GENDER RELATIONS IN ADOPTION OF CLIMATE SMART AGRICULTURAL PRACTICES; A CASE OF RICE FARMERS IN KIRINYAGA COUNTY

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DECLARATION

I declare that this is my original work and to the best of my knowledge, it has not been submitted in any other university or institution of higher learning for examination or any other purposes.

Valentine Wanjiru Waroga

N69/7229/2017

Signature Date

…… …….

Supervisor

This research project has been submitted for examination with my approval as the university supervisor.

Dr. Dalmas Omia

Signature Date

…… …….

DEDICATION

I dedicate this work to my mother Jane Waroga, who has been my pillar and has made sacrifices beyond measure to support my education.

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ACRONYMS AND ABBREVIATIONS

CCAFS	CGIAR research program on Climate Change Agriculture and Food Security
CSA	Climate Smart Agriculture
CIAT	International Center for Tropical Agriculture
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussions
GAAP	Gender Assets and Agricultural Projects
GDP	Gross Domestic Product
GHG	Green House Gas
GOK	Government of Kenya
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KII	Key Informant Interviews
NACOSTI	National Commission for Science, Technology and Innovation
UN WOMEN	United Nations Entity for Gender Equality and the Empowerment of Women
WB	World Bank

ABSTRACT

This is a cross-sectional study on gender relations in the adoption of climate smart agricultural practices among rice farmers in Kirinyaga County, Kenya. Specifically, it sought to establish the current climate smart agriculture practices, the gendered differences in the adoption of climate smart agricultural practices and the socio-economic determinants for the adoption of climate smart agricultural practices among men and women farmers. Data was collected through survey questionnaires, FGDs and KIIs. Convenient sampling was used to select a sample of two hundred and four (204) respondents. Descriptive statistics and regression models were used for analysis of quantitative data while thematic analysis was adopted for qualitative data. The findings reveal that a majority (52%) of the respondents confirmed women are engaged in CSA practices such smart irrigation, chemical spraying, use of fertilizers and seeds and intercropping. The decisions to engage in CSA is largely in the hands of men (55%) underlined by their inherent control of the production assets. Factors affecting the adoption mainly revolve around the gender differentiated levels of access land, productive tools/technologies, information, extension services and agency in decision strongly came out. The study did not establish any significant relationship between having access to loans and agricultural insurance and its influence the adoption of smart agricultural practices. This indicates that adoption of CSA practices is taking place irrespective of the presence of finances and financial services. The study recommends that engagement of local community elders in tackling gender related land issues inherently entrenched in cultural beliefs as key to tackling land issues. Intensified dissemination of CSA knowledge is required for a shared understanding of the position of CSA in climate change adaptation is critical to promote CSA practices. Wider policy and structural reforms that are gender responsive, are needed to enable accelerated CSA adoption in particular, and sustainable intensification in general. Policies that promote an increased income for farmers through input subsidies, regulated government prices taking into consideration use of affirmative procurement policies for marginalized groups are required. As the study has identified that women are mainly involved in the adaptation and building resilience in rice farming, the study recommends that in future, research is undertaken to determine the effects of the adoption of climate smart practices to health and wellness noting the socio-economic determinants for the adoption of CSA practices.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

The world has experienced a rapid increase in population and the increased use of fossil fuel-based mode of production has played a significant role in contributing to climate change. Global temperatures have been rising and precipitation patterns are also changing. As a result, the world is experiencing extreme climatic conditions such as drought, floods, and storms have become frequent. Climate change has emerged as a major threat on food security, agriculture and livelihood of millions of people in across the globe (Field cited in Arun Khatri-Chhetria,et al. (2017). Empirical research further notes that effects of climate change pose additional challenges to agriculture, particularly in developing countries (Campbell et al., 2014).

The emergence of climate-smart agriculture as an approach whose objective is to transform agricultural production systems and food value chains so that they support sustainable development and can ensure food security in the face of climate change (FAO, 2013) is herald as timely. The concept was first launched in 2010 by Food and Agriculture Organization (FAO) as a background paper developed for the Hague Conference on Agriculture. The paper served to describe agricultural systems that provide agricultural benefits to the communities with the overall aim of improved watershed and ecosystem management (FAO, 2010). Climate Smart Agriculture (CSA) focuses on combating the effects of climate change on agriculture through three interlinked objectives that focus on sustainable increase in agricultural productivity and supports increased incomes that are equitable, food security and development; adapting and building resilience to climate change at all levels; and developing opportunities to reduce Green House Gas (GHG) emissions from agriculture compared with past trends (Lipper et al., 2014:107). Consequently, agricultural practices should adapt to the changing climate otherwise food security will remain an endemic challenge to a rising population especially for developing countries. CSA is not just about on-farm practices. It requires investment across landscapes so as to support healthy watersheds and ecosystem services that support adaptation, promote mitigation strategies across all land uses, and supply the full range of agricultural products. A climate-smart landscape approach includes a spatial understanding of land uses and their interactions as well as a process for coordinating the institutional diversity of stakeholders (Scherr et al., 2012).

It is vital to note that climate change is not new and has been a gradual process taking place over time. Traditionally, people dealt with the issue of climate change in specific ways and different people had a particular role in combating the problem. Nevertheless, the traditional people and their way of life such as emission of carbon to the atmosphere contributed to climate change. People relied on local biological diversity and cultural landscape as a source of livelihood. They initially used the land located in tropical forests, coasts, small islands among others and their agricultural activities had significant contributions to climate change. Activities, such as fishing, farming, hunting and gathering posed significant degradation to the environment. Indigenous people, however, conserved the environment and their practices adapted to climate change. Research has unearthed that historically, communities put measures in curbing effects of climate change. Nyong cited in Mafongoya (2017) that in the Sahel region, pastoralists integrated mobility with active management of their herds as a mechanism to survive drought. Furthermore, pastoralists designed strategies to adapt to hazards and disasters which were useful climate change coping mechanisms. In Swaziland where droughts and floods are common disasters, communities devised methods such as observing nest heights of certain bird species, in tress, in order to predict the onset of floods. This explains that traditional techniques have contributed to farmer-led methods of adapting to climate change.

Pacific island has been dealing with the issue of changing the environment for an extended period. As a result, adaption to changes has become a way of life and therefore, traditional knowledge, values, and practices have enabled the people to successfully live as well as thrive in the environment. According to Gyampoh et al., (2010), consideration for culture played a significant role in the indigenous people's integration into reducing disaster risk as well as adapting climate change plans and policies. The indigenous people were engaging in intangible cultural heritage and practices that led to active participation in efforts that ensured effective adaptation to climate change. The study further notes that community-based cultural heritage, helped people pay attention and identify natural disasters and the impacts of climate change. Also, they assessed how their activities could be integrated into minimizing adapting actions for climate change. People who lived around the ocean and lakes adopted various navigation systems and elements by using

a wide range of techniques and strategies to guide voyage. The pacific people, for instance, relied on techniques and observations such as the type and color of clouds, seaweed deposited on the beach. In Africa, on the other hand, people relied on methods such as direction wind, smell of the water, as well as assessing the strength of the waves (Gyampoh et al., 2010). The strategies helped people safeguard the traditional navigation systems using ancient knowledge and skills to respect nature as well as the universe.

Environmental resource management was also a significant issue in the adaption to climatic change. Indigenous people lived a subsistence lifestyle where every gender played a specific role to adapt to climate change. Men, for instance participated in fishing and hunting while women engaged in farming and gathering (Doss, 2012). Safeguarding related to intangible cultural heritage minimized the erosion of self-sufficiency as well as contributed to human resilience to climate change hazards. Agroforestry buffer rainfall stabilized and developed soil and provided a source of wood while nearshore areas were used for fish functions. Traditional farming systems for the indigenous people had a number of mechanisms that enabled sustainable production and supply of produce. According to Doss (2012), mechanisms included the production of surplus food supply, control of food consumption to avoid over-cultivating, and ensuring agricultural resilience that led to diversification of crops. As a result, the systems enabled the traditional communities reduce the risks of impacts of extreme climatic conditions as well ensured food security. In Africa and other parts of the world, communities had calendars that guided their agricultural planning such as harvesting and of crops and forest. In the Pacific, Tonga, for instance, Tonga farmers had their ow calendar that helped them plan for various farming activities. The year in the Tonga community, for instance, contained thirteen lunar months and each lunar had 28 days (Intergovernmental Panel on Climate Change, 2007). As a result, the lunar calendar guided the Tonga people regarding decisions such as harvesting, planting and other farming activities they were to undertake.

In many traditional communities, men participated in fishing. Communities, however, had various traditional fishing control practices that enabled them to adapt to climate change. For instance, they established no-catch zones as well as enacted species-specific prohibition. As a result, the traditional fishery-management practices served as measures for sustainable resource management

and protection of the ecosystem. In Africa, communities developed food-management such as food reserves to cater to various situations such as drought. Indigenous people had various traditional building methods that demonstrate various aspects. For instance, due to disasters and extreme heat waves many building structures demonstrated adaptation to various environmental hazards (UNESCO, 2013). In areas that experienced high temperatures, communities built houses that had high ceiling to reduce heat and open sides to allow winds to pass through and generate humidity (UNESCO, 2013). As a result, the architectural styles adopted by the indigenous people enabled them withstand hazards such as extreme weather and strong winds.

Meeting the demand for food globally requires a closer look at different regions and what agricultural practices are in place to respond to climate change trends. In Europe, there is an advanced practice of Precision Agriculture which data-based management approach is characterized by the gathering and use of field-specific data, which can then be used to inform the application of farm inputs to specialized characteristics of small units of cropland and grassland with an aim to enhance fuel and input use as well as reducing losses that would otherwise result in pollution (Kritikos, 2017:4), Chaudhury et al. (2012) notes that in Chandpur-Bangladesh, new agricultural practices are being adopted- planting of trees near ponds and roadsides is practiced by both men and women because fruits from the trees bring income. Furthermore, the study notes a division of labor between men and women is observed and that men collect seedlings and women plant them.

Adaptation to climate change with reference to agriculture, requires adequate financial resources in order to support farmers in sustainable strategies. This is a substantial barrier for Central Asia countries that do not have the needed financial resources and technical knowledge for anticipatory and planned interventions (William et al., 2012:62). Consequently, farmers are limited in their ability to adapt to climate smart agricultural practices which inhibits their capacity to fully utilize these practices. In addition, William et al. (2012:46) notes that existing social inequalities should be addressed by adaptation strategies, e.g. differences in land tenure/land use and lack of access to resources, credit, education and decision making that affect people's ability to adapt-this could be reached by integrating adaptation strategies into development policies. Therefore, there is a responsibility by policy makers and development practitioners to ensure that policies incorporate

issues related to agricultural practices, land use practices while at the same time taking into consideration the vulnerability to climate change for different groups in the communities.

Sub Saharan Africa is no different when it comes to climate change issues affecting agricultural practices. In Malawi, for instance, some farmers practice recessional agriculture (planting in flooded areas after waters recede) which results in another harvest season (CIAT et al., 2018:4). The study by CIAT further notes that there are differences in use of fertilizers between male headed households (57%) and female headed households (50%) and women farmers also have less access to irrigation technologies and finances. In Ethiopia, there is a correlation between food insecurity and poverty which are closely linked to climatic factors, education levels at the household, productivity, quality and size of land, access to productive assets, with women headed households particularly vulnerable since compared to men, they are less likely to own land and receive education (CIAT et al., 2017:5). In Mozambique, use of short season varieties and small grain crops such as sorghum have also emerged as key strategies for farmers to adapt. The vulnerability of the country to drought vis a vis the underdeveloped irrigation potential has led to the adoption of many CSA methods related to water harvesting and management, especially for potato and vegetable cultivation (CIAT et al., 2017:9).

Unequal access to productive agricultural resources documented between men and women affects the level of productivity that would be realized if women had the same playing field compared to men. The creation of site-specific CSA options can exacerbate structural disparities if this gender gap is not considered (Huyer et al., 2016:2). More so, in the context of climate change, food sources become more erratic and scarcer, making women, youth and vulnerable groups to experience food insecurity and loss of income (GoK. 2017:54). Buechler (2009) as cited in Goh et al. (2012: 6) reports that climate change and related water shortages in Sonora, Mexico, are rapidly affecting women's livelihoods and social connections. Women are less able to earn and control income from the processing of certain fruits and vegetables because of warmer temperatures and water scarcity, also eroding their social connections because they are less able to exchange food products as gifts, a practice used to secure the status of women in important social networks that act as safety networks and important social capital.

Considering gender roles as a significant factor of agricultural practices in the Eastern Africa sub region, strategies that are cognizant of these dynamics are essential. This is because historically there is a gendered division of labor in agricultural activities. Njeru et al. (2016) notes that Men cultivated the land while the seeds were planted by women. Weeding practices were traditionally women's tasks, but women were set free to participate in other household chores with the introduction of herbicides for weed control. Consequently, social dynamics that influence agricultural practices need to be taken in to account in any policy planning in relation to agriculture and climate smart practices.

There is great potential in Sub Saharan Africa for climate smart agricultural practices. Sex-disaggregated CSA data in countries as varied as Kenya, Senegal, Uganda and Bangladesh show that both men and women are effectively adopting new farming practices that are likely to improve their resilience to the impacts of climate change (World Bank et al., 2015). This World Bank study also reports that enhanced access to information and credit for women increases the likelihood of adopting new, transformative CSA techniques. Local agricultural groups are key sources of CSA information, and they are also important to sharing labour for women in particular. This World Bank study further notes that although male farmers receiving extension assistance are more likely to make transformative changes, female farmers obtaining extension advice are not (World Bank et al., 2015). This could be explained through realization that extension services are not gender responsive and do not take into consideration gender differentiated roles and practices in agriculture.

A scoping study in Ethiopia, Uganda and Kenya (FAO,2013) found that among key CSA practices being adopted in the Eastern Africa region, soil and water conservation, rainwater harvesting, agroforestry are the most common practices (Njeru et al., 2016:75). It is evident that there is commitment to building resilience against climate change which has also been reinforced by existing frameworks and policies in place that relate to agriculture in the face of climate change. However, the study also notes that men and women often have differing priorities and CSA initiatives need to take these into consideration (Njeru et al., 2016:81).

Agriculture is one of the driving sectors of Kenya’s overall economy. FAO (2019) reports that the agricultural sector contributes 26% of GDP and 27% of GDP indirectly through linkages with

other sectors. The sector is also an employer of over 40% of the total population in Kenya and more so, 70% of the rural population. This implies that it is critical for the agricultural sector to fully optimize the resources available in order to maintain and increase its productivity in the overall contribution to Kenya's economy.

According to KALRO et al. (2014), agriculture is the main occupation and source of income driving Kirinyaga's economy. It is primarily the source of household food and contributes raw materials for agro-based industries. This report further notes that rice is the highest produced crop in Kirinyaga County. Kirinyaga county is noted to be engaging in climate smart agricultural practices. The report notes that the main adaptation strategies used are tree planting at 44% increased soil and water conservation at 38%, changing the crop type at 33%, irrigation at 29%, diversification of enterprise at 17% water harvesting at 19% and practicing staggered cropping at 19%. At least 74% of all households adapted to the perceived climate change. Disaggregated by gender, at least 76%, 74% and 53% of adult male, female and youth headed household srespectively adapted to the perceived climate change (KALRO et al., 2014). This information exmplains that adaptation of CSA practices exists, and that both men and women are all involved in combating climate change using various techniques.

1.2 Problem Statement

Studies have asserted that climate change is happening, largely spurred by human activities, and it will have many serious and potentially damaging effects in the coming decades. There have been concerted efforts globally and nationally to fight the effects of climate change especially on agriculture and the environment (GoK, 2010). CSA practices and approaches are being promoted and their uptake by all farmers can help to alleviate the impact of climate change on agriculture.

