FACTORS DRIVING THE ADOPTION OF IMPROVED CASSAVA CULTIVARS IN TESO SOUTH, BUSIA COUNTY, KENYA

BY

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DECLARATION

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DEDICATION

This thesis is dedicated to my dad Samuel Obong'o, mum Pamela Obong'o, brother Paul, sister Sheila, aunt Milly, uncle Wilson, other family members and friends for their continued support, encouragement and prayers during the entire study period. I also dedicate this work to the plant breeders who impact the lives of smallholder farmers through the introduction of improved cultivars for sustainable crop production.

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ABSTRACT

Cassava's significance as a food crop is underscored by its ability to thrive in poor soils, withstand drought, and tolerate marginal conditions where other crops might fail. Despite its recognized importance and the introduction of improved cultivars, cassava output in Busia County remains poor. This study analysed the social, economic and institutional factors driving the adoption of improved cassava cultivars among 167 smallholder farmers in Busia County, Kenya. The objectives of the study were to: document the level of adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County; determine the challenges facing cassava production among smallholder farmers in Teso South, Busia County; investigate farmers' perceptions of improved cassava varieties among smallholder farmers in Teso South, Busia County and determine the social, economic and institutional factors influencing the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County. Data was collected from the sampled farmers using a multistage sampling procedure in six wards. A Binary Logit model was used to investigate the effect of the selected social, economic and institutional factors on the adoption of improved cassava cultivars. Majority 127(76.0%) of the respondents indicated that they had not adopted improved cassava cultivars on their farms. A high prevalence of pests and diseases (65.9%) constituted the major challenge. Education level ($p = 0.001$), group membership ($p = 0.001$), and extension visits ($p = 0.007$) are highly significant, with each positively affecting adoption rates. Higher income ($p = 0.010$) also increases the likelihood of adoption. Additionally, gender ($p = 0.045$) and involvement in other farming activities ($p = 0.029$) are significant, indicating that active engagement in farming positively impact adoption. Farmers' perceptions through cultivation techniques, input costs, ease of innovation implementation and farmers' opinions through peer experiences significantly emerged as practical factors driving adoption. The results revealed that the average farm size in Teso South is 2 acres (48.2%), while that set aside for cassava cultivation by households is 0.25 acres (66.4%). To achieve effective adoption in Busia County, it is crucial to develop strategies that create affordable access to improved cassava cultivars. The roles of extension agents, along with a solid understanding of adoption theories, constraints to adoption, and the determinants of adoption, should be integrated into the social system of smallholder farmers through improved institutional support. Policies should be enacted to enhance access to affordable inputs, strengthen extension and farmer groups, promote gender inclusive interventions, and encourage youth participation to improve adoption and productivity in cassava farming. The study acknowledges potential methodological limitations such as recall bias and unobserved confounding variables, which may have implications for the robustness of the findings.

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LIST OF ABBREVIATIONS AND ACRONYMS

CBSD	Cassava Brown Streak Disease
CBB	Cassava Bacterial Blight
CMD	Cassava Mosaic Disease
GDP	Gross Domestic Product
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate Smart Agricultural Project
PEU	Perceived Ease of Use
PRA	Participatory Rural Appraisal
PU	Perceived Usefulness
TAM	Technology Acceptance Model
IPM	Integrated Pest Management
VIF	Variance Inflation Factor

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CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter covers the background of the study, statement of the problem, objectives, hypotheses, significance of the study and scope of the study.

1.2 Background to the Study

Cassava (*Manihot esculanta*) is a South American native that is widely grown in the tropics for its starchy and tuberous roots, which are consumed as food (Parmar *et al*., 2017; Masamha, 2018; Fu, 2021). 800 million people globally eat cassava, making it the sixth most significant food crop (Amelework & Bairu, 2022). In East and Central Africa (ECA), about 200 million people are reliant on cassava production for more than half of their calories, making it the continent's second most important food crop after maize (Cock & Connor, 2021). It is mainly consumed at the household level and is produced by smallholder farmers who own an average cultivated area of less than one hectare (Masamha, 2018).

It is usually intercropped with bananas, legumes, and maize (Mwebaze et al., 2024). Africa's cassava production is over 61% globally, making it the largest producer in the world (Adebayo, 2023). Cassava roots are as well significantly less expensive compared to crops like rice and maize (Mwebaze et al., 2024). Additionally, it is comparatively resilient to seasonal droughts and poor soils making it a perfect crop for food security, especially in times of instabilty like war (Cock & Connor, 2021).

Crop production techniques and technologies are always improving in order to address the issues of rising food demand, environmental sustainability, and shifting climatic circumstances (Gaffney et al., 2019).

Adoption remains a central component of agricultural development, as it determines the extent to which farmers embrace and operationalize innovative agricultural practices (Dessart et al., 2019). Within the context of crop production, adoption can be defined as the decision-making process through which farmers integrate newly developed crop varieties, technologies, or management practices into their existing farming systems (Kangogo et al., 2021). It encompasses both the acceptance and the consistent utilization of innovations aimed at enhancing productivity, profitability, sustainability, or other desirable outcomes in agricultural production.

The adoption of improved cassava cultivars presents several notable advantages, the most prominent being increased productivity (Cock & Connor, 2021). Empirical evidence suggests that improved cultivars often yield significantly higher output than traditional varieties, thereby contributing to increased household income and enhanced food security. Higher yields can also play a critical role in meeting the growing food demands of an expanding global population. By fully exploiting the potential of cassava through the use of improved cultivars, farmers can transform it into a more commercially viable and sustainable crop (Amelework et al., 2021).

The use enhanced cassava cultivars is yet another important advantage by reducing the susceptibility to diseases. The two significant concerns on cassava that might result in significant crop losses are Cassava Mosaic Disease (CMD) and Cassava Brown Streak

Disease (CBSD)(Chikoti & Tembo, 2022). These dangers can however be lessened by creating cultivars that are resistant to certain diseases.

Cultivars that are resistant to diseases protect farmers' investments by reducing the likelihood of crop losses due to CMD and CBSD (Chikoti & Tembo, 2022). In Busia County, the adoption of promoted cassava cultivars such as MH95, MM98, and MM97 can help farmers secure their livelihoods and maintain a reliable source of income from cassava production. Besides the economic gains, these improved cultivars also play an important role in addressing nutritional challenges among households. Ongoing research efforts are focusing on enhancing the nutritional value of cassava to help reduce micronutrient deficiencies that are common in areas where cassava is widely consumed as a staple food (Okwuonu et al., 2021). By breeding selected varieties with higher levels of essential nutrients such as vitamins and minerals, the overall nutritional quality of cassava can be improved (Tize et al., 2021). This improvement has a direct positive effect on the health and wellbeing of people, particularly in communities that rely heavily on cassava as a daily food source. The adoption of such improved cultivars can therefore contribute to better nutrition and help fight malnutrition within the county.

Furthermore, the use of improved cassava cultivars supports sustainable land management. Since high-yielding varieties produce more within the same land area, farmers are able to increase production without clearing additional farmland (Kulkarni, 2024). This practice reduces pressure on natural ecosystems and helps prevent the conversion of forested or marginal lands into agricultural fields. As a result, improved cultivars not only benefit farmers economically but also promote environmental conservation in the long term.

In order to preserve ecological balance and lessen environmental harm, biodiversity and natural resources must be preserved. By using high-yielding cultivars, farmers can lessen the negative environmental effects of agricultural expansion and encourage sustainable agricultural practices (Acheampong et al., 2022). The introduction of improved cassava cultivars is a major step toward a more resilient, sustainable, and productive agricultural system.

Cassava has been widely adopted since it is a staple crop in many regions of the world, particularly in Asia, Latin America, and sub-Saharan Africa (Alene et al., 2018). Its popularity is due to several factors such as its ability to grow in diverse climates and poor soil conditions, its high calorie content, and its versatility as a food source. Millions of people in sub-Saharan Africa rely on cassava as a source of nourishment and income, making it an essential crop for food security (Immanuel *et al*., 2024). It can tolerate drought conditions and adapts well to the region's erratic rainfall patterns. Furthermore, farmers may rely on cassava because of its resistance to pests and illnesses. Cassava is grown as a food crop and for industrial use throughout Asia and Latin America. According to Parmar *et al*., (2017), it is utilized in the manufacturing of starch, flour, animal feed, and biofuels. These areas have a high demand for cassava due to its versatility, affordability, and potential as a raw material for a variety of businesses.

Efforts have been made to promote cassava adoption globally through research and development initiatives, improved varieties, and agricultural practices (Malik *et al*., 2020). These initiatives aim to enhance productivity, reduce post-harvest losses, and increase the resilience of cassava farming systems. Cassava adoption has played a crucial role in

addressing food security, income generation, and economic development in many countries around the world (Inegbedion *et al*., 2020).

Cassava adoption in Africa has been significant due to its resilience and adaptability to diverse climates(Amelework *et al*., 2021). Its drought tolerance and ability to grow in poor soils make it suitable for cultivation in various African regions. The crop plays a vital role in Africa because of its versatility as it can be consumed directly as food, used as livestock feed, or processed into starch and flour for industrial purposes. Despite its importance, farmers still face challenges such as pests, diseases, and significant post-harvest losses. To overcome these obstacles, ongoing efforts in research, improved farming practices, and value chain developments are considered to help in boosting cassava adoption and unlock its potential for strengthening food security and driving economic growth.

Cassava is a critical crop in Kenya, particularly in semi-arid and drought-prone areas where rainfall patterns are highly variable (Opondo et al., 2020). The crop occupies approximately 90,394 hectares and produces an estimated 1,112,000 tons annually, translating to an average yield of 12.3 tonnes per hectare (Munguti et al., 2023). Cassava serves as a major staple food, providing an affordable and reliable source of carbohydrates, while also contributing significantly to rural household income. In addition to the sale of fresh roots in local markets, a growing number of farmers engage in value addition through processing cassava into flour, chips, and starch products that attract considerable demand both domestically and in export markets.

The Kenya Agricultural and Livestock Research Organization (KALRO) has made continuous efforts to develop improved cassava cultivars with enhanced resistance to pests,

diseases, and climatic stresses, aiming to improve productivity and resilience (Rege et al., 2022). However, the rate of adoption of these improved cultivars has remained relatively low, partly due to limited access to planting materials and inadequate dissemination of information.

In Western Kenya, and particularly in Teso South Sub-County, cassava remains an integral component of rural livelihoods, contributing to household income diversification, food security, and employment creation (Mujeyi et al., 2021). In mixed cropping systems, smallholder farmers usually plant cassava alongside vegetables, beans, and maize (Charles et al., 2023; Blomme et al., 2018). This strategy diversifies revenue sources while optimizing land utilization. In addition to being used as a staple food, cassava from this area is extensively processed into a variety of goods, which increases the crop's value. These consist of native foods like "ugali" and cassava flour and chips. Processing cassava increases the crop's value and offers chances to diversify sources of income (Mtunguja et al., 2019). Cassava production in Western Kenya is confronted with several obstacles notwithstanding its significance. Yields can be greatly impacted by diseases such as CMD and CBSD (Navangi, 2021). Other issues facing the industry include limited market opportunities, poor infrastructure for processing and marketing, and restricted access to better planting supplies (Navangi, 2021). Although cassava is currently farmed in the region for subsistence, commercialization and value addition have been prioritized in order to boost consumption and the crop's contribution to the agricultural GDP (Opondo *et al*., 2020). The highly promoted cultivars have various attributes; the MH 95 cassava variety offers high starch content, adaptability to various soil types, and resistance to common diseases like cassava mosaic disease (CMD) and cassava bacterial blight (CBB). It matures

earlier than traditional varieties, produces large uniform tubers, and is ideal for both local consumption and industrial processing. The MM 98 variety is highly drought-tolerant, has high yield potential, and is resistant to several pests and diseases. It reduces the need for chemical inputs, making it sustainable. Its good culinary qualities and high starch content make it appealing for both home use and industrial applications. Additionally the MM 97 variety stands out for its high yield, pest and disease resistance, and early maturity. It also has excellent post-harvest qualities, with a longer shelf life and reduced post-harvest losses, making it suitable for long-distance transport and storage. The Kenyan government has given top attention to cassava enhancement as one of the initiatives being carried out by the Kenya Climate Smart Agriculture Project (KCSAP) to counteract climate change (Okumu, 2021).

1.3 Statement of the Problem

Cassava's significance as a food crop is underscored by its ability to thrive in poor soils, withstand drought, and tolerate marginal conditions where other crops might fail (Simiyu, 2023). Cassava presents a unique potential for adaptation to climate change, which is projected to bring about increased temperatures, altered rainfall patterns, and more frequent extreme weather events, all of which threaten agricultural productivity and food security. Cassava's resilience to these stressors makes it a valuable crop for ensuring food security in the face of climate change. Its capacity to produce high yields in adverse conditions and the ability to be harvested year-round offer stability to farming communities.

Even though cassava is Africa’s most widely grown staple crop, production levels in Busia County remain low despite the introduction of various improved varieties at their disposal (Adjei-Nsiah et al., 2019; Emongor et al., 2023). Although some farmers are aware of the

improved cassava cultivars, there is limited information on the factors that encourage or discourage their use. This mismatch between the crop's potential and its actual uptake presents a practical challenge for many farmers in the area.

The adoption of improved cassava varieties plays a key role in enhancing rural livelihoods and improving household food security, highlighting the need to understand what influences their adoption (Mtunguja et al., 2019). Yet, instead of addressing the root causes of low uptake such as access, knowledge, and farmer perceptions, efforts have mainly focused on breeding of more cultivars. In Busia County, farmers grow several improved types, including MH95, MM98, and MM97 (Emongor et al., 2023). However, the slow adoption of these varieties poses a real threat, as it risks worsening Kenya's already fragile food security outlook. The current high cereal prices create a drive for increased cassava demand in the country, and with the introduction of these new varieties, there was a projection of poverty alleviation among the smallholder farmers in Busia County. It is crucial to note that the factors related to the influence of adopting certain cassava varieties have not been exhausted despite handling some adoption-influencing factors by previous studies. Adoption is still quite low many years after the release of these enhanced cultivars leaving a significant research gap and a pressing need to investigate and address the challenges through comprehensive research and targeted interventions.

1.4 Justification of the study

Cassava is a mainstay food crop for many smallholder farmers in Kenya, and the uptake of improved cultivars has the ability to improve food security and the overall cassava output in the region. By assessing the factors influencing adoption, this study is helping identify

strategies to promote the widespread adoption of improved cultivars and improve food security among smallholder farmers.

The improved cassava cultivars are often more resilient to pests, diseases, and adverse weather conditions, making them a more sustainable option for smallholder farmers. By promoting the adoption of these cultivars, this research adds to the sustainable intensification of cassava production in Busia County, ensuring long-term agricultural productivity and environmental sustainability.

The findings of this study have significant policy implications for agricultural development in Busia County and beyond the county borders. By assessing these factors (social, institutional and economic) policymakers can design targeted interventions to promote the adoption of improved cassava cultivars and support smallholder farmers in the region.

Alongside policy implications, this study fills a knowledge gap in the adoption strategies and contributes to the existing literature on agricultural innovation and technology adoption in smallholder farming systems.

1.5 Objectives

1.5.1 General Objective

The main objective of this study was to analyze the factors driving the adoption of improved cassava cultivars among smallholder farmers in Busia County.

1.5.2 Specific Objectives

i. To document the level of adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County
ii. To determine the challenges facing cassava production among smallholder farmers in Teso South, Busia County
iii. To investigate the perception of cassava innovation technologies among smallholder farmers in Teso South, Busia County
iv. To determine the social, economic and institutional factors influencing the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County

1.6 Research Questions

i. What is the level of adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County?
ii. What challenges do smallholder farmers in Teso South, Busia County, face in cassava production?
iii. How do smallholder farmers in Teso South, Busia County, perceive cassava varieties technologies?
iv. What social, economic and institutional factors influence the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County?

1.7 Significance of the Study

It has been determined that cassava is a traditional crop with great value and significant industrial potential. The government and other interested parties have pushed it in Kenya.

But in spite of all the efforts, cassava has not progressed from a crop used for subsistence to a commercial crop that can be counted on to combat food insecurity (Mbula et al., 2019). The government and other partners have shown that Kenya is capable of producing more metric tons of cassava yearly (Opondo *et al*., 2020). However, the government has observed a decrease in agricultural output, with the annual total of food crops produced on farms falling short of consumption. Achieving household food security has proven to be a challenging endeavor in Sub-Saharan Africa, where population growth has continued and agricultural output has lagged behind (Okello *et al*., 2021).

