FOOD SECURITY AMONG RURAL HOUSEHOLDS IN KENYA

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A Research Project Submitted to the School of Business, Economics, Hospitality, and Tourism Management in Partial Fulfillment of the Requirements for the Award of Master of Economics Degree of Machakos University

SEPTEMBER, 2024

DECLARATION

This research project is my original work and has not been presented for the award of a degree in any other University.

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DEDICATION

I dedicate this research project to my amazing parents whose support and encouragement have been the guiding force behind my academic journey. To my dear sister Faith, thank you for your moral support. And to my adorable niece, Amelia, may this endeavor inspire you to reach greater heights in your academic pursuits.

ACKNOWLEDGMENT

My sincere gratitude goes to the Almighty God, for granting me the strength and wisdom during my study course. I extend gratitude to Machakos University for providing me with an environment of learning and growth. The facilities, resources, and academic support accorded to me at the university have largely influenced my research and intellectual growth.

My heartfelt appreciation goes to my supervisors, Dr. James Karau, PhD and Dr. James Murunga, PhD, for their guidance, outstanding mentorship and enlightening comments throughout the various stages of my research project. Their support has significantly contributed to improving my research work and enhancing my understanding in the field of economics.

To my mum and dad, I am forever grateful for the sacrifices you two have made to ensure that I get all the resources necessary for my education. Thank you for the unwavering support and constant encouragement that you accorded me during the course of my study. May God richly bless you for holding my hands and helping me make this dream a reality.

I acknowledge the entire Department of Economics lecturers at Machakos University for their academic guidance and moral support. Finally, special gratitude goes to my classmates, Maurice Muema David and Pius Ngolanye Mbwia, who have contributed to this research project through their insights, feedback, and assistance. Your involvement and support have been invaluable.

ABSTRACT

In Kenya, ensuring food security among rural households is pivotal for sustainable development and poverty alleviation. Despite the rising global concern and impressive progress in tackling food poverty, food security challenges remain prevalent in Kenya, particularly in Kenya's rural areas. With about 71 percent of Kenya's population living in the rural areas and agriculture being the main economic activity ,36 percent of the rural population, approximately 10 million people are suffering from food insecurity. This study sought to investigate the determinants of food security among rural households in Kenya and the impact of gender differences on the prevalence of food security among rural households in Kenya using the 2015/16 Kenya Intergrated Household Budget Survey data employing a logistic regression model. Findings revealed that education status of the household, access to credit, household size and income are important determinants of food security among rural households in Kenya. Gender disparities were also observed, with female-headed households demonstrating higher food security scores compared to male-headed households, attributed to women's greater involvement in food management and decision-making. The findings further revealed that education status of the household head and household size are important determinants of food security among female headed households while education status of the household head, household size, access to credit and income are important determinants of food security among male headed households. The study recommends that credit facilities be made accessible for rural household heads to help them expand both on farm and off farm operations, thus enhancing household food security. The government should also prioritize expanding education access in rural areas and implement policies to boost household income by supporting agricultural value chains and improving market access. Policy measures focused on family planning should receive adequate attention to reduce household sizes to a level that household heads can manage effectively. Additionally, policy makers should incorporate gender specific considerations into the design of food security policies and reforms to address gendered food security gaps.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACF   Action Against Hunger.

AGRA   Alliance for a Green Revolution in Africa.

FAO   Food and Agriculture Organization.

FAOSTAT   Food and Agriculture Organization Statistical Database.

FIES   Food Insecurity Experience Scale.

GDP   Gross Domestic Product.

HSNP   Hunger Safety Net Programme.

IFAD   International Fund for Agricultural Development.

KCSAS   Kenya Climate Smart Agriculture Strategy.

KeRRA   Kenya Rural Roads Authority.

KES   Kenya Shilling.

KIHBS   Kenya Integrated Household Budget Survey.

KNBS   Kenya National Bureau of Statistics.

NAAIAP   National Accelerated Agricultural Input Access Programme.

NARIGP   National Agricultural and Rural Inclusive Growth Project.

NDMA   National Drought Management Authority.

NIAP   National Irrigation Acceleration Programme.

OxFam   Oxford Committee for Famine Relief.

NSNP   National Safety Net Programme.

PIH   Permanent Income Hypothesis.

SDG   Sustainable Development Goal.

UNICEF   United Nations Children's Fund.

USD   United States Dollar.

WFP   World Food Programme.

WHO   World Health Organization

OPERATIONAL DEFINITION OF TERMS

Household food security: A situation where all household members have reliable access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Food Insecurity: A condition in which households or individuals lack regular access to sufficient, safe and nutritious food necessary to maintain a healthy and active life.

Rural Household: Refers to a person or a group of people living in the same compound in a rural area, answerable to the same household head, sharing a common source of income or food, and having common housekeeping arrangements. A rural household may consist of a single individual or a group of related or unrelated individuals, typically residing in areas outside urban and peri-urban centers and often engaged in agricultural or other rural-based economic activities.

Male-Headed Household: Refers to a household in which the head, who makes key day to day decisions and whose authority is recognized by all other members, is a male.

Female-Headed Household: Refers to a household in which the head, who makes key day to day decisions and whose authority is recognized by all other members, is a female.

CHAPTER ONE
INTRODUCTION

1.1 Background of Study

Kenya, a lower middle-income country known for its rich agricultural potential, is currently grappling with a pressing issue of food self-sufficiency (Welborn, 2018). The issue of food self-sufficiency has been a significant concern both locally and globally, as the availability of food and vital staple foods per capita has been declining over time. Like many other countries, Kenya has made significant efforts to achieve Sustainable Development Goal (SDG) 2, which aims to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. However, the rapidly increasing population, climate change, complex shocks to food systems, higher food prices, conflicts, and natural disasters have led to a growing disparity between food production and consumption, hindering progress towards achieving food security. This has had a direct impact on the socio-economic stability status of the country. Food security at the household level remains a significant issue in Kenya and for many other developing countries, particularly those in Africa (Rono, Rahman, Amin, & Badruddoza, 2022).

Based on the 1996 World Food Summit, food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996). Food security is built on four interconnected pillars that serve as the foundation for providing access to sufficient, safe, and nutritious food (World Bank, 2022). These pillars form a comprehensive framework for addressing the complexities of food security. The four pillars of food security are: Food availability which refers to the physical existence and presence of food in adequate quantities to meet the population's

needs; Food accessibility which focuses on individuals' physical and economic ability to obtain safe, nutritious and healthy food ; Food utilization which focuses on ensuring that individuals have the knowledge, resources, and practices to effectively utilize the available food for optimal nutrition, and food stability which refers to the food system's ability to withstand shocks and stresses without jeopardizing food availability, accessibility, and utilization. Food availability is mainly related to the supply side of food security. The food accessibility pillar emphasize on the removal of barriers that prevent people, particularly vulnerable and marginalized populations, from accessing food while the necessity of resilience and risk management in achieving long-term food security is recognized in the food stability pillar (Clapp, Moseley, Burlingame, & Termine, 2021).

With only seven years remaining until the world's zero hunger goal of ending hunger, providing food security, increasing nutrition, and promoting sustainable agriculture by 2023, the world is on a challenging path. Global agricultural output and crop yield growth rates have slowed in recent years. The war in Ukraine has had multiple implications on the global agricultural market disrupting supply chains thus further affecting prices of grain, fertilizer and energy which has resulted to further food price increase (Arndt, Diao, Dorosh & Thurlow, 2023). At the same time, more frequent and severe extreme climate events are disrupting food supply chains, especially in low-income countries.

1.1.1 Food Insecurity Trends

Despite governments' annual support of almost USD 630 billion for food and agriculture, there has been an increasing trend in global food insecurity overtime (FAO,

2022; IFAD, 2022; UNICEF, 2022; WFP, 2022; WHO, 2022). In 2022, an estimated 30 percent of the global population, equivalent to 2.4 billion people, experienced moderate food insecurity. Additionally, approximately 11 percent, or 900 million people, faced severe food insecurity. Notably, this marked an increase of 100 million, 74 million, and 207 million compared to the years 2021, 2020 and 2019 respectively. Nearly half , about 1 billion of the global 2 billion people facing food insecurity in 2022 lived in Asia; 37 percent (868 million) in Africa; about 11 percent (248 million) in Latin America and the Caribbean; and roughly 4 percent (90 million) in Northern America and Europe (FAO, 2023; IFAD, 2023; UNICEF, 2023; WFP, 2023; WHO, 2023).

The prevalence of food insecurity across different degrees of urbanization provides insights into the varying levels of food insecurity in the rural, peri-urban, and urban settings globally as well as within specific regions in Africa, as stipulated in table I.1 below. The data below highlights the percentage of the population experiencing severe food insecurity and the combined prevalence of moderate or severe food insecurity in each urbanization category. The distinctions among rural, peri-urban and urban areas provide a comprehensive understanding across diverse geographical setting, shedding light on the availability, accessibility, affordability of food resources among different population groups.

Table 1.1: Prevalence of Food Insecurity (%) in Rural, Peri-urban and Urban areas Worldwide and in Africa, 2023.

	SEVERE FOOD INSECURITY (%)			MODERATE OR SEVERE FOOD INSECURITY (%)		
	Rural	**Peri-urban**	**Urban**	**Rural**	**Peri-urban**	**Urban**
World	12.8	11.6	9.4	33.3	28.8	26.0
Africa	25.9	23.1	20.2	64.5	60.3	34.2
Northern Africa	10.1	8.2	11.9	29.9	23.4	30.0
Sub-Saharan Africa	27.6	26.3	23.0	68.1	68.4	62.5
Eastern Africa	25.7	26.7	20.5	68.3	68.9	60.0
Western Africa	44.1	44.0	35.4	81.1	82.5	74.0
Middle Africa	15.9	13.1	10.2	31.7	28.2	21.3
Southern Africa	24.5	22.1	20.2	67.2	69.3	65.3

Source: (FAO, 2023; IFAD, 2023; UNICEF, 2023; WFP, 2023; WHO, 2023)

From table 1.1 above it is shown that approximately 13 percent of the global population in rural areas experience severe food insecurity. Furthermore, on a global scale, about 33 percent of people in rural settings are grappling with moderate to severe food insecurity. A closer look into the African continent shows that severe food insecurity increases to about 26 percent in rural areas. This signifies that a quarter of the rural African population struggles to meet their nutritional needs. Moreover, about 65 percent of people living in rural Africa are facing moderate to severe food insecurity. The situation becomes even more critical in Sub-Saharan Africa, where about 28 percent of the rural population is severely food insecure. Considering the moderate to severe category, about 68 percent of rural Sub-Saharan Africa's population faces significant

food insecurity. Focusing specifically on Eastern Africa, about 26 percent of the rural population is experiencing severe food insecurity. This percentage mirrors the broader regional trend. The prevalence of moderate to severe food insecurity is even higher at about 69 percent, indicating a widespread concern that demands targeted interventions to improve food accessibility, affordability and availability.

Kenya, like many other developing nations globally, is also facing food insecurity threats. It ranks 94th out of 121 countries on the 2022 Global Hunger Index (Worldwide, 2022) and 82nd out of 113 countries in the 2022 Global Food Security Index (Economist Impact, 2022). As of 2022, the Global Food Security Index (GFSI) rankings on Kenya's food availability, affordability, utilization and stability status show that food affordability ranked at position 101 out of 113 countries, with a 41.7 score. Food availability held the 79th position out of 113 countries, with a score of 52.5. Food quality and safety in Kenya ranked 55th out of 113 countries, achieving a 69.8 score. Finally, food stability (including sustainability and adoption) was positioned at 66th out of 113 countries, with a 52.6 score (Economist Impact, 2022).The table below presents the prevalence of moderate or severe food insecurity and severe food insecurity in Kenya over a five-year period from 2016 to 2022.

Table 1.2: Prevalence of Food Insecurity in Kenya: A 3-Year Average Analysis.

YEAR	SEVERE FOOD INSECURITY (%)	MODERATE OR SEVERE FOOD INSECURITY (%)
2016-18	21.60	60.90
2017-19	23.40	64.40
2018-20	24.90	67.70
2019-21	26.10	69.50
2020-22	28.00	72.30

Source: FAO.FAOSTAT, suite of Food Insecurity Indicators database.

Table 1.2 above reveals a concerning trend in Kenya's food security landscape across various intervals with a consistent increase in both moderate or severe food insecurity and severe food insecurity throughout the years. Comparing the periods between 2016-2018 and 2020-2022, the percentage increase in severe food insecurity illustrates a consistent rise, with increments of about 8, 6, 5, and 7 percent respectively. Similarly, during the same periods, the percentage increase in moderate or severe food insecurity reflect a similar upward trend, showcasing increases of about 6, 5, 3, and 4 percent respectively.

1.1.2 Gender Disparities in Food Security

Achieving gender equality by 2030 is a key objective of the United Nations Sustainable Development Goals (SDGs) (United Nations, 2022). Gender equality is not only a fundamental human right, but also a necessary tool and foundation for sustainable development for a given country. The 2012 World Development Report on gender equality and development highlights that failing to acknowledge the roles, differences, and inequities between men and women poses a significant risk to the success of agricultural development efforts (World Bank, 2012).

Gender disparities significantly impact food security, particularly in rural areas where agricultural productivity, resource access, and nutritional outcomes are closely tied to the roles and resources available to different genders. Globally, women bear a disproportionate burden of food insecurity, despite their substantial contribution to food production (WFP, 2022). In many developing nations women produce 60 to 80 percent of food items and oversee half of global food production. However, they face a significantly higher risk of severe food insecurity compared to men, with nearly a 27 percent disparity (WFP, 2022).

While women play a critical role in food production and preparation, they often encounter barriers such as limited access to land, credit, and agricultural inputs (FAO, 2010). Disparities in income and employment opportunities further exacerbate food security, as women may have fewer economic resources to ensure adequate household food supplies (Quisumbing et al., 2015). Addressing these disparities by improving access to resources for both men and women is essential for enhancing food security and fostering sustainable development (World Bank, 2023).

In 2021, about 32 percent of women worldwide were moderately or severely food insecure, compared to about 28 percent of males, a 4-percentage point difference, up from 3 percentage points in 2020. However, in 2022 the global level food insecurity gap between men and women narrowed substantially as about 28 percent of adult women were moderately or severely food insecure, compared to about 25 percent of men, and about 11 percent of women were severely food insecure, compared to about 10 percent of men. The disparity in the prevalence of moderate or severe food insecurity between men and women shrank from about 4 percentage points in 2021 to about 3

percentage points in 2022, while the gap in severe food insecurity shrank from 3 to 1 percentage point (FAO, 2023; IFAD, 2023; UNICEF, 2023; WFP, 2023 & WHO, 2023).

1.1.3 Household Food Security and Expenditure in Rural Kenya

Kenya has established a legal framework within its constitution towards promoting food security. Article 43(1)(c) of the Kenyan Constitution guarantees every citizen the right to be free from hunger and to have adequate food of acceptable quality (Republic of Kenya, 2010). In light of these constitutional provisions, over the years the Kenyan government has implemented various strategic initiatives aimed at fast-tracking the attainment of national food security goals.

Kenya Vision 2030, a development blueprint centered on transforming Kenya into a middle-income country and providing a high quality of life to all its citizens by 2030, included targets to enhance food security and improve nutrition for all inhabitants by 2022. The government aimed at reducing malnutrition among children under five by 27 percent, decreasing food insecurity by 50 percent, and lowering food prices as a percentage of income by 47 percent (Republic of Kenya, 2022). Agriculture plays a vital role in Kenya's economy, contributing 20 percent of the Gross Domestic Product (GDP) and another 27 percent of GDP indirectly through linkages with other sectors. It employs over 40 percent of the total population and more than 70 percent of Kenya's rural population (Republic of Kenya, 2023).

Kenya Vision 2030 identified agriculture as one of the main economic drivers to sustainably attain an average economic growth rate. In 2022 agriculture contributed

about 20 percent of GDP which was a 0.3 and 1.5 percent decline compared to the years 2021 and 2020 respectively. The agriculture sector in rural Kenya relies heavily on rain-fed farming, and failing short and long rains in many regions in recent years have worsened the country's food security. As a result, the agricultural sector's real Gross Value Added contracted by 0.6 percent in 2022 compared to a 0.4 percent contraction in 2021(Republic of Kenya, 2023).

According to Republic of Kenya (2016) , about 36 percent of children aged below 17 years were food insecure, with the majority, about 74 percent (6 million), living in rural areas. The national food poverty rate was 32 percent, indicating that approximately 15 million people were food insecure. Based on their food expenditures, almost one in every three people did not meet the minimal daily calorific need of 2,250 kilocalories (Kihiu, 2021). Food poverty was most prevalent in rural areas, affecting about 36 percent of the population, approximately 10 million people, compared to about 29 percent (nearly 1 million people) in peri-urban areas and about 24 percent, almost 4 million people in core-urban areas (Republic of Kenya, 2018).