The degree to which people are affected by climate change impacts is partly a function of their social status, gender, poverty, power and access to and control over resources (Habtezion., 2013). Women are major actors in the agricultural sector but are themselves affected differently than men farmers by climate change. Women make significant contribution to food production in Africa, but often remain marginalized with minimal access to factors of production. The impacts of gender inequalities and women's recurrent socio-economic disadvantages continue to be ignored and remain a critical challenge to adaptation efforts (Habtezion., 2013). Gender stereotypes on issues

such as technology access, land tenure security, water rights, education, labour, support services and credit are some of the barriers to women's active involvement in agriculture (Williams et al., 2015:5). This means that in order for us to see a change in the climate change adaptation efforts, gender inequalities must be addressed and catered for. CSA practices and approaches should be adapted to differential needs of women and men farmers, and this does not seem to be the case so far. Compounded by the long-lasting unequal access to resources for women and men farmers, women are likely to be facing challenges in adopting CSA practices and approaches.

Gender differences on the impact of climate change and gendered responses have often not been prioritized in policy making and in the provision of supportive services. Extension workers for instance have tended to provide services mostly to men farmers as most of them are likely to be men and with limited skills or experience in working with women farmers.

Persistent factors of unequal access to inputs and technology continue to hinder women's uptake of CSA practices. Nhemachena et al. (2007) in Khatri-Chhetri et al. (2017) notes that farmers' age and gender significantly influence the choice of technologies to climate change adaptation in agriculture. Furthermore, the research elaborates that their economic status (e.g. income and poverty level) and their resource endowment (e.g. landholding size) also influence the adoption of CSA technologies.

Research conducted in Kirinyaga (GoK, 2014) elucidates the following: (i) male headed households accessed two parcels of land compared to one parcel of land accessed by female headed households (ii) decision making for annual production of rice was at 64.9 % for men and 27% for women, (iii) use of agricultural machineries was at 37% for male headed households and 26% for female headed households (iv) access to agricultural related information services and infrastructure was higher in adult male headed households than adult female headed households (v) 20.2% of adult male headed households accessed market information services compared to 6.6% of adult female-headed households (vi) 9% of adult male-headed households accessed agricultural insurance services compared to 1.7% female adult-headed households (vii) access to agriculutral technology at 19% for adult male-headed households and 17% for adult female-headed households. From these statistics and information, it is evident that there are gendered differences in the access to and control of agricultural resources.

The purpose of the study was to analyze gender relations in the adoption of climate smart agricultural practices in Kirinyaga County. The following questions guided the study:

i. What are the current climate smart agriculture practices among rice farmers in Kirinyaga County?
ii. What are the gendered differences in the way in which men and women adopt climate smart agricultural practices in rice farming?
iii. What are the socio-economic determinants for the adoption of climate smart agricultural practices among men and women rice farmers?

Cognizant of the approach of CSA being to tackle three main objectives (as defined in previous section), this study focused on two of these objectives of climate smart agriculture i.e. sustainably increasing food security by increasing agricultural productivity and incomes and building resilience and adapting to climate change.

1.3 Study objectives

1.3.1 Overall objectives

The overall objective of this study was to investigate and establish the current climate smart agricultural practices, gender relations and the socio-economic determinants of adoption of these CSA practices among men and women rice farmers in Kirinyaga County.

1.3.2 Specific objectives

The specific objectives of the study were:

i. To identify the current climate smart agriculture practices for rice farming among men and women in Kirinyaga County.
ii. To investigate the gendered differences in the adoption of climate smart agricultural practices
iii. To establish the socio-economic determinants for the adoption of climate smart agricultural practices among men and women farmers.

1.4 Assumptions of the study

i. Both men and women have been adopting climate smart agricultural practices in Kirinyaga County;

ii. Climate smart agricultural practices are adopted differently due to the gender differences;

iii. The adoption of these practices is determined by socio-economic factors.

1.5 Justification for the study

Climate change is a lived reality that has a clearly established effect on agriculture. In Kirinyaga County, KALRO et al. (2014) note that at least 23% of the households had noticed long-term environmental changes. These long-term changes include changes in average temperatures and rainfall. Other changes noticed include reduction in water volumes, soil degradation and drying of wells and rivers. Reduction in water volumes was the most reported environmental effect (60%) followed by soil degradation and drying wells and rivers all at (39%).

Climate smart agriculture is a way to guide the needed changes of agricultural systems, given the necessity to jointly address food security and climate change (FAO, 2013). The poorest and most disadvantaged groups tend to depend on climate-sensitive livelihoods (e.g. agriculture), which makes them disproportionately vulnerable to climate change (Habtezion, 2013). It is crucial to take a context-specific approach to identify what works where, why and for whom (Neufeldt et al., 2015:3). Analyzing gender specific determinants that drive rice farmers in Kirinyaga County to adopt climate change practices will help identify practices tailored to the existing gaps.

Kirinyaga County was selected as a study focus because it has one of the largest rice irrigation schemes in Kenya. Rice was selected as the crop of focus because it is largely consumed in Kirinyaga County and the Country of Kenya as a whole. FAO (2012) asserts that tit the third most important staple food in Kenya. A study by Bancy (2015) looked at rice intensification systems and their influence on production but did not clearly bring out the role that women have to play in adopting climate smart practices that influence production. This could be because the study objectives were not focused on the role of women and men. The purpose of this study is to build on the existing knowledge and provide insights on gender relations in rice farming in terms of power relations on CSA adoption and what practices are in use.

Similarly, a study conducted by Makini et al. (2017) to assess status, challenges and prospects of agricultural mechanization in the case of the rice value chain in Kenya looked at aspects of land ownership, access to extension services, financing and availability of machinery but the study did not cover gender dynamics and relations in the rice value chain. The study failed to bring out the role gender relations play in the economic, social and agency aspect in rice farming in Kirinyaga County. This study will seek to establish the socio-economic factors affecting the adoption of CSA for rice farming and the gender differences around these factors.

Adaptive strategies that curb the impact of climate change are not gender neutral because vulnerability is often determined by various factors -all of which may differ along the lines of gender (Nelson et al., 2016:5). Women's greater participation is also likely to enhance the effectiveness and sustainability of climate change projects and policies (Habtezion., 2013). Therefore, policies and practices that are considered gender responsive, need to recognize and address the specific needs and realities of women and men based on social constructs on gender roles. Gender-equitable relationships are promoted through gender-transformative interventions (WB et al., 2015). This study will add to the growing literature on the importance of gender responsive CSA practices and approaches and women's uptake of the same.

The Government of Kenya has developed several policy frameworks to combat climate change and adapt climate smart agricultural practices within the country such as: The National Land Use Policy, Kenya Climate Smart Agriculture Strategy (2017-2026), National Climate Change Response Strategy among others that have integrated adaptive measures for agriculture in order to tackle climate change issues. This study will provide an understanding of how women can effectively adopt climate smart practices through control over productive assets including land under the National Land Use Policy (2017). The study will provide ways in which women can be supported in the adoption of climate smart agricultural practices under the strategic issue on women and vulnerable groups in the Kenya Climate Smart Agriculture Strategy (2017-2026).

Closing the gender gap in access to resources and decision-making would result in a 20-30% increase in yields on farms managed by women (Dinesh et al., 2016). This is means increase in productivity will be achieved once gender gaps in agricultural productivity are closed. This study will provide recommendations that will assist in reducing the gender differences that will be

identified in the adoption of climate smart agricultural practices. Increasing the uptake of CSA practices will subsequently result to an increase in productivity among rice farmers in Kirinyaga County.

Researching on CSA practices on a main crop (rice) in a County that has the highest production of the crop in the country provides a real opportunity to investigate the adoption of CSA practices to provide evidence-based recommendations. The study aims to provide policy recommendations to the national rice development strategy. The National Rice Development Strategy (2008-2018) notes the gender dimension that women are not fully integrated in rice value chain. The Strategy has not taken into consideration the gender differentiated roles exist in the rice value chain. The study will give insights to the development of Rice Strategy to create policies that promotes an increased income for farmers through input subsidies, regulated government prices taking into consideration use of affirmative procurement policies for marginalized groups. This will be through identification of where this assistance is needed most based on the findings from this study. Wider policy and structural reforms that are gender responsive, are needed to enable accelerated CSA adoption in particular, and sustainable intensification in general. This is in particular reference to rice farming. The study will provide knowledge in the academia field regarding the practices majorly performed by women and the gender dynamics around these practices.

1.6 Scope and Limitations of the study

The study sought to bring out the gender differences in the adoption of climate smart agricultural practices, what socio-economic determinants influence the adoption of climate smart agricultural practices among men and women in Kirinyaga County and how this might affect the adoption of such practices for women rice farmers in Kirinyaga County. Methodologically, the study was limited to small scale farmers. However, this created and opportunity to critically examine relations at the household level so as to create an opportunity for future studies undertaken to compare with findings at the large-scale levels especially in relation to factors affecting the adoption of CSA practices. The study was also limited to the sample size under study. The researcher ensured to ensure gender representation in the sample size under study to give a true and fair picture of the sample population.

The study was limited to the researcher did not find data that provides evidence of the actual number of small-scale rice farmers in which the sample size would have been measured from. The researcher used the available information on the Kirinyaga County agricultural labour force taking into consideration that rice is one of the top farmed crops in the county and hence the labour force should represent a sizeable portion of rice farmers.

The study was limited by time constraints. This was addressed by use of a research assistant. Resources for more extensive data collection were not available. The study was also limited to small scale farmers. Other minor limitations related to the understanding of CSA practices by the farmers, relating the uptake of CSA practices to the household division of labour. These concepts were however explained and deconstructed to ease the understanding of the respondents.

1.7 Definitions of key terms

Gender relations	Are a social construct that determines the roles men and women play in particular community which comprises of power relations, access to/control over resources, among other factors and is distributed between the sexes.
Adoption	An action accompanied by the intention to use an innovation if the innovation offers a comparative advantage to the already existing method/practice.
Climate smart agricultural practices	Are practices that are context specific and may not necessarily work in all places. In one context, a practice may be climate-smart, but not in another, depending on how, where and why it is used (FAO, 2015:3).

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter covers the review of literature regarding gender relations in agriculture and the factors influencing the adoption of climate smart agricultural practices. In this chapter, an attempt is made to review the work of other researchers that borders around, (i) the use of CSA practices (ii) gender differences in the adoption of CSA practices (iii) factors that affect the uptake of CSA practices.

2.2 Gender relations in agriculture

Agriculture is a significant aspect that provides people with food and acted as an economic activity for that generated income among communities. There are gendered differences in agricultural farming, and this is seen as men and women farm different crops, men and women have access to different resources, receive extension services differently and make different decisions on different things in agriculture including sale of their produce. Learning gender-specific adoption constraints may enable agricultural research systems design new varieties and innovations that are better suited to women's needs, support extension systems recognize the most important adoption constraints, and assist practitioners and policymakers tackle these gender-specific constraints (Meinzen-Dick et al., 2014:83). It is crucial to establish those identified as early adopters are smallholder farmers who have the required capital, have particular ability to adopt or are incentivized to change their existing practices (Murray et al., 2017:121).

Gender relations in the traditional agricultural activities led to differentiation of roles among men and women. Initially, agriculture was not a developed economic activity since people practiced subsistence farming and the produce they got was meant to sustain the community or a household for a specific period. nevertheless, in certain situations, communities could have surplus food supply and they trade it to acquire other commodities that they did not have. Currently, agriculture in many developing nations is underperforming. According to Grace (2014) women represent a critical aspect in agriculture and rural economy through their roles, they continue to encounter challenges as compared to men while accessing productive resources. The national government and international community, on the other hand, have put some effort to address the issue to help women achieve their goals for agricultural development, food security, as well economic growth.

The objective, however, might be realized if various stakeholders build on the contribution's women make and take strategic steps to alleviate the challenges they encounter. Doss (2012) argue that men and women make significant contributions to agriculture, but their roles may vary between different regions. The role of women is changing rapidly in many parts of the world due to strategic steps taken to alleviate the constraints they experience.

Rural women, for instance, pursue different livelihood strategies while managing complex households (Doss, 2012). As a result, their activities entail producing agricultural crops preparing food, collecting fuel, fetching water, as well as working in agricultural fields. Activities such as the use of traditional methods of cooking such as the use of firewood lead to emission of carbon which contributes to climate change. Men, on the other hand, participated in hunting and gathering and they would light fire to prepare meals they had gotten from the fields (Grace, 2014). As such, their activities contributed to climate change due to the emission of harmful gases that severely affected the environment. Thus, the activities women undertake cannot be categorized as economically active as compared to their male counterparts (Grace, 2014). Nevertheless, the role of women in agriculture is essential to the well-being of community households gender differentiation is significant in assessing the role of men and women in agriculture. Different countries have data that provide active participation of different genders in agriculture which offers a comprehensive measure of participation of both men and women. According to Grace (2014), women make a significant percentage in agricultural labor force. Activities such as burning of crops cover and ferrying trees to clear land for farming contributed to environmental degradation and contributed to climate change.

2.2.1 Gender differentiated roles

Gender aspects relate directly and critically to women's and men's roles and responsibilities in the farming household and to decisions about allocating resources or adopting technologies in farming systems (Beuchelt et al., 2013:710). CSA practices are adopted less frequently by women than men, and financial and resource constraints are cited as the cause (Jost et al., 2013:140). Jost further explains that labour intensive tasks were cited by women as a disincentive to agricultural practices

shift such as composting[1] and vermiculture[2]. Reason being these tasks seem to fall on women. Conservation agriculture may increase the burden of labour on women due to increased weeding responsibilities, while decreasing the burden of labour for men due to reduction in tillage responsibilities (Kaczan et al., 2013).

There is sufficient evidence to prove the assertion that climate change is having a significant impact on agricultural production and the livelihoods of people. According to United Nations (2019), men and women experience climate change differently, while the degradation of land and other natural resources are changing agricultural landscape around the world. In developing countries climate change is affecting the availability of surface water which leads to rural women who undertake the role of fetching water to cover greater distances to find the scarce resource. As a result, the impact leads to increased workloads on their substantial roles. According to Grace (2014), there is a strong relationship between climate-related disasters and female mortality where women and young boys and girls are more likely to die than men due to disasters. Women, on the other hand, have limited rights, mobility, decision-making authorities, and access compared to their male counterparts. As a result, such factors render them more vulnerable to the implications of climate change since they have limited capacity to adapt as well as diversify their livelihoods.

A report on Intergovernmental Panel on Climate Change (IPCC), found that climate change hazards enhance the already existing gender inequalities hence contributing to the increased level of climate change vulnerabilities on women. Levels and sources of income, on the other hand, are diversification strategies that help people access to economic capital and productive resources to mitigate climate change. According to United Nations (2019), factors such as human capital, levels and source of income for livelihoods, and social capital influence an individual's vulnerability and capacity to adapt to climate change. Human capital are elements such as skills, literacy level, and access to information that helps people adopt practices that would prevent climate change.

[1]Composting: biological decomposition of organic materials by microorganisms under controlled, aerobic conditions to a relatively stable humus-like material called compost.
[2] Vermiculture: Cultivation of earthworms

A study conducted in Uganda by Jost et al. (2016) indicate that men and women were adopting new crop management practices and gender differences were identified with respect to adoption of soil and water conservation practices/soil enhancement fertility practices. Activities that are more labour intensive were more likely to be practiced by men than women (Jost, et al., 2016:136). Based on the findings of the studies for the three study countries (Uganda, Ghana and Bangladesh) agricultural practices shift occur primarily within existing gender roles as opposed to new CSA practices being introduced, that would challenge existing gender roles. This means that a shift in climate smart practices requires a consideration of gender roles including in terms of labour roles, income incentives for the adoption among other factors (Jost et al.,2016:140).

