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Determinants of food security among pastoralist communities in Kenya: the case study of Samburu County.

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DETERMINANTS OF FOOD SECURITY AMONG PASTORALIST COMMUNITIES IN KENYA: THE CASE STUDY OF SAMBURU COUNTY

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

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ABSTRACT

Food security remains a critical challenge among pastoralist communities in Kenya's arid and semi-arid lands (ASALs), where households heavily depended on livestock and faced recurrent climate shocks. This study investigated the determinants of food security among pastoralist households in Samburu County, focusing on three thematic domains: animal productivity, socio-economic characteristics and climate change adaptation strategies. Guided by the Sustainable Livelihoods Framework and grounded in a positivist philosophy, the study employed a cross-sectional survey design and quantitative methodology. Data were collected from 502 households using structured questionnaires and analyzed through descriptive statistics and multinomial logistic regression. The findings revealed that only 13.7% of households were food secure, while 54.6% were moderately food insecure and 31.7% were severely food insecure. Livestock ownership and productivity emerged as the most influential predictors. Each additional animal increased the probability of a household being food secure by 8.8%, while higher production of livestock by-products (especially milk) and participation in breeding practices significantly improved food security outcomes. Although 98.8% of households reported access to veterinary services, less than 40% engaged in feed production or preservation, exposing them to seasonal shortages and limiting their adaptive capacity. Socio-economic factors, including household asset value, income from livestock sales and land size, were positively associated with food security. However, 85.4% of household heads were uneducated and while education was intuitively important, it was not a statistically significant predictor in the regression model. Climate change adaptation practices were widespread but uneven. While 91.8% of households perceived long-term climate changes and nearly half experienced two or more droughts in the past five years, formal tools such as early warning systems (7.8%) and insurance (2.6%) were scarcely adopted. Nonetheless, the adoption of multiple adaptation strategies had a cumulative effect—each additional strategy increased the probability of food security by 33%. The study recommended expanding climate-smart extension services through community-based organizations, promoting low- literacy communication methods, establishing pastoralist-focused SACCOs to enhance financial inclusion, leveraging mobile technology for climate and market information and implementing targeted food and nutrition interventions during the lean season from March to July. Further research was suggested in three key areas: the role and effectiveness of extension services in influencing adaptive behaviors; the barriers to uptake of early warning systems and trust in institutional information; and the economic viability of adaptation strategies through cost-benefit analysis.

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LIST OF ABBREVIATIONS

ASALs	Arid and Semi-Arid Lands
CBOs	Community-Based Organizations
DFID	Department for International Development
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GMOs	Genetically Modified Organisms
IFAD	International Fund for Agricultural Development
LMICs	Low- and Middle-Income Countries
NGOs	Non-Governmental Organizations
SSA	Sub-Saharan Africa
SPSS	Statistical Package for the Social Sciences
SLF	Sustainable Livelihoods Framework
UNICEF	United Nations International Children's Emergency Fund
WFP	World Food Programme
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of study

Food security is a complex notion that includes the availability, accessibility, utilization and stability of food supplies essential for individuals and communities to sustain a healthy and active lifestyle. The meaning of food security has transformed over time, mirroring shifts in human ideals, economic circumstances and environmental challenges. Food security is achieved when all individuals always have physical, social and economic access to adequate, safe and nutritious food that satisfies their dietary requirements and preferences for a vigorous and healthy life (Sumsion et al., 2023).

From this definition, availability denotes the physical existence of food in adequate amounts, encompassing production, distribution and trade to ensure that it meets the population's needs. Access encompasses the economic and physical capacity of individuals to acquire food, considering elements such as income, food costs and the geographical proximity to food sources, which might influence a household's capability to access sufficient nutrition (Upton et al., 2016). Utilization refers to the nutritional content of food and the body's capacity to absorb and utilize nutrients, affected by factors such as food safety, dietary diversity and health condition, which can influence overall well-being (Ofoedu, Chigozie E., et al. 2021). Stability denotes the reliability of food availability, access and use throughout time, emphasizing the necessity of resilience against disruptions such as economic recessions, natural calamities, or political instability that can affect food systems (Upton et al., 2016).