According to Shibia et al. (2023), the average national food expenditure is approximately 54 percent. Rural households exhibit a greater significance in food consumption spending with households allocating about 65 percent of their income on food compared to peri-urban and core urban households which allocate about 58 percent and 47 percent on food respectively. Purchases consist the primary source of food in Kenya, accounting for about 80 percent of total food consumed. Rural areas rely heavily on purchased food having reported a substantial share of 74 percent of food consumption from purchases while personal production accounts for 20 percent. Rural

areas generally have a higher marginal propensity to consume than urban areas, while the marginal food budget is higher in urban Kenya than in rural Kenya.

Kenya has also been importing substantial quantities of food items to meet domestic demand as local food consumption is surpassing food production capacity. As a result, Kenya's import dependency rate for food products has been increasing overtime. In 2022, the dependency rate rose to about 16 percent from about 14 percent in 2021 (FAO, 2022). Maize, a staple food in Kenya that forms a significant part of the diet for many Kenyans, particularly in rural areas has seen a significant increase in imports over the last three years. Imports reached 793,751.5 thousand metric tonnes in 2022, up from 486,525 and 273,472.2 thousand metric tonnes in 2021 and 2020, respectively. This rise in imports highlights the persistent low local supply of this crucial food item. The combination of this relatively low supply of significant food items coupled with prevailing retail food prices has significantly impacted the prevalence and depth of food poverty, especially among poor households (Headey & Hirvonen, 2023).

Inflation has further exacerbated the affordability of food in Kenya with the annual Consumer Price Index (CPI) rising from about 6 percent in 2021 to about 8 percent in 2022 (Republic of Kenya, 2023). This increase was mainly attributed to the high food prices as food and non-alcoholic items make up over a third of the Consumer Price Index consumption basket which is about 33 percent of total household final monetary consumption expenditure. Consequently, these elevated food prices have consistently pushed overall inflation upwards. The CPI rose from an annual average of 80.2 in 2007 to 169.6 in 2016 mainly due to a steady increase in prices of food and non-alcoholic drinks, which more than doubled over the period, contributing to the present surge in

food prices in Kenya requiring households to spend more on food to maintain their desired consumption levels (Republic of Kenya, 2018). In 2022, Food and Non-Alcoholic Beverages index recorded the highest inflation rate of about 13 percent. Changes in dietary preferences have also led to increased rural household food expenditures as households may opt for more diverse and costly food items, purchasing food products which are more expensive than staple food items.

1.1.4 Factors Influencing Food Security

Various demographic, social, and economic dimensions influence food security (Ougo, 2022). The causes of food security include a complex interplay of demand-side and supply-side factors (Mbow et al., 2019). Demand-side factors include population growth, urbanization, and income levels. In contrast, supply-side factors include input prices, climate variability, rural infrastructure, agricultural investment, and market access by smallholder farmers. Various scholars have distinct thoughts regarding the relationship between population growth and food security. Malthus observed an inverse relationship between population and resources as the exponential growth of the population exerts pressure on the available resources, including food. Rapid population growth and urbanization strain resources such as agricultural land, making it difficult for food production to keep pace with the increasing demand, resulting in challenges in food distribution and access (Matuschke & Kohlern, 2014).

Additionally, climate variability also significantly influences the stability of the food production system. Increased frequency and intensity of droughts and floods threaten food stability locally and in the regional and global food market (FAO, 2015). Extreme weather conditions negatively affect food production in the country, contributing to

inflationary pressures on food prices. Rising inputs prices on products such as fertilizers and improved seeds continuously increase food production costs, forcing farmers to apply less than optimal amounts, adversely affecting and reducing productivity, thus putting pressure on food prices and food security levels (Boulanger et al., 2020).

Sustainable Development Goal 2, target 2a, highlights the need for increased investment in rural agriculture to enhance agricultural productive capacity in developing countries (United Nations, 2015). Moreover, rural infrastructure is also a crucial component of rural development and critical for sustainable poverty reduction and food security as it facilitates production, consumption, distribution, and trade, thus improving rural livelihoods (Turley & Uzsoki, 2019).

1.1.5 Efforts Geared Towards Enhancing Food Security in Rural Kenya

Various efforts have been geared towards enhancing food security by the National government, County governments, and different non-state actors. The National Agricultural and Rural Inclusive Growth Project (NARIGP) is one of the strategic initiatives put in place by the Government of Kenya in collaboration with the World Bank through the Ministry of Agriculture, Livestock, Fisheries, and Cooperatives aimed at fostering inclusive economic growth in rural Kenya by addressing challenges in the agricultural sector (World Bank, 2016). Through infrastructural advancements, value chain improvement support, and easier credit accessibility, NARIGP aims to develop sustainable agricultural strategies and increase rural farmers access to markets. The project supports adoption of modern agricultural technologies by providing training and resources for rural farmers to adopt improved crop varieties, efficient farming methods and mechanization where appropriate.

Through the National Irrigation Acceleration Programme (NIAP), the Kenyan government has also made significant investments in expansive water system consumption projects. For instance, the Galana-Kulalu irrigation scheme is a water system project that seeks to mitigate rainfall unpredictability, which regularly causes crop failures and food insecurity. Irrigation is becoming increasingly important for ensuring sufficient food supplies and better livelihoods for rural populations (Darko, Yuan, Hong, Liu, & Yan, 2015). Developing irrigation frameworks reduces reliance on rainfall, resulting in more reliable crop supplies. This approach has significantly contributed to consistent and increased agricultural output, ultimately strengthening food security.

The National Accelerated Agricultural Input Access Programme (NAAIAP) is an initiative that was incepted in 2008 by the Government of Kenya in collaboration with the Alliance for a Green Revolution in Africa (AGRA), the International Fund for Agricultural Development (IFAD), and Equity Bank, aimed to address food insecurity and poverty among resource-poor farmers by increasing access and affordability of essential agricultural inputs for smallholder farmers to improve agricultural production of staple foods at the household level (NAAIAP, 2014). By 2015, NAAIAP had disbursed over 502,469 input vouchers to 521,515 beneficiaries, resulting in the production of approximately 8.7 million bags of maize valued at KES. 18 billion across 40 counties (Mason, Wineman, Kirimi, & Mather, 2016). By 2016, NAAIAP had successfully reached 537,218 farmers, with a budget of KES 517 million, and as of 2018, the fertilizer subsidy program had distributed about 1.3 billion metric tons of fertilizer at a cost of KES 31 billion (Njagi & Carter, 2019). This initiative aligns with Kenya Vision 2030 objectives and continues to support smallholder farmers,

significantly enhancing food security and economic stability in rural areas (Sheahan et al., 2014).

Both the Kenyan government and international organizations have been actively involved in running food aid programmes. These initiatives primarily target individuals and communities facing acute food shortages, particularly during periods of severe drought. Kenya's National Drought Management Authority (NDMA) recognizes that social protection is a key element in addressing food insecurity and the vulnerability of chronically food insecure people. Accordingly, NDMA has implemented various social protection programmes aimed at reducing poverty and improving food security for vulnerable households. These programmes include the Hunger Safety Net Programme (HSNP), which provides cash transfers to poor households in arid and semi-arid regions, and programmes that target vulnerable groups such as orphans and vulnerable children, the National Safety Net Programme (NSNP).These programmes have served as a safety net for vulnerable populations, improving the livelihoods and resilience of the households to food insecurity.

Through the Kenya Rural Roads Authority (KeRRA), the Kenyan government has also played a noteworthy role in the construction, maintenance and management of the rural roads network in the country for sustainable socio-economic development (Nduati, 2017). SDG goal 9 focuses on accessibility in the rural areas (Mikou, Rozenberg, Koks, Fox & Quiros, 2019). Improving rural infrastructure has also played a crucial role in enhancing food security. Well-functioning rural infrastructure is a necessary condition for the stabilization of food prices. By enhancing infrastructure, post-harvest losses are minimized, and the efficiency of transporting goods to markets is improved. This

facilitates greater market access for rural farmers, thus increasing their income and food security. However, in 2018, Kenya's Rural Access Index was about 47 percent, meaning less than half of the rural population had access to all-season roads within 2 kilometers of their households (Iimi & Serajuddin, 2018).

To combat the challenges posed by climate change, efforts focusing on promoting climate-resilient agriculture and sustainable farming practices have been adopted. The Kenya Climate-Smart Agriculture Strategy (KCSAS) (2017-2026) recognized climate change as an emerging issue for food and nutrition security and advocated for adaptation interventions to build resilience of agricultural systems and adapt to climate change while minimizing Greenhouse gas emissions for enhanced food and nutritional security and improved livelihoods (Republic of Kenya, 2017). These diverse and interconnected initiatives collectively aimed at strengthening food security in rural Kenya, addressing the challenges that have historically contributed to hunger and malnutrition in rural areas.

1.2 Statement of the Problem

Food security is a fundamental human right and a critical indicator of a nation's well-being. As in many other developing countries, food security remain a paramount concern in Kenya due to its profound impact on public health, economic stability, and human development. Despite the constitutional provisions for the right to food in Kenya, the problem of food insecurity continues to persist, and the realization of the right to food is far from the reality. Kenya has implemented various policies, programmes, and initiatives to address food security challenges. These efforts include strategies such as the Kenya Climate Smart Agriculture Strategy (2017-2026), the

National Agricultural and Rural Inclusive Growth Project, the National Irrigation Acceleration Programme, National Accelerated Agricultural Input Access Programme and drought management strategies to curb drought emergencies at the national level. While these interventions have led to some progress, food security remains a stark reality for a substantial portion of the rural population.

In 2022, Kenya ranked 94th out of 121 nations in the Global Hunger index and 82nd out of 113 countries in the Global Food Security Index (Economist Impact, 2022). Annually, about 10 million people in rural households suffer from chronic food insecurity and poor nutrition, and around 29 percent of the population do not meet the minimum nutritional needs (Republic of Kenya, 2018). Food security enhances human capital development and productivity, breaking poverty cycles and reducing healthcare costs by preventing malnutrition-related illnesses. In turn, this strengthens agricultural productivity and stabilizes market supply chains, increasing consumer spending power and creating more investment opportunities, ultimately contributing to long-term economic stability.

The area of food security in Kenya has attracted the attention of few scholars. However, this study differs from theirs on contextual and period terms. Most reviewed studies have focused on the general determinants of household food security and very few looked into how these factors differ between male and female led households. Moreover, these studies may not be used to generalize Kenya's rural population since the results of the studies are regionally demarcated. For instance, Olala (2016) and Kamau (2023) focused on the determinants of household food security in rural Central

and Eastern Kenya and the tea zones of Kirinyaga Counties respectively reflecting localized perspectives thus limiting broader applicability.

Moreover, there also exist scanty literature regarding how various shocks to household welfare affect food security particularly in rural settings. The oversight of such critical factors undermines the thorough understanding of the dynamics that shape food security outcomes in rural Kenyan households. Although Mutinda (2015) focused on the determinants of household food security and food expenditures in rural Kenya the study used the KIHBS 2005/06 data. It was on this backdrop this study sought to investigate the determinants of food security among rural households in Kenya and the impact of gender differences on the prevalence of food security among rural households in Kenya using the latest KIHBS (2015/16) data.

1.3 Research Questions

The study sought to answer the following questions;

i. What are the determinants of food security among rural households in Kenya?

ii. What is the impact of gender differences on the prevalence of food security among rural households in Kenya?

1.4 Research Objectives

The overall objective of this study was to investigate food security among rural households in Kenya.

The study was guided by the following specific objectives;

i.   To examine the determinants of food security among rural households in Kenya.

ii. To examine the impact of gender differences on the prevalence of food security among rural households in Kenya.

1.5 Significance of the Study

This study is of significance to the Government of Kenya because it contributes to the achievement of the Kenya Vision 2030 Sustainable Development Goals (SDGs), precisely SDG No.2, which aims to eradicate hunger, achieve food security, improve nutrition, promote health and promote sustainable agriculture. It recognizes the importance of interconnections between sustainable agriculture, empowering small farmers, gender equality, rural poverty reduction, healthy lifestyles, climate change, and other goals within the 17 Sustainable Development Goals.

The study findings also inform the Ministry of Agriculture, Livestock, Fisheries, and Cooperatives decision making processes enabling them to design, implement and monitor the effectiveness of existing food security programmes and policies that address the underlying causes of food security among rural households. For instance, the ministry can prioritize and stimulate investments in irrigation infrastructure, agriculture extension services, market access initiatives and climate smart agricultural practices based on the identified significant determinants of food security.

Additionally, the study findings are of importance to the National Treasury as it oversees budget allocation and resource mobilization for government projects and programmes including those related to food security and agriculture. The study can

influence budgetary decisions and resource allocation priorities to support agricultural research and development, input and food subsidies and targeted social safety net programmes that protect rural populations from various shocks thus enhancing rural livelihoods and food security outcomes.

Studying household food security could also benefit various Non-Governmental Organizations (NGOs) and aid agencies working in the agriculture, rural and humanitarian development sectors such as World Food Programme(WFP), Food and Agriculture Organization (FAO), Action Against Hunger (ACF) and Oxford Committee for Famine Relief (Oxfam) as they can utilize the findings to inform their programming, resource allocation decisions and advocacy efforts, ultimately contributing to improved food security outcomes for rural populations.

The study will also act as a guide for future scholars, providing a foundation for further research on the household food security allowing for more in depth exploration of specific aspects.

1.6 Scope of the Study

The study aimed to investigate the determinants of food security among rural households in Kenya and to examine the impact of gender differences on the prevalence of food security among rural households in Kenya using the Kenya Integrated Household Budget survey dataset for 2015/16. The data was collected from a total of 24,000 households, drawn from 2,400 clusters, which included 1,412 rural clusters (60 percent) and 988 urban clusters (40percent). However, due to missing values, the total sample consisted of 21,773 households. There were 13,092 rural households and 8,681

urban households among these. As this study focused on rural Kenya, only the 13,092 rural households were considered. While the KIHBS 2015/16 survey covered all the 47 counties in Kenya, Mombasa and Nairobi counties were excluded from this study because they were considered wholly urban.

1.7 Organization of the Study

The remaining chapters are organized as follows: The second chapter discussed the theoretical and empirical literature review on food security among rural households in Kenya. The theoretical literature included an in-depth examination of key theories, and frameworks that are relevant to the research objectives. On the other hand, the empirical literature sought to uncover patterns, designs, and findings that have emerged from prior studies worldwide. The third chapter dealt with the research methodology which outlined the theoretical model of the study, empirical model specification, variables description, sources of data and diagnostic tests used in this study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section of the study provided a comprehensive review of the related theories, empirical studies and existing research gaps identified in the field of study. Section one examined the theoretical literature, exploring the theoretical perspectives that have shaped the understanding of food security. Section two looked into the empirical literature, which encompassed prior studies that have employed various research methodologies to investigate and validate the theories discussed in section one. Finally, section three provided an overview of the literature.

2.2 Theoretical Literature Review

2.2.1 Engel Curve Theory

Economic theory on household's food expenditure is mostly centered on the Engel curve approach. Engel's law, an economic theory developed in 1857 by economist Ernst Engel, is an empirical observation on how income and household expenditure patterns are correlated. According to Engel (1857), as a household's income increases, the percentage of income spent on food decreases while the proportion spent on other non-food products, such as housing, education, and other luxurious goods increases. Engel's Law is based on the hypothesis that as household income increases, basic costs like food expenditures take up less of their total spending. This is often because, compared to other items and services, food is regarded as a necessity and encompasses a lower income elasticity of demand. According to this phenomenon, the proportion of food demand in total expenditure decreases when households experience financial progress and higher average disposable incomes. This phenomenon, which portrays the

relationship between income and the percentage spent on food, is often referred to as the Engel curve.

Engel's Law has significant implications for understanding the structure of household consumption patterns (Clements & Si, 2017). It suggests that households tend to have more shifted consumption designs and allocate more resources to non-food items like housing, transportation, and recreation as the economy and income rise. Over the years this has been empirically evidenced in several other countries. Engel's Law offers a broad perception concerning income and expenditure patterns. Still, it's imperative to understand that the exact measure and shape of the Engel curve can vary significantly between nations, regions, and income levels since it depends on various demographic factors, including gender, age, and level of education. It also depends on other household characteristics (Vreyer, Lambert, & Ravallion, 2020).

Ideally, this theory is essential in understanding how income variations influence food demand. As income levels change, there is a corresponding substitution effect on the type and quality of food that people tend to consume. When individuals experience an increase in income, they are inclined to consume higher quality food (French, Tangney, Crane, Wang, & Appelhans, 2019). By understanding how income changes influence food demand, this study aims to help identify the income thresholds at which households can ensure reliable access to food.

Additionally, analyzing Engel curves can also provide insights that can guide policy recommendations based on income and food expenditure patterns. Despite rising income rural households still allocate a significant portion of their budgets towards food

expenses. This indicates that increasing incomes may not be sufficient in ensuring food security. In cases it becomes necessary to combine efforts such as increasing income levels or implementing social safety nets with measures that focus on the accessibility and affordability of food. By understanding the shifts in consumption patterns policy makers can develop programmes and policies that encourage diverse and nutritious diets which in turn contributes to improving overall food security.