Other factors such as access to technology for instance, transport and communication and provision of agricultural inputs play a significant in minimizing the impact of climate change. Understanding how these factors determine the differences in the specific constraints between men and women especially when making choices regarding climate change adaptation and adoption of smart agriculture is a significant aspect in assessing gender-differentiated roles. Also, it would make the intervention measures more meaningful and effective by considering the differences in climate-smart agriculture interventions to assist men and women farmers cope with the effects of climate change. As a result, it would make the interventions more effective by assessing various social, political, and economic factors that influence vulnerability and adaptive capacity of women and women more vulnerable to adverse climatic changes.

2.2.3 Resource allocation

Gendered allocation of resources often has an effect on the extent to which climate smart practices are adopted. Doss et al. (2015) in Murray et al. (2017:121) notes that gender analysis can shed light on decision-making relating to specific climate smart agricultural practices, including intra-household bargaining and resource allocation.

Mugambiwa (2018) explains that findings by various actors in climate change reveal that frequent cycles of prolonged droughts followed by severe flooding in developing countries have severe impacts on the livelihoods of the people. Thus, concerned stakeholders should adopt appropriate measures that would lead to investment in climate change to build resilience to communities and mitigate greenhouse gas emissions. For instance, appropriate investment in climate change will

develop resilience by targeting budget allocation to projects that ensure disaster risk reduction to enhance the capacity of different communities to prepare, prevent, respond, and recover from severe climatic conditions. According to Peter (2019), ongoing climate change affects the allocation of resources to complex infrastructural projects such as electricity. As such, there is a variety of impact mechanisms working differently in size as well as direction. Many countries have started to adopt the use of clean energy such as solar resources and wind to safeguard the environment by minimizing pollution. In numerous cultures, men own factors of production such as land and hence they control most decisions on its use. Initially, men have been the designated inheritance of family properties which has to skewed passion of land to favor men. Women, on the other hand, are known to work on family properties owned by their parents and husbands and hence they have insignificant influence regarding decision-making.

Responding to climate change requires different decisions while many groups such as officials in executive arm of government and other stakeholders may benefit from the support tools. Various countries are channeling resources towards educating people regarding strategies to limit climate change. As a result, it has led to improved understanding of drivers of climate change and enact measures to mitigate them. Also, there has been investment in interactions of limiting and adapting factors to improve the understanding of climate response by providing options to minimize the impact of climate change. A study by Johnson et al. (2015:305) on GAAP notes that projects that were able to increase women's assets, had an impact on the women's participation in decision making related to adoption of technologies and strategies, and the influence on the outcomes of those (often household-level) decisions are more likely to have better outcome in terms of increased yields.

A case study example is the Gambia Rice Irrigation Project. The project design assumed that rice farming was traditionally practiced by men whereas women grew it for household consumption. However, this project did not succeed because the structure of household relations in this context disfavoured women whereby husbands had to remunerate their wives with wages, to secure their labour contribution on the irrigated rice fields. This resulted in low yields despite external interventions. One reason being that women were reluctant to perform their planned role as family

labourers and this was because women had their own rice crops to cultivate and men found it difficult to recruit women's labour (Razavi et al., 1995:9).

2.3 Factors influencing the adoption of CSA practices

2.3.1 Access and control over productive assets

2.3.1.1 Land

Women's land rights and tenure insecurity may underlie differences in productivity between men and women and the adoption of CSA practices. In Ghana, Goldstein and Udry (2005) in Meinzen-Dick et al. (2014:89) attributed the differences in productivity between male and female farmers to high levels of tenure insecurity by women. In most cases, women do not leave their land fallow because they risk losing the land if they are not actively farming it. This might in turn contribute to soil degradation which could subsequently lead to decrease in agricultural productivity and thus, not meeting the desired objectives of climate smart agriculture. In East Africa, men control agricultural land and therefore, the challenges they experience are slightly minimal compared to women (Mutoko, Kirui, and Rioux, 2015). Men, for instance, may leave their land fallow for an extended period with having to worry about losing it due to inactive involvement in farming.

Women play a significant role in climate change adoption and mitigation, especially in the agricultural sector. Men and women, however, have a varied experience of the impacts of climate change. The extent to which both genders are vulnerable to the impacts of climate change and their capacity to adapt them vary in different aspects due to various aspects that affect the use of agricultural land. Due to limited control on land, women have been facing the issue of land tenure security (UN Women, 2017). As a result, they are often unable to make long term decisions that could promote the adoption of specific climate-smart practices due to instability of land tenure. According to Franze et al., (2018) in many developing countries, women have been experiencing limited control over land which is a significant aspect and enabler of practicing climate-smart agriculture. Also, women especially widows, are the main victims of land grabbing and they encounter discrimination in land allocation compared to men who dominate land tenure system. Thus, systems and customary laws that are inclined to favor while disadvantaging women in land

allocation and ownership have severely affected them and reduced their capacity to implement and practice CSA.

A study of the impact of the Ethiopian land registration program, which included some specific gender-related provisions (requiring ownership registration in the names of both husband and wife as well as the placement of both photographs on the land registration certification in Amhara and the Southern Nations and Nationalities People's Republic) found that land registration increased the likelihood that households had undertaken long-term investments in land (terracing and bunding) in the past 12 months (Meinzen-Dick et al., 2014:89). Land tenure security is therefore likely to promote the adoption of climate smart agricultural practices.

2.3.1.2 Agricultural inputs and technologies

Access to agricultural technologies is a significant aspect that contributes to or inhibits the adoption of climate-smart agricultural practices. Different parts of the world are tackling the issue of climate change caused by agricultural technologies and inputs used. Africa, for instance, requires significant transformation to meet the challenges of climate change by employing effective technology and inputs to attain food security and reduce environmental degradation. According to Goh (2012), climate-smart agriculture entails practices and technology that sustainably improve productivity minimize levels of greenhouse gases, as well as support farmers' adoption of climate change. As a result, a nation will realize food security and achieve poverty reduction goals.

There is a gender gap in agricultural productivity. The inequitable distribution in the allocation of inputs are as a result of social norms dictating gender roles and the gendered division of labour in households and the marketplace. Gendered norms and customs affect input use, productivity and income generation; they also affect producers' adoption decisions and who benefits from innovations (UN Women et al., 2018:12). One of the key findings of the studies undertaken by these UN Agencies on the cost of the gender gap in agricultural productivity for the 5 countries notes that female-controlled plots have relatively lower yields because important inputs such as inorganic fertilizer and pesticides are used mostly on male-controlled plots.

The widespread uptake of climate-smart agriculture must be supported by capacity and development to cater to the needs of both men and women. Women experience limited access to technology and inputs compared to men who are in most cases empowered. According to Franze et al., (2018), technologies considered to be climate-smart vary across different regions. Consequently, various regions experience diversity in technology use and therefore, there is a considerable scope to tailor CSA to individual farmers' needs. Most technologies considered climate-smart demonstrate synergies between productivity, adaption to climate change, as well as revealing certain benefits and opportunities.

There is need for society should support women farmers greater access to technology and inputs to alleviate the challenges women experience in acquiring them. Niger, for instance, has developed a rural code that acknowledges the challenges women experience in acquiring and controlling agricultural inputs and technology (UN Women, 2017). As a result, the government has embarked on various strategies to ensure women access advanced technology and inputs that ensure adaption to climate change. For instance, promoting initiatives that promote women's access to financing is a significant aspect of ensuring accessibility to effective inputs and advanced technology. The use of drip irrigation and treble pumps enables farmers to use water efficiently leading to sustainability and adoption of climate-smart agriculture.

Improved women farmer's productivity and resilience to climate change is a significant aspect of the attainment of climate-smart agriculture objectives. For instance, enhancing women's access to technology and skills would lead to reduction of labor-intensive activities. Capital investment, on the other hand, may promote women's participation in sustainable agriculture and enhance food security. Franze et al., (2018) argue that women experience various challenges such as access to finance, inputs, and extension services compared to men who are favored by system in different parts of the world. As a result, due to use of ineffective technology and lack of access to inputs, women contribute higher levels of climate change on agricultural productivity. The use of fertilizer and other agricultural chemicals leads to environmental pollution which increases the severity of climate change. Constraints related to access to technology and inputs, on the other hand, inhibit women from adopting CSA to mitigate climate change.

Agricultural tools and technologies are critical for the advancement of climate smart agricultural practices. Bernier et al. (2013) as cited in Murray et al. (2017:135) highlights that a key constraint for women's conservation efforts such as tree planting lies in lack of access to the necessary agricultural tools and labour needed for the work. As a result, this creates a situation where women may not efficiently adapt to climate agricultural practices.

2.3.2 Financial services barriers/credit barriers

Farmers face risks arising from effects of climate hazards and subsequently, challenges of managing risks associated with the (initial) high costs of new technologies adoption whose benefits often only come after several years/seasons of production (William et al., 2015:5). Consequently, if men and women do not have access to finances, they may not be able to purchase or have access to the required resources to adopt CSA practices.

According to Farnworth et al., (2016), women are as efficient as their male counterparts, but to lack of access to credit facilities, it makes them produce less. Access to credit also affects control and ownership of assets since it impacts on the ability to acquire land for production. Women experience more barriers while accessing credit due to lack of collateral such as land to enable financial institutions provide credit facilities. As a result, they use fewer inputs and have less access to labor and other significant services required for climate-smart agriculture. When designing climate-smart interventions, involved stakeholders should assess the role of women in CSA and the challenges they experience while accessing credit (Franze et al., 2018). This means that society should develop and implement initiatives that promote women's access to financing to develop more specific credit products that women farmers can access. Implementing different financial programs will ensure that women farmers have access to credit and eradicate barriers that exist while seeking such services. Also, various stakeholders should tailor various insurance packages that cater to the needs of women farmers to help explore and mitigate the risk of loss caused by climate change-related issues.

The inability to access credit facilities is a significant issue affecting women in different parts of the world. Franze et al., (2018) argue that lack of credit prevents women and other vulnerable groups to procure improved agricultural inputs such as seeds, fertilizer, and other technologies to enable them increase yields. In many African rural setups, rural financial programs are designed

and implemented with the male head of the household as the intended client (Farnworth et al., 2016). As a result, stakeholders fail to recognize that women are active and productive in various economic activities such as agriculture. In Nigeria, according to UN Women (2017), creating a bank account in a formal financial institution is a critical step towards ensuring the financial inclusion of both men and women. However, most account holders in various African countries are men and this creates barriers for women to access credit facilities. In developing countries, both men and women experience various challenges in accessing financial tools. Lack of financial facilities leads to use of ineffective technology and inputs that promote climate change (Franze et al., 2018). For instance, farmers that experience inadequate finances may opt for ineffective irrigation system that promotes soil erosion and does not conserve water which leads to lack of sustainable farming methods (Bernier et al., 2016). Women, on the other hand, especially in rural areas, rarely experience credit or cash loans. As a result, their challenges towards the adoption of climate-smart agriculture more compared to those experienced by men.

Implementing effective strategies to ensure equitability in access to credit facilities will be a significant step towards ensuring effective adoption of climate-smart agriculture and sustainability. According to Goh (2012), to succeed in CSA, the implementation of various sustainability practices will succeed depending on institutional and behavioral change to influence different policies. Social inequality and inclusion in reference to access to credit between men and women have been recognized as foundation issues inhibiting implementation of CSA. In various countries in East Africa, some women have made some strides regarding adoption of transformational changes in agricultural practices. Farnworth et al., (2016), observed that transformational CSA practices entail those activities that contribute to diversified livelihoods. Nevertheless, such objectives will be difficult to realize if the government will not ensure equality in access to credit especially for women and other vulnerable groups. climate change in various parts of the world may provoke major changes in productivity of different agricultural enterprises which have severe implications for national food and farmers' livelihoods.

Kabeer (2005) in Meinzen-Dick et al. (2014) reports that although access to financial services does make vital contributions to the economic productivity and social well-being of poor women and their households, it does not automatically empower women. The study elaborates that the design

of financial services for the poor, especially poor female farmers should be based on an empirical understanding of the relationships among context, approach and impact. This means financial services that are tailored to the needs of men and women are necessary to ensure that financial services benefit both men and women.

2.3.3 Access to information and knowledge on climate smart practices

Enhancing men and women's access to climate-smart agriculture information is a critical aspect of making the transition to climate change. According to Franze et al., (2018), lack of training and information is a critical aspect that affects the adoption of CSA across various regions. Thus, various stakeholders should invest in capacity building and knowledge dissemination for farmers to ensure increased adoption of CSA. Lack of information leads to inefficient risk management in farming due to use of insufficient economic resources that inhibit adoption of CSA (Bernier et al., 2016). Farmers' awareness of new technologies must include information on returns of adoption, which requires value judgments on profitability and risk (Meinzen-Dick et al. 2014: 84). Unavailability of information that is timely and accurate, untimely technical advisory services, lack of access to inputs, including appropriate crop varieties, restrict women's ability to assess CSA's risks and benefits and make informed investment decisions (Williams et al., 2015: 5).

There are various techniques such as conservation agriculture, intercropping, organic inputs, and water management that are considered climate smart (FAO, 2012). Most of the techniques, on the other hand, considered climate-smart are often inaccessible to women. As a result, women farmers use ineffective techniques due to inadequate information regarding the appropriate implementation of effective farming methods. Technologies considered to be climate-smart, on the other hand, vary across regions and are diverse and reflect the context specificity of opportunities. According to a study undertaken in Uganda, majority of men prefer to receive climate and weather climate information on media such as radio while women prefer indigenous methods such as through farmers groups, religious and social gatherings and print media (Jost et al., 2016:137). The study further notes that this type of information is mostly useful if contextualized and issued in the local language and is more location specific (Jost et al., 2016:137). This means that there is need to contextualize CSA practices to ensure effective adoption.

In various levels of the food system, there are different opportunities to adapt to the implications of climate change and prevent severe impacts of greenhouse emissions. Inadequate knowledge and lack of access to information lead to women using equipment and inputs that are do not promote sustainability goals in CSA. Different countries, however, have developed various measures and strategies to ensure women access information and knowledge to help them practice climate-smart agriculture. In Kenya, some women in Eastern parts of the country have developed a climate-smart learning site that provides people with access to sustainability farming information (CCAFS, 2015). With support from local partners, the women lead two learning sites that help them try different climate-smart techniques as well as drought-resistant seeds to establish what favors their area. Also, they experiment various practices that would not be a suitable match. Empowering women farmers with knowledge and techniques according to Bernier et al., (2016) gives them confidence to speak up and share the information with various groups. Getting it right is a significant aspect of climate-smart practices since it provides women farmers with the ability to support and educate others adapt and mitigate climate change while at the same time improving productivity (Aryal et al., 2018). The case aforementioned indicates that getting women involved in climate-smart practices by providing women farmers access to information will make significant achievement in realization of sustainability goals.

Women are unfairly disadvantaged when it comes to the issue of access to information and knowledge on climate-smart agriculture. On various occasions, men are the ones who attend to various functions intended to empower farmers with knowledge and skills on sustainability farming. Women, on the other hand, attend to domestic duties while others are afraid of joining their male counterparts on such forums. Low literacy levels of women also inhibit their ability to access CSA information which would help them improve on productivity (Farnworth et al., 2016). CSA programs should be cognizant of these social norms while training women on CSA practices to improve productivity and participation in sustainability farming. Men should also support women and encourage and inform them to participate in forums that educate people on CSA practices. Consequently, we will see many women taking the lead on climate-smart farming and educate others on such practices. Channels of disseminating information, however, do not favor women, hence in developing countries, men are more aware of CSA practices than women (UN Women, 2017). Thus, taking the information to women and other marginalized groups is a critical

aspect to ensuring effective adoption of climate-smart practices and helping them compete with men.