Understanding the new kinds of cultivars and the reasons for their adoption and use is necessary to maximize the potential of the predicted yearly production. This creates a knowledge gap that should be filled. The potential relationship between the improved varieties and adoption is further explored in this study. This will help achieve the goal of the national cassava policy, which aims to raise living standards and end poverty and starvation by promoting root and tuber crops like cassava. Designing efficient tactics for the dissemination of high yielding cassava might benefit from knowing what influences farmers' preferences for an enhanced variety. The most significant of the various elements that raise agricultural output is improved technology, yet adoption has been extremely difficult in Africa. One of the concerns that must be addressed during the technology adoption process is the degree of adoption. Thus, in order to develop breeding programs and well-informed policies based on the preferences and satisfaction of the farmers, it is imperative that stakeholders and cassava farming households along the value chain sample the factors that determine the adoption of improved cassava varieties. The study has given provision for recommendations on what can be done to promote good cassava production

in Busia County, and could be adopted in other cassava growing areas. In addition to other food crops, this will support sustainable cassava production throughout the county, reducing food insecurity in the face of the country's severe climate changes and lowering poverty rates by empowering smallholder cassava producers economically.

Comprehending the variables impacting the acceptance of enhanced cassava cultivars in Busia County was essential in formulating focused treatments and tactics to enhance their adoption. By considering economic factors, institutional factors, and social factors, policymakers, researchers, and development practitioners can as well develop effective approaches that address the barriers and leverage the opportunities to promote the widespread adoption of improved cassava cultivars. Ultimately, a higher adoption rate can contribute to improving farmers' livelihoods, food security, and the overall agricultural productivity in the region.

1.8 Scope of the Study

The purpose of this study was to investigate the variables affecting smallholder farmers' adoption of improved cassava cultivars. The enhanced cultivars are produced and released by breeders and other suppliers through various organizations to the farmers. The study was carried out in Teso South, Busia County. It entailed a cross-sectional survey of the opinion and perception of cassava farmers on the adoption of the new cassava cultivars in the region.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter highlights the various literatures with relevance to the study. It addresses the concepts of the study, theoretical framework, empirical studies and the conceptual framework.

2.2 Concepts of the study

Adoption of improved cassava cultivars is a multifaceted process that is impacted by institutional, social, and economic variables. The areas that are farmed provide an indication of the extent to which the enhanced cassava cultivars have been embraced. Relevant explanatory variables include social factors (farmer's age in years, size of household, gender, marital status, and education level), institutional factors (membership in farmer groups or cooperatives, access to extension services), and economic factors (access to credit services, market accessibility and the size of a farmer's land. It is believed that each of these variables affects both the possibility and degree of employing a superior cassava variety as well as agricultural productivity.

2.2.1 Cassava (*Manihot esculenta*)

Manihot esculenta is a woody shrub that is a member of the Euphorbiaceae spurge family. It is often referred to as manioc, yuca, or cassava, see Appendix IV. It originates from South America, most especially from Brazil, Paraguay, and some Andean regions. Despite being a perennial plant, cassava is commonly cultivated as an annual crop in tropical and subtropical regions due to its starchy root tuber. Though most cassava is consumed raw, a

significant portion is processed to create tapioca starch, which is utilized in industrial processes, food, and animal feed. Edible coarse flours, such as Brazilian farinha and West African garri, are produced by shredding cassava roots, then squeezing out the moisture and drying and roasting the resulting pulp (Appendix V)

Over 500 million people rely on cassava as a staple meal; it is the third-largest source of carbohydrates in tropical diets, behind rice and maize. It can flourish on poor soils and is remarkably resistant to drought. Thailand is the main exporter of cassava starch, whereas Nigeria is the largest producer of the crop.

There are two types of cassava: sweet and bitter. Both contain toxins, but the amounts in the bitter kinds are larger. Since poorly cooked cassava can be poisonous, adequate preparation is necessary to prevent cyanide poisoning. In times of hunger and food shortages, farmers would occasionally select bitter cultivars to minimize crop losses and as a source of sustenance (Nyamekye, 2021).

2.1.2 Improved cassava varieties

A significant staple crop in many tropical countries, cassava (*Manihot esculenta*) is especially important for food security and economic livelihoods in sub-Saharan Africa. Improving agricultural production and sustainability largely depends on the creation and acceptance of improved cassava varieties. Adopting enhanced cassava varieties is primarily driven by the possibility of yield increases (Appendix VI). According to studies, these enhanced cultivars can yield two to three times as much as traditional types (Cock & Connor, 2021). Higher yields result in higher income for farmers, who then benefit from increased food security and economic stability (Afolami *et al*., 2015). Breeders have

developed the MH 95, MM 98, and MM 97 cassava variety series that are available in Busia County. These varieties offer unique attributes that address specific agricultural challenges. MH 95 cassava variety is known for its high starch content and adaptability to various soil types. The plant typically has a medium height with strong, upright stems that support the plant well, even in windy conditions. The leaves are dark green and lance-shaped, indicative of its health and vigor. The MH 95 cassava type can be identified by its rough brown surface and large, cylindrical roots. The flesh has a creamy white inside, which makes it desirable for processing as well as for domestic usage. In addition to its large, homogeneous tubers, farmers appreciate this variety's robust resistance to common diseases like cassava bacterial blight (CBB) and cassava mosaic disease (CMD). Compared to traditional cultivars, it also has the advantage of having a shorter maturation time, which enables earlier harvests. It is particularly beneficial for industrial uses, such as the manufacturing of starch-based goods like adhesives and sweeteners, due to its high starch content (Okoth, 2023).

In contrast, the MM 98 variety is gaining popularity due to its remarkable ability to withstand drought and its potential for high yields. For farmers facing water scarcity, it is a dependable option because it is especially well-suited to regions with erratic rainfall. This cultivar grows robustly and bushy, with a modest canopy spread. Because of its robust, thick stems, which can reach considerable height, this cultivar needs enough of space between plants. Because of its dark green leaves and frequently well-spaced branches, MM 98 facilitates efficient photosynthesis. The roots of MM 98 are typically big, smooth, light brown, conical, and starchy. The flesh of the tubers are white and high in dry matter, making it ideal for processing into flour or other value-added products. MM

98's resilience to drought conditions ensures that farmers can still achieve reasonable yields even in adverse weather conditions. Additionally, this variety is resistant to several pests and diseases, which reduces the need for chemical inputs, making it a more sustainable option for smallholder farmers. The tubers of MM 98 are known for their good culinary qualities, including a desirable texture and taste, which makes them appealing for both home consumption and local markets (Okoth, 2023). Due to its high starch content, the MM 98 series is highly sought after for use in both food and industrial applications.

MM 97 is an improved cassava variety that stands out for its resistance to a wide range of pests and diseases, including CMD and cassava green mite. MM 97 is a medium-sized cassava cultivar with a more compact growth habit compared to others. The stems are relatively short but strong, supporting an abundant canopy of dark green leaves. The leaves are broader, and the plant has a good balance between foliage and root production. The roots are typically smaller but have a uniform shape, being cylindrical or slightly tapered. The outer skin of the roots is smooth and brownish, with white flesh that is rich in starch. MM 97 is valued for its early maturity and consistent yield, making it popular among farmers seeking shorter growing cycles. This variety is particularly valued for its high yield potential, which can significantly improve the food security and income of smallholder farmers. The early maturity, allows farmers to harvest the crop sooner and potentially grow multiple crops in a year. The tubers of MM 97 have good post-harvest qualities, including a longer shelf life and minimal post-harvest losses, which is crucial for farmers who need to store or transport their produce over long distances (Okoth, 2023).

According to Erenstein et al.,(2022) it is widely recognized that increasing agricultural production to the levels needed to feed an expanding world population requires sharply increased public investment in research and development and widespread adoption of new technologies, but funding for national and international agricultural research has rather declined in recent years. Setting priorities has become more crucial in this scenario in order to divide up limited research funds among conflicting demands and produce bigger effects. The lack of clean planting materials is one of the main obstacles to the adoption of improved cassava cultivars. The adoption of new technologies by farmers might be significantly accelerated by the establishment of effective infrastructure for the production and distribution of these materials. Closing yield gaps, which continue to be a significant problem in many parts of Africa, requires encouraging sustainable soil fertility and crop management techniques. Improved cassava varieties need fewer chemical inputs because they are more resistant to pests and diseases, which could help farmers reduce production costs and benefit the environment (Masinde, 2020).

Having access to extension services is also essential for increasing adoption rates. The knowledge and confidence required to switch from traditional to higher-yielding, disease-resistant cassava varieties are acquired by farmers who get training and resources regarding improved varieties (Acheampong et al., 2022). Through the use of demonstration plots and farmer field schools, certain extension groups are gradually promoting these types.

2.2.3 Management practices of improved cassava cultivars in Busia County

The management practices for cassava cultivars such as MH 95, MM 98, and MM 97 are essentially designed to enhance the yield, quality, and overall performance of the cassava

plants (Okoth, 2023). For the MH 95 cassava variety, good root growth starts with proper land preparation. Deep tilling is recommended since it loosens the soil and allows the roots to spread easily. When planting, farmers usually use stem cuttings about 5–10 cm thick, leaving roughly a meter or more between plants and rows so they have enough room to grow. Weeding should be done early and frequently, especially during the first few months, to reduce competition for nutrients and moisture. Both organic and inorganic fertilizers can be applied, though phosphorus and potassium are particularly important for strong root formation and higher starch levels. Even though MH 95 shows moderate resistance to pests and diseases, farmers still need to watch out for cassava mealybugs and mosaic virus. The roots are generally ready for harvesting between nine and twelve months after planting.

The MM 98 variety performs best in soils with good drainage. To achieve this, farmers often prepare the land by making ridges or mounds before planting. Stem cuttings about 15–20 cm long are planted roughly a meter apart. Like MH 95, frequent weeding in the first few months is essential to help the plants establish. Applying fertilizers that supply nitrogen, phosphorus, and potassium can improve growth and yields. MM 98 is naturally drought-tolerant, but light irrigation during long dry spells can help sustain production. The variety also shows good resistance to most pests and diseases, although farmers are advised to use integrated pest management (IPM) and regularly inspect their fields. Harvesting typically takes place 10–12 months after planting, depending on soil conditions and the desired root size.

For MM 97, the process begins with selecting clean, disease-free stem cuttings about 20 cm long. The cuttings should be planted about a meter apart in both directions on well-

prepared soil to avoid overcrowding and ensure good root growth. Early weeding is important to prevent young plants from being overshadowed or starved of nutrients. While MM 97 is fairly resistant to cassava mosaic virus, it's still wise to monitor the crop and take quick action if pests appear. Mulching helps conserve soil moisture, especially during dry periods, and fertilizers rich in nitrogen, phosphorus, and potassium are recommended to promote better yields.

This cultivar is known for its early maturity, so it can be harvested after about 9-11 months, depending on the environment and management practices applied.

2.2.4 Adoption and innovation characteristics of improved cassava cultivars

The adoption of improved cassava cultivars, particularly in areas where cassava is a staple crop, might be impacted by a number of factors related to both the characteristics of the innovations themselves and the socio-economic background of the farmers (Kundiri *et al*., 2022).

Efforts to enhance food security and improve the profitability of cassava production have led to the development of improved cassava varieties characterized by higher yields, greater disease resistance, and superior processing qualities. These varieties often possess additional advantages over traditional cultivars, including resistance to major pests and diseases such as cassava mosaic disease and cassava brown streak disease, both of which have historically caused substantial yield losses.

Farmers are attracted to improved cassava cultivars due to traits such as enhanced nutritional content, shorter maturity periods, and adaptability to diverse soil conditions

(Cock & Connor, 2021). However, adoption decisions are influenced by more than just agronomic performance. Socio-economic factors such as market demand for cassava products derived from these varieties, the costs of production inputs, and the accessibility of quality planting materials also play a crucial role. For instance, if a new variety produces cassava preferred by processors or consumers for its taste or texture, farmers may be more inclined to adopt it due to the associated income potential (Malik et al., 2020).

The dissemination of information on improved cassava cultivars and appropriate management practices is essential in facilitating adoption. Farmers who belong to cooperatives or have access to agricultural extension services are generally more likely to adopt improved varieties, as these networks provide training, technical assistance, and exposure to innovation (Cafer & Rikoon, 2018). Cultural preferences and long-standing reliance on traditional varieties can also affect adoption rates. In communities where indigenous cassava types are deeply integrated into food systems and cultural identity, resistance to change may occur unless the advantages of new cultivars are clearly demonstrated and aligned with local tastes and practices.

Opportunities for participatory learning, such as allowing farmers to test new cultivars on a small scale, can promote confidence and acceptance. Observing peers achieve higher yields or better market returns often motivates others to follow suit. Field demonstrations, agricultural exhibitions, and peer-to-peer learning forums have proven effective in showcasing the benefits of improved cultivars (Mutegi, 2020). The adoption of improved cassava cultivars is influenced by a dynamic interaction between technological attributes and socio-economic considerations (Peprah, 2020). The success of these innovations in

enhancing cassava productivity and farmer livelihoods depends not only on agronomic improvements but also on the extent to which they address the social and economic contexts within which farmers operate.

2.2.5 Social factors on adoption of improved cassava varieties

Age can influence how farmers adopt improved crop varieties in different ways. Older farmers, who are often more comfortable with traditional practices and have long-standing experience, may be slower to embrace new varieties (Von, 2020). In contrast, younger farmers tend to be more open to innovation and are generally more willing to experiment with unfamiliar cultivars (Ayisi et al., 2022).

Gender also plays a part in shaping adoption decisions. In many communities, men and women take on different roles in both household and farming activities. These differences, together with unequal access to resources, information, and decision-making power, can affect how easily each gender adopts improved cassava varieties (Olaosebikan et al., 2019).

Household size is another factor that may influence adoption. Larger families often have more available labor, which can make it easier to manage new varieties (Martey et al., 2020). At the same time, the greater food needs of such households can encourage the uptake of improved cassava varieties that offer higher yields or better nutritional value (Floro IV et al., 2018).

Adoption of better varieties is highly dependent on education. Higher educated farmers typically have better access to information, are aware of the advantages of enhanced varieties, and are equipped with the know-how and abilities to efficiently manage them.

Farmers with greater education are more likely to use cutting-edge inventions and technology, such as better cassava varieties (Kundiri *et al*., 2022).

Cultural preferences and local food traditions may constrain the adoption of improved cassava varieties. In many communities, there exists a strong attachment to indigenous cassava types due to their familiar taste and cultural significance (Mondo et al., 2019). Farmers who have long cultivated and consumed these traditional varieties often demonstrate a preference for them over newly introduced ones, thereby exhibiting reluctance toward adopting improved cultivars.

Marital status may also influence the acceptability of improved cassava varieties through its effect on resource allocation and decision-making within households. In households where decision-making is shared between partners, adoption outcomes may depend on the dynamics of joint decision-making processes (Shibata et al., 2020). Furthermore, access to and control over household resources by the head of household (HOH) can significantly shape the ability to adopt new technologies.

The influence of these social factors tends to vary across contexts, cultures, and locations. A deeper understanding of such socio-cultural dimensions can enable researchers, policymakers, and development practitioners to design more targeted and context-specific interventions aimed at promoting the adoption of improved cassava varieties among smallholder farmers.

2.2.6 Economic factors on adoption of improved cassava cultivars

Landholding size constitutes a significant economic factor influencing the adoption of improved cassava cultivars. Farmers with relatively larger land areas are often better positioned to allocate portions of their farms for experimentation with new varieties (Stringer et al., 2020). Such flexibility enables them to diversify their cropping systems and compare the performance of improved cassava varieties with the commonly cultivated open-pollinated varieties (OPVs). When improved cultivars demonstrate superior yields or other desirable agronomic and economic attributes, farmers are more likely to adopt them.

Equally important is access to financial capital, which determines the extent to which farmers can invest in improved technologies. Availability of credit or other financial services facilitates the acquisition of essential inputs, including fertilizers, pesticides, and high-quality cassava planting materials (Mondo et al., 2019; Missiame, 2020). Conversely, limited access to financial resources constrains investment capacity and may impede the widespread adoption of improved cassava cultivars.

By obtaining credit, farmers can get past their initial financial obstacles and make investments in better cassava varieties, potentially leading to higher income potential and increased productivity (Acheampong et al., 2022).

The presence of accessible markets for cassava products is crucial for farmers considering the adoption of improved cassava varieties (Mtunguja *et al*., 2019).Farmers need assurance that there is a demand for the improved cassava produce and a readily available market where they can sell their harvest. The market value of cassava products may rise as a result of improved varieties' benefits, which frequently include increased yields, disease

resistance, or better processing features (Ceballos *et al*., 2020). According to Darko-Koomson *et al*.,(2020) farmers are more inclined to adopt enhanced cassava varieties if they have access to markets with better pricing or have established supply networks for these varieties. This is because they may anticipate bigger profits and a higher return on their investment.

Economic forces are frequently interrelated and do not operate in a vacuum. Increased income from improved cassava varieties with higher yields can facilitate farmers' access to financing (Acheampong *et al*., 2022). The commercial viability of growing these types can also be increased by the effective adoption of enhanced varieties, which can open up new markets.

