nyandarua County, Kenya. The study aims at evaluating the use (i.e.; adoption level) of Climate-smart Agricultural (CSA) practices by female and male seed potato farmers; Evaluate how adoption is influenced by Gender disparities in decision making, uptake, access to extension information and Labor supply. Any additional volunteer information is highly welcomed. Note that the information given shall purely be used for academic research and its confidentiality is guaranteed.

Thank you for your cooperation.

Thuo Wamaitha Betty

Instructions

- **Kindly do not write your name**
- **Please respond to all questions**

1. Which CSA Practices are mainly practiced in potato in this area?

   .....

2. Does the age of farmers determine their adoption rate in practice of seed potato production?

   .....

3. Which are the current innovations practiced on adoption of CSA technologies in Nyandarua County?

   .....

4. Are there factors affecting adoption of CSA practices among men and women in Nyandarua County in seed potato production?

   …….

5. How would you recommend resolving these problems associated with CSA practices in seed potato production?

   ……

APPENDIX D: Research Permit from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 286763

Date of Issue: 24/October/2021

RESEARCH LICENSE

This is to Certify that Miss.. BETTY WAMAITHA THUO of Egerton University, has been licensed to conduct research in Nyandarua on the topic: GENDER DISPARITIES IN ADOPTION OF CLIMATE SMART AGRICULTURE AMONG POTATO PRODUCERS IN OL-KALOU SUB COUNTY NYANDARUA COUNTY KENYA for the period ending : 24/October/2022.

License No: **NACOSTI/P/21/13415**

286763

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX E: Ethical Clearance Approval from Egerton University

EGERTON UNIVERSITY

TEL: (051) 2217808
FAX: 051-2217942

P. O. BOX 536
EGERTON

EGERTON UNIVERSITY RESEARCH ETHICS COMMITTEE

EU/RE/DVC/009
Approval No. EUREC/APP/155/2021 **14th December, 2021**

Betty Wamaitha Thuo
P.O BOX 2-20100
BAHATI
Telephone: 0715930796
E-mail: wamaithabettie@gmail.com

Dear Betty,

RE: ETHICAL APPROVAL: GENDER DISPARITY IN ADOPTION OF CLIMATE SMART AGRICULTURE AMONG POTATO PRODUCERS IN OL-KALOU SUBCOUNTY, NYANDARUA COUNTY, KENYA

This is to inform you that ***Egerton University Research Ethics Committee*** has reviewed and approved your above research proposal. Your application approval number is ***EUREC/APP/155/2021.*** The approval period is ***14th December, 2021 –15th December, 2022.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. You are required to adhere Institutional Experimental Animals use and Care policy.
iii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***Egerton University Research Ethics Committee.***
iv. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***Egerton University Research Ethics Committee*** within 72 hours of notification
v. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***Egerton University Research Ethics Committee*** within 72 hours
vi. Clearance for Material Transfer of biological specimens must be obtained from relevant institutions.
vii. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
viii. Submission of an executive summary report within 90 days upon completion of the study to ***Egerton University Research Ethics Committee.***

"Transforming Lives through Quality Education"

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely.

EGERTON UNIVERSITY Date. 14/12/2021

Prof. R. Ngure
CHAIRMAN, EGERTON UNIVERSITY RESEARCH ETHICS CTTEE
RMN/BK/

APPENDIX F: Research Authorization from the County Directors Office

MINISTRY OF EDUCATION
State Department of Early Learning and Basic Education

Email: cdenyandcounty@yahoo.com

Cell phone: 0718798460
When replying please quote

COUNTY DIRECTOR OF EDUCATION,
NYANDARUA COUNTY,
P.O. BOX 197 - 20303
OL KALOU.

REPUBLIC OF KENYA

CDE/NYA/GEN/36/VOL.II/20 **16th December, 2021**

Betty Wamaitha Thuo
NACOSTI/P/21/13415
EGERTON UNIVERSITY

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research in Nyandarua County on the topic "***Gender disparities in adoption of climate smart agriculture among potato producers in Mirangine Sub County***". I am pleased to inform you that you are hereby granted permission to carry out the exercise for the period ending **24th October, 2022.**

You are advised to report to Sub County Directors of Education, Mirangine before commencing on the research project.

After completion of your project, you will be required to remit a copy of your findings to this office.

PP

PHILIP KIOKO WAMBUA
COUNTY DIRECTOR OF EDUCATION
NYANDARUA

APPENDIX G: Research Authorization from the Sub- County Director of Education

MINISTRY OF EDUCATION, SCIENCE & TECHNOLOGY
STATE DEPARTMENT OF EDUCATION

Email:-mirangineeducation@yahoo.com
Tel No: 0202641014
When replying please quote

SUB-COUNTY EDUCATION OFFICE
P.O. BOX 11- 20124,
MIRANGINE.

REPUBLIC OF KENYA

REF: MRG/ GEN/3/VOL II/51 **DATE:26th January, 2022**

Betty Wamaitha Thuo
NACOSTI/21/13415
EGERTON UNIVERSITY

RE: RESEARCH AUTHORIZATION

Your reference letter CDE/NYA/GEN/36/VOL.II/20 refers:

Following your application for authority to carry out research on the topic " **Gender disparities in adoption of climate smart agriculture among potato producers"**. I am pleased to inform you have been authorized to undertake research in Mirangine Sub- County.

THE SUB-COUNTY DIRECTOR OF EDUCATION
MIRANGINE
P.O. Box 11 - 20124, MIRANGINE

BENJAMIN M. MUTHENGI
SUB-COUNTY DIRECTOR OF EDUCATION,
MIRANGINE.

APPENDIX H: Publication

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http://www.ijssit.com

GENDER DISPARITIES INFLUENCE ON ADOPTION OF CLIMATE SMART TECHNOLOGIES IN SEED POTATO PRODUCTION IN OL-KALAU SUB COUNTY KENYA

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Abstract: *Climate Smart Agriculture (CSA) offers farmers' the opportunity to improve their economic and food security status. However, farmers' success in adoption of CSA technologies is constrained by gender disparities, i.e., level of education, access to knowledge in CSA, access to finances, availability and nature of CSA technologies, cultural norms and values, attitude of farmers towards the CSA, access to land and lack of CSA skills. This study therefore aimed at determining the variance in adoption of CSA technologies in seed potato production as influenced by gender disparities in Ol-kalau sub-county of Nyandarua county, Kenya. The study results indicated that with the exception of attitude of farmers' there were significant gender differences in adoption of CSA technologies, with males dominating in all CSA practices. Financial services are major reasons why most farmers have not adopted CSA practices. In order to enhance female farmers, women should be encouraged to participate in ventures that help them access, generate and mobilize resources so that they can acquire credit; be supported to access relevant CSA knowledge, skills and resources. Thus, they will be able to offer supplementary support to their male counterparts in adoption of seed potato CSA farming technologies.*

Keywords: *Gender disparities, adoption, climate-smart technologies*