Evidence suggests that women tend to lose income and control as a product moves from the farm to the market (Gurung 2006). This means that women's control over farm resources tends to get weaker as soon as products are in the market and therefore income becomes elusive. Jost et al. (2016) notes that factors limiting women's mobility in access to markets included financial constraints to facilitate transportation, unfavourable infrastructure, insecurity, health concerns, household responsibilities and lack of permission from their spouses. According to this study, mobile phone owners, (mostly young men) are at advantage of accessing timely market opportunities information including on prices which reduces their travel (Jost et al., 2016:136). Many women participate in labour markets as wage workers on farms or as processors and traders along the agricultural value chain, but much of their work is informal or unpaid and goes unrecorded (Quisumbing et al., 2014:3). Information on market access is necessary to ensure that farmers participate in the entire value chain processes of farming. Lack of/inadequate access to information on markets may inhibit farmers interest to engage in agricultural practices that take into consideration a changing climate.

2.3.4 Access to extension services

Various organizations are mandated to provide agricultural extension services to ensure effective adoption sustainability in farming. Nevertheless, government extension services in various countries have failed to reach women farmers due to various factors. According to Olorunfemia et al., (2019) extension officers work more with men since they are the ones considered to be farmers since they are the owners of land. Also, the modes of communication used by extension officers do not favor women especially those with low literacy levels and lack of time since domestic activities take much of their time. Men, on the other hand, are the vast majority of people who work as extension officers and therefore, they may fail to reach women. Bernier et al (2016) argue that lack of adequate extension services has to women using lower levels of agricultural inputs including limited use of improved seeds, and organic fertilizer compared to men. As a result, men experience larger improvements in productivity even in situations where they apply similar inputs which implies that women may use inferior quality products. Also, due to inadequate knowledge

they may use the inputs wrongly such as apply various chemicals at the wrong time. Also, women have inadequate resources such as finances which makes them unable to acquire farm inputs or pay for extension services.

Ragassa et al. (2012) notes that in Ethiopia, male heads are more likely to attend community meetings and visit demonstration plots or research centers. However, other factors also influence the likelihood to access extension services. Education level is significant in male heads' access to different types of extension services, but education level matters to female heads only in accessing or visiting demonstration plots (Ragassa et al., 2012:9). Knowledge awareness on profitability and risks related to technology adoption can be accelerated through effective extension services (Meinzen-Dick et al., 2014:84).

Clear empirical uses for informing farmers and policy makers will depend on how the CSA concept is understood in practices that allow for adaptations and ongoing two-way feedback between researchers, practitioners, farmers and policy makers (Williams et al., 2015:3). In developing countries, people experience various challenges while accessing agricultural extension services. According to UN Women (2017), in Nigeria for instance, the ratio of extension officers to farmers is 1:950 households which imply that the nation has very few extension officers to reach farmers. As such, the officers may prioritize service delivery to big commercial farmers and neglect small scale individuals despite producing the bulk of food consumed in the country.

In developing countries, public institutes undertake extension services on many occasions which is often underfunded (Akrofi-Atitianti et al., 2018). As a result, the extension service officer is unable to reach large number of farmers due to lack of necessary resources. Access to extension services is a significant aspect of promoting agricultural innovation to keep pace with the changing production context. Inclusivity of both men and women, on the other hand, will ensure equality and development in exploring the extent to which extension services can improve the implementation of CSA.

2.3.5 Agency in decision making

Climate change is increasingly affecting people while developing nations experience severe impacts due to lack of capacity to prepare and cope with the implications. According to Farnworth et al., (2016), women and men experience the impacts of climate change differently. Women

farmers may not have the same power as men to make important decisions relating to changing agricultural practices (Murray et al.,2017:120). The study gives an example of Malawi where policies and subsidy programs on tobacco and maize have led to discovery that women are the core source of labour but have limited power over income generation. Sale of produce and decisions over earned income lie with the men.

Men in many African countries are the decision makers which inhibits the capacity of women to contribute in the enactment of CSA objectives (Farnworth et al., 2016). Women, on the other hand, are trying to catch up due to implementation of various policies to alleviate gender imbalance and ensure inclusivity in decision-making. According to Quinn (2017), women have for an extended period experienced discrimination and involvement in decision making due to various customary practices that prevent them from contributing to decision-making. For instance, control over land and the methods used in farming has been for extended period a responsibility of men while women implement the decision made.

Due to low literacy level of women, they have been unable to contribute to contribute to various issues affecting the adoption of climate smart agriculture. According to Franze et al., (2018) men have higher literacy level and own factors of agricultural production such as land, equipment, and knowledge. Also, various customary norms and practices have contributed to relegating women to do not participate in decision-making process. As a result, the development of various CSA decisions has become a sole responsibility of men while women are only direct to implement them. Thus, ensuring inclusivity would be a significant strategy to ensure both men and women have equal opportunities in the decision-making process.

Dominance of men in decision-making affects the implementation of CSA practices and the achievement of sustainability goals in farming. Lack of involvement of women, for instance affects the adoption of CSA practices and sustainability by women farmers. As a result, they report low yield compared to men who have access to information on CSA. According to Gockowski et al., (2011), women farmers in different countries are experiencing unstable productivity due to changing climate and weather patterns caused by failure to implement sustainability objectives in farming. As such, their involvement in the decision-making process would ensure they implement practices that mitigate climate change by adopting CSA practices. Women farmers in developing

countries are vital to global agriculture as well the ensuring productivity. Nevertheless, women farmers have been facing increased discrimination by various stakeholders regarding dissemination of information in involvement in decision-making. Failure to involve women in CSA has prevented them from participating and implementing sustainable farming practices. Thus, concerned stakeholders should work towards ensuring inclusivity of both men and women in decision-making regarding CSA practices.

Various strategic decision-making processes have played a significant role in affecting the implementation of CSA by men in women in different parts of the world (Jost et al., 2016). As such, the involvement of more women in decision-making will alleviate the lack of inclusivity that has been inexistent in the development of CSA practices which have not been able to reach many women. UN Women (2017) observed that there is need to bridge the gap by ensure that women are increasing involved in decision-making process as well as have increased control of factors of agricultural production. As a result, we will ensure inclusivity and fairness in decision-making and avoid a situation where women are unfairly disadvantaged due to lack of a platform to air their opinions.

2.3.6 Policy environment

Existing policy frameworks whose formulation has not been informed by CSA's needs or demands are likely to present challenges in terms of compatibility (Williams et al., 2015:4). World Bank (2011) in Chauhan et al. (2016:183) notes that a survey in 141 countries shows that nearly 103 countries persist in imposing legal differences on the basis of gender that may hamper women's economic opportunities. Compared to men, women face massive challenges in accessing levels of policy issues and decision-making process. This renders them less able to influence policies, programmes, decisions and implementation that impact their lives.

It is important for governments to develop tailored programs to ensure small scale farmers acquire extension services and they are trained on climate-smart agriculture and sustainability. Existing policy frameworks whose formulation has not been informed by CSA's needs or demands are likely to present challenges in terms of compatibility (Williams et al., 2015:4). For instance, government should include more women in extension services delivery by choosing hard-working rural farmers and train them on exemplary productivity. The trained lead farmers will impart the

knowledge and skills acquired to women and transfer the skills and technologies. Also, government should ensure that they train more women to minimize cultural barriers to accessing male extension officers by women farmers. Clear empirical uses for informing farmers and policy makers will depend on how the CSA concept is understood in practices that allow for adaptations and ongoing two-way feedback between researchers, practitioners, farmers and policy makers (Williams et al., 2015:3). Due to low literacy level of women, extension officers should ensure they simplify the information to ensure effective delivery. Such measures will ensure women are empowered as well as they are able to implement climate-smart agriculture and sustainability objectives. Also, it will reduce the inequalities that existed which position men at a favorable position of receiving extension services than women.

2.4 Theoretical framework

The research was grounded on the Empowerment theory and the Women's Empowerment Framework.

2.4.1 Empowerment theory

The Empowerment theory is a theoretical model that helps people understand the system and consequences of the effort to exercise control and influence over decisions that have significant implications over our life (Zimmerman,2000:43). According to Zimmerman (2000:44), it is essential to differentiate between the values that underlie empowerment between the approach to social change and empowerment theory. Empowerment theory provides specific values and bases for organizing our knowledge in different social, cultural, and political contexts. According to Richards et al. (2012:3), empowerment is the ability to influence others and the capacity to exert controls. According to Zimmerman, & Douglas (1995:573) theories of empowerment incorporate both outcomes and processes revealing that actions or structures may be empowering and that the results of those processes lead to certain levels of being empowered. The outward form of empowerment processes, on the other hand, vary in their capacity to derive different meanings. At a household level, empowering processes may consist of collective action to access community and government resources.

Zimmerman & Perkins (1995:571) argue that too much concentration on a single construct restricts community psychology even though it does not provide a compelling approach. As such, it is

essential to push people to think critically about empowerment by introducing certain concepts to the community to liberate their perception. Access to resources such as technology, extension services, information, market opportunities, and land are significant aspects of the process of empowering society through agriculture. Take market opportunities,which include places where the community can take their farm produce after harvesting for instance. A WB (2019) report notes that the structure, dynamics, and organization of markets are changing rapidly more so in developing countries. Information consists of education given to farmers regarding the best crops that yield high produce and the method of farming that incurs fewer costs (Pokhrel, 2010:12). Empowerment therefore creates an environmment that supports decision making of available market opportunities locally or internationally and the right timing to avoid overproduction which would lead to low prices.

Extension services, on the other hand, include access to experts who advise farmers on the appropriate chemicals to spray and the right method to administer them. Government has a critical role in restructuring agricultural extension (Rivera et al., 2003:7). Providing the right services and products would be a significant aspect towards economic empowerment of a society comprising of men and women.

Zimmerman's perspective of empowerment theory focuses on development and measurement where he argues that psychological empowerment takes different forms hence a single operationalization cannot adequately illustrate it (Zimmerman & Douglas, 1995:575). Also, it is not possible to develop a universal measure or appropriate goal which may provide a clear view of the specific criteria.

Various authors have different interpretations of empowerment which derives different meaning to the concept. Florin and Wandesman (1990:42), for instance, argue that methods and ideas can help enhance empowerment theory and practices such as citizen participation, voluntary organizations, and community development.

2.4.2 Women's Empowerment Framework

This framework as designed by Sarah Longwe is grounded on five approaches: welfare, access,conscientization, participation/mobilization andcontrol.

At the **welfare** level, women are viewed as passive recepients and are not empowered with respect to foodsupply, income and medical care. This is because reference to whether women are active creators and producers of material needs is not recognized. (Longwe, S. (1995) as cited in Teberg, M. (2011))

At the **access** level, women are made aware of the gender gap and animated to take actions of gaining access to their fair and equal share of available resources. This automatically leads the to the next phase.

Conscientization- At this level, there is an understanding of the sex and gender differentiated roles withthe belief that gender relations and the gender division of labour should be fair and agreeable to both sides, and not based on thedomination of one over the other. At this level, equlity of access to resources and factors of production is obtained by securing equality of opportunity through legal reforms to remove discriminatory provisions.

Participation/mobilization enables collective analysis of gender issues and the collective commitment of action. In development projects, it includes involvement in needs assessment in the whole project cycle (design, implementation, evaluation etc).

At the **control level**, empowerment seeks a balance of power between men and women so that neither is in a position of dominance. It means that women have power alongside men to influence their destiny and that of their society.

2.4.3 Relevance of the theories to the study

Due to the growing need to adapt in a changing climate, there is a need to factor theories that support how the society can shift towards adaptive strategies in a changing climate. This is while taking in to consideration the gender roles and responsibilities and how these influence the way in which decisions are made,as well as access and control in agricultural farming. This will be critical to building a resilient community. The **empowerment theory** explains the functionality of a society in a changing climate while being cognizant of various factors that affect resource allocation in a society.

The Women's Empowerment Framework's five approches give a picture of the different stages in which efforts can be enhanced to create a conducive environment for the empowerment of women in relation to the adoption of climate smart agricultural approaches. These five levels explain the extent to which influence in terms of access, control, use of resource decision making may be excersised by women. This framework will be useful to assess gender relations in adoption of climate smart agricultiural practices for these five levels of approach.

These theories explain that empowerment requires an analysis of factors including the policy environment that exists to support the adoption of agricultural practices. For instance, stakeholders such as Governments, must provide farmers with the right policy spaces for adoption of gender responsive technologies, gender responsive access to extension services, markets among other issues. Furthermore, land tenure security is a significant agricultural tool for production and should be accessed with control by both men and women, which is often not the case.

Information consists of education given to farmers regarding the best crops that yield high produce and the method of farming that incurs fewer costs. The empowerment theory entails farmers having information access on available technologies, market opportunities locally or internationally, financial services and credit facilities available for farmers in addition to weather information.

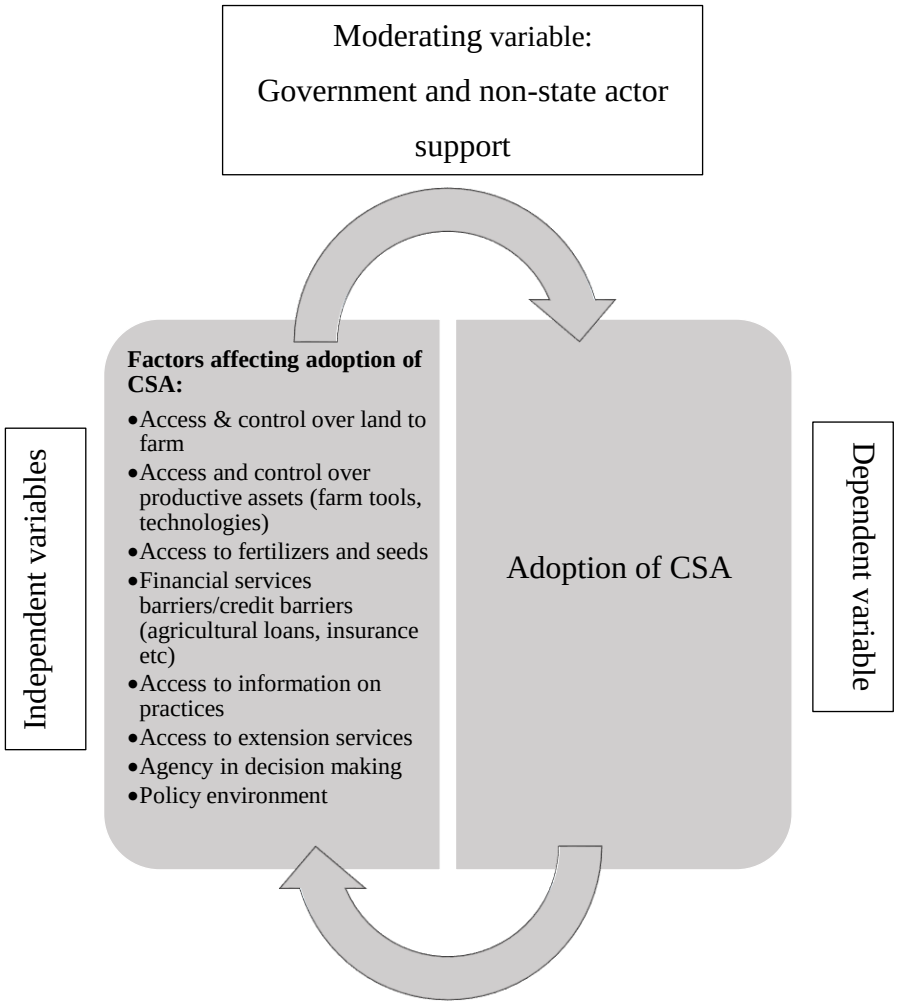
Community development can be a significant aspect of agriculture due to its focus on capitalizing the strengths of the community and individuals. An environment that is conducive to ensure the participation and decision making regarding farming practices is inclusive of both men and women. Citizen participation, on the other hand, is a significant opportunity that society can use to air the issues affecting them (Florin, & Wandesman, 1990:43). The practice can incorporate the skills and talents of the community to meet collective goals affecting their livelihoods.