Another significant impediment to adoption is restricted credit availability. According to Afolami *et al*.,(2015) a large number of smallholder farmers lack the capital to purchase improved cassava varieties and the required inputs. Farmers might not be able to afford the switch from conventional to enhanced varieties if they do not have access to credit resources. One of the main obstacles to the adoption of improved cassava cultivars may be their high initial costs. These expenses pay for better seeds, fertilizer, and other inputs required for the best crop performance (Okonkwo et al., 2018). Farmers with lower incomes might find it difficult to afford these expenditures, which would discourage them from utilizing the new varieties.

The adoption of improved cassava varieties may be adversely affected by inadequate infrastructure, such as bad roads and a lack of storage facilities. Farmers may be less financially motivated to adopt improved cultivars due to reduced post-harvest losses and

limited market access caused by inadequate infrastructure (Uzochukwu et al., 2021). The potential for waste and deterioration as a result of subpar storage facilities may also deter farmers.

2.2.7 Institutional factors on adoption of improved cassava cultivars

The adoption of improved cassava varieties can be significantly impacted by institutional factors, such as participation in farmer groups or cooperatives and access to extension services (Donkor, 2024). These components create an atmosphere that motivates farmers to embrace superior cultivars by offering knowledge, experience, resources, and assistance. These institutional factors have improved farmers' knowledge, trust, and adoption of improved cassava varieties. Odhiambo (2018). According to Kondo et al. (2020), farmer groups and cooperatives are essential in encouraging the use of improved cassava varieties, and they have a number of significant effects on the process. These groups serve as effective channels for knowledge dissemination and provide venues for discussing the benefits of improved cassava cultivars. They can set up workshops, displays, and training sessions to educate their members on the advantages of adopting these new cultivars. Farmer groups play a vital role in promoting peer learning and collective progress. When members witness positive outcomes from using improved cassava varieties, they often inspire others to follow suit. This kind of social influence strongly encourages wider adoption. Moreover, cooperatives and farmer organizations promote collective decision-making, allowing members to plan joint purchases and negotiate better prices once there is sufficient interest in the improved varieties. Working together in this way not only simplifies access to planting materials but also reduces the logistical challenges faced by individual farmers.

Farmer organizations also enhance access to essential resources. By pooling funds and securing loans collectively, members can share financial risks and make investments in improved cassava varieties more manageable. This shared approach ensures that even farmers with limited resources can participate. Finally, effective extension services are crucial for providing farmers with information, training, and technical assistance. According to Kwapong et al. (2020), such services are key to encouraging the adoption of improved cassava varieties.

These services give farmers the technical know-how and training they need to grow, care for, and comprehend the advantages of these improved varieties. With this information, farmers are better equipped to see the potential benefits of adopting these varieties, including improved disease resistance, higher yields, and higher profits.

Moreover, extension services often establish demonstration plots and conduct field trials to showcase the performance of improved cassava varieties. When farmers witness the success of these varieties in a practical setting, they are more likely to adopt them. Additionally, extension workers offer customized advice and support tailored to each farmer's specific needs and circumstances. This personalized assistance helps farmers overcome challenges related to pest and disease management, market access, and post-harvest handling, making the transition to improved varieties smoother.

Another significant contribution of extension services is facilitating access to high-quality planting materials for improved cassava varieties. By ensuring that these materials are readily available and accessible, extension services remove a major barrier to adoption, enabling more farmers to benefit from the improved varieties. Extension services greatly

increase farmers' chances of implementing improved cassava varieties through these coordinated efforts, which eventually improves agricultural results. Adoption may be hampered by a lack of knowledge and understanding regarding the advantages and handling of improved cassava varieties. Farmers may be reluctant to alter their long-standing practices if they are unaware of the benefits and appropriate cultivation methods of improved varieties (Owusu-Sekyere et al., 2024). This issue is often exacerbated in remote areas where extension services are limited.

Risk aversion and uncertainty about the performance of improved cassava varieties can be a deterrent to adoption. Farmers may be hesitant to adopt new technologies due to fear of potential crop failure or unfamiliarity with the new varieties. This reluctance is often more pronounced among smallholder farmers who rely heavily on cassava for their livelihoods

2.3 Theoretical Framework

The numerous hypotheses that have contributed to our understanding of adoption were taken into account in this study. Two prominent theories were examined: the adoption-diffusion theory, which has been extensively employed to pinpoint the elements influencing a person's choice to accept or reject an innovation, and the theory of reasoned action, which highlights the significance of knowledge obtained from the information available in adoption of any decision. The researcher used the technology acceptance model to comprehend how individuals choose new technologies in daily life.

2.3.1 Adoption-Diffusion Theory

The theory of adoption and spread of innovations has been extensively explored to pinpoint the elements that affect a person's choice to adopt or reject an innovation (Claudy *et al*., 2015). The traditional adoption-diffusion hypothesis has come under fire for its pro-innovation, victim-blame, and equality-related biases. Adoption-diffusion researchers first discovered adopters' traits that affect the chance of adoption, including socioeconomic position, personality, communication style, and risk tolerance. Adoption-diffusion research has recently centered on the characteristics of innovations and adoption rates. An innovation's relative advantage and observability characterize the short- and long-term financial gains (i.e., profits) from employing it, whereas compatibility, complexity, and trialability show how simple or difficult it is to use.

2.3.2 Theory of Reasoned Action

Social psychologists created the Theory of Reason Action as a collection of connected ideas and claims to comprehend and forecast human behavior (Lopes et al., 2012). According to Quiggin (2012), the theory is one of the "expectancy-value" theories of human behavior and shares many terminology with the widely used subjective expected utility model among economists. The hypothesis is predicated on the idea that people frequently behave logically, as the name suggests. They take into account the information at hand as well as the explicit or implicit effects of their decisions. The premise is that an individual's intention to engage in a behavior ultimately determines that behavior. Unless there are unanticipated circumstances, people are expected to act in a way that is consistent with their goals. This theory is closely associated with information-focused knowledge.

Generally speaking, humans are quite rational beings who use the information available to them methodically.

2.3.3 Technology Acceptance Model

The Technology Acceptance Model (TAM) is a theoretical framework that helps explain how humans embrace and use new technology. The information systems and technology domains make substantial use of TAM, which was developed by Fred Davis in 1989 (Adeoye & Olanrewaju, 2019). The Technology Acceptance Model, derived from an extension of their work, proposes two beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEU), which determine attitude towards the acceptance of new technology. PU is the extent to which an individual believes that utilizing a particular system would enhance his or her productivity at work.

Perceived Ease of Use (PEU) refers to how much an individual believes that using a particular system will require little effort. According to the Technology Acceptance Model (TAM), external factors such as social influence and the availability of support or resources can also shape a user's intention to adopt new technology. In this study, TAM is relevant because it helps explain how cassava farmers view the adoption of improved technologies. Understanding these perceptions can guide researchers in developing technologies that are easier for farmers to apply in their daily activities.

The underlying assumption of TAM is that a person's behavior can be predicted by examining their behavioral intentions. In this context, a farmer's attitude toward technology, its perceived usefulness, and its ease of use all play a role either directly or indirectly in determining whether or not the technology is actually adopted. This study took

adoption diffusion theory into account to evaluate the factors that impact a farmer's choice to accept or reject the use of improved cassava cultivars. The TAM model will aid in the explanation of how, over time, perceptions of a new technology's utility and usability spread among various groups of potential adopters in the context of adoption diffusion theory. As more people adopt a new technology and share their experiences, others may become more aware of its potential benefits and easier to use, which can increase their likelihood of adoption.

Reasoned action theory was applied in this study. A useful foundation for comprehending farmers' decisions to embrace improved cassava varieties, including the MH 95, MM 98, and MM 97 series, is provided by the Theory of Reasoned Action. The TRA emphasizes how attitudes and subjective norms play a significant role in influencing farmers' adoption decisions, emphasizing the significance of both social and cognitive evaluations. Using this knowledge, agricultural stakeholders can create focused interventions that target normative and attitudinal issues, increasing the uptake of better cassava varieties. For adoption rates to rise and agricultural productivity and food security to improve, initiatives to develop supporting subjective norms through community participation and extension services and to foster favorable attitudes through information distribution are essential.

2.3.4 Economic theory of adoption

This theory of adoption, often regarded as the theory of utility maximization, explains how farmers respond to newly introduced technologies (Weersink & Fulton, 2020). According to this theory, a farmer will adopt a new technology if the utility gained from it surpasses that of the existing one. The theory assumes that a farmer or potential adopter makes

decisions based on the satisfaction they expect to derive from the technology. Their choices are influenced by the goal of maximizing expected utility, considering factors such as prices, policies, personal characteristics, and available natural resources.

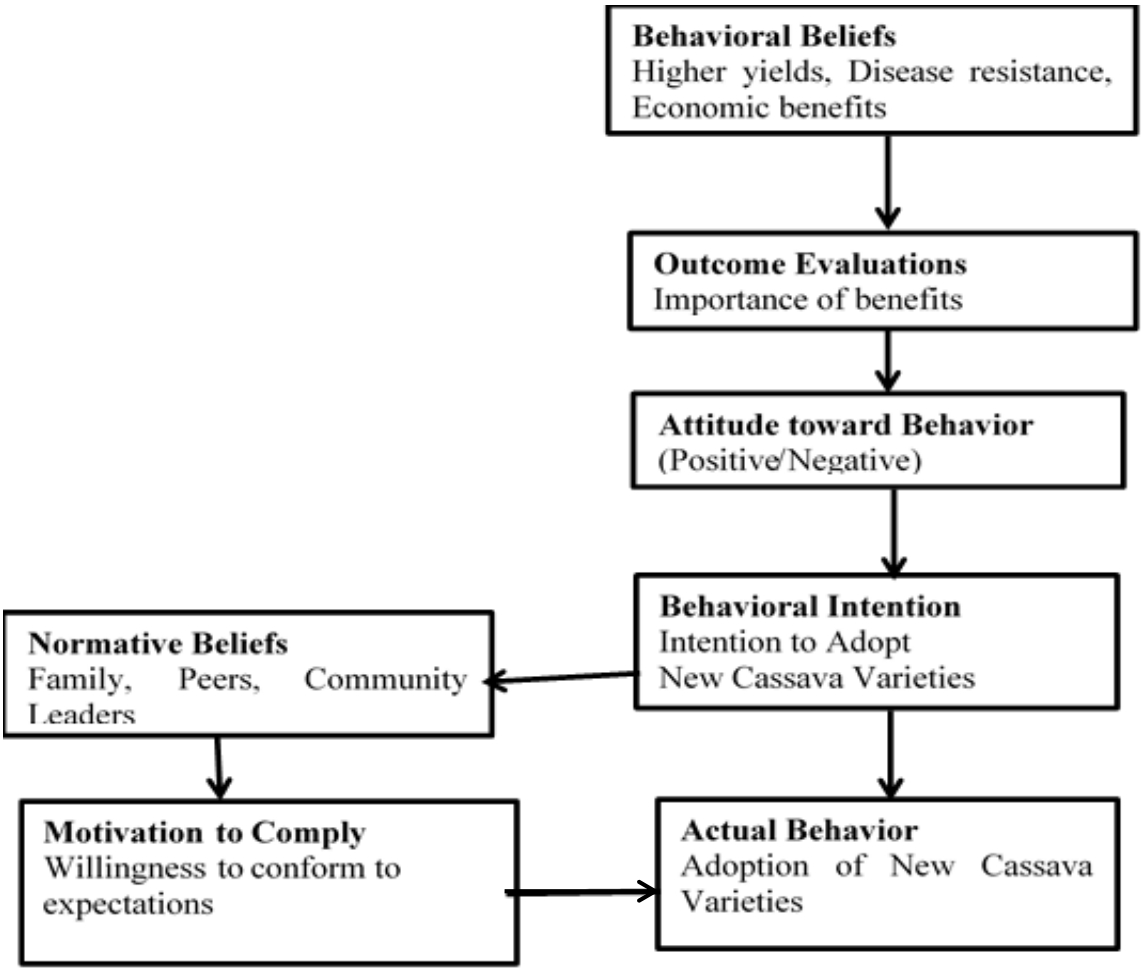

Figure 2.1: Adoption Decisions (Source: Author, 2024)

2.4 Empirical Studies

A number of empirical researches have examined the factors that impact the creation and uptake of enhanced cassava varieties because of the crop's significance in promoting food security across the globe. In order to investigate the factors influencing Nigerians' adoption

of improved cassava cultivars, Alene et al. (2018) used econometric models. This approach uses statistical models to identify the key factors affecting the adoption of improved cassava cultivars. The study was carried out using survey data collected from 450 families in Oyo, Cross River, and Akwa Ibom, Nigeria's three main cassava-growing states. The study's findings demonstrated that a number of factors affect Nigeria's adoption of enhanced cassava cultivars. A few of the most important variables found are farm size, market accessibility, credit availability, education, and information availability. In particular, the study discovered that adoption of improved cassava varieties is positively and significantly impacted by education. This implies that farmers who have received greater education are more likely to use enhanced cassava cultivars. It was also discovered that the adoption of enhanced cassava varieties was positively and significantly impacted by finance availability.

This suggests that farmers are more inclined to adopt better varieties if they have access to credit. It was discovered that the adoption of improved cassava varieties was positively and significantly impacted by information access. This implies that farmers are more likely to embrace better cassava varieties if they are aware of their advantages. The adoption of enhanced cassava varieties is positively and significantly impacted by farm size, according to the study. This suggests that better cultivars are more likely to be adopted by larger farms. Market access was found to have a positive and considerable impact on the adoption of enhanced cassava varieties. This implies that farmers are more likely to adopt improved cassava varieties if they have access to markets for their cassava goods. The study's overall findings suggest that increasing market access, information availability, credit availability, and education can boost Nigeria's adoption of enhanced cassava varieties. The policy

measures intended to encourage the adoption of better cassava varieties in Nigeria and other developing nations will be significantly impacted by these findings.

In order to examine the variables impacting Ethiopia's adoption of enhanced cassava varieties, Asfaw *et al*., (2011)conducted a survey. This method finds the elements influencing adoption through survey data gathering and statistical analysis. 384 cassava growers were questioned as part of the survey, which was carried out in four different parts of the nation. The study applied statistical methods to identify the factors that affect farmers' adoption of improved cassava cultivars. The findings indicated that several elements influenced adoption, including demographic factors such as age, gender, household size, and education level.

According to the study, male farmers were more likely than female farmers to adopt improved cassava varieties. Younger, better-educated farmers with smaller households also adopted improved cassava cultivars more often. Farmers were more likely to use improved cassava varieties if they had access to extension services and knowledge about them. The study suggests that extension services and information dissemination should be strengthened to increase the adoption of improved cassava varieties.

The study also discovered that the adoption of enhanced cassava varieties was significantly influenced by the availability of loans and market knowledge. These varieties were more likely to be adopted by farmers who had access to credit and market knowledge. The study suggests that in order to promote the adoption of better cassava varieties, farmers need be given access to loans and market information. Finally, the study found that farmers'

perceptions of the improved cassava varieties' flavor, yield, and pest resistance affected their adoption.

If farmers believed improved cassava varieties had positive traits, they were more likely to adopt them. The study suggests that efforts should be made to improve the modified cassava varieties' qualities in order to encourage their acceptance. All things considered, the study by Asfaw et al. (2011) highlights the importance of a number of factors in Ethiopia's adoption of improved cassava cultivars. According to the study, measures should be taken to improve market knowledge, credit, extension services, and information access in order to encourage the adoption of improved cassava varieties. The qualities of improved cassava varieties should also be improved.

Onyegbulam et al. (2019) used a qualitative research methodology to investigate the factors influencing Nigerians' adoption of enhanced cassava varieties. This study employed a qualitative approach to examine the factors influencing the adoption of improved cassava varieties. The findings revealed that several interrelated factors contributed to the uptake of enhanced cassava cultivars in Nigeria.

Farmers' perceptions emerged as a critical determinant of adoption. Many farmers chose to adopt improved cassava varieties based on their belief that these cultivars offered superior yield potential, better taste, and enhanced resistance to pests and diseases. The study further established that access to information significantly influenced adoption decisions. Farmers who regularly obtained agricultural information through extension services, radio programs, and agricultural fairs demonstrated higher levels of awareness and were more inclined to adopt the improved varieties.

The availability and accessibility of quality planting materials, particularly clean and disease-free cassava stems, also played a decisive role in adoption. Socioeconomic characteristics such as income, educational attainment, and access to credit facilities further shaped farmers' adoption behavior. Farmers with higher income levels and better education were generally more capable of meeting the financial and technical requirements associated with adopting new technologies.

Market related factors equally contributed to adoption outcomes. Where farmers perceived a strong market demand for cassava-based products such as flour and chips, they exhibited a greater willingness to cultivate improved varieties.

Overall, these findings provide valuable insights for policymakers, extension agents, and other agricultural stakeholders in designing targeted interventions to promote the uptake of improved cassava varieties. The study underscores the importance of participatory rural appraisal (PRA) in identifying context-specific factors that influence adoption among farming communities.