While Engel curves are a valuable tool in understanding income and food expenditure patterns, there are a few shortcomings associated with the Engel curve theory. Engel curve theory assume that consumer preferences remain constant overtime while neglecting the diversity of tastes and preferences among consumer groups. This oversimplification fails to depict consumption patterns across various population groups. The Engel curve theory stands out as the most suitable framework for the current study due to its comprehensive consideration of various demographic, social and economic factors influencing household food security. By incorporating these diverse factors, the Engel curve theory provides a robust framework for understanding how income variations and various demographic and socio-economic factors influence food demand and expenditure patterns. Thus, it offers valuable insights into the complex interplay of social, economic and demographic factors affecting household food security.

2.2.2 Life Cycle Income Hypothesis

The life cycle income hypothesis is an economic theory that suggests that consumer spending is influenced by an individual's life stage and their expected future income rather than their current income (Ando & Modigliani, 1963). This hypothesis,

developed by economists Franco Modigliani, Albert Ando, and Richard Brumberg, proposes that individuals attempt to maintain a relatively stable standard of living by adjusting their consumption and saving behavior appropriately (Modigliani & Brumberg, 1954).

The Life Cycle Income Hypothesis model emphasizes on how saving could transfer purchasing power from one phase of life to another. Labour income is usually low in early life relative to later working years. Income typically peaks in the last part of the working life and then drops at retirement. Consumers who wish to smooth consumption would prefer to borrow during the early low-income years, repay those loans, build up wealth during the high-income years, and then spend off the accrued savings during retirement (Parker, 2010). In the later stages of life, as individuals approach retirement, their incomes often decrease, and they use their accumulated funds to sustain their desired consumption levels. According to the life cycle income hypothesis, individuals gradually spend their money to meet their consumption needs throughout retirement. This theory also acknowledges that individuals face uncertainty regarding their future income, health, and life expectancy. As a result, they may engage in precautionary saving over their working years to build up a safety net against unforeseen events and income fluctuations.

The levels of income for rural households are likely to vary with seasonal agricultural variations, employment opportunities, and general economic conditions. It's important to understand how these income variations and economic factors influence food consumption and overall food security in order to grasp the dynamics at play. According to the theory households tend to save during periods of higher income in

order to maintain a consistent standard of living in the future. In terms of food security, it becomes crucial to understand how Kenyan rural households allocate their income between food consumption and savings for purchases or activities that generate income. This understanding can provide insights into the role played by savings in mitigating food insecurity during low income periods. When their income isn't sufficient for maintaining a standard of living households might turn to borrowing or depleting their savings. Analyzing whether Kenyan rural households' resort to borrowing for meeting their food needs during low income periods and examining the implications this has on their food security is crucial. Accumulating levels of debt for fulfilling immediate food requirements can have long term consequences on household food security.

The Life Cycle Income Hypothesis theory acknowledges that different stages, within a person's life cycle involve varying patterns of both income and consumption. In this study, factors such as age, household size, and composition were considered to understand how they influence food security. For instance, households with young children or elderly members may have different food consumption needs and income sources. Age also play a significant role in the Life Cycle Income Hypothesis theory, as it acknowledges that individuals have varying income and consumption needs at different life stages. This study explored how age and household size/ composition affect food expenditure patterns. However, despite these considerations the theory may not fully account for the socio-economic dynamics specific to rural households in Kenya. As such, its inability to fully account these variables renders it less suitable for understanding food security dynamics within the context of rural Kenyan households.

While the Life Cycle Income Hypothesis is valuable for understanding household consumption behaviour, it has some notable weaknesses. It often overlooks incorporation of bequest motives and intergenerational transfers, which can significantly impact household's consumption and savings decisions. The desire to leave an inheritance for future generations can lead to different consumption patterns than those predicted by the hypothesis. Additionally, the theory assumes a steady and predictable income over an individual's lifetime which does not align with the uncertainties and fluctuations in income levels and employment opportunities, especially in the face of economic downturns, technological changes, or industry disruptions.

2.2.3 Permanent Income Hypothesis

The permanent income hypothesis (PIH) theory links an individual's consumption at any point in time to individual's total future income over his/her lifetime (Friedman, 1957). The PIH was authored by economist Milton Friedman in 1957. The two fundamental principles underlying this hypothesis are that individuals make consumption decisions based on their permanent income rather than their current income and that they seek to maintain their consumption levels by saving less during periods of low income and borrowing more during periods of high income (Aguiar & Hurst, 2008).

According to PIH temporary changes in income levels such as windfall gains and earning shocks are momentary occasions and do not significantly influence households long term consumption patterns since they would prefer to smooth out their consumption overtime. When individuals get an unexpected increment in income,

whether a bonus or inheritance, a substantial proportion of the additional income is saved or invested instead of increasing their consumption expenditures. Similarly, during economic recessions or periods of lesser income individuals may turn to borrowing to maintain their desired consumption levels (Jappelli & Pistaferri, 2010).

According to the PIH, individuals coherently base their consumption decisions on their expectations for future income and the soundness of their overall financial situation. This theory also considers individual's access to credit markets, which enables them to save or borrow money in reaction to fluctuations in their income (Kozlov, 2023). It is assumed that individuals dynamically modify their spending propensities in response to shifts in income, such as career advancements or increments in earning potential. Additionally, an individual saving rate is influenced by their level of income; the higher the permanent income that an individual earns, the more they are likely to save, and the lower the permanent income, the less one can save.

The PIH provides a comprehensive framework for estimating the determinants of household food security in rural Kenya by considering income dynamics, savings behaviour, access to credit and expectations about future economic conditions. However, it is essential to note that the PIH has faced criticism and improvement concerns over the years. Some critiques argue that individuals wouldn't be able to precisely predict their future income, borrowing and liquidity constraints may apply, or other factors can influence their consumption decision beyond the scope of the hypothesis. Specifically, it overlooks the significant impact of social factors such as shocks to household welfare, which often disrupt income stability and hinder households' ability to smooth consumption overtime. The PIH also overlooks the

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influence of various demographic variables which shape individuals' preferences, priorities and ability to allocate resources effectively thus influencing food security outcomes.

Therefore, while the PIH provides valuable insights into the economic determinants of household food security, it is crucial to integrate additional factors, such as social and demographic factors, to gain a more comprehensive understanding of food security dynamics in rural Kenya.

2.2.4 Keynesian Theory of Consumption

Keynesian consumption theory was created by the reknown economist John Maynard Keynes in 1937. It forms the basis of modern macroeconomics. In this theory Keynes emphasized on the importance of disposable income in determining how much consumers spend, including food expenditures. According to Keynesian consumption theory there are two factors that influence consumer spending; the marginal propensity to consume (MPC) and the average propensity to consume (APC). The MPC refers to the portion of income that individuals choose to spend on goods and services than saving it. Keynes put forward a psychological law of consumption, according to which, as income increases consumption increases but not by as much as the increase in income. In other words, marginal propensity to consume is less than one. Understanding the MPC can help identify the proportion of increased income that rural households allocate to food expenditures. This insight is valuable for assessing the resilience of households against food insecurity as their incomes fluctuate. On the other hand, the APC represents the proportion of income that individuals allocate for consumption. Keynes argued that as income increases people tend to save a portion than spending it

all resulting in a decrease in APC as income rises. This has implications, for food security policies and planning for needs.

The economic policy implications of Keynes's approach are fairly well known. The magnitude of the MPC determines the magnitude of government expenditures and tax multipliers and thus the effectiveness of fiscal policy (Drakopoulos, 2021). For instance, when the government invests more in development of rural infrastructure or programmes to support farmers it can create impacts that extend throughout the entire food supply chain. As a result, this can lead to increased food production, lower prices and improved availability of food for households in rural areas.

The Keynesian theory of consumption, while influential and valuable in understanding economic behavior, has its weaknesses and limitations. One of the main weaknesses is that the Keynesian consumption theory assumes a high degree of rationality and immediate adjustment of consumption to changes in income. In practice, behavioural economics has shown that individuals often exhibit bounded rationality and limited self-control, leading to deviations from the predictions of the Keynesian model.

The Keynesian theory of consumption emphasizes on the relationship between disposable income and consumer spending which supports the study by highlighting how income levels impact household food expenditures. Specifically, it highlights how variations in disposable income can affect the ability of households to purchase food products, thus directly impacting food security. However, the Keynesian theory may fail to capture the complex reality of rural households in Kenya, where income levels can vary widely and consumer spending behaviour is also significantly influenced by a

myriad of other demographic, social and economic factors. Therefore, to gain a more comprehensive understanding of food security dynamics in the rural context, it is essential to consider the interplay of these aforementioned factors beyond just disposable income.

2.3 Empirical Literature Review

Several studies on the determinants of household food security have been conducted in both developed and developing economies. Studies like Sekhampu (2013) study looked into households' food security in the South African township of Bophelong. This study was based on a questionnaire-based household survey. Based on these data, a logistic regression model was constructed with the household food security status (food secure or insecure) as the dependent variable and demographic characteristics as explanatory variables. Findings revealed that around 26 percent of the studied households were food secure. Further investigation revealed that household income, household size, marital status, employment status, age, and gender of the household head were all significant factors influencing food security. While other variables had a positive impact on food security, household size and the marital status of the household head were negatively associated with food security. The estimated results also indicated that household head's educational attainment did not play a crucial role in explaining the variation in household food security status. While the study identified significant demographic characteristics influencing food security status, it failed to capture some of the broader socio-economic factors that contribute to food insecurity. Factors such as access to credit, food prices, and various shocks to household welfare could significantly assess the household food security status but are not adequately addressed in the study. To

address this gap, the study included the aforementioned factors in its analysis to provide a more comprehensive understanding of the determinants of household food security.

Abafita & Kim (2014) investigated the factors influencing food security in Ethiopian rural households. Using the most current Ethiopian Rural Household Survey dataset the study utilized two measures of household food security: a self-reported food security status and a multidimensional index created using principle components analysis. First, Ordinary Least Square regressions were used to identify relevant factors based on the two measurements while disregarding endogeneity concerns. Subsequently, to account for endogeneity difficulties the authors performed an Instrumental Variable (IV) estimate test. The findings revealed that household food security was strongly and positively related to the age and education of the household head, rainfall adequacy, livestock possession, participation in off-farm activities, soil conservation practices, and per capita consumption expenditure while access to credit and remittance had a negative impact on household food security. The study findings suggested that an effective combination of interventions aimed at boosting off-farm activities, education, training, and extension services, enhancing livestock output and creating awareness of better and more productive uses of resources like credit in the rural areas could contribute to boosting household food security. However, this study overlooked crucial variables such as income, household size and food prices and the study's findings may not fully capture variations in food security determinants and status in Kenya's rural regions as Ethiopia is a diverse country with varying geographical, agro-ecological zones and socio-economic contexts.

Mango, Zamasiya, Makate, Nyikahadzoi & Siziba (2014) study focused on factors influencing household food security among smallholder farmers in Zimbabwe's Mudzi district. The authors employed a standardized questionnaire to collect data from 120 randomly selected households. The analytical methodologies employed in the study included descriptive statistics to outline the characteristics of the respondents and Ordinary Least Squares (OLS) regression analysis to establish the factors influencing household food security. The study's findings indicated that the age and education of the household head, household labour, household size, animal ownership, access to market information, and remittances all positively and significantly impacted household dietary diversity. Through linear regression on the explanatory variables based on the Household Food Insecurity Access Score (HFIAS), labour, education of the household head, household size, remittances, livestock ownership, and access to market information all affected household food security. Specifically, the study suggested that for the government and other development organizations to improve food security among smallholders they should encourage labour-saving technology, increase remittances to rural areas, improve access to market information, and educate small-holder farmers. However, this study failed to capture marital status of the household head and access to credit a coping strategy that households often resort to in periods of economic downturns so as to maintain their consumption levels.

Mutinda (2015) study investigated the determinants of household food expenditure and food security in rural Kenya. The study utilized the Kenya Integrated Household Budget Survey 2005/06 secondary data obtained from the Kenya National Bureau of Statistics. The study's specific objectives were to investigate rural Kenya expenditure patterns, to establish the food security status in rural Kenya, and to determine how household food

expenditure influences food security in rural Kenya. The ordinary least squares were used to estimate the association between the variables under consideration, and the data was analyzed using Stata. At the 5 percent level of significance, the findings revealed that the education level of the household head, household size, and household income level were all positive and statistically significant in affecting food expenditure. However, while the study acknowledged significant factors like the education level of the household head and gender it relied on an older dataset and therefore it lacked examination of various pertinent factors that influence food security outcomes. This study built on this research by analyzing the most current 2015/16 dataset to explore if any other factors influence household food expenditure and food security in rural Kenya.

Mutea, Bottazzi, Jacobi, Kiteme, Ifejika Speranza & Rist (2019) conducted a study exploring the link between food security and livelihood characteristics within rural households in the North-Western Mount Kenya Region. The study involved 600 randomly selected households from three agro-ecological zones situated near large-scale agricultural investments in Kenya's Mount Kenya region. Utilizing the Ordinary Least Square (OLS), the authors assessed the livelihood characteristics that substantially impact food security. The findings revealed a significant relationship between the composite Food Security Index (FSI) score and each classical measure as determined through Spearman's rank-order correlation and the student's T-test. Additionally, 32 percent of households were classified as food secure, while the remaining 68 experienced food insecurity. The estimation results in this study indicated that household ownership of productive hand tools, off-farm income, consumption of self-produced food, agro-ecological zone, farm income, and several critical crops

afflicted by pests had a positive and significant impact on food security while household size, available land size, and household members' engagement in substantial agricultural investments as wage labourers or sub-contract farmers had an insignificant impact on food security. However, the findings derived from this study may not be fully generalizable to the broader rural populations beyond the confines of the North-Western Mount Kenya Region owing to variations in socio-economic conditions and demographic characteristics across different rural regions in Kenya. Therefore, the author included all rural regions in Kenya to fill this gap.

A study investigating food security status and food security drivers among households in Nsukka, Enugu State, Nigeria was done by (Sidique & Muhammad, 2019). Using the expenditure approach of determining food security status, the study revealed that approximately 60 percent of households experienced food insecurity. In a subsequent analysis using the binary logistic regression approach income and the age of the household head were revealed as key factors influencing food security, they have a favorable impact on food security, meaning that gainfully employed people and older family heads are more likely to be food secure. Among other recommendations, the authors advocated for policies that can promote a decent business environment for the rural and urban poor. Despite its strengths, the study was limited to a specific region in Nigeria and lacked a detailed analysis of various pertinent independent variables, such as shocks to household welfare, education level of the household head and access to credit. Including these variables could offer more comprehensive insights into household food security status.

Abdullah, Deyi, Sajjad, Waqar, Izhar Ud & Aasir (2019) used a binary logistic regression approach to analyze factors affecting household food security in the rural northern hinterland of Pakistan. This study used the random sampling technique data to collect data from 294 rural families. The findings of the study revealed that some factors including age, gender, education, remittances, unemployment, inflation, assets, and disease were critical determinants in determining household food security. Notably, gender played a significant influence on food security, with female-headed households experiencing food insecurity while male-headed households demonstrated food security. The study's authors concluded that implementation of policies should be prioritized to promote education, place a greater emphasis on female-headed households, and stimulate the inflow of remittances. However, this study was limited to a specific rural region in Pakistan and lacked detailed analysis of various factors such as income, household size and shocks to household welfare that often disrupt households' food systems stability.

Omotayo & Aremu (2020) study investigated the socio-economic and food security status of South Africa's North West Province households. The study relied on data on food security and indigenous plants acquired from a small number of rural households in South Africa's North West Province. The data was obtained through a multi-stage sampling strategy. The authors employed descriptive methods and Foster-Greer-Thorbecke (FGT) along with binary logistic regression to analyze the acquired data. The models demonstrated a good fit for the data and the estimated F-value was statistically significant ($p < 0.01$). The incidence of food insecurity was determined to be 0.4060, signifying that about 41 percent of individuals were food insecure, while about 59 percent were food secure. The binary logistic regression results indicated that

factors such as, age, gender, educational status, indigenous plants incorporation in diet, food expenditure, and study area accessibility all had a significant impact on food security. The authors suggested that appropriate holistic policies should be developed to encourage the introduction of indigenous plants into the rural households' food chain. However, the interpretation and generalizability of these findings may not be applicable to the rural regions of Kenya given that the sample size used is not representative of Kenya's rural regions due to various geographical, demographic and socio-economic disparities.

Udaykumar, Umesh & Gaddi (2022) study sought to investigate the food consumption patterns, food security status, and the factors influencing food security in the Northern area of Belanguru in Karnataka, India. The study revealed that, among diverse types of consumption, grains were used the most commonly used across households with diverse characteristics. Cereals constituted the primary source of calories consumed for rural households with overall consumption substantially lower in the rural areas. The total energy derived from diverse food products was highest in the urban region (2491.90 Kcal/capita/day), followed by the peri-urban areas (2415.82 Kcal/capita/day) and rural areas (2383.28 Kcal/capita/day). The Simpson Index of Dietary Diversity was more significant in urban households (0.81), followed by peri-urban areas (0.80) and rural areas (0.77). Urban areas had the most significant percentage of food-secure households (76.25%), followed by peri-urban (63.75%) and rural (58.75%) areas. OLS regression analysis revealed that education, monthly household income, and urbanization were all significant drivers of food security. Based on the findings the study recommended the enhancement of existing food security programmes and emphasized the importance of raising household awareness about maintaining a

balanced diet through diversifying production, income, and consumption patterns. Despite these noteworthy findings, the study was limited to the Northern Belanguru area in Karnataka, India and relied on the household caloric acquisition method as a proxy measure of Food Security Index (FSI) which solely focuses on the amount of food available within the household thus did not satisfactorily account for issues related to food accessibility, affordability and utilization.