The empoerment theory brings out the psychological and mindest aspect of empowerment whereas women's empowerment framework explains the different levels of approach in empowerment. These two concepts compliment and help explain how gender relations come into play while adopting CSA practices.

2.5 Conceptual Framework

The study hypothesized the interplay between the adoption of climate smart agricultural practices and factors that influence the adoption of climate smart agricultural practices in Kirinyaga County. The independent variables are the factors affecting the adoption of CSA. The dependent variable is the adoption of climate smart practices. This relationship of variables is shown by a conceptual framework in the figure below.

Figure 1: Conceptual Framework



Source: (*Researcher, 2019)*

Agricultural approaches that contribute to climate change adaptation in crop production:

- ecosystem-based approaches.
- conservation agriculture.
- integrated nutrient and soil management.
- mulch cropping
- cover cropping
- alterations in cropping patterns and rotations
- crop diversification
- using high quality seeds and planting materials of adapted varieties
- integrated pest management
- integrated weed management
- grasslands management
- water and irrigation management
- landscape-level pollination management
- organic agriculture
- land fragmentation (riparian areas, forest land within the agricultural landscape).

Source: *FAO (2008)*

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter describes the methods that were applied while conducting the research. This includes research site, design, study population, sample and sampling procedures, data collection methods, data processing, analysis and presentation. The chapter concludes by discussing the ethical considerations that guided the study.

3.2 Research site

Kirinyaga County is one of the 47 Counties in Kenya. Kirinyaga County covers an area of about 1,435.6 square kilometers and it borders Nyeri County to the North West, Murang'a County to the West and Embu County to the East and South. The county is divided into five administrative sub-counties, namely, Kirinyaga East, Kirinyaga West, Mwea East, Mwea West and Kirinyaga Central. These sub-counties are further divided into 12 divisions, 30 locationsand81sub-locations (GoK, 2013:4).

From the Kenya Population and Housing Census report (2009), the population of the county stood at 528,054 persons (260,630 males and 267,424 female). The population is projected to be 613,511 in 2019, 632,195 in 2021 and 651,449 in 2023. 60.78 percent of the population is below the age of 30 years. The agricultural labour force is 193,257 (GoK, 2013). Out of the total area of the county, 1170.7 km²square kilometers is arable land. The largest proportion of arable land is used for agriculture with farms averaging 2.5 acres forming the majority following land fragmentation over the years; large scale farms average 10 acres.

Agriculture is the county's main occupation and source of income with 87 percent of the total population deriving their livelihood from the sector and accounting for 72 percent of household income (GoK, 2013:24). Household food emanates primarily from agriculture. Agriculture also provides raw materials to agro-based industries. The area under food crops is50,864 hectares while that under cash crops is 31,244 hectares. The main food crops include rice, maize, beans, bananas, mangoes, Irish potatoes and assorted vegetables (GoK, 2014:2).

Kirinyaga County is Kenya's largest producer of rice (GoK, 2014:3). Presence of rice milling factories and rice product stores are evident in the County. The above-mentioned household survey report further notes that a substantive proportion of the County's income emanates from rice farming. In 2012/2013 financial year, Kirinyaga County received about KES 5.7 billion from the major crops, with rice contributing about KES 1.6 billion. Rice and sweet potato account for 55% of the estimated income from crops (GoK, 2014:3).

This 2014 Household survey report also articulates that key challenges in agricultural production in the county include: high dependence on rainfall which is often unreliable with erratic rainfall patterns as a result of climate change, high costs attributed to poor infrastructure and limited access to farm inputs, inadequate extension services due to a wide farmer to staff ratio, laxity in the enforcement of land use regulations, poor market access (GoK, 2014:3-4).

3.3 Research design

This study used a cross-sectional descriptive design. The cross-sectional descriptive research design assisted the researcher to establish the current climate smart agricultural practices, the gender relations in the adoption of these practices as well as the factors affecting the adoption of CSA practices. Data collection by use of questionnaires was administered over a period of ten days. Data collected by use of questionnaires captured the demographic information, current CSA practices in use, the gender dynamics on who performs these tasks and factors affecting the adoption. This quantitative data was analyzed and presented using frequency tables and pie charts. Qualitative data was collected through focus group discussions and use of key informant interviews. FGDs comprised two groups with both men and women rice farmers to allow room for participants to give perspectives that give a picture that reflects the views of both men and women. FGDs were also used as a means of triangulating/corroborating findings from the survey questionnaires. The researcher conducted three key informant interviews. The KIIs were probed for more information on the current CSA practices, the major stakeholders in rice farming in Kirinyaga County as a means to understand the support farmers receive, the role of men/women in rice farming and the influences on resource allocation for rice farming among men and women in Kirinyaga County. This information served as a confirmation of the already existing practices

and sought to get the perspective of the KIIs on how rice farming is practiced between men and women. Qualitative data was analyzed according to themes guided by study objectives and verbatim quotes to project the voices of the informants.

3.4 Study population and unit of analysis

Study population refers to the inferences made from a defined population from which the sample has been selected (Barnejee et al., 2010). The study population for this study were men and women rice farmers in Kirinyaga County. The unit of analysis is the entity under study, who is being described or analyzed (Korb, 2012). The unit of analysis for this study was an individual man farmer and woman farmer. These farmers were targeted from the Mwea region in which rice farming is majorly undertaken. The researcher had the advantage of being a native speaker of the local language and coming from a neighbouring county, the respondents were at ease of interacting with the researcher. Rice was selected as the crop of focus because it is largely consumed in Kirinyaga County and the Country of Kenya as a whole. FAO (2012) asserts that tit the third most important staple food in Kenya. Therefore, an analysis of the rice growing is important to understand the dynamics in a changing climate. The study population sought to examine those already assumed to be practicing CSA.

3.5 Sample and sampling procedure

Sampling is the selection of some part of an aggregate on the basis of which an inference about the aggregate is made (Kothari, 2004). Sampling was done by the researcher to determine the members or items of the target population to be included in the study. For the questionnaire, the researcher used convenient sampling method in which participants were approached based on their convenient presence at the farm fields. Participants of the focus group discussions were purposively selected and reached through the key informants who hold regular meetings with farmers. Key informants were conveniently selected on the basis of their availability, knowledge on CSA in rice farming and factors affecting the adoption of climate smart agricultural practices within Kirinyaga County.

The formula for sample size determination used -Yamane's formula (1967): $n = \frac{N}{1+N(e)^2}$

Where:

n = Sample size

N = Population size

e = Desired level of precision or margin of error (0.07).

$n = \frac{N}{1+N(e)^2} = \quad n = \frac{193{,}000}{1+193{,}000(0.07)^2} = 204$

The agricultural labour force who consist of 193,000 according to the Kirinyaga Household Survey (2014) was used as the population size from which the sample size would be determined.

3.6 Data collection methods

3.6.1 Survey

Data was collected using self-administered structured questionnaires. The questionnaire was based on numerical scale and Likert scale and was prepared in accordance with the objectives of the study. The survey questionnaire was administered to the selected 204 men and women rice farmers and it comprised of three sections. This comprised of 104 men and 100 women. The first section sought to establish demographic information of the respondents such as age, period in which the respondents have been practicing rice farming, household head, period of residency in Kirinyaga County and the rice value chain processes that the respondents are involved in. This information was useful because it assisted the researcher create a link between how this demographic information relates to the adoption of CSA practices. The second section sought information that would assist the researcher understand the CSA practices that are currently in use, who performs the identified practices and also sought to identify who makes the decisions around these practices. The third section of the questionnaire collected data on factors affecting the adoption of climate smart agriculture. This was by separating these between the men and women to understand which of the factors affect what gender and to what extent (Appendix 1 was used to collect this data).

3.6.2 Focus Group Discussion

Focus group discussions are group discussions organized to explore a specific set of issues (Kitzinger, 1994). Kitzinger further notes that the group is ‘focused’ in that it involves some kind of collective activity. Focus group discussions were conducted with rice farmers and the

participants in these discussions were eight. This was conducted at the Millers in Ngurubani. The first group comprised of five women and three men and the second group comprised of four women and four men. The researcher opted for mixed groups of FGDs to allow room for participants to give perspectives that give a picture that reflects the views of both men and women. FGDs were also used as a means of triangulating/corroborating findings from the survey questionnaires and key informants. The information sought through the FGDs was to provide more information on gender differentiated roles in rice farming including on allocation of resources, as well as on factors affecting the adoption of CSA practices (The focus group discussion guide Appendix 2 was used to collect the data).

3.6.3 Key Informants Interviews

Key informant interviews are interviews conducted to a select group of individuals who are likely to provide in-depth information and insights, and usually those identified to be knowledgeable on the particular subject (William et al., 2006). The researcher conducted KIIs with agriculture extension officers in Kirinyaga County under the Horticultural Development Authority and this took place in their offices. The KIIs were conducted on the following days; two on 4 October 2019 and one on 7 October 2019. The KIIs were probed for more information on the current CSA practices, the major stakeholders in rice farming in Kirinyaga County as a means to understand the support farmers receive, the role of men/women in rice farming and the influences on resource allocation for rice farming among men and women in Kirinyaga County. This information served as a confirmation of the already existing practices and sought to get the perspective of the KIIs on how rice farming is practiced between men and women. (A KII guide-Appendix 3 was used to collect this data).

3.7 Data collection process and analysis

The data for the study was collected by use of questionnaires, focus group discussions and key informant interviews presented as below. The researcher administered 204 questionnaires and out of those, 115 were returned and thus, 56% of the questionnaires were returned. Out of this number, 55 of the respondents were male and 60 were female. The study initially sought to undertake 4 FGDs but only 2 were conducted. There was a challenge in time constraints and availability of the respondents to due to competing priorities, so the researcher took advantage of the weekly

meetings held to get the respondents for the FGDs. The initial intended number of KIIs was 6 but only 3 KII were interviewed. This is because of the unavailability of these respondents and their numerous postponements. One KII turned down citing reasons of not wanting to be recorded. The findings of the study from the data collected from the questionnaires was analyzed using statistical package for social sciences (SPSS).

Table 3.7.1 Summary of data collection methods

Data collection method	**Planned**	**Actual**
Questionnaires	204	115
Focus Group Discussion (FGDs)	4	2
Key Informant Interviews	6	3

Quantitative data collected was analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics and variance analysis was used to analyze the data. Frequency tabulations were used to analyze the data and establish the characteristics of the population. Pie charts were used to analyze the socio-economic determinants for the adoption of CSA. Variance analysis was chosen because the dependent variable in this study is dichotomous[3]. Fisher's test statistics (F-statistics), Cronbach's Alpha were used to assess the goodness fit of the hypothesis that the adoption of CSA is dependent on certain factors. Qualitative data was analyzed using sub-thematic analysis method whereby the researcher was able to generate information in different areas in terms of information being sought. Results of qualitative data analysis are presented in narrative prose.

3.8 Ethical considerations

The researcher informed by explaining verbally to the respondents of the confidentiality of the information given and that the information was mainly being used for academic purposes and thus, monetary expectations to be limited. Consent was obtained orally from the respondents to be involved in the research. Confidentiality was ensured during data collection through use of pseudo-

[3] One that takes on one of only two possible values when observed or measured

names in cases where verbatim quotes were obtained. Anonymity was observed during the report writing and analyses of the findings from the study and where verbatim quotes have been written, pseudo-names were used. A data collection permit was obtained from NACOSTI license number NACOSTI/P/19/1558 (Appendix 4). The researcher also approached the administration through the Horticultural Development Authority in Kirinyaga and informed them of the intent to carry out research in Kirinyaga County. The researcher shared the NACOSTI copy with them. The researcher aims to share the findings of this research with the research community in Kenya through publishing in academic journals and sites.

CHAPTER FOUR: GENDER IN CLIMATE SMART AGRICULTURE PRACTICES UPTAKE

4.1 Introduction

This chapter attempts to interpret the findings from the study and discusses gender relations in the adoption of CSA practices with reference to rice farming in Kirinyaga Country. The chapter also discusses the results of data analysis from the respondents. The chapter describes the level of impact gender roles has in CSA and analyses the most glaring factors that affect the adoption of CSA practices and highlights to what extent access and control over land, access to agricultural technologies and inputs, access to extension services and information are deemed significant in the adoption.

4.2 Profile of the respondents

Demographics comprise of an array of socioeconomic information that offers a generalization of a particular geographical population. The demographic information collected in this study provided an overview of the population mainly practicing rice farming in order to situate how adoption of CSA practices is taking place.

4.2.1 Age

From the research findings, it was established that out of 115 respondents who returned the questionnaires, 1% were below the age of 26, 23% were between the ages of 26-36, 41% were between the ages of 37-47, 31% were between the ages of 48-58 and 3% were the age of 59 and above. A study conducted by Rasyid et al., (2016) established that the age of farmers was positively correlated with rice farm experience and increased experience and knowledge led to increased technical efficiency). Theoretically, the researcher found out that the respondents were unevenly distributed in terms of age with the higher age brackets recording higher figures than the lower age brackets. Chandra et al., (2013) as cited in Howland et al., (2018) notes that age can contribute to potential negative effects in the decision making for the adoption of CSA practices. Thus, it is important that all age groups are involved in adoption process. This could implicitly indicate that the number of young people practicing rice faming is not as much. Adoption of CSA practices

requires to be at all levels especially because technology innovation is key in CSA. The KIIs provide a recommendation to the researcher on the use of young people for transplanting activities due to the nature of work involved.

Table 4.2.1 Age of respondents

Age	Frequency	Percentage
Below 25 years	1	1%
26-36	27	23%
37-47	47	41%
48-58 years	36	31%
59 years and above	4	3%
Total	**115**	**100%**

4.2.2 Period of residency

The findings of the study established that 3% of the respondents interviewed had been residents of Kirinyaga for a period of 7-10 years, 25% have been residents 11-14 years and 72% have been residents for a period of 15 years and above. Roncoli (2008) as cited in Howland et al (2018) asserts that residency (among other factors) is particularly relevant as it reflects that adaptive capacities are grounded in cultural identities and social relations mediated by community. As a result, period of residency also provides an understanding of the social cultural influences in gender roles and who does what in farming. The findings of this study confirm those cited above as residency provides an understanding of gender differentiated roles stemming from sociocultural practices.

Table 4.2.2 Period of residency

Period of residency	Frequency	Percentage
Below 3 years		
3-6 years		
7-10 years	3	3%
11-14 years	29	25%
15 years and above	83	72%
Total	**115**	**100%**

4.2.3 Period of rice farming

The results of this study established that 10% of the respondents had been practicing rice farming for three to six years while 23% of the respondents had practiced for a period of seven to ten years. 17% of the respondents confirmed to have been practicing for eleven to fourteen years while the majority of the respondents at 50% confirming to have practiced for over a period of 15 years and above. Previous studies have established that the most important factor affecting the level of technical efficiency was farmer experience in rice farming Rasyid, et al., (2016). From this study, we can deduce that if a farmer consistently grows rice, they will increase technical efficiency over time as well as their ability to adopt CSA practices will also increase. One of the FGD respondents stated that:

A famer is easily able to adopt farming practices that respond to climate change if they have been practicing farming over a longer period of time (FGD respondent, male rice farmer).