A study by Ouma et al. (2012) used PRA techniques to investigate the factors influencing Kenya's adoption of improved cassava cultivars. The study emphasized how crucial it is to comprehend the elements that impact smallholder farmers' adoption of improved cassava varieties in order to increase that uptake. The results indicated that increasing seed availability, highlighting improved varieties' potential for yield, and raising farmers' knowledge and understanding of the advantages of improved varieties should be the main goals of initiatives to encourage the adoption of improved cassava varieties.

2.5 Conceptual Framework

A conceptual framework is a graphical or diagrammatic model of presentation of the relationship between variables in a study (Mbulwa & Kinyua, 2021). It should be mentioned that it is a hypothesized model that identifies the concepts being studied and their connections. The framework offers a foundation for comprehending how different factors interact to affect adoption. In order to improve cassava adoption and, consequently, production and yield output, this interaction is crucial in raising farmers' awareness. A logical farmer seeks to minimize inputs and maximize output in agriculture. Adoption is the study's dependent variable. The study's dependent and independent variables are conceptualized in the figure, which also illustrates their relationships. The study's independent variables highlight how institutional, social, and economic factors interact to promote the use of improved cassava varieties. These elements influence the adoption process. According to Torres et al. (2013), adoption is the process by which farmers learn different techniques and information about a specific biotech crop and then implement them on their farms. Historically grown crops will have less acreage when a crop is adopted and made popular, or the previous systems will completely disappear. A crop's adoption is subject to a number of uptake pathways and constraints. The idea of induced innovation states that when the population changes, land pressure rises, agricultural product demand rises, and institutional changes intensify land use (Herrero et al., 2014). In order to increase food production and enhance family food security, researchers have been forced to investigate alternatives and create improved cassava varieties due to the worsening climate and increasing food scarcity. When new varieties are introduced, farmers take their time adopting them because they want to compare them to the local varieties they have

been growing. The need for an improved cassava variety is driven by the desired production and consumption characteristics. The maturity periods, storage root yield capacity, disease resistance, ease of preparation, cyanide content, and flavor of boiled fresh roots are the components that make up the desirable bundles. Extension agents and other farmer groups reestablish and convince all of these bundles based on the merits of the promotion.

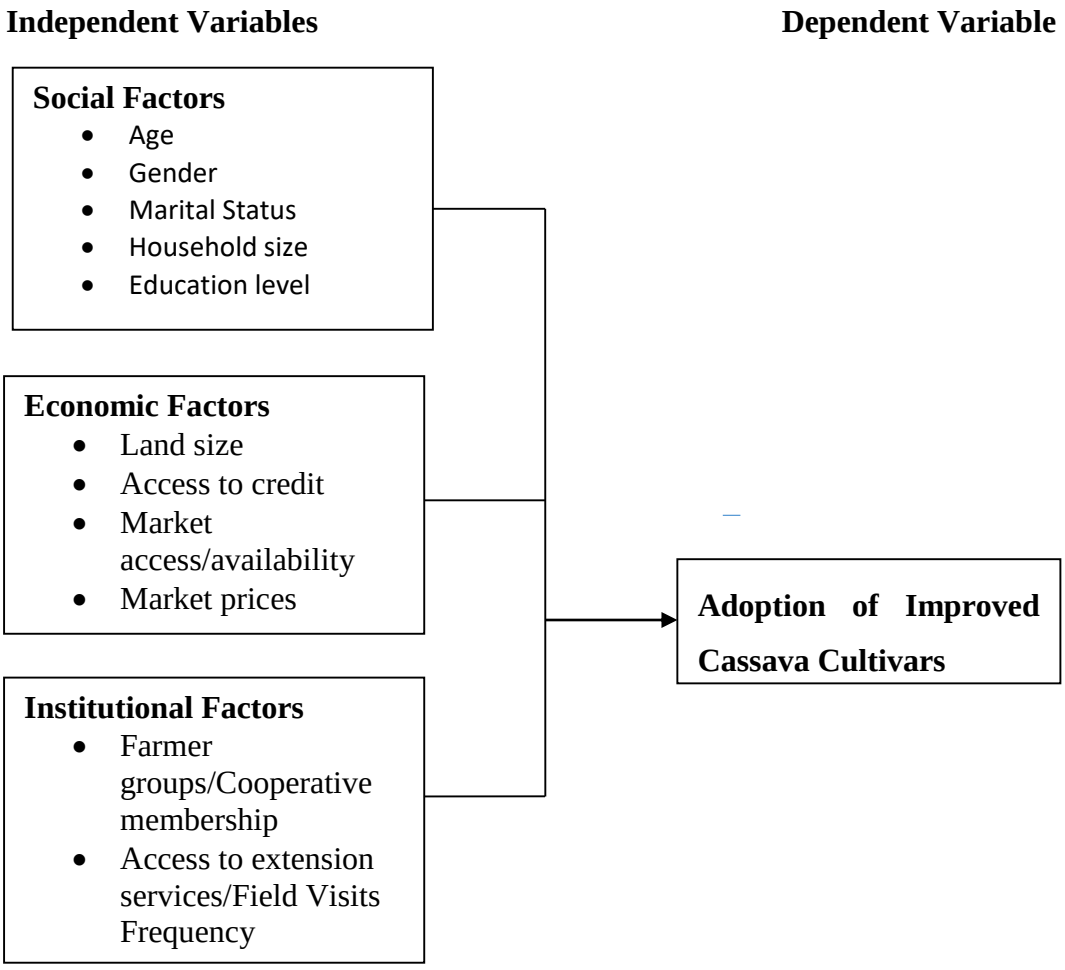

Figure 2.2 Conceptual Framework (Source: Author, 2024)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

This chapter entails the methodology used to arrive at the findings. It focuses on the study area, research design, target population, sample size determination, sampling procedures, model specifications, data analysis the expected output. Research variables, research instruments, validity and reliability and ethical considerations of the study are also discussed.

3.2 Study Area

The study site was Teso South, a Sub County in Busia County. Busia County, located in Western Kenya, shares borders with Kakamega County to the east, Bungoma County to the north, Lake Victoria to the south, and Uganda to the west (Appendix VIII). According to the 2019 census, it has 893,682 residents and a total area of 1,695 km². The county is organized into 7 subcounties and a total of 45 electoral wards, with the headquarters located in Busia town. Amukura West, Amukura East, Amukura Central, Angorom, Chakol North, and Chakol South are the six wards that make up Teso South. Amukura is the main town and the administrative center of the region. Due to the trading opportunities and social amenities it offers, the town draws a sizable population. The majority of the population is still youthful. It lies between an altitude of 1130M and 1500M above the sea level with an average annual temperature of 22 °C, and the average annual rainfall ranging between 750mm and 1800 mm. The majority of the county's soils are sandy loam, however the northern and center regions have dark clay soils. The County's economy is mainly

dependent on rain-fed agriculture, with sugarcane serving as the main cash crop. The study area was selected purposively due to the region's favorable climate, providing optimal conditions for cassava cultivation hence making it a suitable location for studying the adoption of improved cassava cultivars. Additionally, the area is home to a large population of smallholder farmers who depend on cassava as a staple crop, ensuring the relevance of findings to a broader demographic. Moreover, the availability of reliable data on cassava production in the region enhances the study's validity and the potential for the results to be representative of similar agro-ecological zones. The area has been a focus of agricultural development efforts, making it ideal for assessing the impact of interventions like improved cultivars.

3.3 Research Design

Rahi *et al*., (2019) define a research design as a comprehensive method that allows a researcher to incorporate numerous study components in a coherent and logical manner. The study employed an explanatory research design, which is a form of research methodology that investigates and explains the cause-and-effect relationship between variables. It aims to provide a better understanding of the underlying elements that drive a specific phenomenon or behavior. The main goal of explanatory research is to identify and explain the reasons behind observed relationships or patterns. It goes beyond simply describing a situation and aims to uncover the underlying mechanisms or processes that contribute to the observed outcomes. Explanatory research often involves quantitative methods, such as surveys, experiments, or statistical analysis of existing data sets. These methods allow researchers to examine the relationships between variables, test hypotheses, and determine the strength and direction of associations. The researcher was able to

comprehend and validate the results while balancing the drawbacks essential to adopting any other strategy by employing a quantitative research design (Stainton, 2017).

3.4 Target Population

Population is the totality of individuals in question (Tipler *et al*., 2018). The target population for the study comprised of all the smallholder cassava farmers in Teso South Sub County, Busia County.

3.5 Sample Size Determination

A sample size is the number of people included in the study (Malhotra *et al*., 2014). According to Quintiere, (2020), the smaller the population, the greater the sample ratio required for an accurate sample. A Cochran (1977) formula for determining sample size was utilized ;

$$n_o = \frac{z^2\ p(1-p)}{e^2}$$

Where:

e is the desired level of precision (i.e. the margin of error),

p is the (estimated/rounded up) proportion of the population which has the attribute in question,

Z- Standard normal deviation value found in a Z table.

For every 10 households in the region, 9 households are involved in cassava cultivation. Cassava production and utilization is mainly concentrated in the Western regions of Kenya (Mulu-Mutuku *et al*., 2013)

$\frac{1.96^2 * 0.9(1-0.9)}{0.05^2}$ = 138.2976

A total of 139 respondents were selected for the survey.

A percentage of extra respondents were added to the sample size to decrease the margin of error (Levy & Lemeshow, 2013) using the formula;

$$Adjusted\ Sample\ Size = n + \left(\frac{Percentage \times n}{100}\right)$$

Where:

- n is the original sample size
- $Percentage$ is the desired percentage increase

$$Adjusted\ Sample\ Size = 139 + \left(\frac{20 \times 139}{100}\right)$$

The adjusted sample size, with an additional 20% translated to 167. This means that instead of surveying 139 individuals, 167 respondents were surveyed to provide more leeway for potential errors and increase the precision of the results.

Table 3.1: Sampling frame

Ward	Total number of farmers	Sample Size
Chakol South	**15,351**	**36**
Angorom	**13,730**	**32**
Amukura Central	**12,326**	**29**
Amukura East	**11,549**	**27**
Chakol North	**9,450**	**22**
Amukura West	**8,862**	**21**
Total	**71,268**	**167**

3.5.1 Sampling Procedure

A sampling frame was obtained from the sub-county agriculture office's community list of farmers across all six wards. A purposive sampling approach was first employed to identify cassava farming households. From this list, a proportionate sampling technique was utilized to select a sample size, with 36 farmers from Chakol South, 32 from Angorom, 29 from Amukura Central, 27 from Amukura East, 22 from Chakol North, and 21 from Amukura West, as detailed in Table 3.1. The population in various wards were divided into manageable strata and systematic sampling used to select the respondents. Selected individuals were mapped out using geographic locations for spatial independence. Households were assigned serial numbers, and simple random sampling was then used to select the final sample. This approach ensured that every farmer had an equal chance of being included in the sample, thereby enhancing the representativeness of the study. Questionnaires (Appendix VII) were administered systematically, with a single questionnaire given to the head of each selected household, and if absent, to the second in command.

3.6 Model Specification

The likelihood of adopting an enhanced cassava variety as production technology and the many factors impacting it are correlated using the Logit regression model. When researchers analyze outcomes that take only two possible values such as “yes” or “no,” or “adopt” versus “not adopt”, they often use a statistical approach known as the logit model. This model is a type of generalized linear model that relates the probability of a given outcome to a set of explanatory variables through the log-odds transformation.

In essence, the logit model converts the binary response into a continuous variable that spans from negative to positive infinity by taking the natural logarithm of the odds of the event occurring. This transformation allows the relationship between the predictors and the probability of the event to be estimated using techniques similar to linear regression.

The logit model is particularly useful in studies of technology adoption, for example, examining whether farmers decide to adopt improved cassava cultivars. Unlike the Tobit model, which is designed for censored continuous outcomes, the logit model is better suited for situations where the dependent variable represents a simple yes or no decision.

Moreover, the model produces odds ratios that are straightforward to interpret, they indicate how changes in explanatory variables affect the likelihood of adoption relative to non-adoption. Another advantage of the logit model is that it assumes the error terms follow a logistic distribution, which tends to be more robust in the presence of outliers or extreme observations that might otherwise distort the analysis. Because of this, it is particularly suitable for actual agricultural data, which often exhibits volatility. Compared to the Probit model, which assumes that errors are regularly distributed, the logit model is easier to use

and understand in real-world adoption studies. Additionally, it provides more computational simplicity. It involves choosing whether to implement the technology in manufacturing. The Logit model is defined theoretically as:

$$\log_e[P/(1-p)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

Where:

P is the probability of adopting improved cassava cultivars

1-*P* is the probability of not adopting

β_0 is the intercept term (constant term)

E is the error term

β1, β2,… βn are the coefficients for the predictor variables *X1, X2,… Xn*

X1, X2, and *Xn* are the predictor variables that are thought to influence the adoption of improved cassava varieties. The odds of adopting improved cassava variety are calculated as the ratio of the probability of adopting improved cassava variety to the probability of not adopting improved cassava variety. The categorical social and economic characteristics that are assumed to have an impact on the adoption of the enhanced cassava cultivars are among the predictor variables. The coefficients show how much and in which direction each predictor variable affects the likelihood of choosing a better cassava variety. Probability of Adoption is quantified as:

Adopter = any farmer who used at least 10% of their land to produce an improved cultivar; and

Non-adopter = any farmer who uses less than 10% of their land to produce, as used by (Ullah *et al*., 2020)

3.6.1 Specific Social Economic Factors Model

This model includes variables such as age, household size, gender, marital status, education level of the farmer, other farming activities, farmer groups, access to extension services, agricultural credit access, market accessibility, the size of a farmer's land and income level. The equation was modeled as follows:

$$\log_e[P/(1-p)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 \beta_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \varepsilon$$

Age (X_1), Household Size (X_2), Gender (X_3), Marital Status (X_4), Education Level (X_5), Other farming activities(X_6), Farmer groups(X_7), Access to extension services(X_8), Agricultural Credit Access (X_9), Cassava field (X_{10}), Farm Size (X_{11}), Income level (X_{12})

3.7 Data Analysis

According to Kothari, (2004) data analysis is converting unprocessed data into logical knowledge by employing precise analytical procedures and reasoning about the entirety of the data. In documenting the level of adoption and innovation characteristics of Improved Cassava Cultivars, descriptive statistics was used to summarize the data on adoption levels,

categorize farmers; adopters and non-adopters, farm sizes set aside for cassava cultivation and innovation analysis like ease of use.

Descriptive statistics such as frequencies and percentages were used to summarize farmers' perceptions. Logistic regression was used to examine how various factors influence farmers' likelihood of perceiving a practice as beneficial or adopting the innovation. While determining the social factors influencing adoption, logistic regression was used to identify the impact of various social factors on the likelihood of adoption. Correlation Analysis was used to assess the strength and direction of relationships between social factors and adoption rates. Thematic analysis was used to interpret opinions and identify recurring social themes influencing adoption.

The influences of economic factors and institutional factors on adoption were analyzed using logistic regression.

The data was analyzed using version 21 of the Statistical Package for Social Sciences (SPSS). Pearson correlation and regression analysis were utilized as inferential statistics to test hypotheses and determine the significance of relationships between variables. Research variables were evaluated at 5% level of significance.

3.8 Ethical Considerations

The researcher initially sought permission from the University of Eldoret, Teso South Sub County Agricultural office and the National Council for Science, Technology, and Innovation (NACOSTI) (Appendix IX), authorizing the study among farmers and their respective farms. The respondents were made aware of the purpose of the study, its

significance, and the researcher's goal of collecting data from them. Permission was sought from the respondents to voluntary participate in the response of the questionnaire and assurance given on the confidentiality of the recorded data.

CHAPTER FOUR

RESULTS

4.1 Adoption levels of the improved cassava cultivars among smallholder farmers in Teso South, Busia County

The majority of respondents 127(76.0%), reported that they had not adopted improved cassava cultivars in their farms as illustrated in Figure 4.1.