Kolog, Asem & Mensah-Bonsu (2023) estimated the factors of food security in Ghana's Upper East area utilizing data collected from 405 rural households. The analysis employed descriptive statistics and ordered Probit regression. The study utilized two measures of household food security; the Household Hunger Scale (HHS) and the Household Food Security Access Scale (HFIAS). Based on the two food security measures the findings revealed that education status of the household head, farm size, access to credit, and the accessibility of extension services were all significant drivers of household food security. Factors such as household size, access to good road infrastructure, access to formal cooperatives and jobs availability were found to be significant determinants of household food security as measured by the Household Food Security Access Scale (HFIAS). Additionally, the gender of household head and proximity to markets were found to be significant determinants of food security according to the Household Hunger Scale (HHS) model. To combat food insecurity, the study recommended initiatives such as improved education, enhanced social infrastructure including improved roads and markets as well as support services such as credit and extension programs. However, the study was limited to Ghana's Upper East area and was more inclined on the Household Hunger Scale (HHS) and the Household Food Security Access Scale (HFIAS) food security measurement scales

which majorly rely on subjective assessments and composite indices and did not adequately describe the household food expenditures which offer a more practical and quantitative measure of households' ability to access and afford food.

2.4 Overview of the Literature

Reviewed literature on the determinants of food security among rural households revealed there is a need for empirical studies that establish the determinants and prevalence of food security among rural households in Kenya from a gender perspective. Several studies conducted in Kenya and other developing countries had mainly established the determinants of food security among rural households in general. Studied factors only gave a connection between the predictor variables and the dependent variable and failed to say anything about the disparities in the prevalence of food security among distinct male and female headed households.

For instance, studies conducted outside Kenya (Sekhampu (2013) and Omotayo & Aremu (2020) in South Africa; Abafita & Kim (2014) in Ethiopia; Mango, Zamasiya, Makate, Nyikahadzoi & Siziba (2014) in Zimbabwe; Siddique & Muhammad (2019) in Nigeria; Abdullah, Deyi, Sajjad, Waqar, Izhar Ud & Aasir (2019) in Pakistan; Udaykumar, Umesh & Gaddi (2022) in India; Kolog, Asem & Mensah-Bonsu (2023) in Ghana) had primarily examined the determinants of food security among rural households in general terms, without analyzing how these determinants vary between male-headed and female-headed households. Similarly, studies conducted in Kenya had either analyzed the determinants of food security in general (Mutinda, 2015), or established the linkage between food security and livelihood characteristics (Mutea, Bottazzi, Jacobi, Kiteme, Ifejika Speranza & Rist, 2019). This brought to light the

limited empirical studies on the gender disparities on the prevalence of food security across the globe.

The empirical literature review encompassed several studies investigating the determinants of household food security across various regions and contexts. Common determinants included demographic characteristics like the age, education level, and gender of the household head; socio-economic factors such as household income, household size and access to credit; and environmental factors including rainfall adequacy and agricultural practices. Studies consistently found that higher household income and employment status significantly enhanced food security, with gainfully employed household heads being more likely to ensure food security (Sekhampu, 2013; Siddique & Muhammad, 2019). Conversely, larger household sizes were found to negatively impact food security due to resource constraints (Sekhampu, 2013; Abafita & Kim, 2014).

The education level of the household head also played a critical role, positively influencing food security by enhancing employment opportunities and decision-making capabilities (Abafita & Kim, 2014; Mango, Zamasiya, Makate, Nyikahadzoi & Siziba ,2014; Mutinda, 2015). Access to credit showed mixed results, it positively impacted food security by providing necessary capital for investments, but also had negative effects due to mismanagement or high-interest rates (Abafita & Kim, 2014; Kolog, Asem & Mensah-Bonsu, 2023). Agricultural practices and asset ownership, such as livestock and agricultural tools, significantly enhanced food security by diversifying income sources and improving productivity (Mango, Zamasiya, Makate, Nyikahadzoi & Siziba, 2014; Mutea, Bottazzi, Jacobi, Kiteme, Ifejika Speranza & Rist, 2019).

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Marital status and the gender of the household head were also important, with female-headed households often experiencing higher levels of food insecurity due to socio-economic disadvantages (Sekhampu, 2013; Abdullah, Deyi, Sajjad, Waqar, Izhar Ud & Aasir (2019).

Studies by Omotayo & Aremu (2020); Mutinda (2015); Mutea, Bottazzi, Jacobi, Kiteme, Ifejika Speranza & Rist (2019); Mango, Zamasiya, Makate, Nyikahadzoi & Siziba (2014) ; Abafita & Kim (2014) and Sekhampu (2013) closely aligned with the current study's focus as they examined various pertinent demographic and socio-economic factors such as age, education level and marital status of the household head, household income, household size and access to credit relevant to understanding household food security dynamics. However, these studies did not consider food prices and various shocks to household welfare, which could significantly affect the overall resilience and stability of the households in diverse circumstances.

There were variations in the scope of the reviewed studies. With the exemption of Mutinda (2015), all studies reviewed were geographically limited to specific rural areas. The geographical limitations of these studies could impact the generalizability of their findings to broader rural populations. Unique socio-economic and demographic dynamics can present distinct challenges that were not fully captured in the geographically confined studies. To fill this gap the study used a nationwide survey that expanded the research scope by including a more diverse set of rural regions in Kenya, providing a more holistic understanding of the determinants of food security and enabling the development of more robust and context specific policy recommendations

and interventions to address the challenges associated with food security at rural household level.

Methodologically, the studies reviewed employed various estimation techniques to establish the determinants of food security. These included, logistic regression (Omotayo & Aremu (2020); Sekhampu (2013); Siddique & Muhammad (2019); Abdullah, Deyi, Sajjad, Waqar, Izhar Ud & Aasir (2019)), ordered Probit regression (Kolog, Asem & Mensah-Bonsu (2023)) and Ordinary Least Squares regression (Mutinda (2015); Udaykumar, Umesh & Gaddi (2022); Mutea, Bottazzi, Jacobi, Kiteme, Ifejika Speranza & Rist (2019); Abafita & Kim (2014); Mango, Zamasiya, Makate, Nyikahadzoi & Siziba (2014)). This study utilized the logistic regression model because it provides stable results and valuable insights into the relationship between predictor variables and the probability of a given outcome occurring (household being food secure or food insecure).

Studies conducted in Kenya to investigate the determinants of food security utilized data from 2005/06 Kenya Integrated Household Budget Survey (KIHBS). This study used the most current KIHBS 2015/16 dataset. This dataset was chosen due to its incorporation of under-researched variables of interest, such as shocks to household welfare which are crucial for understanding the dynamics and determinants of food security within rural households.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlined the study's theoretical model, empirical model specification, description of variables, sources of data, and diagnostic tests used in this study.

3.2 Theoretical Framework

Examining how households allocate their income to food expenditures relative to their total expenditures provide insights into food demand dynamics within the rural population. This study was based on the Engel curve theory which illustrates how the demand for a particular good change as consumer income varies assuming all other factors, such as prices and consumer preferences, remain constant. Following Leser (1963) the basic engel curve equation was illustrated as follows;

$$Q=f(Y)………………………………………………………………… (3.1)$$

According to the Engel curve theory as household income increases the proportion of income allocated to food expenditures decreases, although the absolute expenditure on food may increase. This phenomenon reflects Engel's Law which suggests that initially, households allocate a significant portion of their income to basic necessities such as food. However, as household income increases households tend to diversify their consumption patterns incorporating diverse and higher quality food items into their diets.

In this study quantity demanded proxied the demand for food items, while income served as a determinant factor influencing food demand and consumption behaviours. The Engel curve for food expenditures is expressed as follows;

$Q_f = f(y)$ ……………………………………………………. (3.2)

Where Q_f represents the quantity of food demanded, y denotes household income and the functional form f(y) denotes how the quantity demanded for food changes as income varies across different income levels.

While income plays a significant role in shaping food consumption patterns, other economic, demographic, and social factors contribute significantly to a household's food security status. Working (1996) and Lesser (2017), placed a greater emphasis on inclusion of various additional correlates that are anticipated to be related to the quantity of food demanded rather than income. Therefore, this study was guided by the Working-Leser Engel curve specification for food expenditures model which built upon the traditional Engel curve framework by incorporating additional variables to capture demographic characteristics, regional variations, and other factors influencing food consumption behavior. To account for these factors, the Engel curve was extended to include demographic, economic, and social factors, all of which were denoted as M. The modified equation is represented as follows;

$Q_f = f(y, M)$ …………………………………………………. (3.3)

Demographic factors provide insights into the composition and structure of the household population. Demographic variables included in the study are age, gender, education level, marital status, and household size as they significantly influence decision making processes, resource allocation, and labour participation within the household. Economic factors included in the study are income, food prices and access to credit as they directly affect households purchasing power and food affordability. Additionally, social factors highlight the vulnerability, resilience and adaptive

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capabilities of households in response to unexpected events that may disrupt household well-being.

The study also considered economic, social and environmental shocks to household welfare. Following Mutea et al. (2022), economic shocks included livestock death, non-agricultural business failure, loss of salaried employment or nonpayment of salary, large falls in crop sale prices, significant rises in food prices, and increases in agricultural input prices. Social shocks encompassed livestock theft, the end of external assistance or remittances, birth in the household, the death of a household head or working member, death of other family members, household break-ups, breadwinner imprisonment, robbery or carjacking, dwelling damage, eviction, conflicts, ethnic clashes, and HIV/AIDS. Environmental shocks included fire incidents, droughts or floods, crop diseases or pests, and severe water shortages. Each shock was recorded as a binary variable, indicating whether or not the household experienced the event.

Acknowledging the multidimensional nature of food security, this study considered a case where households have either demanded food or not. This distinction translated into a binary model that categorized households into food-secure and food-insecure groups based on their demand for food and food expenditure behaviours.

Therefore, the functional analytical model for this study was specified as follows;

$$\Pr(Z_i=1) = F(\alpha+\beta X+\gamma W+\delta S) \dots\dots\dots\dots\dots\dots\dots\dots\dots (3.4)$$

Where:

Z= Household food security (Z_i=1 if the household is food secure and 0 if the household is food insecure)

X = a set of demographic factors such as age, gender, education level, marital status, and household size.

W = a set of economic factors such as income, food prices and access to credit.

S = a set of shocks to household welfare related variables.

α, β, γ, and δ = Parameters that capture the relationships between the predictor variables and the likelihood of households being food secure.

F(.) = Logistic distribution function that ensures estimated probabilities range between 0 and 1.

3.3 Model Specification

In this study the dependent variable, household food security status, was dichotomous in nature. Given the bounded nature of the dependent variable this study had two applicable models namely, the Probit and logit models. This study employed the logistic regression model, as it provides more stable results and valuable insights into the relationship between the predictor variables and the probability of a given outcome occurring (the likelihood of a household being food secure or insecure).

Thus, the binary logistic model for this study is specified as follows;

$$Z_i = F\ (X_i\ \beta + \varepsilon)\ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\ (3.5)$$

Where Z_i represent the binary dependent variable food security (Zi=1 if the household is food secure, and Zi=0 if the household is food insecure), β identifies the vector of parameters to be estimated, X_i is the vector of predictor variables that influence household food security, and ε represent the unobserved predictors not included in the model.

Objective 1: To examine the determinants of food security among rural households in Kenya.

To address the first objective, the following empirical model was derived from the binary logistic regression model above;

$Z_i = \beta_0 + \beta_1 inc_i + \beta_2 age_i + \beta_4 educ_i + \beta_5 hsize_i + \beta_6 fprice_i + \beta_7 credit_i + \beta_8 marital_i + \beta_9 shocks_i + \varepsilon_i$ .... (3.6)

Where;

Z_i =Household food security status

age_i =Age of household head

inc_i =Household income

$hsize_i$ =Household size

$educ_i$ =Education status of household head

$fprice_i$ =Food prices

$marital_i$ =Marital status of household head

$credit_i$ =Access to credit

$Shocks_i$ =Shocks to household welfare

ε_i =Stochastic error term

β_1-β_9 =regression coefficients

Objective 2: To examine the impact of gender differences on the prevalence of food security among rural households in Kenya.

To examine how the gender of the household head influences food security in rural Kenya, the study estimated the effects of gender of the household head on rural Kenya household's food security status, controlling for a set of household demographic and socio-economic characteristics.

Previous studies have often combined data from both male-headed households (MHHs) and female-headed households (FHHs) and then estimated a gender dummy coefficient using a pooled regression approach. However, a significant drawback of the pooled regression approach is its assumption of a homogeneous slope coefficient (Adjei-

Mantey et al., 2022). Implying that, it assumes that MHHs and FHHs will experience the same effects of covariates on food security. This assumption may not hold in rural Kenya, where gender roles and access to resources differ significantly between male and female household heads.

Therefore, this study ran separate logistic regressions for MHHs and FHHs to address this limitation. This method is considered superior as it accounts for how gender influences food security while considering other covariates affecting a household's likelihood of being food secure. Specifically, following Kassie et al. (2014), separate regressions were run for MHHs if the gender of the household head was 1, and for FHHs if gender of the household head was 0, as follows;

$$Z_m = F\ (X_m\,\beta_m + \varepsilon_m)\ \text{if g=1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3.7)}$$

$$Z_f = F\ (X_f\beta_{f\,+}\ \varepsilon_f)\ \text{if g=0} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3.8)}$$

Where z represents food security, g denotes the gender of the household head (taking the value of 1 for MHHs and 0 for FHHs), and subscripts m and f represent male headed households and female headed households respectively. X_m and X_f are vectors of explanatory variables that influence food security, β_m and β_f are the coefficients to be estimated and ε_m and $\varepsilon_{f\,are}$ stochastic error terms.

The gender food security gap was calculated as the difference in the mean predicted probabilities of food security derived from the aforementioned separate regression equations for male headed and female headed households.

3.4 Variable Description and Measurement

3.4.1 Dependent Variable in this Study

Household food security: The study assessed household food security using the Food Insecurity Experience Scale (FIES), which consists of eight questions regarding household self-reported food-related behaviors or experiences over the past 12 months. These questions were derived from the 2015/16 Kenya Integrated Household Budget Survey, which included a section on food security. This set of questions was deemed suitable for assessing food security among rural households in Kenya, as it aligned with the Food Insecurity Experience Scale developed by the Food and Agriculture Organization (FAO).

Based on the responses and frequency of occurrence per question, the households were grouped in to four food security levels. They were classified as food secure if the respondents answered no to all questions (qa1 through qa8), mildly food insecure if respondents answered yes to any of the first three questions (qa1, qa2, or qa3) , moderately food insecure if the respondents answered yes to any of the questions qa4, qa5, or qa6, and no to qa7 and qa8 and severely food insecure if the respondent answered yes to either qa7 or qa8.

However, for this study only two classifications of household food security were used, food secure if classified by FIES as food secure or food insecure if classified by FIES as mildly food insecure, moderately food insecure, and severely food insecure since the statistical method applied was logistic regression and requires only binary groups of the

dependent variable. The dependent variable was coded as follows: Household food security status (1 = food secure, 0= food insecure).

3.4.2 Independent Variables in this study

Table 3.1: Description of Predictor Variables

Variables	Definition	Measurement
Income	This variable represented the household's total income, encompassing earnings from both labour-related activities and non-labour sources.	1= Household received income; 0 otherwise.
Age	This variable captured the age of the household head in years.	Continuous variable
Gender	This variable indicated the gender of the household head.	1 =Household head was male; 0 = otherwise
Education level	This variable captured the highest level of education the head of the household attained. Dummies were used to capture the level of education, that is, those with no formal education to primary, secondary, tertiary, graduate, and postgraduate levels.	1 =Household head had no formal education; 0 otherwise 1=Household head had primary education; 0 otherwise 1=Household head had secondary education; 0 otherwise 1=Household head had tertiary education; 0 otherwise 1= Household head had graduate education; 0 otherwise

		1= Household head had postgraduate education; 0 otherwise
Household size	This variable represented the total number of individuals living within the household.	Continuous variable.
Access to credit	This variable indicated whether the household had access to credit formally through financial institutions or informally through community sources.	1=Household had access to credit; 0 = otherwise
Marital Status	This showed the marital status of the household head. Dummies were used to represent those that are married, single and never married.	1 = Household head was married; 0= otherwise 1 = Household head was single; 0 = otherwise 1 = Household head was never married; 0 = otherwise
Shocks to household welfare	This variable captured unexpected events or incidents affecting the availability, affordability, or accessibility of food for the household. Dummies were used to capture social, economic and environmental shocks.	1 = Household experienced social shocks; 0 = otherwise 1 = Household experienced economic shocks; 0 = otherwise 1= Household experienced environmental shocks; 0 = otherwise
Food prices	This variable captured the cost of food items or the general price level of food typically measured as the price of a food basket, reported in Kenyan Shillings (KES).	Continuous variable

3.5 Data Type and Source

This study used the 2015/16 Kenya Integrated Household Budget Survey cross section data collected by the Kenya National Bureau of Statistics (KNBS). The collection was conducted for 12 months to capture seasonality from September 2015 to August 2016. The sampling frame for the 2015/2016 Kenya Household Integrated Budget Survey was based on the fifth National Sample Survey and Evaluation Programme (NASSEP V), which was designed in 2010. The study included 2,400 randomly selected primary sampling units known as clusters, of which 1412 were rural, and 988 were urban. A random sample of 10 households was chosen randomly from each cluster, yielding a national sample size of 24,000 households. However, due to missing values, the total sample consisted of 21,773 households. There were 13,092 rural households and 8,681 urban households among these. As this study focused on rural Kenya, only the 13,092 rural households were considered. However, it is important to note that Mombasa and Nairobi counties were exempted from the rural stratum as they were considered to be wholly urban.