Table 4.2.3 Period of rice farming

Period of rice farming	Frequency	Percentage
Below 3 years		
3-6 years	11	10%
7-10 years	26	23%
11-14 years	20	17%
15 years and above	58	50%
Total	**115**	**100%**

4.2.4. Head of household

The results of the study revealed that male headed households consisted of 71% of the respondents, 26% consisted of female headed households and 3% indicating the number of households with the sibling as the head. Other previously conducted studies note that household head plays a key role in adoption of CSA practices. According to Quinn (2017), women have for an extended period experienced discrimination and involvement in decision making due to various customary practices that prevent them from contributing to decision-making. Howland et al., (2016) reports

that motivations for adoption of CSA practices vary with the household decision maker. This means that depending on the gains to be realized, the household head could decide whether or not to adopt CSA practices. The findings of this study also bring out the empowerment level of women as decision makers as noted in the empowerment theory where a power balance should be sought between men and women so that neither is in a position of dominance.

Table 4.2.4 Household head

Household head	Frequency	Percentage
Father	82	71%
Mother	30	26%
Sibling	3	3%
Total	**115**	**100%**

4.2.5 Value chain engagement

The findings of the study note that majority of the respondents mentioned to be in more than one value chain process in rice. 92% confirmed to be doing a combination of two or more processes that range from planting, harvesting, husking transportation and storage and wholesale/retail services. From the study, 6% mentioned to be in planting alone and 2% in harvesting only. Value chain integration can generate mutual benefits for smallholder farmers and the business community. World Bank (2018) notes that understanding how women contribute to value chains and taking this into account in the design of supply chain interventions creates value for the farming community and businesses. This is also corroborated by FGDs who mentioned mostly to be performing various functions within the rice value chain such as planting, harvesting and husking.

Table 4.2.5 value chain engagement

Rice farming value chain	Frequency	Percentage

Respondents in more than one rice value chain process (Planting, harvesting, husking, storage/transportation, wholesale/retail)	106	92%
Respondents in planting only	7	6%
Respondents in harvesting only	2	2%
Total	**115**	**100%**

4.3 The CSA practices

The researcher attempted to capture the gender relations in rice farming by looking at the current practices, the dynamics around those who perform these tasks and the decision making on who performs what role, when the role is performed and who makes the decision on the access and control over resources for rice farming. Upon probing on what are some the climate smart agricultural practices that have been adopted in the recent past, the following practices were identified:

Pumping technologies (that is use of generators)-this practice is used to ensure that water flows to the fields especially in larger pieces of farms. 45% of the respondents cited pumping technologies as the most widely adopted CSA practice. This is mainly because of the reducing level of water which is a critical component in rice farming. Rice is mainly planted and retained in the water throughout the growth period. This is mainly practiced by men as they own the generators. Previous studies have asserted that farmers face risks arising from effects of climate hazards and subsequently, challenges of managing risks associated with the (initial) high costs of new technologies adoption whose benefits often only come after several years/seasons of production.

Irrigation was established as a key CSA practice with 26% of the respondents citing it as a key practice in rice farming. Irrigation methods (such as smart irrigation) to ensure that rice fields constantly have water flow seeing that rice is largely dependent on water for growth. Both men and women undertake this practice. KII respondents informed the researcher that irrigation and machine technologies to pump water mainly rely on river sources. River Thiba & Nyamindi were mentioned as the main sources of water for rice farming in Mwea area. This means that if the water levels recede, farmers still require innovative methods to ensure water is still available for rice

farming. Use of **boreholes** was cited by 2% of the respondents, mainly practiced when there a longer periods of drought/delayed rainfall periods and dominantly practiced by women as they regularly use the boreholes for water.

Piping water into farms was established to be critical due to limited availability of water in some periods with 15% citing piping water into farms as a key CSA practice in rice farming. Piping water into farms is also a means to ensure regular flow of water into the farms. This practice is dominantly practiced by women.

Chemical spraying, use of different fertilizers and **use of different seeds** are practiced ensuring rice stays healthy and provides maximum yield. These practices were cited in the research with 2% citing chemical spraying, 1% use of different fertilizers and 3% mentioned use of different seeds. Practices found mainly undertaken by women. Use of different seeds was cited by both men and women. One of the key findings of studies undertaken by UN Agencies on the cost of the gender gap in agricultural productivity for 5 countries notes that female-controlled plots have relatively lower yields because important inputs such as inorganic fertilizer and pesticides are used mostly on male-controlled plots (UN Women et al., 2018).

Intercropping i.e. through planting of other crops e.g. grass(hay) and maize was cited as method of promoting soil fertility and promoting high yields with 6% citing it as a practice-mainly practiced by women. Murray cited Bernier et al. (2013) that a key constraint for women's conservation efforts g lies in lack of access to the necessary agricultural tools and labour needed for the work. This research findings could explain the reason why intercropping is not as widely practiced.

Digging water terraces was also cited as a practice to allow water to flow from canal to farm. Only 1% of the respondents this practice which is mainly undertaken by men. Studies have shown that activities that are more labour intensive were more likely to be practiced by men than women (Jost et al., 2016). Jost also describes that labour intensive tasks were cited by women as a disincentive to agricultural practices. This could explain the reason this practice is dominantly undertaken by men.

KIIs informed the researcher that previously, rice was being planted and retained in the water throughout the growth period. Currently, the rice is grown only up to a period of 3 months in order to save on water due to limited availability and thereafter, it is harvested and dried on land. Water Saving Rice Culture a practice that is use of water on a need basis. From these findings, it is important that climate change is happening and farmers the CSA approach is being used by farmers to combat the effects of climate change through efforts on adaptation, resilience and increasing productivity for increased incomes.

Table 4.3.1 CSA practices

CSA practices	Frequency	Percentage	Gender performing task
Pumping technologies (generators)	52	45%	Men
Irrigation methods (such as smart irrigation)	30	26%	Men and women
Use of boreholes	2	2%	Women
Piping water into farms	17	15%	Women
Chemical spraying	2	2%	Women
Use of different fertilizers	1	1%	Women
Use of different seeds	3	3%	Men and women
Intercropping (planting of other crops e.g grass(hay) and maize	7	6%	Women
Digging water terraces to allow water to flow from canal to farm	1	1%	Men
Total number of respondents	**115**	**100%**	

4.4 Gender roles in rice farming

It is worth noting that majority of the respondents cited women majorly being at the center of performing these CSA practices with 52% affirming that it is women who mainly perform the CSA practices as noted in the table 4.5.1. Respondents cited the following reasons:

Women's availability to perform CSA practices; This response can be explained using the empowerment theory where men allocate tasks to women to perform and often have the ability to influence women and their capacity to exert controls. This is also confirmed in the literature review section of this study whereby Jost, et al., (2016) notes that new tasks that are more labour intensive, such as seem to fall on women, an issue cited by women as a disincentive to changing agricultural practices.

Women are hard workers hence work gets done faster; This finding corroborate the reason women constitute a substantive number of agricultural labour force as noted that they make up almost 50 percent of the agricultural labour force in sub-Saharan Africa (FAO 2011), Their contribution, however, does not translate to agricultural productivity that equates their effort. Policies that ensure agricultural productivity is remunerated according to input are required. One of the FGD respondents stated that:

We boycott working in the field in the event we feel we are not financially benefiting from all the hard work we undertake in the rice fields (FGD respondent, female rice farmer).

Women are mostly at home hence can easily perform these tasks; This was cited by the survey respondents and corroborated by FGD respondents that women are mostly within the homestead and can easily and readily perform these activities that require immediate attention. This response brings in the gender dynamics at the household level where women are expected to take household duties and responsibilities which is translated by men to mean they should be performing on farm tasks. These findings explain the importance of the empowerment framework where women at the conscientization level have an understanding that the gender division of labour should be fair and agreeable to both sides, and not based on the domination of one over the other.

Women plant while men supervise the work; This response corroborates the findings of dominance by men in agency and decision making which lies with them. We can conclude from this finding that the women in this study have not reached the control level where they are fully empowered as explained in the women empowerment framework that seeks a balance of power between men and women so that neither is in a position of dominance. The FGD respondents cited functions such as harvesting, managing the markets, transportation of rice-being engaged by men and this is due to the money management issues. There was a sense that women do not get to decide on expenditures and use of money and sometimes this might influence the interest in rice farming and the adoption of CSA practices.

On the other hand, 37% of the respondents cited that these tasks are performed by both men and women depending on one's availability and also because men are available so as to operate the heavy machinery. FGDs respondents also corroborated these findings.

From the findings, 10% of the respondents cited that men mainly perform the CSA practices reasons being they are stronger and can operate machineries. These results are also confirmed in the literature review section of this paper whereby Jost, et al., (2016) notes that that a shift in climate smart practices requires a consideration of gender roles including in terms of labour roles, income incentives for the adoption among other factors. The findings of the study bring out the fact that women are majorly the agricultural labour force while the decision-making powers on the adoption of CSA practices lie with the men as noted in the findings below.

Table 4.4.1 Gender differentiated roles

Gender performing tasks	Frequency	Percentage
Men	12	10%
Women	60	52%
Both	43	37%
Total number of respondents	**115**	100%

4.5 Allocation of resources

Gendered allocation of resources often has an effect on the extent to which climate smart practices are adopted. From the research, 55% of the respondents cited that decision making on who performs CSA practices and who decides on access and control of resources being the responsibility of the man. Reasons given for this was that men are primarily the head of the households and owners/keepers of the money and finances. 12% responded that it is the woman who makes the decision whereas 30% responded that these decisions are made by both the man and the woman. Those respondents that cited women as the decision makers explained that this is usually the case when the woman is the head of the household.

The respondents who answered that decisions are made by both the man and the woman cited that this is usually the case depending on how helpful the idea is and also depending on one's knowledge of the practice. More so, 63% of the respondents confirmed that the decision maker greatly influences when the CSA practices will be performed. This was explained by the fact that the decision maker often holds the cash resources and therefore, has to have the final say on when

the CSA practices are used. 38% percent responded that the decision maker has little influence on this. Additionally, respondents cited that access and control over the CSA practice has little influence on when practice is used with 66% responding so. 33% of the respondents confirmed that access and control over resources influences to a great extent when the CSA practices is used. These results help explain the rate of adoption of CSA practices and whether the adoption of these practices results in rice farmers being adaptive to climate change. These findings confirm the women's empowerment framework theory noted in the literature review section where women are seen as passive recipients, merely providing the agricultural labour force without necessarily contributing to the decision making over resource allocation. At this level, women are considered not empowered.

There was a slight variation from some respondents with 3% citing that the Rice Irrigation Boards make the decisions on when CSA practices are to be used. The results discussed above are highlighted in the table below.

Table 4.5.1 Decision making

Decision making on who performs tasks/decision making on access and control over the CSA practices identified	**Frequency**	**Percentages**
Men	63	55%
Women	14	12%
Both	34	30%
Others (Identified irrigation boards)	4	3%
Total number of respondents	**115**	**100%**

Extent the decision maker influences when tasks are to be performed	**Frequency**	**Percentage**
1-Not at all	-	
2-Little extent	44	38%
3-Great extent	71	62%
Total	**115**	**100%**

Level of influence access and control has over the CSA practice on when practice is used	Frequency	Percentage
1-Not at all	1	1%
2-Little extent	76	66%
3-Great extent	38	33%
Total number of respondents	**115**	100%

(Source: *Researcher 2019*)

4.6 The socio-economic determinants of CSA adoption.

Adoption of new technologies, innovations or practices take place within a socio-cultural environment and requires key capital inputs such as labour, finances, produced and social capital (Mutoko et al., 2015). Shapiro (2006) as cited in CCAFS (2018) further notes that motivation is a major contributor to the adoption of, or changes in agricultural practices. Motivation is also highly linked to increased food security and improving productivity for an increased income. The study hypothesized that socio-economic factors influence the adoption of climate smart agricultural practices among men and women farmers. Adoption is closely linked to a mix of changes in knowledge, skills and attitudes and that factors such as access and control over productive resources, access to extension services, information and agency in decision making influence CSA uptake. The planning of CSA interventions should be cognizant of diversity if CSA practices and the underlying social norms and attitudes in the adoption. This promotes tailor made strategies for the uptake of CSA (CCAFS, 2018).

The researcher adopted one-way analysis of variance to test the study hypothesis. Since the researcher used multiple Likert questions, Cronbach's alpha was used to measure internal consistency (reliability) for scale. Cronbach’s alpha is most commonly used when assessing the internal consistency of a questionnaire (or survey) that is made up of multiple Likert-type scales and items. Table 4.5 gives reliability statistics with Cronbach’s alpha equals 0.742 suggesting that the items have relatively high internal consistency.

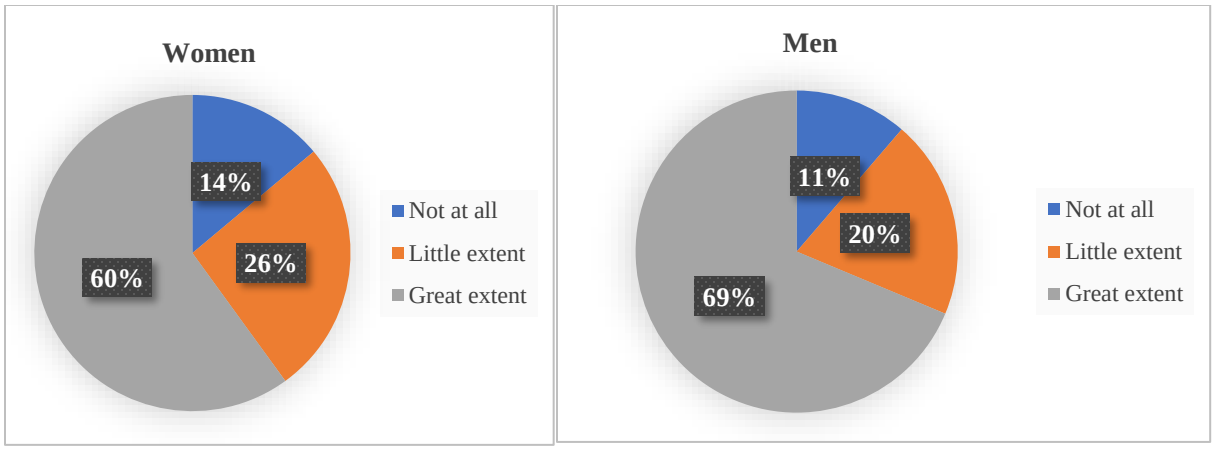
Table 4.6 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.742	.726	7

4.6.1 Access and control over land farm

This was cited as a factor that affects to a great extent for both women and men with 60% of the respondents citing this greatly affects women and 69% responding that this greatly affects men. Empirical literature notes land rights and tenure security underlie differences in productivity between men and women and the adoption of CSA practices. The respondents of the FGDs made emphasis that there are gender differentiated roles in rice farming. The division of labour was found to be mainly because the men own the land and provide the cash inputs for the tractors, or for the animal traction for leveling. Padding, weeding and other activities are performed by the women. The assertion was also corroborated by the KIIs. The study findings note that 26% responded access and control to land affecting women to a little extent and 14% responded not at all whereas 20% responded as these affecting men to a little extent and 11% not at all as indicated below. Land is a critical component in rice farming because rice grows through water retention throughout the growth period. The findings of this study confirm that women's ability to adopt CSA practices is largely dependent on the access and control over land-which in most cases have access to as they are main agricultural labour force but do not decide on the resource dynamics around it. Responses from KIIs confirmed that men are the owners of the fields and most times control the operations of the field and control decision making e.g. in the lands being leased women are often involved when men are unavailable.