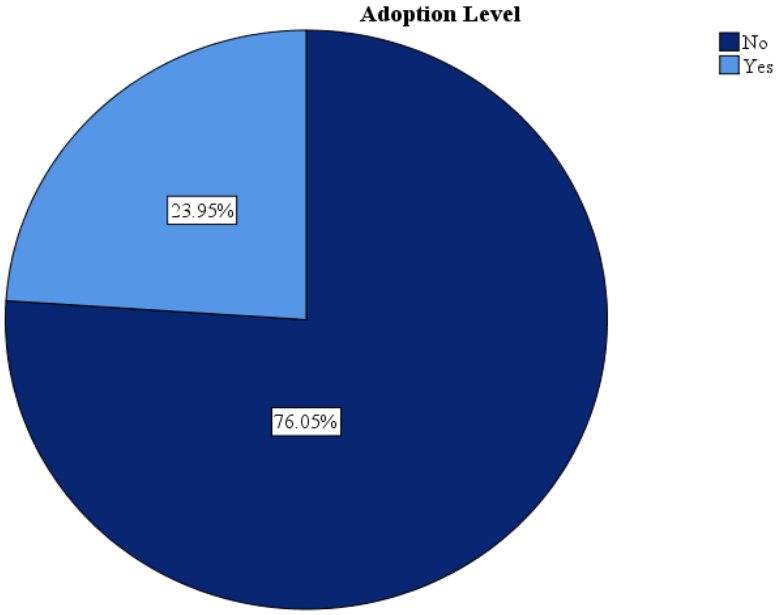

Figure 4.1: Adoption levels of the improved cassava cultivars

4.2 Major challenges faced in cassava cultivation among smallholder farmers in Teso South, Busia County

The major challenges faced in the cassava cultivation by respondents included high cost on inputs 44(26.3%), lack of market for produce 6(3.6%) and, pests and diseases 110(65.9%) capturing the highest percentage as shown in Figure 4.2.

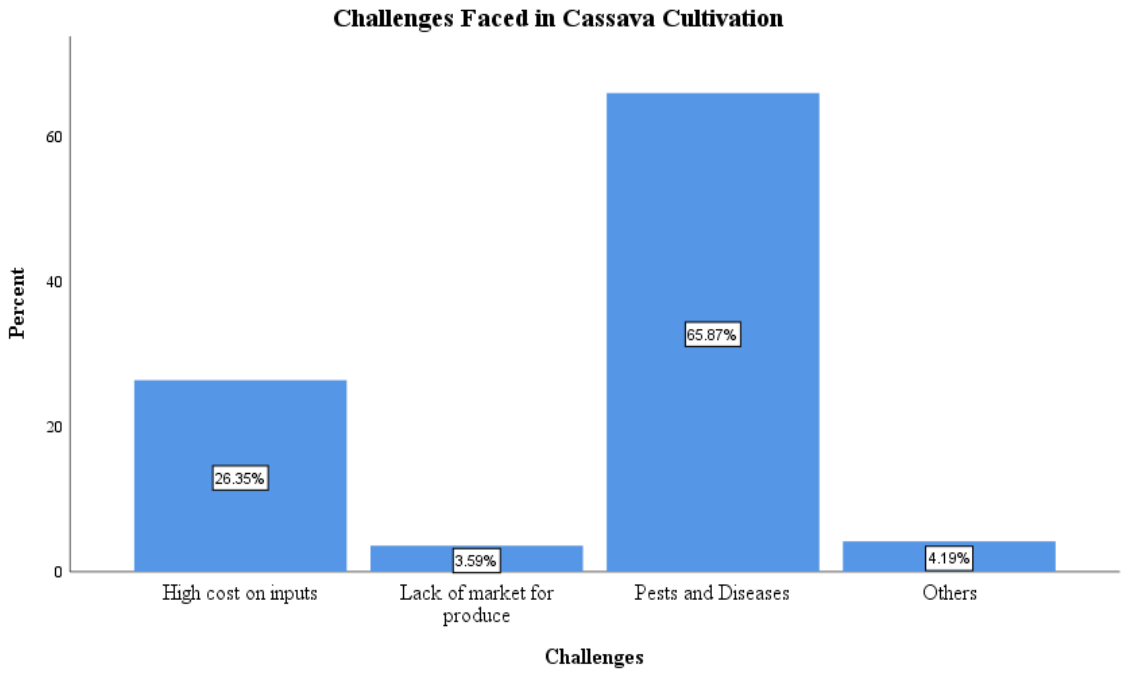

Figure 4.2: Major challenges faced in cassava cultivation

4.3 Farmer perceptions of cassava innovation technologies among smallholder farmers in Teso South, Busia County

When respondents were asked to give their perception regarding the improved cassava cultivars, majority were neutral 124(74.3%) as illustrated in Figure 4.3.

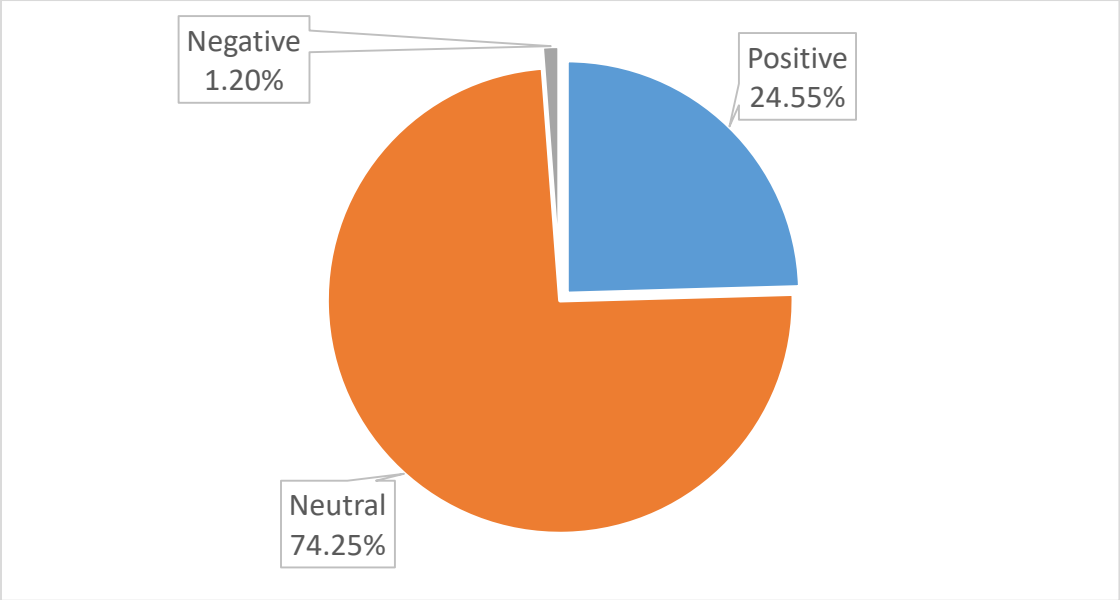

Figure 4.3: Respondents perception on the improved cassava cultivars

When it came to the statement, "I believe that adopting improved cassava cultivars would enhance my cassava farming productivity," the majority of respondents (127) 76.0% were neutral. Seventy six(128) were likewise neutral with the statement that using improved cassava cultivars would be easy for them to implement in their farming practices but 129(77.2%) agreed with the statement that the opinions and experiences of other farmers influence their decision to adopt improved cassava cultivars.

As shown in Table 4.2, the respondent's social status was not regarded as essential indicator 163 (96.6%) in the adoption of an improved cassava cultivar. When asked how important they felt the cost of inputs was in adopting an improved cassava variety, 144 (86.2%) of the respondents said it was very important as shown in Table 4.2. A high proportion of respondents 132(79.0%) indicated they were unfamiliar with the cultivation

techniques that are important for the improved cassava cultivars. This was a great variation from those who indicated that they were very familiar 30(18.0%) with these techniques.

Table 4.2: Farmer perceptions of cassava innovation technologies among smallholder farmers in Teso South, Busia County

Question	Attribute	Frequency	Percent (%)
I believe that adopting improved cassava cultivars would enhance my cassava farming productivity	Strongly Disagree	1	0.6
	Disagree	0	0.0
	Neutrals	127	76.0
	Agree	39	23.4
	Strongly Agree	0	0.0
	Total	167	100.0
I believe that using improved cassava cultivars would be easy for me to implement in my farming practices	Strongly Disagree	0	0.0
	Disagree	0	0.0
	Neutral	128	76.6
	Agree	39	23.4
	Strongly Agree	0	0.0
	Total	167	100.0
The opinions and experiences of other farmers influence my decision to adopt improved cassava cultivars	Strongly Disagree	0	0.0
	Disagree	2	1.2
	Neutral	24	14.4
	Agree	129	77.2
	Strongly Agree	12	7.2
	Total	167	100.0
How important is social status in the adoption of an improved cassava cultivar	Very unimportant	0	0.0
	Important	4	2.4
	Unimportant	163	97.6
	Neutral	0	0.0
	Very important	0	0.0
	Total	167	100
Importance of cost of inputs in the adoption of improved cassava varieties	Very Important	144	86.2
	Important	21	12.6
	Neutral	0	0.0
	Unimportant	2	1.2
	Very unimportant	0	0.0
	Total	167	100.0
How familiar are you with the cultivation techniques for the improved cassava cultivars	Very unfamiliar	0	0.0
	Unfamiliar	132	79.0
	Neutral	0	0.0
	Somewhat familiar	5	3.0
	Very familiar	30	18.0
	Total	167	100.0

4.4 Social characteristics of smallholder cassava farmers in Teso South, Busia County

Gender-wise, 147 (88%) of the participants in the survey were females, and the remaining participants were males. Individuals over 40 years 128(77%) made up the largest portion of the respondents, with the majority falling between the 40 and 50 years age range. Those who were below the age of 30 years represented 4% while those who were above the age of 60 years represented 10%. In terms of family types, married individuals represented the largest portion of the population at 88% as compared to those who were widowed (11%) and singles (1%). For household size, an average family had between 5- 8 people 105(63%) representing the majority while those households with above 8 people represented 13%. Both formal and informal education status was recorded in this study with majority of the respondents having formal education ranging from primary (53%), secondary (27%) and tertiary (5%). When asked if there was any other farming activities carried out for livelihood besides cassava farming, majority of the respondents indicated yes (76%). One hundred and two (61%) of the respondents stated that they had been cultivating cassava for more than 20 years as illustrated in Table 4.3.

Table 4.3: Social characteristics of smallholder cassava farmers in Teso South, Busia County

Demographic characteristic	Attribute	Frequency	Percentage (%)
Respondent's gender	Male	20	12
	Female	147	88
	Total	167	100
Respondent's Age	<30	6	4
	31-40	33	20
	41-50	71	42
	51-60	40	24
	60>	17	10
	Total	167	100
Family Type	Married	148	88
	Single	1	1
	Widowed	18	11
	Total	167	100
Household Size	1-4 people	40	24
	5- 8 people	105	63
	above 8 people	22	13
	Total	167	100
Education Level	No formal education	24	14
	Primary	89	53
	Secondary	46	28
	Tertiary	8	5
	Total	167	100
Years in cassava cultivation	<10	33	20
	11-20	32	19
	>20	102	61
	Total	167	100

4.5 Economic characteristics of smallholder cassava farmers in Teso South, Busia County

4.5.1 Farm size and cassava cultivation

Respondents were asked to indicate the size of the farm they owned in acres (Figure 4.4). From the analysis, majority had approximately two (2) acres of land (48.2%), followed by those who had approximately 1 acre (28.7%) while a few had less than an acre with a significant difference. In cross tabulation, gender, age, marital status and education level did not influence the size of the farm owned by the individuals ($p>0.05$).

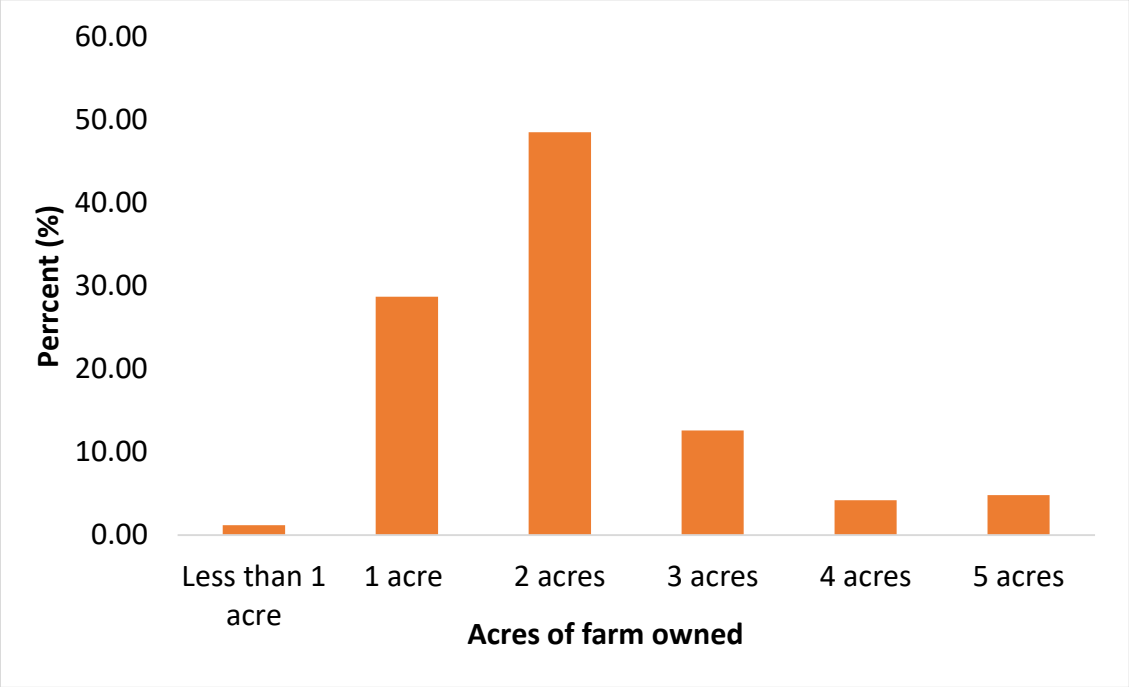

Figure 4.4: Size of the farm in acres owned by respondents

When asked about the size of land used for cassava cultivation by the household, most respondents (66.5%) reported cultivating cassava on 0.25 acres of land or less while a low proportion indicated about 1 acre of land (4.8%) as shown in Figure 4.5. Gender, age,

marital status and education level did not influence the size of the farm set aside for cassava cultivation by the individuals (p>0.05) in cross tabulation. A significant number of respondents also added that they never had any other portions of land rented or leased for cassava cultivation.

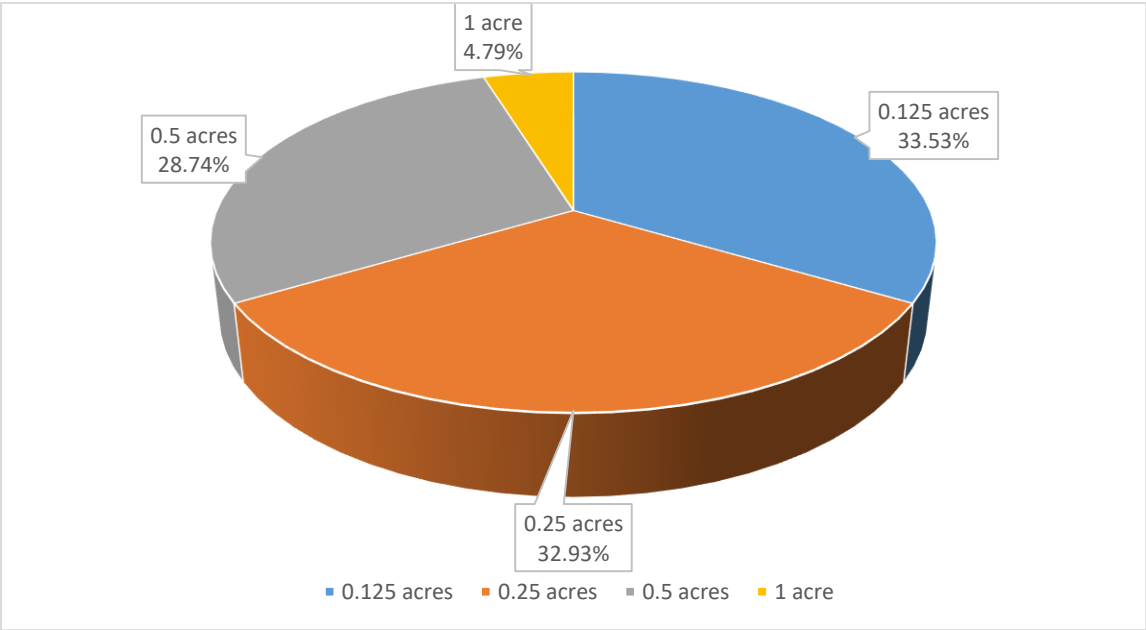

Figure 4.5: Size of the farm in acres set aside for cassava cultivation

4.5.2 Credit services, markets, income and produce purpose among smallholder cassava farmers in Teso South, Busia County

A question about respondents' access to agricultural credit services was posed. A majority of respondents 135(80.8%) said "no," while the remaining respondents said "yes." In cross tabulation the farmers' ability to obtain agricultural finance services was unaffected by their gender, age, marital status, or educational attainment (p>0.05). All respondents expressed dissatisfaction with the accessibility of the cassava produce market. One hundred and ten respondents (65.9%) said they cultivated cassava mostly for their own consumption, the

remaining 6(3.6%) said they produced it purely for sales and 51(30.5) for both purposes. The reasons behind each person's decision to cultivate cassava were unaffected by gender, age, marital status, education level, or the amount of land used for the crop ($p>0.05$) in a cross tabulation. Those who sold their produce added that they did so majorly at the local market 51(30.5%), to the domestic consumers in open air markets or at the farm gate. The other 6(3.6%) noted that they sold their produce to the regional markets through aggregation centers who facilitated the trade network.