3.6 Diagnostic Tests

Various diagnostic tests were conducted before the empirical estimation of the model to ensure reliability in the study findings. These tests included normality, multicollinearity and heteroscedasticity tests.

3.6.1 Normality Test

A normality test was conducted to determine whether the residuals of the model followed a normal distribution. Normality test is essential as it determines whether the study should adopt a linear or non-linear model (Jarque & Bera, 1987). Normality can be assessed through visual methods, such as graphs, and formal statistical tests. The

Shapiro-Wilk test evaluates whether a sample comes from a normally distributed population and is particularly suitable for small sample sizes while the Jarque-Bera test combines skewness and kurtosis to test for normality and is suitable for larger sample sizes (Mishra et al., 2019). This study employed the Jarque-Bera test to assess the normality assumption. The decision to carry out the Jarque-Bera test was informed by the large sample size of the used data. The null hypothesis for the normality test, under Jarque- Bera test, is that the series is normally distributed (Ghasemi & Zahediasl, 2012). Rejecting the null hypothesis implies that the residuals are non-normal.

3.6.2 Multicollinearity Test

Multicollinearity relates to a situation where two or more independent variables in a regression model are highly correlated, making it difficult to distinguish the individual effects of these variables on the dependent variable (Kim, 2019). It can arise due to model misspecification or the inclusion of highly related variables in the regression model. Multicollinearity often leads to unstable and imprecise parameter estimates, unbiased estimates, and insignificant coefficients, making it challenging to interpret the significance of individual independent variables and thus reducing the overall predictive power of the model (Daoud, 2017).

This study used the Variance Inflation Factor (VIF) to detect the presence and severity of Multicollinearity. A VIF greater than or equal to 10 suggests the presence of Multicollinearity among variables. The null hypothesis (H0), under VIF, is that there is no multicollinearity among the independent variables in the regression model. Should

the null hypothesis be rejected, corrective measures such as such dropping the highly correlated independent variables were to be employed.

3.6.3 Heteroscedasticity Test

Heteroscedasticity occurs when the error term's variance changes with the magnitude of the explanatory variables (Williams, 2015). It can occur due to the omission of relevant variables, including irrelevant variables, data manipulation issues, or outliers in the data. Heteroscedasticity violates the assumption of homoscedasticity, leading to biased and inconsistent standard errors (Cleasby & Nakagawa, 2011). This affects the reliability of the statistical tests, making some of the variables appear statistically significant when they are not.

This study used the Breusch-Pagan test to test for heteroscedasticity. The null hypothesis (H0) posits that there is no heteroscedasticity present in the residuals, suggesting that the variance of the error term remains constant across all levels of the independent variables while the alternative hypothesis (H1) proposes that heteroscedasticity is present in the residuals, indicating that the variance of the error term varies with the magnitude of the independent variables. To correct for heteroscedasticity, the study adopted robust standard errors.

3.7 Estimation Technique

In this study, the researcher utilized the logistic regression model, commonly known as logit model. The logit model was chosen for its suitability in analyzing binary outcome variables which aligns with the nature of the dependent variable in this study, providing insights into the probability of a household being either food secure or food insecure based on given predictor variables.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the data analysis, discussion and interpretation of the results on the determinants of food security among rural households in Kenya and the impact of gender differences on the prevalence of food security among rural households in Kenya. It includes the summary statistics, normality, multicollinearity and heteroscedasticity tests as well as the logistic regression results.

4.2 Descriptive Statistics

Table 4.1 and 4.2 describes the summary statistics of the variables used in the study. It presents the mean, standard deviation, maximum and minimum values of the variables under study.

Table 4.1: Summary Statistics of Qualitative Variables

Variable	Observation	Mean
Marital status		
Marital status (Household head is married=1)	3,043	0.6960
Marital status (Household head is single=1)	3,043	0.2113
Marital status (Household head is never married=1)	3,043	0.0927
Education		
No education (Household head has no education=1)	2461	0.0081
Primary Education (Household head has primary education=1)	2461	0.5286
Secondary education (Household head has secondary education=1)	2461	0.2816
Tertiary education (Household head has tertiary education)	2461	0.1239
Graduate (Household head is a graduate=1)	2461	0.0488
Post graduate (Household head has postgraduate education=1)	2461	0.0089
Income (Household received labour and non labour income=1)	13,092	0.0499
Credit (Household could access credit=1)	13,092	0.0472
Shocks to household welfare		
Social shocks (Household experienced social shocks=1)	13,092	0.1632
Economic shocks (Household experienced economic shocks=1)	13,092	0.2644
Environment shocks (Household experienced environmental shocks=1)	13,092	0.5538

Source: Author's computations based on data from the Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

From table 4.1 above education level of the household head was explored and established that approximately 0.81 percent of household heads had received no formal education, while the majority, accounting for around 52.86 percent, had attained primary education. The higher attainment of primary education can be attributed to the accessibility of primary education in Kenya, bolstered by initiatives such as Free Primary Education (FPE). This policy abolished tuition fees which has been particularly beneficial in rural areas where poverty rates are higher, and families often struggle to afford school fees thus significantly reducing the financial burden on families and increasing school enrollment rates (Opata & Wesonga, 2016). Secondary education was prevalent among approximately 28.16 percent of household heads. This can be attributed to Kenya's government commitment to expanding access to education beyond primary level through initiatives like the Free Secondary Education (FSE) policy which reduced tuition fees and significantly increased enrollment, retention and completion rates in secondary schools (Wanjala & Hussein, 2017).

Tertiary education accounted for about 12.39 percent of the sample. Additionally, approximately 4.88 percent of household heads were classified as graduates while roughly 0.89 percent had achieved postgraduate education, representing the highest educational attainment within the sample. Pursuing graduate and post graduate education requires significant financial resources and can be more affordable when utilizing available financial aid options. However, limited knowledge regarding financial resources available to pursue such studies limits access for the rural population (Kennedy et al., 2016). This lack of awareness about available financial aid options perpetuates the cycle of low graduate and post graduate education attainments among rural populations.

Marital status among household heads was explored and it was established that approximately 69.60 percent of household heads were classified as married, including those in monogamous and polygamous marriages, as well as those living together. The high proportion of married household heads may be due to the societal and cultural importance of marriage in rural areas (Lowe, Joof, & Rojas, 2020). Additionally, about 21.13 percent of household heads were identified as single, encompassing those who were separated, divorced or widowed. This relatively higher percentage can be attributed to the evolving and changing societal attitudes towards marriage and divorce which has made it more acceptable for individuals to separate or divorce where necessary. Additionally, the difficulties and financial hardships of rural life increase the risk of marital instability, leading to separation (Gudmunson, Beutler, Israelsen, McCoy, & Hill, 2007). Furthermore, about 9.27 percent of household heads were categorized as never married. The relatively low rate of never married household heads in rural areas can be attributed to cultural expectations of rural communities which often emphasize on traditional values, in which marriage is seen as a rite of passage and an essential part of adult life, leading most individuals to marry at some point in life (Lebese, Mothiba, Mulaudzi, Mashau, & Makhado, 2022).

Among 13,092 observations, it was found that approximately 4.99 percent of households received income from both labour and non-labour sources. This finding can be attributed to the fact that rural households have increasingly embraced diverse income generating activities by tapping into various diverse economic activities within their local economies to spread risks, ensure financial stability and build resilience to economic shocks (Abera, Yirgu, & Uncha, 2021). Access to credit was also explored,

showing that approximately 4.72 percent of the rural households were able to access credit facilities. This finding reflects the persistent challenges in rural financial inclusion in developing countries as highlighted by (Dienillah, Anggraeni, & Sahara, 2018). This can be attributed to limited financial literacy among rural residents, as many are unfamiliar with formal financial products and services (Cicchiello, Kazemikhasragh, Monferrá, & Girón, 2021). Additionally, collateral requirements pose further challenges particularly in rural communities where resource ownership is communal.

Additionally, the statistics offered insights into the various shocks impacting household welfare, categorized into social, economic, and environmental dimensions. It was established that approximately 16, 26 and 55 percent of the rural households experienced social, economic and environmental shocks respectively. The relatively lower percentage of social shocks experienced by rural households may be attributed to the presence of strong social networks and support systems among rural communities which buffer households against social shocks (Osabohien et al., 2024). The relatively low percentage of economic shocks among rural households could be as a result of diversified rural livelihood strategies which help them mitigate the impact of economic fluctuations (Gautam & Andersen, 2016). The higher percentage of environmental shocks among rural households can be attributed to lack of emergency preparedness measures and limited adaptive capacity of rural households in the event of environmental challenges such as natural disasters, climate change impacts and environment degradation (Blocher, Hoffmann, & Weisz, 2024).

Table 4.2: Summary Statistics for Quantitative Variables

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Household size	13,092	4.65498	2.532963	1	28
Age (Household head)	3,042	44.95991	16.2934	15	98
Food prices	13,092	177.7096	433.9127	0	20833.33

Source: Author's computations based on data from the Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

From table 4.2 it is observed that the least number of individuals in the households surveyed, was 1 while the highest was 28. The descriptive statistics further revealed that age of the household head deviated from its mean (44years) by 16.2934 with the majority of the respondents being about 45 years of age. The youngest household head was 15 years old while the oldest was 98 years. Further it was revealed that food prices deviated from its mean (KES 177.7096) by 433.9127 with the lowest price being KES 0 and the highest price being KES 20,833.33. The zero value for the lowest price of food items can be attributed to the fact that some rural households engage in subsistence farming, producing sufficient food quantities for their own consumption and therefore eliminating the need to purchase these items.

Table 4.3: Summary Statistics for Qualitative Variables Disaggregated by Gender of the Household Head

Variables	Female (990)			Male (2053)		
	Observation	Mean	Standard Deviation	Observation	Mean	Standard Deviation
Married	990	0.364	0.481	2053	0.856	0.351
Single	990	0.506	0.500	2053	0.069	0.254
Never married	990	0.13	0.337	2053	0.075	0.263
Primary education	676	0.561	0.497	1785	0.517	0.500
Tertiary education	676	0.127	0.333	1785	0.123	0.328
Secondary education	676	0.259	0.438	1785	0.29	0.454
Graduate	676	0.046	0.209	1785	0.05	0.218
Postgraduate	676	0.001	0.038	1785	0.012	0.108
No education	676	0.006	0.077	1785	0.009	0.094
Credit access	990	0.04	0.197	2053	0.047	0.211
Income	990	0.056	0.229	2053	0.059	0.236
Social shocks	990	0.179	0.384	2053	0.161	0.368
Economic Shocks	990	0.263	0.440	2053	0.270	0.444
Environmental shocks	990	0.533	0.499	2053	0.551	0.498

Source: Authors computations based on Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

Table 4.3 above presents a comparative analysis of various demographic and socio-economic variables between female and male led households, offering insights into their respective observations, means, and standard deviations.

In terms of marital status, the data revealed that the percentage of married female household heads stood at 36.4 percent, significantly lower than 85.6 percent observed among male household heads. The statistics further revealed that about 50.6 percent of

female household heads were single while male household heads exhibited a lower 6.9 percent. Similarly, the data showed that 13 percent of female household heads and 7.5 percent of male household heads were never married. The higher percentage of married male household heads may be attributed to the fact that men have historically been designated as household heads within married couples. Additionally, men are also more likely to remarry after divorce, separation or death of a spouse while women are more likely to remain single thus heading their households (Berenji, 2022).

The mean percentages analysis of the education status among household heads revealed significant differences between genders across various educational levels. For primary education, a slightly higher proportion of female household heads, about 56.1 percent, had attained this level compared to about 51.7 percent of male household heads. This disparity underscores the impact of implemented targeted policies and initiatives specifically aimed at increasing access to education for girls, resulting in a higher proportion of female household heads completing primary education (Psaki, Haberland, Mensch, Woyczynski, & Chuang, 2022). In tertiary education, the mean percentages were closely aligned, with about 12.7 percent of female household heads and 12.3 percent of male household heads attaining this level. Similarly, secondary education attainment was slightly lower among female household heads at 25.9 percent compared to male household heads who stood at 29 percent. This trend is supported by a study by Aslam and Kingdon (2012), which has documented that while secondary education rates have improved for both genders, male students often have a slight edge due to socio-economic factors that favour boys' education in many rural settings.

For graduate education, about 4.6 percent of female household heads had attained graduate education, a percentage slightly lower than 5 percent observed among male household heads. Similarly, postgraduate education attainment was notably low for both genders, with female household heads at 0.1percent and male household heads at 1.2 percent. The prevalent low attainment for graduate and post graduate education among household heads across both genders may be attributed to obstacles in funding tuition fees, as well as difficulties in balancing family responsibilities along with academic pursuits especially in rural communities which are often characterized by lower average incomes and limited economic opportunities. However, the attainment is lower for female household heads compared to male household heads. This disparity can be attributed to traditional gender roles that place a greater burden of the household including caregiving responsibilities on women, limiting their time and resources for pursuing higher education (Cerrato & Cifre, 2018). Additionally, a small percentage of both female and male household heads, approximately 0.6 percent and 0.9 percent respectively, had not received any formal education.

In terms of credit access, approximately 4 percent of female headed households and 4.7 percent of male headed households had access to credit. This observation is in agreement with Allen, Demirguc-Kunt, Klapper, & Martinez Peria (2016) who found low credit access rates for both female and male led households. The lower credit access rate for female headed households corroborates with Roy & Patro (2022) assertion that despite the efforts and progress in promoting financial inclusion among rural women, there still exists significant gender disparities in financial inclusion. For income levels, about 5.6 percent of female headed households and 5.9 percent of male headed households reported receiving both labour and non-labour income.

Looking at shocks to household welfare, 17.9 percent of social shocks occurred in female headed households, while only 16.1 percent were observed in male headed households. In terms of economic shocks, female headed households accounted for 26 percent, slightly lower than the 27 percent observed in male headed households. Studies suggest that male-headed households might be more engaged in economic activities that are highly vulnerable to market fluctuations and shifts in economic policies (Agarwal, 2018). In contrast, female-headed households often rely more on diverse and potentially more stable income sources, such as informal trade or small-scale agriculture, which provide some degree of protection against economic volatility (Quisumbing et al., 2017). Additionally, approximately 53.3 percent of female headed households experienced environmental shocks, in contrast to about 55.1 percent of male headed households. The higher percentages prevalent in both male and female headed households indicate that environmental shocks are a widespread issue impacting households food security regardless of the gender of the head.

Table 4.4: Summary Statistics for Quantitative Variables Disaggregated by Gender of the Household Head

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Household size	990	4.683	2.618	1	28
	2053	4.692	2.499	1	15
Food prices	990	162.502	330.141	3.333	5000
	2053	183.905	436.090	0	5000
Age	990	47.946	18.132	16	98
	2053	43.52	15.181	15	98

Source: Author's computations based on data from the Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

From Table 4.4, it is observed that the least number of individuals in female-headed households was 1, while the highest was 28. In male-headed households, the least number of individuals was 1, while the highest was 15. The descriptive statistics further revealed that the age of the household head in male-headed households deviated from its mean (43.52 years) by 15.181, with the majority being about 43 years of age. The youngest male household head was 15 years old, while the oldest was 98 years. Alternatively, the age of the household head in female-headed households deviated from its mean (47.946 years) by 18.132, with the majority being about 47 years of age. The oldest female household head was 98 years old, while the youngest was 16 years. Furthermore, it was revealed that food prices in male-headed households deviated from their mean (KES 183.905) by 436.090, with the lowest price being KES 0 and the highest price being KES 5,000. Additionally, food prices in female-headed households

deviated from their mean (KES 162.502) by 330.141, with the lowest price being KES 3 and the highest price being KES 5,000.

4.3 Correlation Analysis.

Correlation matrix is as shown in the table below.