Food insecurity is a critical global challenge, with far-reaching impacts on health, economies and social stability. According to the 2022 State of food security and Nutrition in the world report (SOFI), over 828 million people worldwide suffer from hunger, with sub–Saharan Africa being disproportionately affected. Inadequate food security is associated with numerous health problems, such as stunted growth in children and heightened vulnerability to diseases (Thorne-Lyman et al., 2010). Food security fosters economic stability by enabling populations to participate in productive endeavours free from the constraints of hunger. It enhances labour productivity and economic growth, as people experiencing food insecurity may find it challenging to work efficiently (Naylor et al., 2023). Moreover, guaranteeing food security can enhance social stability and solidarity within

communities. Reliable access to food can mitigate tensions and conflicts associated with resource scarcity (Sumsion et al., 2023). The global food security crisis is further intensified by climate change, which disrupts agricultural systems, causing unpredictable rainfall patterns, prolonged droughts and extreme weather events. This has cascading effects on food production, availability and access, leaving millions at risk. The global focus on food security is encapsulated in sustainable development goal 2 (Zero Hunger), which underscores the urgent need for sustainable food systems to ensure that all individuals have reliable access to sufficient and nutritious food. In 2023, an estimated 2.4 billion individuals worldwide were food insecure, with 1.9 billion facing moderate or severe food insecurity, according to the FAO (2023). This concerning data indicates a substantial rise in food insecurity, especially in low- and middle-income nations.

The State of Food Security and Nutrition in the World report (FAO et al., 2017) indicates that food insecurity and undernutrition remain prevalent in Sub-Saharan Africa (SSA). Undernutrition and food insecurity are believed to incur substantial economic costs, along with long-term or irreversible health consequences. The Global Panel (2014) estimates that child undernutrition costs Ethiopia 16% of its GDP, whereas Bhutta et al. (2013) estimate that Sub-Saharan Africa loses an average of 11% of its GDP annually.

In Kenya, food insecurity is particularly severe arid and semi-arid lands (ASALs), which constitute about 89% of the county's landmass are home to approximately 36% of the population. These regions are highly susceptible to climate shocks, including prolonged droughts and erratic rainfall, which disrupts agricultural and livestock production. According to the Kenya National Bureau of Statistics, approximately 16 million Kenyans were unable to meet the food poverty line threshold in 2022, with arid and semi-arid land (ASAL) areas being the most affected (Kenya National Bureau of Statistics, 2022). Pastoralist communities in these regions depend heavily on livestock for their livelihoods. However, challenges such as limited access to markets, inadequate veterinary services and poor infrastructure exacerbate their vulnerability to food insecurity (UN, 2023; Mongabay, 2023). Government initiatives like Kenya Vision 2030 and the Global Food Security Strategy plan for Kenya aim to address these issues but have yet to fully mitigate the specific vulnerabilities faced by pastoralist communities (Kenya Vision 2030, 2023; USAID, 2018).

Consequently, the prognosis for global food security is troubling, with forecasts suggesting that, absent substantial intervention, the population of food-insecure humans may persist in increasing. Confronting the fundamental causes of food insecurity, such as poverty, inequality and climate change, is crucial for attaining sustainable food security objectives (Adesete et al., 2022).

Food security in pastoralist communities is affected mainly by livelihood strategies which are critical for pastoralist communities. The core components of this strategies are animal productivity which contributes directly to food security by providing milk, meat and income, making it a central focus in pastoralist economies (FAO, 2023). Social-Economic factors such as education, income and gender roles significantly influence food access and utilization, as evidenced in recent studies in ASAL regions (KNBS, 2023). Climate adaptation practices: with increasing climate variability, adaptation strategies which include adopting drought resistance breeds and diversification are critical for resilience Intergovernmental panel on climate change (IPCC Report, 2022). Samburu County relies heavily on livestock, faces frequent droughts and has socio-economic vulnerabilities, making these three factors particularly relevant.

1.1.1 Determinants of food security

In pastoralist communities, animal output, predominantly dependent on livestock, constitutes an essential source of sustenance and revenue. The health and productivity of livestock directly influences food security, as pastoralists rely on animal products such as milk, meat and blood for their nutritional requirements (Gitungwa et al., 2021). The implementation of sustainable animal husbandry methods and technologies has demonstrated an enhancement in food security through increased livestock productivity and efficiency (Rasyid, 2024). Furthermore, the commercialization of livestock is crucial; research demonstrates that engagement in livestock markets alleviates food insecurity by enhancing household income and food accessibility (Benti et al., 2022).