Additionally, respondents were asked to estimate the present level of income from cassava production. 51(30.5%) of the respondents, received less than Ksh. 10,000 annually, whereas only 6(3.6%) of the farmers earned a range Ksh. 10,000–50,000 from the sale of their produce with a majority 110(65.9) having no annual income. According to the data, the size of land used for cassava farming affected the amount of money that individuals made from the sale of cassava ($p<0.05$). The income derived from cassava farming significantly influenced the response pertaining to reason for adopting improved cassava variety by the individuals ($p<0.05$) as illustrated in Table 4.4.

Table 4.4: Credit services, markets, income and produce purpose among smallholder cassava farmers in Teso South, Busia County

Question	Attribute	Frequency	Percent (%)
Access to agric. credit services	No	135	80.8
	Yes	32	19.2
	Total	167	100.0
Market accessibility	Very dissatisfied	0	0.0
	Dissatisfied	167	100.0
	Neutral	0.0	0.0
	Satisfied	0.0	0.0
	Very Satisfied	0.0	0.0
Produce purpose	Sale	6	3.6
	Own Consumption	110	65.9
	Both	51	30.5
	Total	167	100.0
Customers	Domestic Consumers	51	30.5
	Cooperatives/Aggregation Centers	6	3.6
	None	110	65.9
	Total	167	100.0
Markets	Local Market	51	30.5
	Regional Market	6	3.6
	National Market	0	0.0
	None	110	65.9
	Total	167	100.0
Current income level from cassava production	<Ksh.10000	51	30.5
	Ksh. 10000-50000	6	3.6
	No Income	110	65.9
	Total	57	100.0

4.6 Institutional characteristics of smallholder cassava farmers in Teso South, Busia County

According to the results in Table 4.5, the majority of cassava farmers (134) 80.2% were not a part of any farmer organization or cooperative, compared to (33)19.8% of them. Regarding the availability of extension services for cassava production, the majority of respondents 125(74.9%) said they did not receive the services. Furthermore, it was established that NGO Staffs 42(25.1%) supplied extension services to the individuals who received the trainings. A sizable majority of the respondents (71.9%) said they were unaware of any government initiatives encouraging the application of improved cassava cultivars. Respondents stated that the primary support expected from the government to encourage the adoption of improved cassava cultivars is input subsidies in terms of cassava cuttings, accounting for 162 (97.0%), whilst others preferred market connections. As shown in Table 4.5, those who had adopted reported that, in contrast to those who had learned through media 18(10.8%) and field extension agents 4(2.4%), they had learned about the new cultivars primarily from other farmers 22(13.2%). One hundred and twenty seven (76.0%) of the respondents reported not to have learnt about these cultivars, forming part of the non-adopters.

Table 4.5: Institutional characteristics of smallholder cassava farmers in Teso South, Busia County

Question	Attribute	Frequency	Percent (%)
Membership to a farmer group or cooperative	No	134	80.2
	Yes	33	19.8
	Total	167	100.0
Access to extension services for cassava cultivation	No	125	74.9
	Yes	42	25.1
	Total	167	100.0
Who are the extension agents	NGO Staffs	42	25.1
	None	125	74.9
	Total	167	100.0
Awareness on any stakeholders/gvt. that promote the adoption of the improved cassava cultivars	No	120	71.9
	Yes	47	28.1
	Total	167	100.0
Support expected from the government to encourage the adoption of improved cassava cultivars	Inputs Subsidies	162	97.0
	Market linkages	5	3.0
	Total	167	100.0
Importance of government support in the adoption of improved cassava cultivars	Very important	34	20.4
	Important	6	3.6
	Not important	127	76.0
How did you get to learn of the new cultivars	Total	167	100.0
	Fellow farmers	22	13.2
	Media	14	8.4
	Field Extensionists	4	2.4
	None	127	76.0
	Total	167	100.0

4.7 Effect of farmer perceptions of cassava innovation technologies on the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County

Among the variables tested, those that significantly influenced the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County included; Cultivation techniques (β=-.148, t=6.886., p<0.001), Impact of yield on adoption (β=0.057, t=3.393, p<0.001), Implementation ease(β=0.434, t=11.240, p<0.001), Opinions of farmers (β=0.004, t=0.425, p=0.001), and Input cost (β=-0.040, t=0.710, p<0.001),as shown in table Table 4.6.

Table 4.6: Effect of farmer perceptions of cassava innovation technologies on the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig.
		Beta	Std. Error	Beta		
1	(Constant)	-1.155	.231		-2.299	.023
	Cultivation techniques	-.148	.021	-.280	6.886	.000
	Yield impact on adoption	.057	.017	.061	3.393	.001
	Implementation ease	.434	.039	.430	11.240	.000
	Opinions farmers	.004	.008	.004	.425	.001
	Input Cost	-.040	.057	-.037	.710	.000
	Social status	-.018	.027	-.006	-.646	.520

4.8 Determinants of adoption

Prior to doing the binary logistic regression analyses, the diagnostic tests for the predictor variables' goodness of fit, heteroscedasticity and multicollinearity were done.

4.8.1 Test for heteroskedasticity

Heteroskedasticity occurs when the variance of the error terms in a regression model is not constant across all levels of the independent variables(Skiera *et al*., 2021). A Breusch-Pagan test for heteroscedasticity that examines whether the variance of the errors depends on the independent variables was carried out. The main aim was to test for the relationship between the residuals of the regression and indicator variables that are hypothesized to be related to the homoskedasticity. The absence of a significant p-value in hat and hatsq indicates that there was no evidence of either linear or nonlinear heteroscedasticity, as demonstrated in Appendix I.

4.8.2 Test for multicollinearity

Multicollinearity occurs when two or more independent variables in a regression model are strongly correlated, making it difficult to isolate the individual effect of each variable (Shrestha, 2020). This problem often leads to inflated standard errors, which in turn reduces the precision of the estimates and makes it harder to identify statistically significant relationships. Although multicollinearity is less of a concern in models that focus mainly on prediction, it becomes important to address when the goal is to interpret the contribution of specific predictors. In this study, the presence of multicollinearity among explanatory variables was assessed using the Variance Inflation Factor (VIF) and the Pearson correlation matrix.

Pearson's correlation matrix test revealed that the highest absolute correlation was -0.509 between Age and Education as shown in Appendix II. Age was considered less critical and removed to reduce multicollinearity. After making adjustments to confirm that multicollinearity had been mitigated without compromising the model's predictive capabilities, the VIF table indicated moderate multicollinearity among several predictors, with the highest VIF being 4.83 and a mean of 3.08 which is moderate and doesn't exceed the common threshold of 5 as presented in Appendix III. As a rule of thumb, if the VIF is greater than 5, then the variable is highly collinear.

4.8.3 Determinants of adoption of the improved cassava cultivars among smallholder farmers in Teso South, Busia County

The analysis reveals several significant variables influencing the adoption of the improved cassava cultivars. Education is highly significant ($p = 0.001$), with higher levels of formal education strongly associated with increased likelihood of adoption. Similarly, group membership or cooperation shows a significant positive effect ($p = 0.001$), indicating that participation in cooperative groups substantially enhances the probability of adoption. Extension visits are also highly significant ($p = 0.007$), suggesting that more frequent visits from extension services are linked to higher adoption rates. Income ($p = 0.010$) plays a critical role, with higher income levels significantly increasing the odds of adoption. Additionally, other farming activities ($p = 0.029$) and gender ($p = 0.045$) are significant at the 5% level, implying that more involvement in farm-related activities and being of a certain gender (likely male) positively influence adoption as displayed in Table 4.7.

Table 4.7: Determinants of adoption of the improved cassava cultivars among smallholder farmers in Teso South, Busia County

Adopted	Coef.	Std.Erorr	t-value	p-value	[95% Conf.	Interval]	Sig
Gender	12.213	15.245	2.00	.045	1.058	141.027	**
Marital S.	1.031	.384	0.08	.935	.497	2.14	
H/H Size	1.04	.134	0.31	.759	.809	1.338	
Education	12.507	9.192	3.44	.001	2.961	52.815	***
F. Activities	16.851	21.857	2.18	.029	1.326	214.142	**
Farm Size	1.926	1.487	0.85	.396	.424	8.752	
Cassava Field	3.198	2.163	1.72	.086	.849	12.042	*
Agric Credit S.	3.328	2.698	1.48	.138	.68	16.302	
Income	13.823	14.154	2.56	.01	1.858	102.848	**
Group/Coop	13.886	11.373	3.21	.001	2.789	69.139	***
Extension V.	9.859	8.392	2.69	.007	1.859	52.287	***
Constant	0	0	-3.62	0	0	.004	***
Pseudo r-squared		0.675	Number of obs			167	
Chi-square		124.076	Prob > chi2			0.000	
Akaike crit. (AIC)		83.800	Bayesian crit. (BIC)			121.216	

**** p<.01, ** p<.05, * p<.1*

CHAPTER FIVE

DISCUSSION

5.1 Adoption levels, challenges facing cassava production and farmer perceptions of innovation technologies of improved cassava cultivars among smallholder farmers in Teso South, Busia County

From the study, majority of respondents (76.0%) have not adopted improved cassava cultivars suggesting significant barriers to the adoption of agricultural innovations in the community. The major challenges reported to be affecting cassava production by the respondents were the high cost of inputs (26.3%), lack of market for produce (3.6%), and the high prevalence of pests and diseases (65.9%). These provide insights into the factors limiting or promoting the adoption of improved cultivars depending on farmer perceptions and interactions with these varieties.

The high cost of inputs, such as improved planting materials, is a common barrier in many rural agricultural settings. Studies have shown that when farmers perceive the costs of adopting new technologies to be too high relative to their expected benefits, they are less likely to adopt them. This aligns with findings from other regions where financial constraints significantly hinder the uptake of improved agricultural practices (Kernecker *et al*., 2020 ; (N. M. Thompson et al., 2019).

The lack of market access is another critical factor. When farmers are uncertain about their ability to sell their produce at profitable prices, they may be reluctant to invest in new or improved cultivars. This is consistent with previous research indicating that access to

reliable and profitable markets is crucial for encouraging the adoption of new agricultural technologies (Ruzzante *et al*., 2021)

The most significant challenge identified to be affecting cassava cultivation is pests and diseases (65.9%). Pests and diseases continue to pose a major constraint to cassava production. Previous research indicates that infestations such as the cassava mealybug, and diseases including cassava mosaic disease and cassava brown streak disease, can cause extensive crop damage and substantial yield reductions (Chikoti & Tembo, 2022; Orek, 2024). These challenges may discourage farmers from adopting improved cassava cultivars, particularly when they perceive the new varieties as insufficiently resistant or when they lack the capacity to implement appropriate control measures. Nevertheless, recurrent pest and disease outbreaks may also serve as a catalyst for the adoption of improved cultivars. Farmers who have experienced significant losses due to these biotic stresses may be more inclined to adopt varieties that are believed to offer enhanced resistance. Consequently, effective promotion and demonstration of the resilience of improved cassava cultivars could encourage a shift from traditional to improved varieties among smallholder farmers. The possibility for higher yields, fewer crop losses, and perhaps lower costs associated with managing pests and diseases may exceed the perceived dangers of adopting new agricultural practices. This dilemma may lead to increased collaboration and information sharing among farmers. As they search for solutions to these common problems, farmers might be more likely to consult with agricultural extension agencies, go to training sessions, or learn from the experiences of early adopters in their region. The fact that most respondents (74.3%) had a neutral opinion of enhanced cassava cultivars raises a number of questions about how they feel about these agricultural

advancements. A neutral position can suggest that many respondents don't know enough about the improved cassava varieties. It is possible that they were not exposed to these cultivars enough to develop a strong opinion either positive or unfavorable. This could point to a gap in extension services or information dissemination, where farmers are not adequately informed about the potential benefits, characteristics, and management of these improved varieties echoing findings by Nderitu (2020) on adoption of improved cassava processing technologies among farmers. Farmers might be as well uncertain about the actual benefits of adopting improved cassava cultivars. They may have heard about these varieties but are unsure whether the promised advantages, such as higher yields, pest resistance, or better marketability, will materialize in their specific farming conditions. Some farmers may respond cautiously or remain neutral when faced with uncertainty about new agricultural technologies. This hesitation often stems from mixed experiences in the past. For instance, farmers who previously struggled with improved crop varieties, perhaps due to pest infestations, diseases, or disappointing yields, may view new innovations with skepticism (Lockie et al., 2020). Their attitudes are therefore neither fully supportive nor entirely opposed to adopting improved cultivars. In addition, deep-rooted sociocultural traditions can shape perceptions; in communities where conventional farming practices are valued, farmers may be reluctant to depart from long-held methods or to express strong opinions that challenge local norms (Kernecker et al., 2020). Moreover, practical challenges such as high input costs, limited access to markets, and persistent pest problems may further dampen enthusiasm, leading to a more indifferent or neutral stance toward these innovations. Farmers may believe that these outside obstacles will keep them from benefiting even if cultivars are improved.

One hundred and twenty seven respondents, representing 76.0%, neither agreed nor disagreed with the notion that adopting these cultivars would improve their output. This neutral stance might suggest a lack of conviction or understanding regarding the tangible benefits of these cultivars or perhaps uncertainty about their effectiveness in their specific farming contexts. This is consistent with findings from studies such as (Nwafor, 2023), emphasizing the role of research and extension efforts in demonstrating technology benefits. Similarly, a large number of respondents, 128 (76%), also maintained a neutral position on the ease of implementing improved cassava cultivars into their farming practices. This neutrality could be indicative of either a lack of sufficient information or experience with these cultivars or a cautious approach due to perceived risks or challenges in adopting new agricultural practices. However, it's noteworthy that 129 respondents (77.2%) acknowledged that the opinions and experiences of other farmers played a significant role in influencing their decision to adopt improved cassava cultivars. This highlights the importance of social networks and peer influence in the decision-making process among farmers.

Furthermore, the survey results indicate that social status was not deemed a crucial factor in the decision to adopt improved cassava cultivars, with 163 respondents (96.6%) considering it irrelevant. This suggests that the decision to adopt these cultivars is more likely driven by practical considerations rather than social prestige or standing within the community (Balogh *et al*., 2021).

One of the most significant findings is the high value placed on the cost of inputs, with 144 respondents (86.2%) identifying it as a very important factor in their decision to adopt

improved cassava cultivars. This underscores the economic considerations that are central to farmers' decision-making processes. Farmers are likely weighing the potential benefits of improved cultivars against the financial implications of purchasing the necessary inputs (Giller, Delaune, Silva, van Wijk, et al., 2021).

Lastly, there appears to be a considerable gap in knowledge regarding the cultivation techniques required for improved cassava cultivars. A large proportion of respondents, 132 (79.0%), indicated unfamiliarity with these techniques, in stark contrast to the 30 respondents (18.0%) who felt very familiar with them. There could be a number of reasons for the noteworthy percentage of respondents who said they were unfamiliar with the techniques. First, since many smallholder farmers are frequently unfamiliar with contemporary agricultural methods, restricted access to training and extension services may have been a major factor. Furthermore, information about these methods may not have been widely disseminated or specifically targeted, especially in rural areas with poorer communication infrastructure like Teso South, Busia County (Oruta & Amuya, 2021). Low information may also result from the techniques' perceived difficulty, which may prevent adoption. Their capacity to acquire and apply the techniques may be further hampered by limited access to technology and resource limitations. The smaller, more seasoned group, on the other hand, might have profited from focused agricultural programs, workshops, or increased contact with extension agents or lead farmers, which enabled them to gain the information and abilities required to implement the methods.

5.2 Social characteristics of smallholder cassava farmers in Teso South, Busia County

The study indicates a notable gender disparity, with a majority 147(88.0%) of female participants, highlighting how gender dynamics influence agricultural practices and decision-making. This could be due to traditional gender roles where women take on more responsibility for subsistence agriculture and household food security. In many rural or agricultural communities, women are often more engaged in certain types of farming or economic activities, particularly those related to household food production and small-scale farming. Additionally, men might be more involved in wage labor or larger-scale farming activities (Quisumbing & Doss, 2021), which could explain their lower participation in the study. Traditional roles often assign women to agricultural labor, despite limited access to land and resources. Their involvement in labor-intensive tasks like planting and harvesting is driven by perceived suitability and necessity. Access to agricultural education empowers women to assume leadership roles and contribute to sector innovation (Hillenbrand & Miruka, 2019). This is heightened with the evidence of women being the primary participants in cassava farming activities in the study area.