Table 4.5: Matrix of Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Household size	1.000																	
(2) food prices	-0.013	1.000																
(3) Married	-0.021	0.034	1.000															
(4) Single	0.037	-0.015	-0.721	1.000														
(5) Never married	-0.014	-0.031	-0.570	-0.158	1.000													
(6) Primary education	-0.015	0.036	-0.017	0.150	-0.154	1.000												
(7) Tertiary education	0.013	0.016	0.012	-0.042	0.032	-0.398	1.000											
(8) Secondary education	0.014	-0.038	0.032	-0.088	0.058	-0.663	-0.235	1.000										
(9) Graduate	0.000	-0.020	-0.071	-0.081	0.196	-0.240	-0.085	-0.142	1.000									
(10) Postgraduate	-0.018	-0.013	0.049	-0.042	-0.020	-0.101	-0.036	-0.059	-0.022	1.000								
(11) No education	-0.018	-0.007	0.005	-0.004	-0.003	-0.096	-0.034	-0.057	-0.020	-0.009	1.000							
(12) Gender	0.009	0.022	0.477	-0.452	-0.145	-0.039	-0.006	0.031	0.008	0.049	0.015	1.000						
(13) Social shocks	-0.032	-0.015	-0.004	-0.010	0.018	-0.002	0.006	-0.010	0.011	-0.007	0.021	-0.026	1.000					
(14) Economic shocks	-0.003	-0.008	0.003	-0.009	0.006	-0.022	0.012	0.017	0.002	0.010	-0.025	0.006	-0.270	1.000				
(15) Environmental shocks	0.027	0.013	-0.005	0.021	-0.018	0.015	-0.013	-0.002	-0.013	-0.000	0.010	0.018	-0.486	-0.668	1.000			
(16) credit access	-0.001	-0.010	0.019	-0.007	-0.018	0.027	0.003	-0.025	-0.015	0.019	-0.020	0.018	-0.079	0.289	-0.191	1.000		
(17) Age	0.034	-0.001	0.015	0.251	-0.318	0.164	-0.059	-0.095	-0.111	-0.008	0.049	-0.009	-0.038	-0.012	0.037	0.021	1.000	
(18) Income	0.057	-0.011	0.017	-0.003	-0.021	-0.000	0.013	-0.019	0.017	-0.005	0.016	0.004	0.017	-0.006	-0.016	0.010	-0.001	1.000

Source: Author's computations based on data from the Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

The results revealed a weak positive correlation between marital status-married and age of the household head (0.015) suggesting that the possibility of getting married increases with age. A Negative weak correlation was revealed between being never married and age of the household head (-0.318), indicating that younger household heads are more likely to be never married. There is a weak but positive correlation between social shocks to household welfare and access to credit (0.289) indicating that households actively seek credit facilities as a buffer against household shocks. This could be as a result of recent improved financial inclusion in rural areas facilitated by both formal and informal credit sources. There exists a weak positive correlation between income and access to credit (0.010). This may be true because lenders are more inclined to extend credit to individuals with higher incomes because they perceive them as lower credit risks as they are generally better positioned to repay loans and honour credit obligations.

A negative and weak correlation was revealed between age of the household head and income (-0.001). This is because as people progress to the later stages of their careers their income may decline due to factors such as health limitations affecting work capacity. Food prices and environmental shocks showed a positive but weak correlation (0.013). This may be due to the fact that environmental shocks often disrupt agricultural production and distribution channels, leading to shortages in food supply and subsequently driving up food prices.

4.4 Diagnostic Tests Findings

4.4.1 Testing for Normality

The Skewness and Kurtosis test was conducted to test for normality.

Table 4.6: Matrix of Skewness and Kurtosis Tests for Normality

	Skewness/Kurtosis tests for Normality				
Variable	Obs	Pr (Skewness)	Pr (Kurtosis)	adjchi2(2)	Prob>chi2
residual	2,461	0.0000	0.4258	.	0.0000

Source: Author's computations based on data from the Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

Since the p value was less than 0.05 (0.00<0.05), the null hypothesis of normality was rejected, indicating that the residuals were non-normal. Therefore, the study employed a logistic regression model, which is suitable for analyzing non-normally distributed data.

4.4.2 Testing for Multicollinearity

To test for multi collinearity the study used the Variance Inflating Factors (VIF). This is crucial because VIF reveals if an explanatory variable is highly correlated with other predictors in the model. According to Black & Babin (2019), a VIF value less than 10 suggests that multicollinearity is insignificant and does not pose a problem in the regression model.

Table 4.7: Matrix of Multicollinearity

Variable	VIF	1/VIF
Primary education	5.92	0.168985
Secondary education	5.00	0.199822
Tertiary education	3.18	0.314464
Single	2.61	0.382613
Married	2.48	0.403759
Environment shocks	1.41	0.708958
Social shocks	1.37	0.731012
Gender	1.35	0.743325
Age	1.19	0.841333
Postgraduate	1.19	0.843214
No education	1.17	0.853871
Credit access	1.08	0.922201
Household size	1.01	0.991291
Income	1.01	0.994443
Food prices	1.00	0.995330
Mean VIF	2.06	

Source: Author's computations based on data from the Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

In this case the mean variance inflating factor for all the exogenous variables was less than 10 hence there was no evidence of multi collinearity.

4.4.3 Testing for Heteroscedasticity

Since the study employed a logistic regression model the Breusch-Pagan test was employed to evaluate whether there existed a systematic relationship/pattern between the squared residuals and the independent variables.

Table 4.8: Test for Heteroscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of Foodsecurity_Status
chi2(1) = 36.25
Prob > chi2 = 0.0000

Source: Author's computations based on data from the Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2016).

Heteroscedasticity was found to be present as the null hypothesis of no heteroscedasticity was rejected given that the p-value was 0.000. This implied that the variance of the error term varied with changes in the magnitude of the explanatory variables. The study corrected this by adopting robust standard errors in the logistic regression model.

4.5 Empirical Findings

4.5.1 To Examine the Determinants of Food Security among Rural Households in Kenya

Table 4.8 below presents the logistic regression results based on the various independent variables influencing food security among rural households in Kenya.

Table 4.9: Logistic Regression Results on Determinants of Food Security among Rural Households in Kenya

VARIABLES	Logit Results	Marginal Effects
Household size	-0.0960***	-0.0159***
	(0.0229)	(0.0037)
Food prices	0.0000242	0.00000403
	(0.000117)	(0.000194)
Married	0.0381	0.00632
	(0.176)	(0.0292)
Single	0.00941	0.00156
	(0.212)	(0.0353)
Primary education	0.0238	0.00396
	(0.239)	(0.0397)
Tertiary education	0.179	0.0297
	(0.263)	(0.0436)
Secondary education	-0.0842	-0.0139
	(0.244)	(0.041)
Postgraduate	0.918*	0.153*
	(0.502)	(0.0833)
No education	0.186	0.0309
	(0.582)	(0.097)
Social Shocks	-0.0480	-0.0079
	(0.154)	(0.0255)
Environmental Shocks	-0.0992	-0.01649
	(0.117)	(0.019)
Credit access	0.437*	0.073*
	(0.224)	(0.037)
Age	-0.00228	-0.00037
	(0.00374)	(0.00062)
Income	0.847***	0.1407***
	(0.185)	(0.030)
Constant	-0.768**	
	(0.299)	
Observations	2,461	
Prob>chi^2	0.000	
Pseudo R^2	0.0210	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From table 4.8 it is revealed that all factors were jointly statistically significant in influencing food security status in rural Kenya as evidenced by a significant F statistic. The pseudo R-squared showed that the independent variables explained 2.10 percent of the variation in household food security status.

The results revealed a negative and significant coefficient of household size. Specifically, the marginal effects results revealed that the probability of a household being food secure decreases by 1.60 percent with a one-member increase in household size holding all other variables constant. This suggested that larger households are associated with a lower likelihood of experiencing food security compared to smaller households. This may be due to increased food demand in larger households which can result in difficulties purchasing sufficient food quantities to meet the dietary needs of all household members, thus worsening food security. This is in line with various previous studies, for instance Nyangasa, Buck, Kelm, Sheikh, & Hebestreit (2019) which found that larger households were more likely to experience food insecurity compared to smaller households.

The marginal effects results revealed that, ceteris paribus, the probability of a household being food secure increases by 0.63 percentage points when the household head is married as opposed to being never married. This may be attributed to the pooling of resources and sharing of financial responsibilities among partners in marriage enabling households to better access and afford an adequate and nutritious diet, consequently contributing to improved food security. Studies such as Kumba (2015) and José & Molina (2018) agree with these results confirming a higher prevalence of food security among rural households headed by married household heads. Further the results

revealed that compared to a never married household head, on average, the probability of a household being food secure increased by about 0.9 percentage points when the household head was single, ceteris paribus. This may be attributed to the fact that single household heads have greater control over their resources and household budgets as well as easier access to government assistance programmes, which helps them maintain food security.

Household food security status was also positively influenced by the education levels of the household heads. Specifically, tertiary and postgraduate education levels had positive coefficients (0.179 and 0.918, respectively), indicating a higher probability of food security. The marginal effects results revealed that holding other factors constant the probability of a household being food secure increased by 2.97 and 15.26 percentage points on average if the household head had tertiary and postgraduate education, respectively. This can be attributed to better job opportunities, higher incomes, and improved decision-making skills associated with higher education levels. These findings are in concurrence with the previous findings by Gwada, Ouko, Mayaka, & Dembele (2020) who established that households led by individuals with higher education levels are more likely to be food secure.

Food security was also influenced by the social shocks to household welfare. The marginal effects revealed that holding all other factors constant, on average, the probability of a household being food secure decreases by 0.80 percent when the household experiences social shocks, as opposed to economic shocks. This can be attributed to the fact that social shocks, such as the death of household heads or working members, often coincide with economic disruptions, such as job losses and household

income reductions thus undermining households purchasing power, making it more difficult for a household to afford adequate and nutritious diets (De Stefani et al., 2022).

Food prices also exhibited a small but statistically insignificant positive effect on food security. The marginal effects results revealed that on average, ceteris paribus, for every one unit increase in food prices, the probability of a household being food secure increases by approximately 0.000403 percent. Past evidence shows this positive relationship can be explained by the dual role of many rural households as both consumers and producers of food (Ferreira, Almazán-Gómez, Nechifor, & Ferrari, 2022). When food prices rise, households that produce more food than they consume benefit from selling their surplus at higher prices, which increases their income. This additional income allows them to diversify their food products and invest in their farms thus enhancing their overall food security.

Environmental shocks to household welfare was also found to have a negative insignificant effect on food security among rural households in Kenya. The marginal effects results revealed that holding other factors constant, on average, the probability of a household being food secure decreases by 1.65 percentage points when households' experiences environmental shocks as opposed to economic shocks. This can be explained by the fact that environmental shocks, such as droughts, floods, and crop pests and diseases can lead to agricultural losses, infrastructure damage, and displacement of populations. The impacts of environmental shocks can undermine households' access to food sources, disrupt food production and distribution systems, and increase food prices, ultimately leading to a decline in food security.

The results revealed a positive significant relationship between access to credit and food security status. Specifically, the marginal effects results revealed that, holding all other factors constant, households with access to credit, on average, have a 7.26 percentage point higher probability of being food secure compared to those without access. This aligns with the permanent income hypothesis theory and previous findings such as Boltana, Tafesse, Belay, Recha, & M.Osano (2023) whose findings suggested that rural farming households with greater access to credit tend to have better food security outcomes since households are able to smooth out consumption during periods of low income and cope with unexpected expenses related to food acquisition or agricultural production.

Age of the household head was found to be negative and insignificant in determining household food security status. This may be attributed to increased economic dependency, diminishing income earning capacity and increased healthcare expenses associated with aging, placing additional strain on the available resources and potentially impacting food security negatively. Regarding the marginal effects, while holding other factors constant, a one-year increase in the age of the household head decreases the probability of a household being food secure by about 0.04 percentage points. This finding is consistent with studies by Mutinda (2015), (Furaha Ndakije Sesabo, Robert Michael Lihawa, & Eliaza Mkuna (2024) and Mohammed, Wassie, & Teferi (2021).

Additionally, the results show that holding other factors constant, household income (labour and non-labour income) has a positive significant effect on food security status, indicating that household food security increases with higher levels of household

income. The marginal effect indicated that, holding other factors constant, one Kenya Shilling increase in household income, on average, increases the probability of a household being food secure by about 14.07 percentage points. This is because increased income provide greater purchasing power, allowing households to buy more food quantities and access higher quality and more nutritious food products thus better food security outcomes. This finding agrees with that of (Worku, 2023) and (Fikire & Zegeye, 2022).

4.5.2 To Examine the Impact of Gender Differences in the Prevalence of Food Security among Rural Households in Kenya

Table 4.9 presents the effects of gender of the household head on rural Kenya households food security status, controlling for a set of household demographic and socio-economic characteristics. Columns 1 and 2 present the coefficients associated with the logistic regression model used to estimate the predicted food security outcome means for Female headed households (FHH) and Male headed households (MHH), respectively.

Table 4.10: Logistic Regression Results on the Impact of Gender Differences in Prevalence of Food security among Rural Households in Kenya

VARIABLES	FHH	MHH
Household size	-0.0867*	-0.0997***
	(0.0502)	(0.0250)
Food prices	0.000256	-3.81e-05
	(0.000258)	(0.000136)
Married	0.382	-0.130
	(0.295)	(0.223)
Single	0.417	-0.390
	(0.323)	(0.339)
Primary education	-1.059**	0.482
	(0.421)	(0.302)
Tertiary education	-0.636	0.548*
	(0.459)	(0.332)
Secondary education	-0.839**	0.263
	(0.426)	(0.309)
Postgraduate	-6.118***	1.381**
	(1.087)	(0.546)
No education	-0.713	0.518
	(1.215)	(0.667)
Social shocks	-0.0428	-0.0748
	(0.283)	(0.185)
Environmental shocks	-0.107	-0.127
	(0.222)	(0.139)

Credit access	0.297	0.464*
	(0.447)	(0.259)
Age	0.00342	-0.00381
	(0.00733)	(0.00443)
Income	0.404	0.994***
	(0.385)	(0.215)
Constant	-0.454	-0.983***
	(0.524)	(0.360)
Observations	2,461	2,461

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

An increase in household size in both female and male headed households significantly decrease the probability of these households being food secure by about 8.67 and 9.97 percent respectively. This is in line with the findings of (Mango, Zamasiya, Makate, Nyikahadzoi & Siziba, 2014). The level of dependency within the household serves as a robust indicator of the household's food security status (Mutisya, Ngware, Kabiru, & Kandala, 2016). As household size increases, so does the demand for food and other resources. In response to these heightened demands, households may resort to coping strategies such as reducing portion sizes and skipping meals. While these strategies may offer short term relief, they are often unsustainable and may actually worsen food security over the long run (Carranza & Niles, 2019).

An increase in the age of the household head increase the probability of female headed households being food secure by 0.342 percent and decrease the probability of male

headed households being food secure by 0.381 percent. This may be attributed to the cultural norms and gender roles prevalent in many societies which often shape the division of labour, decision-making processes, and access to resources within households (Gebre et al., 2021). In many cultures, older individuals, especially women, are often responsible for managing household resources, benefiting from established social networks, community support, and alternative income sources that contribute to better food security scores.

Access to credit increases the probability of both female and male headed households being food secure by about 29.7 and 46.4 percent respectively. This result indicates that credit access is crucial for improving food security outcomes for rural households. This result is consistent with Boltana, Tafesse, Belay, Recha, & M.Osano (2023) whose study found out that in both male and female headed households credit is often used to obtain food products. However, increased access to credit has a greater and significant impact on food security in male headed households. This could be explained by the fact that male household heads have potentially higher levels of financial literacy, greater control over financial resources and decision-making with regards to economic activities Additionally, they may have better access to markets and economic opportunities due to the prevailing gender norms and social structures.

Household income has a positive and significant effect on the probability of food security for male-headed households, while its effect is positive but statistically insignificant for female-headed households. For female headed households, a one Kenya Shilling increase in income increase the probability of the household being food secure by about 40.4 percent ceteris paribus. On the other hand, in male headed

households a one Kenya Shilling increase in income increases the probability of a household being food secure by about 99.4 percent. This may be due to the fact that given limited formal employment opportunities in the rural settings male household heads have better access to off farm employment opportunities which increase household income and subsequently improve food security (Bai, Zeng, Fu, & Zhang, 2024). However, female household heads may encounter barriers to accessing formal employment due to factors such caregiving and home management responsibilities, limiting their ability to increase household income and enhance food security. This observation aligns with previous research by Duah Dwomoh et al. (2023) which highlighted the gender disparities in employment opportunities and their implications for household food security.

Social and environmental shocks were found to have a negative but statistically insignificant impact on the probability of food security. Specifically, social shocks reduce the probability of a household being food secure for both male- and female-headed households. In male headed households the probability of being food secure decreases by about 7.48 percent in the event of social shocks. Regarding female headed households, if a social shock occurs, the probability of that household being food secure decreases by about 4.28 percent. Similar results were reported by Knippenberg & Hoddinott (2019) whose findings revealed that female headed households may exhibit some resilience to social shocks, which can be attributed to stronger social support networks or coping mechanisms enhancing such households to smooth out their food consumption levels in the event of social shocks.