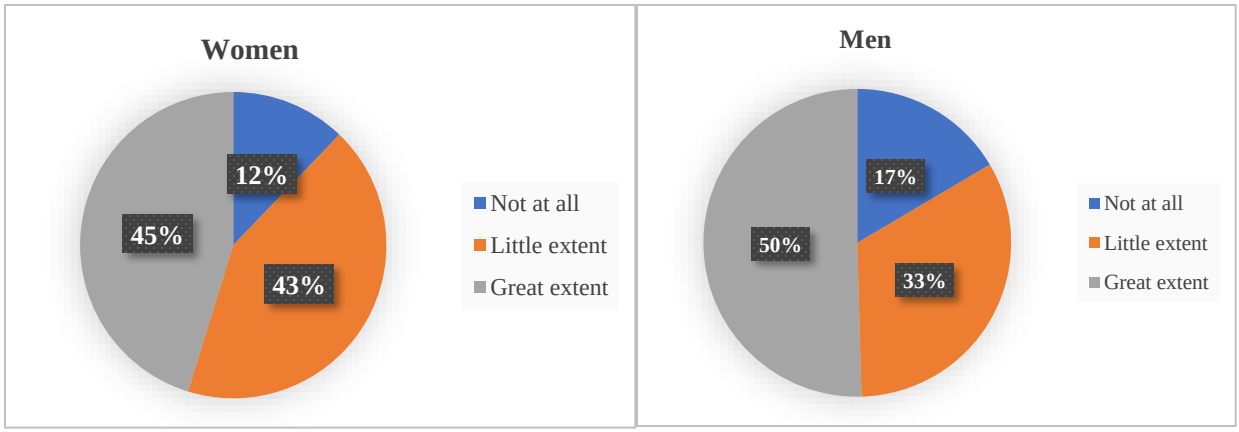
Figure 4.6.1 Access and control over land farm



4.6.2 Access and control over farm tools and equipment

The respondents cited that this affects women with 45% responding to a great extent. The findings revealed that 50% of the respondents cited this as a factor affecting men to a great extent as well whereas 43% responded as affecting women to a little extent and 30% percent responded this affect to a little extent for men. Findings revealed 12% respondents cited women not being affected at all and 17% responded so for men as indicated below. The findings corroborate the findings mentioned in previous section in which the respondents mentioned that it is men who normally operate the farm equipment/technologies and they are the owners of the financial resources. These findings elucidate that men are at an advantage to decide which CSA tools to be adopted.

Figure 4.6.2 Access and control over farm tools and equipment



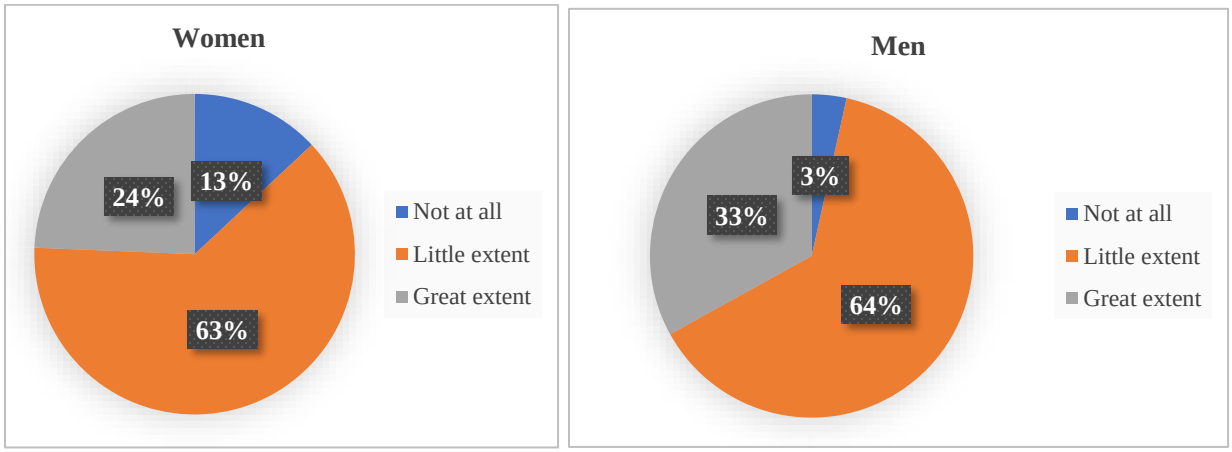
Respondents of the FGDs revealed that accessibility and availability of agricultural technologies is a key issue in rice farming in Mwea. Currently, men are trying to get involved in planting after the introduction of these machineries for weeding which used to be mainly a female practice when it was manual. Furthermore, the large farm machineries services are leased which sometimes affects the interests of the farmers to lease these services depending on their cash availability. The findings of this study support literature that notes that women may lack access to the necessary agricultural tools as well as labour required to efficiently adapt climate smart agricultural practices.

KIIs brought to light differentiated technological practices between small scale farmers and large-scale farmers. KIIs shared on the use of the combine harvesters that are being used to minimize rice wastage as opposed to manual practices previously carried out. The respondents shared that these combine harvesters can only be used for large pieces of land and therefore the harvesters may not largely benefit small pieces of land.

4.6.3 Access to fertilizers and seeds

Respondents noted this affects women to a great extent with 24% confirming whereas 63% responded as affecting to a little extent and 13% not at all. Furthermore, 33% responded as a factor affecting men to a great extent, 63% responded to a little extent with 3% responding not at all as indicated in the figure below. The results also support the responses given by the survey participants on the CSA practices currently in use as very little percentage of the respondents cited fertilizers and seeds being a major CSA practice in rice farming as indicate in the chart below. However, studies note have provided that norms and customs around input use affects producers' decisions and beneficiaries of various innovations. The KII respondents cited a previous practice by the government of air spraying the rice fields, but this was abolished. In addition, birds are a threat to rice farming, and this is mitigated by use of scarecrows. KII respondents informed the researcher that currently the quantity produced by Kenyan rice seeds in an acre in approximately 3 tons. However, this can be improved with other seed varieties. Furthermore, there is controlled water use in the way irrigation and pumping of water to the fields is done. This is due to water shortage. The respondents informed the researcher that a dam is currently underway for development to aid in rice farming.

Figure 4.6.3 Access to fertilizers and seeds

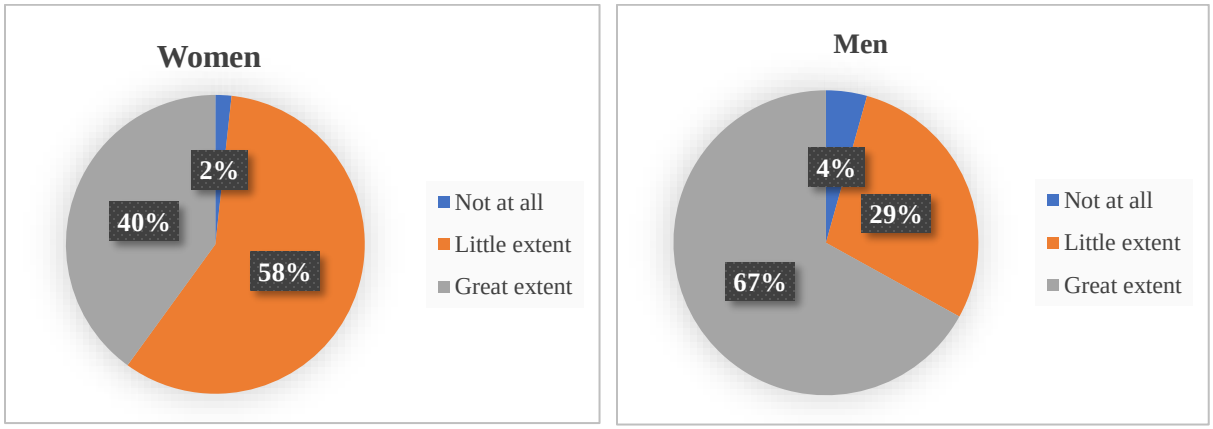


4.6.4 Access to finances and financial services

The study revealed that 40% responded that access to finance and financial service has an influence on women to a great extent whereas 58% responded that the influence is to a little extent and 2% responding not at all. 67% responded that this affects men to a great extent whereas 29% responded to these affecting men to a little extent and 7% responded not at all as indicated the figure below. The respondents mentioned the use of the technologies for farming which are mostly on a hire basis which they sometimes lack cash for hiring. It was also noted that some of the respondents were not aware whether financial services such as the agricultural insurance exists. Furthermore, evidence as noted in the literature review section reports that even though financial services access contributes vitally to the socio-economic well-being of women, it does not automatically empower women. One of the respondents indicated that:

Some practices do not really require huge financial investments. Finding innovating tools easily accessible within the community often serve the purpose. (FGD respondent, male rice farmer)

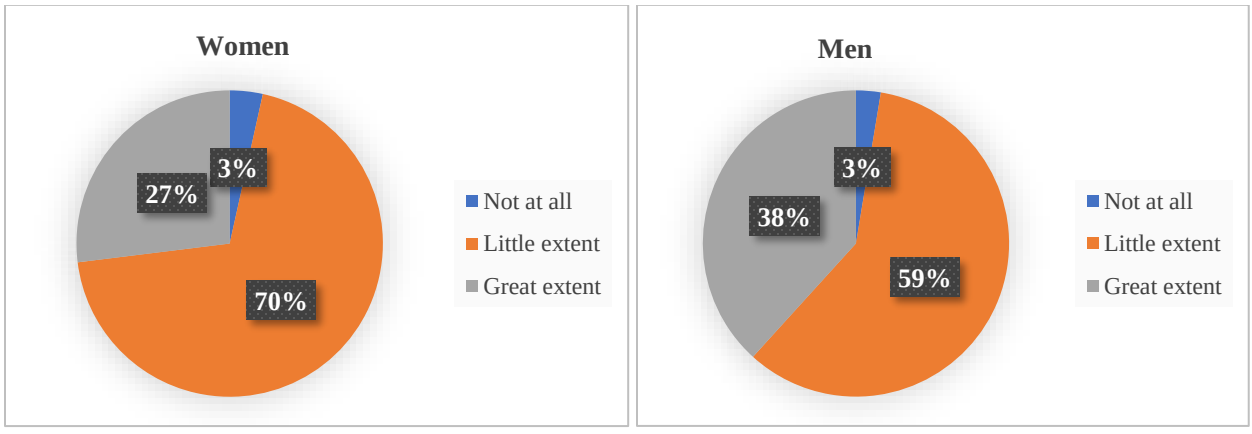
Figure 4.6.4 Access to finances and financial services



4.6.5 Access to information

Based on the research, 27% responded that this affect to a great extent, 70% little extent and 3% not at all. This was almost similar for men with 38% responding that this affects to a great extent 59% little extent and 3% not at all as indicated below. These findings support the evidence that lack of accurate and timely information, including technical advisory services, constrain farmers' ability to assess the risks and benefits of CSA and make informed investment decisions. The KII respondents cited a challenge in policies for rice farming: There are no policies in place currently but previously there used to be a policy that rice could only be sold to the rice boards and only limited rice could be sold. This policy was abolished and now farmers can sell their rice to anyone.

Figure 4.6.5 Access to information

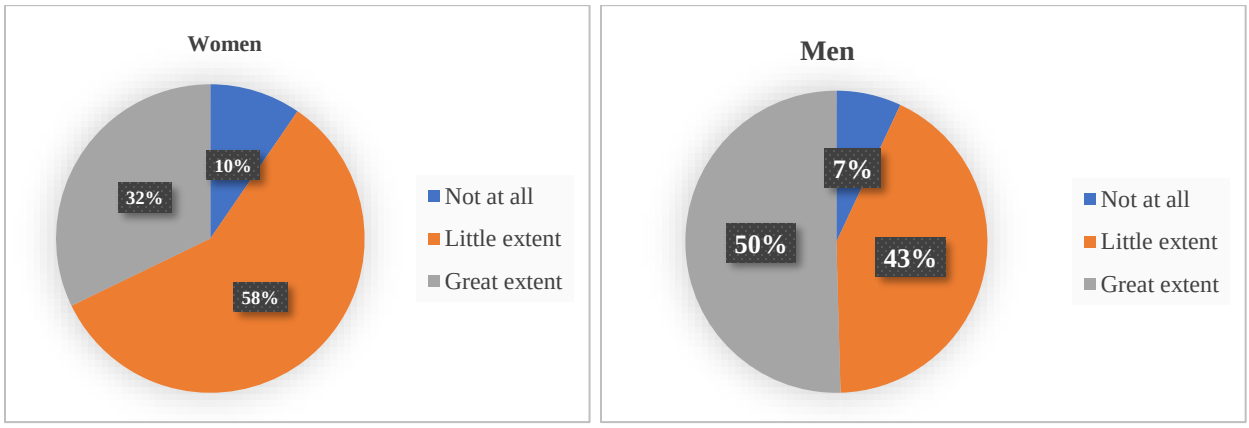


4.6.6 Access to extension services

The respondents cited that this affects women with 32% responding this affects to a great extent, 58% little extent and 10% not at all. 50% cited this affects men to a great extent 43% little extent and 7% not at all as indicated in the figure below. What was observed was that regular meetings are held with the rice farmers and this gives them an opportunity to consult on rice farming practices and access extension services on a regular basis. FGD respondents shared that extension services are provided on a regular basis including on the use of irrigation methods. Previous studies noted in the literature review section notes that effective extension services can accelerate the spread of knowledge about the profitability and risks associated with new technologies.

The key stakeholders identified by the KII respondents for rice farming in Kirinyaga were: Rice Map (who provide capacity building and trainings on agronomy to rice farmers), Mwea Irrigation Board and KALRO. Their functions being to supply and control water, sometimes to purchase from the farmers, to repair the water canals and also produce research around rice. Mwea Irrigation Agricultural Development (MIAD)-contributes mainly to research and also selling and supplying of rice seeds for planting, Ministry of Agriculture within the County provide extension services.

Figure 4.6.6 Access to extension services

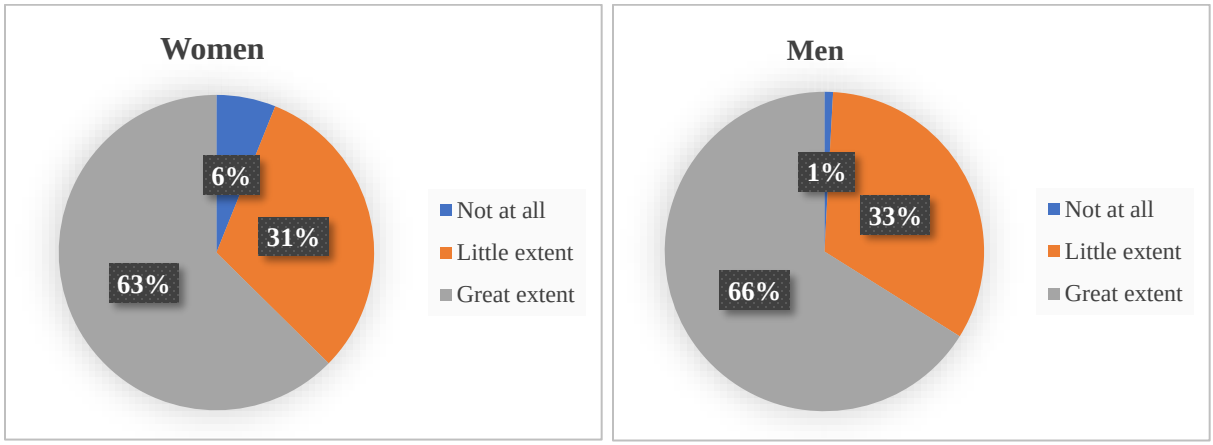


4.6.7 Final decision maker

This was cited as a great influencer for both men and women in rice farming as 63% responded to affecting women to a great extent, 31% to little extent and 6% no extent at all. In comparison, 66% responded to affecting men to a great extent, 33% to a little extent and 1% to no extent at all. This is indicated in the figure below. The decision-making dynamics are also explained in the

paragraphs above where men have the overall decision making on who and when CSA practices are adopted and performed. The findings support the evidence that women farmers may not have the same power as men to make important decisions relating to changing agricultural practices. The FGD responses brought to light that in some cases, women sell rice from the fields-at the field level because the proceeds of the sales done at the markets do not get to their pockets.