The predominance of respondents aged 40years and above (42.5%), particularly in the 40-50years age group, reflects demographic trends where younger generations tend to migrate to urban lifestyles and find exposure in diverse food cultures. As a result, traditional foods like cassava are no longer as popular in diets. Younger generations may favor fast food or more easily accessible commercial products over traditional staples like cassava, which take longer to prepare, due to convenience, modernity, and international food trends. According to studies on rural livelihoods, the high percentage of married people and larger households highlights agriculture's crucial role as a primary livelihood strategy for

supporting families (Diarra, 2021). Even though higher education is less prevalent, training programs and extension services can still build upon the foundational knowledge base. Opportunities for educational interventions in agriculture are suggested by respondents' emphasis on primary and secondary education (Koju et al., 2020). Additionally, many respondents engage in diverse farming activities beyond cassava, reflecting broader livelihood strategies (Liru, 2020).

5.3 Economic characteristics of smallholder cassava farmers in Teso South, Busia County

5.3.1 Farm size and cassava cultivation

The results indicate that the majority of respondents owned small farms, with approximately two acres (48.2%) being the most common size. This is because high-productive regions frequently experience land fragmentation, with land being divided among several heirs over several generations, leading to smaller and more dispersed land holdings (Richardson, 2023). As land gets divided among more people, the average size owned by each person tends to shrink. In many rural parts of Africa, for example, it is common for families to subdivide their land among their children when passing it on (Bryceson, 2019). Over several generations, this practice can lead to significant fragmentation, with each heir receiving smaller and smaller portions. In densely populated areas, the growing number of people competing for the same land makes the situation even tighter. Even so, farmers can still produce good harvests on small plots if they manage them carefully through methods like intercropping, crop rotation, and using organic fertilizers. Smallholder farmers often focus on high-value crops, maximizing output per unit of land. Additionally, small lands allow for closer attention to detail in farming

practices, leading to better crop quality and reduced waste (Smith *et al.*, 2020) However, challenges include limited economies of scale, which make it harder to invest in machinery, improved seeds, or irrigation systems. Small plots are also more vulnerable to climate shocks and soil degradation, as there is less flexibility to mitigate these risks through diversification or fallow periods. Economic factors, including high land prices and the availability of alternative livelihoods, make it difficult for individuals to acquire large tracts of land in these areas. Government policies related to land redistribution, land use planning, and agricultural subsidies also influence land ownership patterns, sometimes encouraging or requiring smaller land holdings for specific purposes (Ellickson *et al*., 2020). Cultural and social factors, such as preferences for smaller, more manageable land holdings or traditional inheritance practices, also play a role in shaping land ownership patterns in high-productive areas (Ford & Brown, 2021).

When specifically asked about the size of land used for cassava cultivation, the majority indicated using less than 0.25 acres for this purpose. For a variety of reasons, farmers may choose to cultivate cassava on less than 25% of their land. First off, growing cassava could be a component of a diversified farming system, in which farmers cultivate a number of crops to lower the risk of crop failure or market volatility. Farmers can maintain a variety of crops to satisfy different household needs and market demands by devoted only a portion of their land to cassava. Farmers may also think about the labor costs and financial benefits of growing cassava in comparison to other crops (Cock & Connor, 2021). In order to concentrate on crops like maize, beans, and groundnuts that provide larger economic returns per unit of land, farmers may decide to devote less land to cassava.

This result is consistent with earlier studies that have shown how common smallholder farming is across a range of settings. For instance, Turland *et al*.,(2018) found similar trends in a study on smallholder agriculture in Sub-Saharan Africa, where a large proportion of farmers operated on relatively small plots of land for crops with lower economic returns. Similarly, a study by Giller *et al*., (2021) also reported comparable results, emphasizing the predominance of small-scale farming practices in the region.

The significant difference observed in the distribution of land sizes for both overall farm ownership and cassava cultivation underscores the importance of understanding the dynamics of land allocation within agricultural systems. This finding is consistent with the literature on land use patterns, which often highlights the complex interplay of socio-economic factors, environmental considerations, and agricultural practices in shaping land tenure arrangements (Sosa Gomez, 2023).Moreover, the lack of significant influence of demographic variables such as gender, age, marital status, and education level on farm size and cassava cultivation size is consistent with some previous studies e.g. (Dadzie *et al*., 2022). However, it contradicts findings from other research that have identified demographic factors as significant determinants of landholding patterns (Hossain *et al*., 2016). The divergent views on the findings highlight the importance of context-specific dynamics, indicating that demographic influence may vary depending on local socio-economic, cultural, and institutional conditions.

The revelation that the majority of respondents in the current study only subdivided their own plots and did not rent or lease additional land for cassava cultivation highlights their reliance on existing land resources for agricultural activities. This may be attributed to the

fact that majority may have limited financial resources to afford additional land or may prioritize other household expenses over expanding their agricultural operations. Farmers that work in a variety of agricultural pursuits, like raising livestock or producing other crops, frequently have different priorities when it comes to allocating their resources, which may influence their readiness to embrace new cassava cultivars. There might not be much suitable land available for them to rent or lease in their area, particularly in high-demand locations where land is expensive or hard to come by. Furthermore, rather than developing on new land, farmers might want to concentrate on increasing the productivity of their current land through better agricultural techniques. Additionally, some farmers may be reluctant to sign rental or lease agreements because they would rather keep control of their land, which could be influenced by cultural or social factors. This result is in line with research by Mouratiadou et al. (2021), which highlighted how crucial it is for smallholder farmers to maximize their land use efficiency in order to increase sustainability and productivity. This dependence on already-existing land resources suggests that a lack of land access may prevent many farmers from increasing cassava production. In order to make the most use of the available land, farm practices like crop rotation, intercropping, and effective land management become essential.

5.3.2 Credit services, markets, income and produce purpose

The study reveals significant economic challenges faced by cassava farmers, including limited access to finance, poor market accessibility, low income levels, and motivations primarily driven by subsistence needs rather than commercial profit. These findings resonate with prior research in rural development and agricultural economics. Many respondents(81%) reported lacking access to agricultural finance services, hindering their

ability to invest in necessary inputs like seed cuttings, as noted in studies emphasizing the critical role of credit availability for small-scale farmers (Mizik, 2021). Market access was universally criticized by respondents(100%), impacting their ability to sell cassava produce effectively and maintain profitable prices, consistent with research highlighting market accessibility as pivotal for small-scale farmers (Aseete, 2021). The majority of farmers prioritize cassava for household consumption rather than income generation, reflecting a prevalent focus on food security over commercial profit, a trend supported by recent studies (Thiele *et al*., 2022). Furthermore, the study underscores the financial hardship of cassava farming.

Only 34.1% of the respondents had an income from farming, and of those, 30.5% earned less than Ksh 10,000 annually, aligning with findings on low income levels among small-scale farmers (Mbata, 2019). These insights underscore the complexities and challenges faced by cassava farmers in achieving sustainable livelihoods and economic resilience.

The study demonstrated that among the economic factors examined, access to credit services significantly influenced the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County. This result is consistent with earlier studies that highlighted the critical role that financial access plays in smallholder farmers' adoption of technology (Khan et al., 2024). However, the study discovered non-significant coefficients for variables like income level and land tenure, suggesting that these factors had no discernible impact on adoption choices. This calls into question the widespread belief that having more money or owning land automatically encourages people to adopt new technologies. According to similar findings by Liu et al. (2018) in similar agricultural

settings, if other conditions, such as market access or perceived risks, are unfavorable, factors like land tenure security may not have a significant impact on adoption. The results of the study also demonstrate the complexity of adoption choices, indicating that variables other than economic ones, like market demand and risk perception, might be more important. This is consistent with findings from Nazu et al. (2021) about income levels and the adoption of new technologies, where they contended that perceived risks may have a greater impact on adoption decisions than possible income gains.

5.4 Institutional factors on the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County

There is a dearth of collective organization among the agricultural community, as seen by the majority (80.2%) of cassava growers surveyed not belonging to any farmer group or cooperative. This result aligns with earlier studies conducted by (D'Amico, 2021); (Molina *et al*., 2021) , who emphasized the difficulties brought about by low involvement in farmer groups, including fewer options for access to resources and markets. According to the majority of respondents, there is a large gap in the availability of extension services for cassava farming, as revealed by the survey. This result is consistent with the findings of (Nnahiwe *et al*., 2023) which highlight the vital role that extension services play in providing smallholder farmers with access to agricultural technologies and expertise. The dependence on non-governmental organization personnel to provide extension services draws attention to certain weaknesses in government-run extension initiatives and emphasizes the necessity of improved cooperation and coordination amongst all parties involved in the agricultural extension system.

The findings indicate varying levels of awareness of government programs aimed at promoting the adoption of improved cassava cultivars. While a substantial proportion of farmers reported awareness, a significant percentage (71.9%) remained uninformed about these initiatives. This disparity underscores the importance of effective communication and outreach strategies to ensure that farmers are aware of available support programs. Similar observations have been made by Bizikova *et al*., (2020), who stress the need for targeted and participatory approaches in agricultural development interventions to reach marginalized farmer groups effectively.

This finding also aligns with the emphasis on knowledge dissemination and technology transfer in sustainable agriculture, as highlighted by Makate,(2020).

5.5. Effect of farmer perceptions of innovation technologies of improved cassava cultivars among smallholder farmers in Teso South, Busia County

The perception and innovation characteristics results presented suggest several factors that significantly influence the adoption of improved cassava cultivars among smallholder farmers in Teso South, Busia County. The findings indicate that cultivation techniques exerted a negative influence on the adoption of improved cassava cultivars ($\beta = –.148$, $t = 6.886$, $p < 0.001$). This suggests that farmers who perceived the cultivation practices required for these varieties as complex or labor-intensive were less inclined to adopt them. Simplifying the associated agronomic practices or providing more practical training could therefore enhance adoption rates (Thakur et al., 2022).

In contrast, yield had a significant positive effect on adoption ($\beta = 0.057$, $t = 3.393$, $p < 0.001$). Farmers who observed or believed that improved cultivars increased productivity

were more likely to embrace them. These results highlight the importance of demonstrating yield advantages through field trials and farmer demonstrations to promote greater acceptance (Takahashi et al., 2020).

Ease of implementation exhibited the strongest positive relationship with adoption ($\beta = 0.434$, $t = 11.240$, $p < 0.001$). This finding implies that when improved cultivars are perceived as compatible with existing farming systems and easy to integrate into current practices, their adoption is more likely. Technologies that require minimal changes to established routines tend to be favored by smallholder farmers, underscoring the need to minimize perceived barriers to implementation.

The influence of other farmers' opinions, though statistically significant, was relatively weak ($\beta = 0.004$, $t = 0.425$, $p = 0.001$). Nonetheless, the result suggests that peer interactions and social dynamics may play a modest role in shaping farmers' adoption behavior. Promoting positive farmer-to-farmer communication and communal learning platforms could therefore reinforce the diffusion of improved cultivars (Kosmowski et al., 2020).

Input costs had a negative but weaker effect on adoption ($\beta = –0.040$, $t = 0.710$, $p < 0.001$). Higher costs associated with improved varieties appear to discourage uptake among resource-constrained farmers. Policies or interventions aimed at improving access to affordable inputs or credit facilities could mitigate this constraint and encourage broader adoption (Martey et al., 2020). Reducing the cost burden, either through subsidies or efficient input distribution, could mitigate this barrier and foster adoption.

5.7 Determinants of adoption of the improved cassava cultivars among smallholder farmers in Teso South, Busia County

The study identified that gender showed a positive effect on adoption likelihood, contrary to expectations influenced by gender norms in agricultural decision-making, as found in similar studies by (Bendell *et al.*, 2020). The finding that gender has a strong beneficial impact on adoption highlights the role that gender dynamics play in farming households' decision-making. The ease with which men and women adopt new agricultural technologies or processes may be impacted by the disparities in their access to networks, resources, and knowledge. Men have traditionally had easier access to vital resources like land, capital, and extension services in many rural areas, which can facilitate their adoption of innovations (Galiè et al., 2022). Studies show that male-headed families are more likely to have greater assets and decision-making power, which makes them more inclined to adopt riskier or more expensive technology. Men-headed families in Ghana, for example, were more likely to adopt enhanced maize varieties due to their easier access to credit and labor (Gaya et al., 2021). Women's participation in agriculture is increasingly recognized as being crucial to the adoption of innovations, especially in sub-Saharan Africa, despite the fact that men may have easier access to resources. Under some circumstances, women may be more likely to adopt technologies that improve household well-being, such as those that reduce work or improve food security. (Kassie *et al.*, 2020) demonstrated that when women are empowered with access to extension services and decision-making power, they are more likely to adopt sustainable agricultural practices. The positive significance of gender in the model reflects that both male and female farmers play important roles in the adoption process, but the context in which they operate determines their likelihood to adopt

the innovation. In some areas, female farmers may face more significant barriers, such as limited land ownership or cultural norms that restrict their participation in decision-making, which could reduce their adoption potential compared to men.

Education is one of the strongest predictors of adoption in the model, depicting that higher or formal education levels significantly increase the likelihood of adoption. This finding is supported by numerous studies in agricultural adoption research. For instance, studies on the adoption of improved agricultural technologies consistently show that education enhances farmers' awareness, ability to understand innovations, and capacity to evaluate the benefits of adoption (Piñeiro et al., 2020; Odongo., 2022). Even if education makes adoption more likely, some research in very traditional societies has shown that this effect might be constrained by cultural or deeply rooted customs (Rola-Rubzen et al., 2020). In these circumstances, education alone might not result in significant changes unless paired with targeted awareness campaigns or demonstration projects that consider local norms.

According to the positive relevance of other farming activities as a factor of adoption, farmers who engage in a wider range of agricultural activities are more likely to adopt new technology or techniques. Farmers who participate in a range of on-farm activities tend to have more diverse revenue streams, which lowers the risks associated with adopting new technologies. Farmers can invest in innovative methods without fear of the consequences of a potential failure thanks to the financial security that diversification brings (Alletto et al., 2022). Households who have a variety of revenue streams are less susceptible to economic shocks and are therefore more equipped to embrace new farming methods or technologies. Similarly, farmers who engage in more on-farm activities are likely to interact with a greater variety of individuals and groups, increasing their access to

information and resources. For example, farmers who engage in livestock production alongside crop farming may interact with both crop-specific and livestock-specific extension services, which can expose them to more information about innovative practices. This is consistent with research by Baiyegunhi et al. (2022), which showed that farmers' access to networks and resources that facilitate adoption was improved by diversified farm activities.

Participating in several on-farm activities often requires the allocation of additional labor and resources. Farmers who can efficiently handle a range of chores may have more labor available or better utilize family labor, which could facilitate the introduction of labor-intensive technologies. Farmers who have interacted with diverse production systems often exhibit greater openness to adopting innovative practices that enhance productivity across different agricultural enterprises. In Teso South, Busia County, the size of a cassava field plays a significant role in influencing the adoption of improved cultivars. Field size determines the farmer’s capacity to justify investment in new technologies, manage production risks, and mobilize necessary resources. Farmers operating larger cassava plots are generally more inclined to adopt improved technologies, as they can exploit economies of scale. A larger production area facilitates the distribution of fixed costs, such as those associated with improved planting materials, fertilizers, and other inputs across a wider base, thereby reducing the per unit cost of adoption. Consequently, large-scale producers are better positioned to absorb potential risks and to benefit from technological innovations (Giller et al., 2021).

Additionally, larger fields tend to produce more, which might serve as a safeguard against potential risks related to the use of new technology. A large cassava crop allows a farmer to experiment with a piece of the field while relying on the remaining portion to generate consistent income. They are therefore more receptive to experimenting with novel cultivars or methods that offer long-term advantages. In order to maximize their return on investment, farmers may choose to use improved varieties of cassava because larger fields usually result in higher input demand. Higher yields, resistance to pests and diseases, or quicker maturation times are common features of improved cassava cultivars. Farmers with larger cassava fields are motivated to adopt these varieties to optimize their land productivity. This is consistent with findings by (Ruzzante et al., 2021) who found that larger farms were more likely to adopt improved seed varieties because the expected yield gains justified the investment. Farmers with larger fields are often more visible to extension agents and development programs, which tend to target farmers with more significant farming operations. These farmers are likely to receive more frequent visits from agricultural officers and have better access to support services. Studies, such as those by (Amadu et al., 2020), highlight how the presence of extension services is closely linked to adoption rates, especially for farmers who manage larger plots of land. Larger-scale farmers may also have better access to formal agricultural institutions or credit facilities, which can facilitate adoption. They may have the collateral or financial capacity to invest in improved seeds or inputs, as found in studies like Kansanga *et al*., (2021), which showed that wealthier farmers with larger landholdings are more likely to adopt sustainable agricultural practices due to greater access to resources.

Farmers with more extensive cassava fields are more likely to engage in the commercialization of cassava, rather than subsistence farming. Commercial-oriented farmers tend to adopt innovations that enhance productivity and marketability. Improved cassava cultivars, for instance, often produce higher yields, are more resistant to disease, or have better quality traits (e.g., higher starch content) that fetch better market prices. Larger farms are more inclined to adopt innovations that improve profitability, especially in competitive markets (Giller *et al*., 2021).