In the event environmental shocks occur, the probability of both female and male headed households being food secure decreases by about 10.7 and 12.7 percent respectively. This aligns with the findings of Nelson et al. (2018) who noted that environmental shocks often disrupt crop yields, damage infrastructure, and undermine livelihoods, particularly in rural and agrarian communities where households rely heavily on agricultural activities for food and income. However, these results also contradict findings by FAO (2019) and IPCC (2021) which highlight the disproportionate impact of environmental shocks on women, who often face heightened risks of food insecurity and malnutrition in the aftermath of environmental disasters.

The marital status of the household head had a positive but statistically insignificant effect on food security scores in both male and female headed households. The analysis showed that the probability of a female headed household being food secure increases by approximately 41.7 percent when the household head is single and by approximately 38.2 percent when the household head is married. These findings suggest that households led by single female household heads have a slightly higher likelihood of being food secure compared to those led by married female household heads. This trend may be explained by the fact that that single female heads often benefit from targeted support programs or have developed more efficient resource management strategies, which enhance their food security (Bryan, Ringler, & Meinzen-Dick, 2023).

Looking at male headed households, the results indicated that the probability of a household being food secure decreases by approximately 39 percent when the household head is single and by about 13 percent when the household head is married. Research by Mokari-Yamchi et al. (2020) found that single male heads are less likely

to receive social support from extended family or community networks compared to their female counterparts, making them more vulnerable to food insecurity. Furthermore, single male household heads may also have less access to support programs designed to aid single-parent households, which often prioritize women. According to a study by Madhavan, Clark, & Schmidt (2020), many food security programs are tailored specifically for single mothers, inadvertently excluding single fathers who may have similar needs. This lack of targeted support can exacerbate the economic pressures faced by single male heads further reducing their food security. These findings align with existing literature that underscores the importance of family structure and support networks in ensuring food security. For instance, a comprehensive review by Balistreri (2017) emphasized on the importance of family structure and social support in enhancing food security among single parent households.

Household head education level was negatively associated with the probability of female headed households being food secure. The negative coefficients observed for primary, secondary, tertiary education and postgraduate education levels suggest that higher educational attainment among female household head decreases the probability of those households being food secure. Specifically, primary, secondary and postgraduate education demonstrated negative and statistically significant effects on food security outcomes for female-headed households. These results are in line with findings by (Quisumbing et al., 2015) and (Doss, Meinzen-Dick, Quisumbing, & Theis, 2018). These studies suggest that while education is generally regarded as a pathway to economic empowerment, the increased aspirations for socioeconomic advancement in female headed households that come in hand with higher education levels, potentially

translate into increasing living costs thus reducing resources allocated towards food expenditures therefore worsening food security.

Finally, the education level of household heads was positively associated with the probability of male headed household being food secure. Specifically, tertiary education and postgraduate education demonstrated positive and statistically significant effects on food security outcomes for male-headed households. These results imply that higher levels of education contribute to improved food security outcomes in these households. This may be attributed to the fact that educated male heads are more likely to invest in agricultural technology and practices that improve food production and security (Mutenje, Kankwamba, Mangisonib, & Kassie, 2016). Studies such as Mutisya, Ngware, Kabiru, & Kandala (2016) have demonstrated the socio-economic benefits associated with higher education levels. Individuals with higher education levels often have access to better employment opportunities, higher incomes, and enhanced decision-making capabilities, which can positively impact household food security.

Table 4.11 presents the predicted mean food security scores for both male- and female-headed households based on a binary logistic regression model.

Table 4.11: The Mean Predicted Probabilities of Food Security.

Household Type	Binary Logistic Regression Model
	Outcome Variable: Food Security (Binary)
Male-headed	0.211***
Female-headed	0.228***
Difference	0.017

As evident in table 4.11, Female-headed households in rural Kenya are more likely to be food secure than their male counterparts. The predicted mean food security score for female headed households is 22.8 percent while for male headed households it stands at 21.1 percent, implying that, on average, approximately 22.8 percent and 21.1 percent of these households' exhibit food security, respectively. Thus, on average, the probability of a household being food secure decreases by about 0.0171 units when the household head is male compared to when the household head is female, while controlling for other variables in the model. This observation aligns with previous research by Yoosefi Lebni et al. (2020) and Felker-Kantor and Wood (2012) who also found that female headed households tend to be more food secure than male headed households, particularly in the rural setting. This may be attributed to women's greater involvement in household food management and decision-making processes.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This chapter presents a summary of the key findings, the conclusion of the study, policy recommendations, limitations of the study and areas for future research.

5.2 Summary of the Key Findings

Findings suggested that education status of the household head, access to credit, household size and income are important determinants of food security among rural households in Kenya. Specifically, education status of the household head, access to credit and income were found to be positive and statistically significant while household size was found to be negative and significant.

Female headed households demonstrated higher food security scores compared to male headed households suggesting that they tend to be more food secure compared to the male counterparts. However, both male and female headed households experienced a decline in food security as household size increases. Access to credit positively influenced food security in both male and female headed households, with a stronger impact observed in male headed households. Household income positively affected food security for both male and female headed households, with income increase associated with relatively higher food security probabilities in male headed households.

Additionally, higher education levels among household heads were associated with reduced food security in female headed households, while they enhanced food security outcomes in male headed households.

5.3 Conclusion

The determinants of food security parametric results indicated that education status of the household head, access to credit, household size and income were important determinants of food security among rural households in Kenya.

The study concluded that female headed households are more food secure than male headed households. The findings revealed that gender significantly influences food security outcomes. For female-headed households, the level of education attained by the household head emerged as a crucial determinant, affecting food security through its impact on economic opportunities and resource management. Additionally, household size was a significant factor, as larger households often face challenges in resource distribution, which negatively impact food security. In contrast, for male headed households, key determinants of food security included the education status of the household head, household size, access to credit and income.

Therefore, given the findings of the study, it is evident that gender differences significantly influence food security among rural households in Kenya. This underscores the importance of incorporating gender specific considerations into the design of food security policies and reforms. Bridging the gender gap in food security requires targeted efforts to address educational disparities, manage household size, increase income opportunities, and access to financial resources.

5.4 Recommendations

The government should implement targeted policies to support female-headed households, leveraging their demonstrated higher food security levels. This could

include programs aimed at further enhancing their food security through increased access to resources and employment opportunities that enhance their economic independence.

The government should enact and enforce policies directed towards reproductive rights and ensure universal access to family planning services, as these will be essential steps toward achieving the goal of limiting household size to sustainable levels thus improving food security situation among both female and male led households. Additionally, public awareness campaigns should be launched to enlighten these households about the significance of family planning in enhancing food and nutrition security.

The government and financial institutions should expand financial inclusion by implementing targeted microfinance programs, offering low-interest loans, and conducting financial literacy workshops. These measures will empower both female and male-headed households to invest effectively in food security. Additionally, establishing robust financial literacy programs is essential to ensure responsible borrowing and the effective utilization of credit funds. These initiatives will significantly enhance overall food security.

The government should prioritize increasing rural incomes by investing in agricultural development. This includes improving market access through better infrastructure, such as roads and storage facilities, and creating market linkages to facilitate more profitable sales of agricultural produce. Additionally, promoting value-added agricultural activities is essential. Supporting initiatives that invest in processing facilities and technologies will enable rural farmers to transform raw products into higher-value

goods. By focusing on these areas, the government can boost rural incomes and foster economic growth and stability within the agricultural sector, thereby enhancing food security outcomes for both male and female headed households.

Increasing access to educational resources for male household heads is crucial, as education positively and significantly influences food security in male-headed households. The government and education sector stakeholders should focus on developing and implementing programs that boost educational attainment, including vocational training and adult education initiatives. These programs should be designed to enhance skills in agricultural practices, financial management, and decision-making. By providing resources and training that improve economic opportunities and resource management skills, male household heads will be better equipped to make informed decisions that directly contribute to improved food security.

5.5 Limitations of the Study and Future Research

The data type used in this study was cross section which has limitations on capturing changes and trends over time. Future research could employ longitudinal study designs to investigate food security determinants, outcomes and gender differences over time. Additionally, the study's focus on rural Kenya raises concerns about generalizability, as the findings may not accurately reflect food security dynamics in core-urban or peri-urban areas. Therefore, similar studies should be conducted in these diverse contexts to offer a more comprehensive understanding of food security across various geographical settings.

REFERENCES

Abafita, J., & Kim, K.-R. (2014). Determinants of Household Food Security in Rural Ethiopia: An Empirical Analysis. *Journal of Rural Development/Nongchon-Gyeongje*, *37*(2), 1–29.

Abdullah, Zhou, D., Shah, T., Ali, S., Ahmad, W., Din, I. U., & Ilyas, A. (2019). Factors affecting household food security in rural northern hinterland of Pakistan. *Journal of the Saudi Society of Agricultural Sciences*, 18(2), 201–210.

Abera, A., Yirgu, T., & Uncha, A. (2021). Determinants of rural livelihood diversification strategies among Chewaka resettlers' communities of southwestern Ethiopia. *Agriculture & Food Security*, *10*(1).

Adjei-Mantey, K., Kwakwa, P. A., & Adusah-Poku, F. (2022a). Unraveling the effect of gender dimensions and wood fuel usage on household food security: evidence from Ghana. *Heliyon*, 8(11), e11268.

Agarwal, B. (2018). Gender equality, food security and the sustainable development goals. *Current Opinion in Environmental Sustainability*, *34*, 26–32.

Aguiar, M., & Hurst, E. (2008). Permanent-Income Hypothesis. *The New Palgrave Dictionary of Economics*, 1–5.

Allen, F., Demirguc-Kunt, A., Klapper, L., & Martinez Peria, M. S. (2016). The foundations of financial inclusion: Understanding ownership and use of formal accounts. *Journal of Financial Intermediation*, *27*, 1–30.

Ando, A., & Modigliani, F. (1963). The "Life Cycle" Hypothesis of Saving: Aggregate Implications and Tests. *The American Economic Review*, 53(1), 55–84.

Arene, C. j. and Anyaeji, C.R. (2010). Determinants of food security among households in nsukka metropolis of Enugu state, Nigeria. *Pakistan Journal of Social Sciences*. 30(1): 9-16.

Arndt, C., Diao, X., Dorosh, P., Pauw, K., & Thurlow, J. (2023). The Ukraine war and rising commodity prices: Implications for developing countries. *Global Food Security*, 36, 100680.

Asghar, M. A., Asghar, Z., & Ahmad, M. (2013). *Socio-economic determinants of household food insecurity in Pakistan*. Munich Personal RePEc Archive.

Aslam, M., & Kingdon, G. G. (2012). Parental Education and Child Health—Understanding the Pathways of Impact in Pakistan. *World Development*, *40*(10), 2014–2032.

Assenga, E. A., & Kayunze, K. A. (2020). Socio-Economic and Demographic Determinants of Food Security in Chamwino District, Tanzania. *Tanzania Journal for Population Studies and Development*, 27, 82-105.

Bai, Y., Zeng, X., Fu, C., & Zhang, L. (2024). Off-farm employment, agriculture production activities, and household dietary diversity in environmentally and economically vulnerable areas of Asia1. *Journal of Integrative Agriculture/Journal of Integrative Agriculture*, *23*(2), 359–373.

Balistreri, K. S. (2017). Family Structure and Child Food Insecurity: Evidence from the Current Population Survey. *Social Indicators Research*, *138*(3), 1171–1185.

Berenji, H. (2022, February 23). *Fascinating Remarriage Statistics 2022 Update*. Berenji & Associates.

Black, W., & Babin, B. J. (2019). Multivariate Data Analysis: Its Approach, Evolution, and Impact. *The Great Facilitator*, 121–130.

Blocher, J. M., Hoffmann, R., & Weisz, H. (2024). The effects of environmental and non-environmental shocks on livelihoods and migration in Tanzania. *Population and Environment*, *46*(1).

Boltana, A., Tafesse, A., Belay, A., Recha, J. W., & M.Osano, P. (2023). Impact of credit on household food security: The case of Omo microfinance institution in southern Ethiopia. *Journal of Agriculture and Food Research*, *14*, 100903.

Boulanger, P., Dudu, H., Ferrari, E., Mainar, A. J., & Ramos, M. P. (2020). Effectiveness of Fertilizer Policy Reforms to Enhance Food Security in Kenya: A Macro-Microsimulation Analysis. *Applied Economics*, 1–21.

Bryan, E., Ringler, C., & Meinzen-Dick, R. (2023). Gender, Resilience, and Food Systems. *Springer*, 239–280.

Carranza, M., & Niles, M. T. (2019). Smallholder Farmers Spend Credit Primarily on Food: Gender Differences and Food Security Implications in a Changing Climate. *Frontiers in Sustainable Food Systems*, *3*.

CBK. (2023). *Agriculture Sector Survey of January 2023*. Central Bank of Kenya.

Cerrato, J., & Cifre, E. (2018). Gender Inequality in Household Chores and Work-Family Conflict. *Frontiers in Psychology*, *9*.

Chai, A. (2018). Household consumption patterns and the sectoral composition of growing economies: A review of the interlinkages. *Discussion Papers in Economics*.

Cicchiello, A. F., Kazemikhasragh, A., Monferrá, S., & Girón, A. (2021). Financial inclusion and development in the least developed countries in Asia and Africa. *Journal of Innovation and Entrepreneurship*, *10*(1).

Clapp, J., Moseley, W. G., Burlingame, B., & Termine, P. (2021). The case for a six-dimensional food security framework. *Food Policy*, 106, 102164.

Cleasby, I. R., & Nakagawa, S. (2011). Neglected biological patterns in the residuals: A behavioural ecologist's guide to co-operating with heteroscedasticity. *Behavioral Ecology and Sociobiology*, *65*(12), 2361–2372.

Clements, K. W., & Si, J. (2017). Engel's Law, Diet Diversity, and the Quality of Food Consumption. *American Journal of Agricultural Economics*, 100(1), 1–22.

Daoud, J. I. (2017). Multicollinearity and Regression Analysis. *Journal of Physics: Conference Series*, 949(1).

Darko, R. O., Yuan, S., Hong, L., Liu, J., & Yan, H. (2015). Irrigation, a productive tool for food security – a review. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science*, 66(3), 191–206.

De Stefani, A., Laws, A., & Sollaci, A. (2022). Household Vulnerability to Income Shocks in Emerging and Developing Asia: The Case of Cambodia, Nepal and Vietnam. *IMF Working Papers*, 2022(064), 1.

Dienillah, A. A., Anggraeni, L., & Sahara, S. (2018). Impact of Financial Inclusion on Financial Stability based on Income Group Countries. *Buletin Ekonomi Moneter Dan Perbankan*, *20*(4), 397–410.

Doss, C., Meinzen-Dick, R., Quisumbing, A., & Theis, S. (2018). Women in agriculture: Four myths. *Global Food Security*, *16*, 69–74.

Drakopoulos, S. (2021). *Theories of Consumption*. Munich Personal RePEc Archive.

Duah Dwomoh, K. A., Oppong Tuffour, H., Tetteh, A. O., Godi, A., & Aryeetey, R. (2023). Modeling inequality in access to agricultural productive resources and socioeconomic determinants of household food security in Ghana: a cross-sectional study. *Agricultural and Food Economics*, *11*(1).

Economist Impact. (2022). *Global Food Security Index 2022*. Economist Impact.

Egah, J., Zakari, S., Idrissou, L., Kotobiodjo, N., El Ghazi, I., Baco, M. N., & Kestemont, M.-P. (2023b). Eliciting the gender income influences on household's food security in west africa. *Heliyon*, *9*(6), e17408.

Engel, J., & Kneip, A. (1996). Recent approaches to estimating Engel curves. *Journal of Economics*, 63(2), 187–212.

FAO, IFAD, UNICEF, WFP and WHO. 2023. The State of Food Security and Nutrition in the World 2023. *Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum*. Rome, FAO.

FAO. (1996). *World Food Summit - Final Report - Part 1*. Food and Agriculture Organization.

FAO. (2010). *The State of Food and Agriculture Women in Agriculture Closing the gender gap for development.* Food and Agriculture Organization.

FAO. (2015). *Climate change and food security: risks and responses*. Food and Agriculture Organization.

FAO. (2022). *World food and agriculture – statistical yearbook 2022*. Food and Agriculture Organization.

Felker-Kantor, E., & Wood, C. H. (2012). Female-headed households and food insecurity in Brazil. *Food Security*, *4*(4), 607–617.

Ferreira, V., Almazán-Gómez, M. Á., Nechifor, V., & Ferrari, E. (2022). The role of the agricultural sector in Ghanaian development: a multiregional SAM-based analysis. *Journal of Economic Structures*, *11*(1).

Fikire, A. H., & Zegeye, M. B. (2022). Determinants of Rural Household Food Security Status in North Shewa Zone, Amhara Region, Ethiopia. *The Scientific World Journal*, *2022*, 1–8.

French, S. A., Tangney, C. C., Crane, M. M., Wang, Y., & Appelhans, B. M. (2019). Nutrition quality of food purchases varies by household income: The SHOPPER study. *BMC Public Health*, *19*(1).

Friedman, M. (1957). *Theory of the consumption function*. Princeton university press.

Furaha Ndakije Rashid, Sesabo, J. K., Robert Michael Lihawa, & Eliaza Mkuna. (2024). Determinants of household food expenditure in Tanzania: implications on food security. *Agriculture & Food Security*, *13*(1).