Figure 4.6.7 Decision making



4.7 Multivariate Analysis

Table 4.8 illustrates analysis of variance for relationship between socio-economic factors and adoption of smart agricultural practices among men and women. The researcher used Fisher's test statistics (F-statistics) to either reject or accept our null hypothesis. The null hypothesis is that there is no difference between social-economic factors and adoption of smart agricultural practices. F-statistics is the ratio of variance between sample means to variance within the sample means. We do not reject null hypothesis if the probability value (significance level) is less than 5% level of significance. Table 4.8 demonstrate that access/control over land farm, access to farm tools, access to fertilizers, access to information and access to extension services have significant relationship with adoption of smart agricultural practices at 5% level of significance. The finding implies that adoption of smart agricultural practices significantly depends on access to land, access to farm tools, access to fertilizers, access to information and access to extension services. These findings are also supported by the findings under the descriptive statistics.

The study did not establish any significant relationship between having access to loans and agricultural insurance and its influence the adoption of smart agricultural practices since the probability value is 31.5% which is greater than the threshold of 5% level of significance.

Table 4.8 Analysis of variance

		Sum of Squares	df	Mean Square	F	Sig.
Having access/control over to land to farm	Between Groups	25.558	2	12.779	45.894	.000
	Within Groups	30.907	111	.278		
	Total	56.465	113			
Having access/control over to farm tools, equipment, tractors	Between Groups	17.759	2	8.879	30.704	.000
	Within Groups	32.101	111	.289		
	Total	49.860	113			
Having access to fertilizers and seeds	Between Groups	4.774	2	2.387	8.904	.000
	Within Groups	29.491	110	.268		
	Total	34.265	112			
Having access to loans, agricultural insurance	Between Groups	.610	2	.305	1.166	.315
	Within Groups	29.013	111	.261		
	Total	29.623	113			
Having access to information through seminars, farmer group meetings	Between Groups	7.407	2	3.703	17.099	.000
	Within Groups	24.041	111	.217		
	Total	31.447	113			
Having access to extension services	Between Groups	9.759	2	4.879	15.883	.000
	Within Groups	34.101	111	.307		
	Total	43.860	113			

(Source: Researcher 2019)

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The main objective of this study was to investigate gendered differences in the adoption of climate smart agricultural practices with reference to men and women rice farmers in Kirinyaga County. This chapter discusses the summary of the study undertaken, makes conclusions of the findings and gives relevant recommendations.

5.2 Summary of the study undertaken

The objective of this study was to investigate and establish the current climate smart agricultural practices, gender relations in the adoption of these practices and the socio-economic determinants of adoption of these CSA practices among men and women rice farmers in Kirinyaga County. The study established that CSA practices are in use for rice farming in Kirinyaga County. Key practices identified were pumping technologies through use of generators and this is performed by men (45% of the respondents confirmed to be using this practice). It was established that irrigation is also a key practice with 26% of the respondents confirming this. Irrigation is being practiced by both men and women. Piping water into farms was also identified as a key practiced that is performed by women (15% of the respondents confirmed this practice). These findings corroborate those of previous studies such as by Arya, et al., (2018) in which the largest practice found in the study being on the use of pumping technologies to the rice paddies. This means that these practices are significant to support increased productivity for rice farming and contribute to building resilience.

Further analysis established gender differentiated roles in the adoption of CSA practices. The study revealed that women are mostly the ones performing this task with 52% affirming this and 55% of the respondents confirmed that men are the decision makers in regard to adoption of CSA practices, access and control over resources for rice farming. The findings of this study support a previous study by Jost et al., (2016) that CSA practices adoption requires a consideration of gender roles as men and women are adopting differently. From this study, the division of labour was found out to be mainly because the men own the land and provide the cash inputs for the tractors, or for the

animal traction for leveling. Padding, weeding and other activities are done by the women. The study also revealed that women do not decide on expenditures and use of money and this influences their interest in rice farming and the adoption of CSA practices. Power relations play a significant role in determining what practices are to be performed and by who and this was noted in this study.

Further regression analysis revealed that access/control over land farm, access to farm tools, access to fertilizers, access to information and access to extension services have significant relationship with adoption of smart agricultural practices at 5% level of significance. These findings agree with those by Arya, et al., (2018) who note that access to technologies, extension services other information sources among other factors are found to play a crucial role in increasing CSA uptake. The study did not establish any significant relationship between having access to loans and agricultural insurance and its influence the adoption of smart agricultural practices since the probability value is 31.5% which is greater than the threshold of 5% level of significance. This could be attributed to the high-risk nature of agricultural farming which often could result in low output due climate change related issues which in turn affects the farmers ability to repay loans related to agriculture.

5.3 Conclusion

Based on the findings, the study concludes that men and women are aware that climate change is happening and are taking required precaution to adapt and build resilience. There are CSA practices that have been adopted for rice farming in Kirinyaga County. The study also concludes that gender differentiated structures are in place that distinguish who performs what role. From the study findings, there are socio-economic factors affecting the adoption of CSA practices. The findings of the study have challenged previous literature that noted that CSA practices are adopted less frequently by women than men, and financial and resource constraints are cited as the cause (Jost et al., 2013:140). This is because the study did not establish any significant relationship between having access to loans and agricultural insurance and its influence the adoption of smart agricultural practices and confirm that CSA adoption is taking place regardless.

5.4 Recommendations

From the analysis, findings, and discussions of this study, it was found out that access/control over land farm, access to farm tools, access to fertilizers, access to information and access to extension services were found to have a significant relationship with adoption of smart agricultural practices. Cognizant of this, the researcher wishes to make the following recommendations:

- Engagement of local community elders in tackling land tenure security issues especially for women as a way of promoting equal rights for both men and women. This can be done through provision of incentives to promote equitable land allocation especially as it relates to customary beliefs on land.

- Intensified dissemination of CSA knowledge is required for a shared understanding of the position of CSA in climate change adaptation which is critical to promote CSA practices. Regular trainings on adapting and building resilience to climate change, awareness raising on understanding what climate change and localized use of communication tools to promote and share knowledge on CSA so as to encourage increased adaptation to climate change.

- Wider policy and structural reforms that are gender responsive, are needed to enable accelerated CSA adoption in particular, and sustainable intensification in general. This is in particular reference to rice farming.

- Furthermore, inclusion of rice farmers voices (both men and women) in the design of agricultural policies through public participation forums as well as at the validation of policy documents and frameworks. This is especially for policies designed at the County level that cater to the needs of the specific community. This will ensure that the farmers are at the center of policy frameworks.

- Policies that promote an increased income for farmers through input subsidies, regulated government prices taking into consideration use of affirmative procurement policies for marginalized groups are required.

5.5 Recommendation for further research

The study shed light on the intense burden of women to adopt CSA practices and their immense contribution to adapting and building resilience to climate change and recommends that a study be undertaken to determine the effects of the adoption of climate smart practices to health and wellness noting the socio-economic determinants for the adoption of CSA practices. .

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5.0 APPENDICES

Appendix 1: Survey Questionnaire

Section A: Background information

1. What is your age bracket?

   Below 25 years [ ]

   26-36 years [ ]

   37-47 years [ ]

   48-58 years [ ]

   59 years and above [ ]

2. How long have you been a resident in Kirinyaga County?

   Below 3 years [ ]

   3-6 years [ ]

   7-10 years [ ]

   11-14 years [ ]

   15 years and above [ ]

3. Who is the household head in this family?

   Father [ ]

   Mother [ ]

   Sibling [ ]

   Others (specify) …….

4. How long have you been engaged in rice farming?

   Below 3 years [ ]

3-6 years [ ]

7-10 years [ ]

11-14 years [ ]

15 years and above [ ]

5. Tick as appropriate the of rice farming value chain you are engaged in?

   Production [ ]

   Harvesting [ ]

   Husking [ ]

   Storage/transportation [ ]

   Wholesale/retail [ ]

   Whole value chain [ ]

   Others (specify)…….

Section B: CSA practices and gender relations in rice farming

6. With the current climate change trend (long periods of sun, no rains), is there anything you are doing differently as compared to before? Example, use of different rice seeds, irrigation methods, farming machines, use of fertilizers or any other practice?

   ……

   ……

   ……

7. Who between men and women are performing the different practices that have been in use? Why are they performing these tasks? Who decides on who performs these tasks?

   ……

   ……

   ……

8. Between men and women, who decides on when to access and control the identified CSA practices? For example, if it's acquiring farm tractors, buying new seeds, getting extension services, irrigation periods among others.
9. Among the practices/tasks identified in number 6 above, could you please tell us to what extent does the decision maker influence when these CSA practices are to be performed? On a scale of 1-3 where: 1= not at all, 2=little extent, 3=great extent.

Practice identified	**1**	**2**	**3**

10. Among the tasks identified, could you please tell us to what extent access and control over the CSA practices influences when the practice is used? On a scale of 1-3 where: 1= not at all, 2=little extent, 3=great extent.

Practice identified	**1**	**2**	**3**

Section C: Factors affecting the adoption of CSA practices

11. Could you please tell us to what extent do the following factors influence[4] **women** in rice farming in Kirinyaga County? On a scale of 1-3 where: 1= not at all, 2=little extent, 3=great extent.

[4] This is influence in terms of their interest and willingness to participate in rice farming

Constraints	**1**	**2**	**3**
Having access/control over to land to farm			
Having access/control over to farm tools, equipment, tractors			
Having access to fertilizers and seeds			
Having access to loans, agricultural insurance			
Having access to information through seminars, farmer group meetings			
Having access to extension services			
Who makes the final decision on rice farming			
Others (please specify) ……			

12. Could you please tell us to what extent do the following factors influence **men** in rice farming in Kirinyaga County? On a scale of 1-3 where: 1= not at all, 2=little extent, 3=great extent.

Constraints	**1**	**2**	**3**
Having access/control over to land to farm			
Having access/control over to farm tools, equipment, tractors			
Having access to fertilizers and seeds			
Having access to loans, agricultural insurance			
Having access to information through seminars, farmer group meetings			

Having access to extension services			
Who makes the final decision on rice farming			
Others (please specify) ……			

Appendix 2: Focus Group Discussion Guide

Introduce yourself to the group and guide members to know one another. Introduce the topic of discussion and moderate it as guided by the following themes:

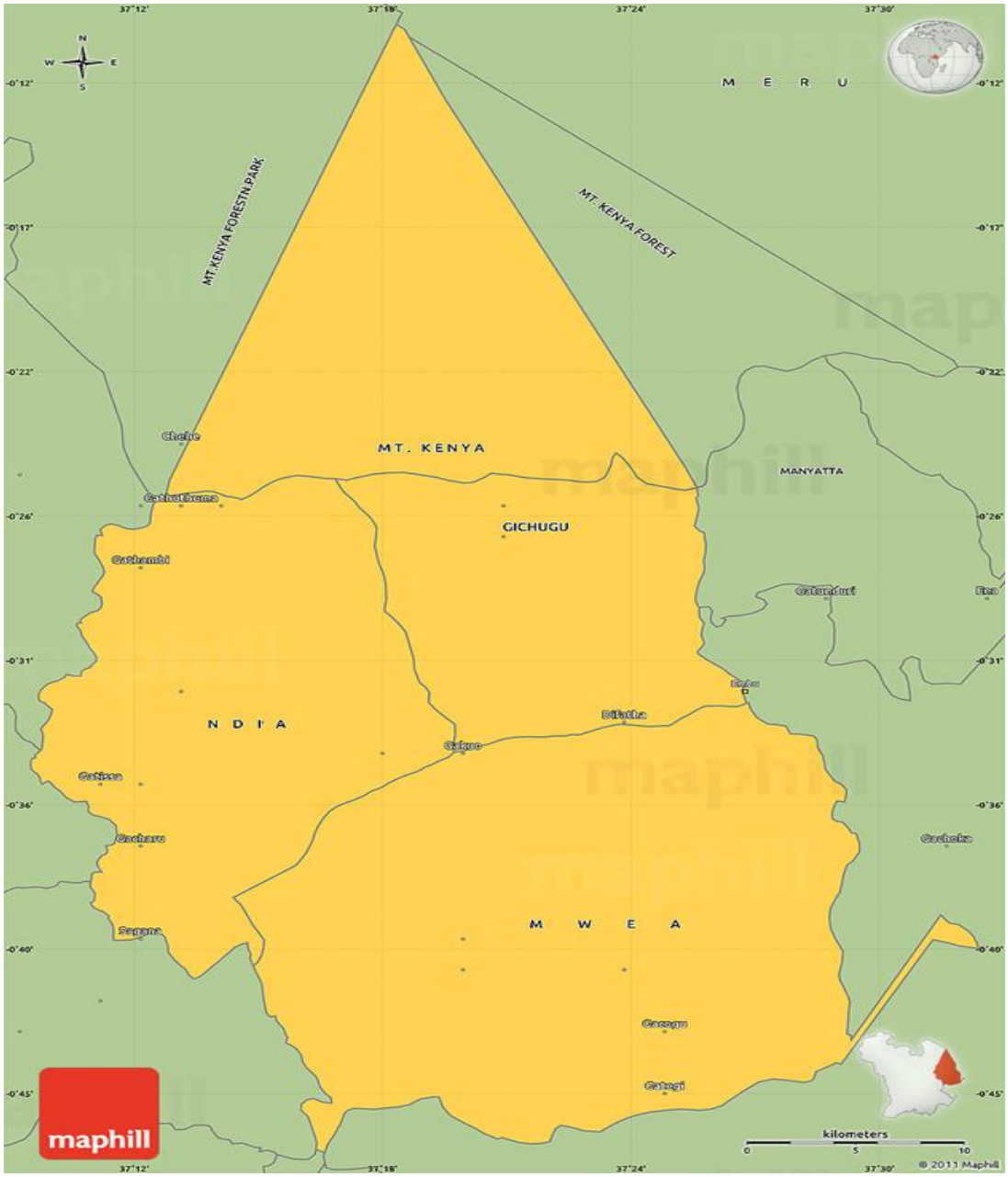
1. Rice farming in Kirinyaga County: How this is practiced, the current CSA techniques in place, who performs these tasks.
2. Gender relations in rice farming
    i. Gender differentiated roles in production, harvesting etc.
    ii. Resource allocation (land, capital etc.)
3. Factors affecting the adoption of climate smart agricultural practices in rice farming
    i. Control over productive assets
        1) Land
        2) Agricultural technologies
    ii. Financial services barriers/credit barriers
    iii. Access to information on practices
    iv. Access to extension services
    v. Agency in decision making
    vi. Policy environment

Appendix 3: Key Informant Interview Guide

Introduce the interview and ask questions as guided in the list of questions below. Probing questions can be asked where necessary.

1. How is rice farming practiced currently in Kirinyaga County? In terms of innovations or adaptations to changing climate.
2. What roles do men/women undertake in rice farming in Kirinyaga County?
3. What influences resource allocation in rice farming among men and women in Kirinyaga County?
4. Are there factors affecting the adoption of climate smart agricultural practices among men and women rice farmers in Kirinyaga County? If yes, which are these factors?
5. How would you recommend resolving these factors?
6. Who are the major stakeholders in rice farming in Kirinyaga County?

Appendix 4: Map of Kirinyaga County



Appendix 5: Research permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 982015

Date of Issue: 19/September/2019

RESEARCH LICENSE

This is to Certify that Ms.. Valentine Waroga of University of Nairobi, has been licensed to conduct research in Kirinyaga on the topic: GENDER RELATIONS IN ADOPTION OF CLIMATE SMART AGRICULTURAL PRACTICES, A CASE OF RICE FARMERS IN KIRINYAGA COUNTY, KENYA for the period ending : 19/September/2020.

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