The shift toward commercialization drives the need for innovation as larger cassava farmers seek to maximize profitability and meet market demands. This aligns with findings by Teferi Alemaw *et al*., (2021), which demonstrated that farmers with larger landholdings were more likely to adopt hybrid maize varieties in Ethiopia due to the commercialization potential.

In contrast, while the model shows a positive association between cassava field size and adoption, the magnitude and nature of this effect can vary based on contextual factors like land fragmentation. In regions where land is highly fragmented or under customary tenure systems, even farmers with larger cassava fields may face challenges in adopting innovations. This is because fragmented land parcels may not generate the same economies of scale or ease of management as contiguous fields. In some cases, smallholder farmers with smaller cassava fields may adopt innovations if they are focused on intensive production for subsistence or niche markets. This may be particularly true in areas where improved cassava cultivars are promoted for food security rather than for market-oriented farming.

There is a significant positive relationship between income and adoption of improved cassava cultivars. This reflects findings from other studies that suggest that wealthier households are more likely to adopt new technologies. Farmers with relatively higher income levels possess greater financial capacity to meet the costs associated with adopting agricultural innovations. Such resources enable them to purchase improved cassava cuttings, invest in enhanced farming equipment, or hire additional labor when necessary. Beaman et al. (2021) observe that farmers with greater wealth are generally more inclined to undertake risks associated with new technologies, particularly when adoption entails substantial upfront expenditure. Similarly, Takahashi et al. (2020) note that innovations requiring financial investment such as improved seed varieties and fertilizers tend to be adopted more readily by farmers with stronger economic standing.

Conversely, in subsistence oriented farming systems where household cash income is limited, adoption decisions are often shaped less by income itself and more by access to credit facilities and informal financial support networks. Although credit services were not explicitly included in the current model, previous studies have demonstrated that access to credit can help overcome financial constraints and facilitate technology adoption even among lower-income households (Wanof, 2023).

In addition, group-based collaboration plays an important role in promoting the uptake of improved cassava cultivars. This finding is consistent with existing literature on collective action and social capital in rural contexts, which emphasizes that membership in farmer groups or cooperatives enhances access to information, peer learning, and financial resources all of which are critical for the adoption of new agricultural technologies.

According to Mendes et al. (2024), farmers who belonged to cooperatives or social networks had a higher propensity to adopt new technology because of the knowledge exchange and risk mitigation provided by social learning. In a similar vein, social networks considerably raised the possibility that smallholder farmers in Uganda will embrace improved banana cultivars (Sanya et al., 2020). The impact of cooperatives on adoption, for example, can vary depending on the group's internal governance and access to outside resources, according to Deng et al. (2021), who suggested that simply being a member of a group does not ensure adoption unless the group actively promotes access to innovations.

In agricultural research, it is often known that adoption is greatly influenced by extension access. In order to help farmers comprehend and implement new developments, extension services serve as essential conduits for the exchange of information and technical assistance. Frequent and high-quality extension visits are associated with increased adoption rates of agricultural innovations, according to studies like (Yitayew et al., 2021). Likewise, T. Thompson & Gyatso (2020) demonstrated that extension programs in Sub-Saharan Africa significantly boosted farmers' adoption of productivity-enhancing technologies. This is particularly true when extension services are tailored to local contexts and delivered in participatory formats. However, contrasting findings arise in cases where extension services are under-resourced or ineffective. Chanza *et al*., (2023) observed that in some countries, poorly funded or poorly trained extension agents failed to provide the necessary support for innovation adoption, reducing the overall effectiveness of extension programs. Therefore, the success of extension services in driving adoption hinges on their quality, frequency, and ability to address the specific needs of farmers.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

A majority of respondents have not adopted improved cassava cultivars in Teso South, Busia County. This suggests significant barriers to the adoption of agricultural innovations in the community. However, adopters did report pleasure with the way other farmers' perspectives and experiences influenced their adoption choices. There is a high value placed on the cost of inputs with respondents identifying it as a very important factor in their decision to adopt improved cassava cultivars.

The gender gap in agricultural practices was highlighted by the fact that women made up the majority of responders. In rural areas, where younger generations frequently migrate for work or education, older people may continue to engage in traditional farming practices, such as growing and eating cassava, while younger generations increasingly adopt modern, convenience-based diets. This is reflected in the survey's preponderance of older respondents. The respondents' high level of formal education points to possible avenues for educational interventions aimed at boosting farmers' capabilities. The study also shows that a large number of respondents work on farms doing tasks other than growing cassava, underscoring the diverse nature of rural livelihoods. Cassava farmers face a number of challenges, such as low income levels, high input costs, and restricted access to markets and loans. The survey found that most respondents did not lease or rent additional land for cassava production, instead depending on the land resources already available for agricultural activities.

Additionally taken into account were institutional elements like access to extension services and farmer group membership. The majority of respondents did not belong to any farmer groups or cooperatives, which underscored the lack of collective structure among farmers.

6.2 Recommendations

Based on the findings of this study, the following recommendations were proposed:

- Regarding enhanced cassava cultivars, most respondents held a neutral stance. This suggests a poor adoption rate because people aren't generally aware of how they feel about these agricultural improvements. Addressing the negative perception of improved cassava cultivars and increasing their acceptance rate need strengthening extension services and enhancing the dissemination of information. Collective organizing through farmer groups or cooperatives is essential to enhancing their access to resources and opportunities. Farmers should have easier access to more comprehensive instruction on the benefits, characteristics, and management practices of these improved cultivars. Additional cassava-focused communication techniques, on-farm demonstrations, and farmer-to-farmer learning opportunities can all help achieve this. Additionally, offering trial seeds and enlisting the aid of local influencers may encourage adoption even further by providing farmers with the opportunity to engage directly with the cultivars. Regular monitoring and feedback collection are required to ensure that these programs are effectively meeting farmers' needs and addressing any knowledge gaps. More stakeholders, including government officials and non-governmental organizations, should broaden their networks for cassava projects in order to encourage the adoption of the new cultivars. Gender-sensitive strategies should be taken into account in interventions meant to increase adoption. By improving their access to land, resources, and agricultural education, gender-responsive policies should be put in place to empower women, especially in agricultural leadership and decision-making. Given that women are the main smallholder cassava participants, this would improve long-term household food security.
- Since elderly farmers make up the majority, efforts should be taken to draw and keep younger generations in agriculture by providing chances for innovation, training, and incentives. By providing customized educational programs that are

suited to farmers' educational levels and emphasize practical skills in a variety of farming operations, extension services should concentrate on expanding the body of knowledge already in existence. Furthermore, encouraging diversification tactics that complement more general livelihood requirements might improve food security and household resilience. In order to ensure inclusive and efficient support for all farmers, these initiatives should be strengthened by combining community-based and institutional approaches that take traditional roles and demographic trends into account.

- It is essential to establish strategies that provide cheap access to better cassava cultivars in order to address the economic factors that influence smallholder farmers. In order to lower input costs, this can entail providing subsidies such as stem cuttings, financing facilities, or bulk purchase schemes.Additionally, providing detailed cost-benefit analyses and demonstrating the long-term economic advantages of adopting these cultivars can help farmers make informed decisions. Extension services should also focus on educating farmers about cost-effective practices for managing inputs, ensuring that financial barriers do not hinder the adoption of improved cassava cultivars.
- To achieve effective adoption in a rural setting, the roles of extension agents, along with a solid understanding of adoption theories, constraints to adoption, and the determinants of adoption, should be integrated into the social system of smallholder farmers through improved institutional support.

6.3 Recommendations for further research

- It is crucial to investigate the variables influencing farmers' decisions to join or refrain from farmer associations, as seen by the notable disparity between those who were represented in group memberships and those who were not.
- A comparative study on the economic viability and productivity of different improved cassava cultivars in various agro-ecological zones can be conducted to help identify the most suitable varieties for different regions, ensuring that farmers choose the best cultivars for their specific conditions.
- The influence of market access and integration into cassava value chains on the adoption of improved cultivars can also be examined to explore how access to markets and the development of value-added products from cassava encourage adoption.

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APPENDICES

Appendix I: Test for heteroskedasticity

Heteroskedasticity

Iteration 0: log likelihood = -91.938029
Iteration 1: log likelihood = -34.220806
Iteration 2: log likelihood = -30.368782
Iteration 3: log likelihood = -29.85973
Iteration 4: log likelihood = -29.8308
Iteration 5: log likelihood = -29.830623
Iteration 6: log likelihood = -29.830623

Logistic regression Number of obs = 167
LR chi2(2) = 124.21
Prob > chi2 = 0.0000
Log likelihood = -29.830623 Pseudo R2 = 0.6755

Adopted	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
_hat	0.975	0.198	4.920	0.670	0.587	1.364
_hatsq	-0.022	0.058	-0.390	0.700	-0.136	0.092
_cons	0.056	0.387	0.140	0.885	-0.703	0.815

Appendix II: Pearson correlation coefficients for multicollinearity test

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Adopted	1.000												
(2) Gender	0.398	1.000											
(3) Age	-0.114	-0.084	1.000										
(4) MaritalS	0.028	-0.130	0.246	1.000									
(5) HHSize	-0.028	0.072	0.336	0.006	1.000								
(6) Education	0.492	0.299	-0.509	-0.151	-0.117	1.000							
(7) FActivities	0.204	-0.020	0.257	0.054	0.103	-0.013	1.000						
(8) FarmSize	0.119	0.027	0.258	-0.096	0.066	0.015	0.122	1.000					
(9) CassavaF	0.328	0.287	0.058	-0.083	0.192	0.072	0.156	0.128	1.000				
(10) CreditS	0.155	0.055	-0.024	-0.074	-0.061	0.064	-0.026	-0.084	-0.060	1.000			
(11) Income	0.435	0.231	-0.078	0.089	-0.110	0.217	-0.047	-0.018	0.185	-0.013	1.000		
(12) GroupCoop	0.484	0.162	-0.037	0.112	-0.013	0.237	0.180	0.113	0.172	0.035	0.225	1.000	
(13) ExtensionV	0.320	0.150	0.039	0.193	-0.036	0.108	0.057	0.130	0.007	0.001	0.228	0.089	1.000

Appendix III: Description of Variables used in the binary logistic regression

VIF

Variable	VIF	1/VIF
HHSize	4.83	0.207157
Income	4.72	0.211936
CassavaF	4.42	0.226151
Education	4.18	0.239279
FActivities	4.17	0.239908
MaritalS	3.33	0.299941
FarmSize	2.10	0.476567
GroupCoop	1.81	0.552060
ExtensionV	1.66	0.602772
Gender	1.44	0.696277
CreditS	1.26	0.795419
Mean VIF	3.08	

Source: Author 2024

Appendix IV: Cassava Shrubs

Cassava (*Manihot esculenta*) (Author 2024)

Appendix V: Un-peeled and peeled cassava

Un-peeled and peeled cassava (Author 2024)

Appendix VI: Some of the improved cassava varieties

Some of the improved cassava varieties (Author 2024)

Appendix VII: Questionnaire

Voluntary participation: Your participation in this study is entirely at your discretion. At any time, you have the option to withdraw from the research study. Participants in the physical survey can leave the survey at any point before it is completed by simply abandoning it. Participants in the survey can also skip any questions they do not wish to answer .You can direct any questions you have regarding this research study to the investigator here. This consent form explains the research study in which you will be asked to take part in. Before agreeing to participate in the study, please read this form carefully and ask any questions you may have. You can also ask questions after you've joined the study. The goal of this study and survey is to engage society and the community in addressing the issue of sustainable food production amidst the harsh economic times and diverse climatic changes. There is no correct or incorrect answer, what is required of you is to give your opinion on the asked questions in the different sections that will help in

addressing the adoption inefficiencies by helping in formulation of appropriate production and management strategies in the future. Your corporation is highly appreciated.

Is it okay if we ask you some questions and look around your farm?

INSTRUCTIONS.

Kindly answer all the questions appropriately.

SECTION 1: Social Factors

Ward:……
Village:……..

1. Respondent's gender? Male ☐ Female ☐

2. Respondent's Age?

   <30
   30-39
   40-49
   50-59
   >60

3. What is your marital status? [Married,Single,Divorced,Widowed]

4. What is your household size?.....

5. What is your level of education? [No formal education, Primary, Secondary, Tertiary]

6. Are there any other on-farm activities that you carry out for your livelihood? [Yes/No]

Section 2: Economic factors

1. What is the size of your farm in acres?.....
2. What is the size of land used for cassava cultivation by the household?
3. Do you have any other portion of land rented or leased for cassava cultivation? [Yes/No]
4. Do you have access to credit services? (Yes/No)
5. How would you rate your market accessibility for cassava products? [1. Very dissatisfied 2. Dissatisfied 3. Neither dissatisfied nor satisfied 4. Satisfied 5. Very satisfied]
6. Do you sell your produce, use it for your own consumption or both?

7. Whom and where do you sell your produce to?
    - [Consumers, Retailers, Wholesalers, Contract institutions, Cooperatives/Aggregation centers]
    - [Local Markets, Regional Markets, National Markets]
8. What is your current income level from cassava production?
    a. Less than KES 10,000
    b. KES 10,000-50,000
    c. KES 50,000-100,000
    d. Above KES 100,000

9. How important is the cost of inputs in the adoption of improved cassava variety?
    a. Very Unimportant
    b. Unimportant
    c. Neutral
    d. Important
    e. Very Important
10. What challenges have you faced in adopting the new cassava cultivars?
    a. High Cost of Inputs
    b. Lack of Market for Produce
    c. Pests and Diseases
    d. Other (Specify)

SECTION 3: Institutional Factors

1. Are you a member of a farmer group or cooperative? (Yes/No)
2. Do you have access to extension services for cassava cultivation? (Yes/No)

3. If yes, what is the frequency of extension visits(classify; National government, County or Ngo staffs)
4. Are you aware of any government programs that promote the adoption of the improved cassava cultivars?
    a. Yes
    b. No
5. What support do you expect from the government to encourage the adoption of improved cassava cultivars?
    a. Subsidies for Inputs
    b. Training on Cultivation Techniques
    c. Market Linkages
    d. Other (Specify)
6. How important is government support in the adoption of improved cassava cultivars?
    a. Very Unimportant
    b. Unimportant
    c. Neutral
    d. Important
    e. Very Important
7. How familiar are you with the cultivation techniques for the improved cassava cultivars?
    a. Very Unfamiliar
    b. Unfamiliar
    c. Familiar
    d. Very Familiar
8. How important is access to information in the adoption of improved cassava cultivars?
    a. Very Unimportant
    b. Unimportant
    c. Neutral
    d. Important
    e. Very Important

Section 4: Adoption

1. What is your perception of the improved cassava cultivars?
    a. Positive
    b. Neutral
    c. Negative
2. Have you adopted improved cassava cultivars on your farm? (Yes/No)

3. How did you get to learn of the new cultivars(Fellow Farmers,Media,Extensionists)
4. Please indicate your level of agreement with the following statement: "I believe that adopting improved cassava cultivars would enhance my cassava farming productivity." [1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly Agree]
5. Please indicate your level of agreement with the following statement: "I believe that using improved cassava cultivars would be easy for me to implement in my farming practices." [1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly Agree]
6. Please indicate your level of agreement with the following statement: "The opinions and experiences of other farmers influence my decision to adopt improved cassava cultivars." [1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly Agree]

7. How important is social status in the adoption of an improved cassava cultivar?
    a. Very Unimportant
    b. Unimportant
    c. Neutral
    d. Important
    e. Very Important
8. How many years have you been cultivating cassava?

Thank you for your participation! Your responses will be kept confidential and used solely for academic purposes.

Appendix VIII: Map of Study Area

Source: Author 2024

Appendix IX: Nacosti Permit

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Appendix X: Similarity Report

DrillBit

The Report is Generated by DrillBit Plagiarism Detection Software

Submission Information

Author Name	Obongâ€™o Erick Ochiengâ€™ SAGR/AGE/M/005/21
Title	FACTORS DRIVING THE ADOPTION OF IMPROVED CASSAVA CULTIVARS IN TESO SOUTH, BUSIA COUNTY, KENYA
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Result Information

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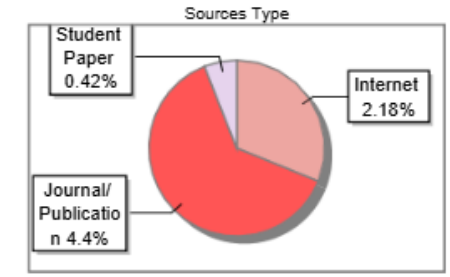

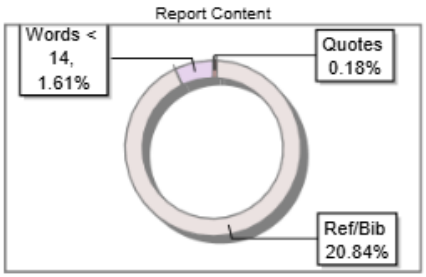

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