Ganesh Thapa, Anjani Kumar, P. K. J. (2018). Household food expenditure share. *International Dietary Data Expansion Project*, March, 6–8.

Gautam, Y., & Andersen, P. (2016). Rural livelihood diversification and household well-being: Insights from Humla, Nepal. *Journal of Rural Studies*, *44*, 239–249.

Ghasemi, A., & Zahediasl, S. (2012). Normality Tests for Statistical Analysis: A Guide for Non-Statisticians. *International Journal of Endocrinology and Metabolism*, *10*(2), 486–489.

GoK. 2017. *Kenya Climate Smart Agriculture Strategy:* 2017–2026. Ministry of Agriculture, Livestock and Fisheries, Nairobi, Kenya.

Gudmunson, C. G., Beutler, I. F., Israelsen, C. L., McCoy, J. K., & Hill, E. J. (2007). Linking Financial Strain to Marital Instability: Examining the Roles of Emotional Distress and Marital Interaction. *Journal of Family and Economic Issues*, *28*(3), 357–376.

Gwada, R. O., Ouko, K. O., Mayaka, Z. O., & Dembele, B. (2020). Determinants of Food Security Among Small-Scale Soybean Households in Butere Sub-County, Kenya. *Contemporary Agriculture*, *69*(3-4), 90–101.

Hasan, S., & Mozumder, P. (2017). Income and energy use in Bangladesh: A household level analysis. *Energy Economics*, *65*(C), 115–126.

Headey, D., & Hirvonen, K. (2023). Higher food prices can reduce poverty and stimulate growth in food production. *Nature Food*, *4*(8), 699–706.

Iimi, A., & Serajuddin, U. (2018). *SDG 9.1.1. The Rural Access Index*. World Bank Group.

Intergovernmental Panel on Climate Change. (2019). *Chapter 5 — Special Report on Climate Change and Land.* Intergovernmental Panel on Climate Change.

Jappelli, T., & Pistaferri, L. (2010). The Consumption Response to Income Changes. *Annual Review of Economics*, *2*(1), 479–506.

Jarque, C. M., & Bera, A. K. (1987). A Test for Normality of Observations and Regression Residuals. *International Statistical Review / Revue Internationale de Statistique*, *55*(2), 163.

José, O., & Molina, A. (2018). *Household Collective Models: Three Decades of Theoretical Contributions and Empirical Evidence*.

Kamau, J. (2023). *Factors Influencing Household Food Security in the Tea Zone of Kirinyaga County, Kenya*.

Kassie, M., Ndiritu, S. W., & Stage, J. (2014). What Determines Gender Inequality in Household Food Security in Kenya? Application of Exogenous Switching Treatment Regression. *World Development*, 56, 153–171.

Kedir, A., & Girma, S. (2007). Quadratic Engel Curves with Measurement Error: Evidence from a Budget Survey. *Oxford Bulletin of Economics and Statistics*, *69*(1), 123–138.

Kennedy, M. S., Lanier, S. K., Ehlert, K. M., High, K. A., Pegues, K. K., & Sharp, J. L. (2016). *Understanding the role of knowledge related to financial resources on decisions to attend graduate school*.

Kenya National Bureau of Statistics (KNBS). (2018). *Basic Report on Well-Being in Kenya Based on the 2015/16 Kenya Integrated Household Budget Survey (KIHBS)*. Kenya National Bureau of Statistics.

Kenya National Bureau of Statistics (KNBS). (2023). *Economic Survey 2023*. Kenya National Bureau of Statistics.

Kenya National Bureau of Statistics. (2016). Basic report on well-being in Kenya: *Based on the 2015/16 Kenya Integrated Household Budget Survey (KIHBS)*. (2018). Kenya National Bureau of Statistics.

Kenya National Bureau of Statistics. (2016). *Basic report: Based on 2015/16 Kenya integrated household budget survey (KIHBS)*. Kenya National Bureau of Statistics.

Kihiu, E. (2021). *Gender, access to agricultural resources and food security in Kenya*. Kenya Institute for Public Research and Analysis.

Kim, J. H. (2019). Multicollinearity and misleading statistical results. *Korean Journal of Anesthesiology*, *72*(6), 558–569.

Kirimi, L., Gitau, R., & Olunga, M. (2013). Household Food Security and Commercialization among Smallholder Farmers in Kenya. *RePEc: Research Papers in Economics*.

Knippenberg, E., & Hoddinott, J. (2019). Shocks, social protection, and resilience: Evidence from Ethiopia. *Gates Open Res*, *3*, 702.

Kolog, J. D., Asem, F. E., & Mensah-Bonsu, A. (2023). The state of food security and its determinants in Ghana: an ordered probit analysis of the household hunger scale and household food insecurity access scale. *Scientific African*, 19, e01579.

Kozlov, R. (2023). The Effect of Interest Rate Changes on Consumption: An Age-Structured Approach. *Economies*, 11(1), 23.

Kumba, J. (2015). The Role of Household Characteristics in Determining Food Security in Kisii Central Sub-County, Kenya. *Online)*, *5*(7), 2225-0484.

Lebese, R. T., Mothiba, T. M., Mulaudzi, M. T., Mashau, N. S., & Makhado, L. (2022b). *Rite of passage: An African indigenous knowledge perspective* (F. M. Mulaudzi & R. T. Lebese, Eds.). PubMed; AOSIS.

Leser, C. E. V. (1963). Forms of Engel Functions. *Econometrica*, 31(4), 694.

Lowe, M., Joof, M., & Rojas, B. M. (2020). Social and cultural factors perpetuating early marriage in rural Gambia: an exploratory mixed methods study. *F1000Research*, *8*, 1949.

Madhavan, S., Clark, S., & Schmidt, S. (2020). Single mothers coping with food insecurity in a Nairobi slum. *Urban Studies*, *58*(13), 2703–2720.

Magaña-Lemus, D., Ishdorj, A., Rosson, C. P., & Lara-Álvarez, J. (2016). Determinants of household food insecurity in Mexico. *Agricultural and Food Economics*, 4(1).

Mallick, D., & Rafi, M. (2010). Are Female-Headed Households More Food Insecure? Evidence from Bangladesh. *World Development*, 38(4), 593–605.

Mango, N., Zamasiya, B., Makate, C., Nyikahadzoi, K., & Siziba, S. (2014). Factors influencing household food security among smallholder farmers in the Mudzi district of Zimbabwe. *Development Southern Africa*, 31(4), 625–640.

Mason, N. M., Wineman, A., Kirimi, L., & Mather, D. (2016). The Effects of Kenya's "Smarter" Input Subsidy Programme on Smallholder Behaviour and Incomes: Do Different Quasi-Experimental Approaches Lead to the Same Conclusions? *Journal of Agricultural Economics*, 68(1), 45–69.

Matuschke, I., & Kohler, S. (2014). Urbanization and food security. In Bündnis Entwicklung Hilft [Alliance Development Works] & United Nations University – *Institute for Environment and Human Security (*UNU-EHS) (Eds.), World Risk Report 2014 (Chapter 2.4).

Mbow, C., Rosenzweig, C., Barioni, L., Benton, T., Frank, S., Kriewald, S., … Van Diemen, R. (2019). SPM 5 Food security Coordinating Lead Authors: *Lead Authors*.

Mikou, M., Rozenberg, J., Koks, E., Fox, C., & Quiros, T. (2019). Assessing Rural Accessibility and Rural Roads Investment Needs Using Open Source Data.In *World Bank, Washington, DC eBooks*.

Mishra, P., Pandey, C. M., Singh, U., Sahu, C., Keshri, A., & Gupta, A. (2019). Descriptive Statistics and Normality Tests for Statistical Data. *Annals of Cardiac Anaesthesia*, *22*(1), 67–72.

Modigliani, F., & Brumberg, R. (1954). Utility analysis and the consumption function: An interpretation of cross-section data. *Franco Modigliani*, 1(1), 388-436.

Mohammed, A., Wassie, S. B., & Teferi, E. T. (2021). Determinants of Smallholders' Food Security Status in Kalu District, Northern Ethiopia. *Challenges*, *12*(2), 17.

Mokari-Yamchi, A., Faramarzi, A., Salehi-Sahlabadi, A., Barati, M., Ghodsi, D., Jabbari, M., & Hekmatdoost, A. (2020). Food Security and Its Association with Social Support in the Rural Households: A Cross-Sectional Study. *Preventive Nutrition and Food Science*, *25*(2), 146–152.

Monica, O. (2016). *Determinants of Household Food Security in Rural Central and Eastern Kenya*. Jooust.ac.ke.

Monticone, Chiara (2023), Gender differences in financial literacy and resilience, in OECD, *Joining Forces for Gender Equality: What is Holding us Back?* OECD Publishing, Paris.

Mutea, E., Bottazzi, P., Jacobi, J., Kiteme, B., Speranza, C. I., & Rist, S. (2019). Livelihoods and Food Security Among Rural Households in the North-Western Mount Kenya Region. *Frontiers in Sustainable Food Systems*, 3.

Mutea, E., Hossain, M. S., Ahmed, A., & Ifejika Speranza, C. (2022). Shocks, socio-economic status, and food security across Kenya: policy implications for achieving the Zero Hunger goal. *Environmental Research Letters*, 17(9), 094028. https://doi.org/10.1088/1748-9326/ac8be8

Mutenje, M., Kankwamba, H., Mangisonib, J., & Kassie, M. (2016). Agricultural innovations and food security in Malawi: Gender dynamics, institutions and market implications. *Technological Forecasting and Social Change*, *103*, 240–248.

Mutinda, G. B. (2015). *Determinants of Household food expenditure and Food Security in Rural Kenya*. Erepository.uonbi.ac.ke.

Mutisya, M., Ngware, M. W., Kabiru, C. W., & Kandala, N. (2016). The effect of education on household food security in two informal urban settlements in Kenya: a longitudinal analysis. *Food Security*, *8*(4), 743–756.

National Accelerated Agricultural Inputs Access Program. (2014). *Soil suitability evaluation for maize production in Kenya*. National Accelerated Agricultural Inputs Access Programme (NAAIAP) in collaboration with Kenya Agricultural Research Institute (KARI).

Nduati, J. K. (2017). *Institutional Factors Influencing Completion of Kenya Rural Roads Authority Projects in Ruiru Sub County, Kenya.* Erepository.uonbi.ac.ke.

Nechifor, V., Ramos, M. P., Ferrari, E., Laichena, J., Kihiu, E., Omanyo, D., Musamali, R., & Kiriga, B. (2021). Food security and welfare changes under COVID-19 in Sub-Saharan Africa: Impacts and responses in Kenya. *Global Food Security*, 28, 100514.

Nelson, G., Bogard, J., Lividini, K., Arsenault, J., Riley, M., Sulser, T. B., … Rosegrant, M. (2018). Income growth and climate change effects on global nutrition security to mid-century. *Nature Sustainability*, *1*(12), 773–781.

Nyangasa, M. A., Buck, C., Kelm, S., Sheikh, M., & Hebestreit, A. (2019). Exploring Food Access and Sociodemographic Correlates of Food Consumption and Food Insecurity in Zanzibari Households. *International Journal of Environmental Research and Public Health*, *16*(9), 1557.

Olayemi, A. O. (2012). Effects of Family Size on Household Food Security in Osun State, Nigeria. *Asian Journal of Agriculture and Rural Development*.

Omotayo, A. O., & Aremu, A. O. (2020). Evaluation of Factors Influencing the Inclusion of Indigenous Plants for Food Security among Rural Households in the North West Province of South Africa. *Sustainability*, 12(22), 9562.

Opata, P., & Wesonga, J. (2016). Journal of Resources Development and Management www.iiste.org ISSN 2422-8397 An International Peer-reviewed. *Journal*, *20*.

Osabohien, R. A., Amar Hisham Jaaffar, Ibrahim, J., Usman, O., Igharo, A. E., & Adeleke Abdulrahman Oyekanmi. (2024). Socioeconomic shocks, social protection and household food security amidst COVID-19 pandemic in Africa's largest economy. *PLOS ONE*, *19*(1), e0293563–e0293563.

Ougo, J. (2022). *Assessment of trends and determinants of household food insecurity in Marsabit county-Kenya*. Repository.maseno.ac.ke.

Parker, J. (2010). *Economics 314 Coursebook, 2010.*

Psaki, S., Haberland, N., Mensch, B., Woyczynski, L., & Chuang, E. (2022). Policies and interventions to remove gender-related barriers to girls' school participation and learning in low- and middle-income countries: A systematic review of the evidence. *Campbell Systematic Reviews*, *18*(1).

Quisumbing, A. R., Kumar, N., & Behrman, J. A. (2017). Do shocks affect men's and women's assets differently? Evidence from Bangladesh and Uganda. *Development Policy Review*, *36*(1), 3–34.

Quisumbing, A. R., Rubin, D., Manfre, C., Waithanji, E., van den Bold, M., Olney, D., Meinzen-Dick, R. (2015). Gender, assets, and market-oriented agriculture: learning from high-value crop and livestock projects in Africa and Asia. *Agriculture and Human Values*, *32*(4), 705–725.

Republic of Kenya. (2010). *The Constitution of Kenya*. Nairobi: National Council for Law Reporting.

Republic of Kenya. (2022). *Vision 2030 Flagship Programmes and Projects Progress Report (FY 2020/2021): Towards A Globally Competitive and Prosperous Nation.* Government of Kenya.

Rono, P. K., Rahman, S. M., Amin, M. D., & Badruddoza, S. (2022). Unraveling the Channels of Food Security of the Households in Northern Kenya: Evidence from an Exclusive Dataset. *Current Developments in Nutrition*, 100005.

Roy, P., & Patro, B. (2022). Financial Inclusion of Women and Gender Gap in Access to Finance: A Systematic Literature Review. *Vision: The Journal of Business Perspective*, *26*(3), 097226292211042.

Sekhampu, T. (2013). Determination of The Factors Affecting the Food Security Status of Households in Bophelong, South Africa. *International Business & Economics Research Journal (IBER),* 12(5), 543.

Sheahan, M., Olwande, J., Kirimi, L., & Jayne, T. S. (2014). Targeting of Subsidized Fertilizer Under Kenya's National Accelerated Agricultural Input Access Program (NAAIAP). *Food Security Collaborative Working Papers*. 65(1), 55-72.

Shibia, A., Omanyo, D., Chemnyongoi, H., Kihiu, E., Waweru, G., Onsomu, E., Nguli, J. (2023). *Cost of Living and the Role of Markets KER 2023 Technical Committee*. Kenya Institute for Public Policy Research and Analysis.

Sidique, S. F. B., & Muhammad, N. A. (2019). Determinants of Food Security Among Households in Nigeria. *Pakistan Journal of Nutrition*, 18(11), 1042–1052.

Silva, A., Astorga, A., Faundez, R., & Santos, K. (2023). Revisiting food insecurity gender disparity. *PLOS ONE*, *18*(8), 1–16.

Turley, L., & Uzsoki, D. (2018). *Financing Rural Infrastructure: Priorities and pathways for ending hunger IISD REPORT*. International Institute for Sustainable Development.

United Nations. (2015). The 17 sustainable development goals. Retrieved from United Nations website: https://sdgs.un.org/goals.

United Nations. (2022). United Nations: *Gender Equality and women's Empowerment.* Www.un.org; United Nations.

Vreyer, P. D., Lambert, S., & Ravallion, M. (2020). *Unpacking Household Engel Curves*. NBER Working Papers.

Wanjala, G., & Hussein, A. K. (2017). *Impact of Subsidised Fees on Students' Access to Quality Education in Public Secondary Schools in Wajir County, Kenya.* Erepository.uonbi.ac.ke.

Welborn, L. (2018). *Food security under threat in Kenya*. Institute for Security Studies.

WFP. (2022, April 22). *WFP and Gender Brief*. World Food Programme.

Williams, R. (2015). *Heteroskedasticity*. SAGE Publications Limited.

Worku, C. (2023). Determinants of food security status of household in west Gojjam zone, Ethiopia. *Food Science & Nutrition*, *11*(10), 5959–5966.

World Bank. (2012). *World Development Report 2012*. The World Bank.

World Bank. (2016). *Republic of Kenya Ministry of Devolution and Planning National Agricultural and Rural Inclusive Growth Project (NARIGP) Environmental and Social Management Framework.* World Bank.

World Bank. (2022). *What is food security*? World Bank Publications.

World Bank. (2023). *Accelerate Gender Equality for a Sustainable, Resilient, and Inclusive Future.* World Bank.

Worldwide, C. (2022, October 13). *2022 Global Hunger Index*. Concern Worldwide.

Yoosefi Lebni, J., Mohammadi Gharehghani, M. A., Soofizad, G., khosravi, B., ziapour, A., & Irandoost, S. F. (2020). Challenges and opportunities confronting female-headed households in Iran: a qualitative study. *BMC Women's Health, 20(1).*

Yusuf, A.S., Balogun, L.O., & Falegbe, E.O. (2015). Effect of urban household farming on food security status in Ibadan metropolis, Oyo State, Nigeria. *Journal of Agricultural Sciences*, Belgrade, 60, 61-75.

APPENDICES

Appendix I: Research Permit

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