Socio-economic factors, such as household size and gender roles, are essential determinants of food security in pastoralist communities. More extensive households typically own greater labor resources for herding and agricultural endeavors, hence potentially improving food security

(Amwata et al., 2015). Furthermore, women's management of livestock resources has been associated with enhanced dietary diversity and food security results (Gitungwa et al., 2021). Nonetheless, socio-cultural norms may also impede women's access to resources, hence intensifying food insecurity. The interaction of these socio-economic factors underscores the necessity for gender-sensitive strategies in food security initiatives (Benti et al., 2022). Poverty levels, with almost one-third of the population residing behind the poverty threshold, restrict access to food and essential resources for agricultural output (Lokuruka, 2021). Moreover, the economic inequalities between urban and rural regions result in disparate access to food, with rural households experiencing elevated levels of food insecurity (Mutea et al., 2022). The absence of educational access, especially for women, intensifies these issues, as educated individuals are more inclined to adopt effective farming methods and make informed nutrition decisions (Chebuche & Wakhungu, 2021; Mikalitsa, 2010). Household income affects the ability to buy food and cope with crises. Education enhances decision-making related to nutrition and climate adaptation. Meanwhile, gender dynamics in pastoralist communities influence control over resources, which in turn impacts access to food.

Climate change also presents a considerable risk to food security in pastoralist communities, especially in semi-arid areas where pastoralism is the predominant means of subsistence. Changes in climate patterns may result in droughts, less pasture availability and heightened animal mortality, hence directly affecting food production (Ndiritu & Muricho, 2021). Adaptation practices by pastrolists, including income diversification and enhanced livestock management practices, have demonstrated efficacy in bolstering resilience to climate-related shocks (Ndiritu & Muricho, 2021). Moreover, the advancement of sustainable land management methods might alleviate the detrimental impacts of climate change on food security (Salau et al., 2019). Understanding such adaptation strategies helps improve resilience, ensuring stability in food access over time.

1.1.2 Food security

Food security in Kenya is marked by a considerable proportion of households facing different levels of food insecurity. As defined by FAO (2022), food security is a condition where all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs for a healthy life. A thorough review revealed that a significant segment of the population experiences food insecurity, with estimates indicating that approximately 30% of

households are affected (Kiboi et al., 2022). This predicament is intensified by insufficient dietary diversity, frequently associated with socioeconomic factors including poverty and restricted access to nutrient-dense foods (Momanyi et al., 2019). The dietary diversity score in locations like Kiandutu and Kitui is stated to be below recommended levels, signifying dependence on a limited variety of food sources (Momanyi et al., 2019).

Dimensions of food security include availability, which refers to the physical existence of food in adequate amounts for household consumption; access, which is the ability of households to obtain food through income, markets, or self-production; utilization, which involves proper food intake and absorption for maintaining good nutrition and health; and stability, which refers to consistent food access without seasonal or shock-related disruptions.

Samburu County, the focus of this research, is situated in the Rift Valley region of Kenya and is mostly populated by the Samburu people, who are semi-nomadic pastoralists. The County is defined by its arid and semi-arid lands (ASALs), which profoundly affect the livelihoods and food security of its inhabitants. Samburu County has over 21,000 square kilometers and has a population of approximately 310,327, as per the 2019 Kenya Population Census (Iannotti et al., 2021). The county is adjacent to other counties, namely Laikipia to the south, Turkana to the northwest, Baringo to the West and Isiolo to the southeast. The terrain predominantly consists of savannah and semi-arid regions, presenting difficulties for agriculture and livestock husbandry.

The Samburu communities predominantly depend on livestock herding for their primary livelihood, managing cattle, goats, sheep and camels. Livestock functions not just as a food source but also as a symbol of wealth and social prestige within society (Iannotti et al., 2021). The Samburu's cultural practices are intricately linked to their pastoral lifestyle, encompassing traditional expertise in animal husbandry, seasonal migration patterns and communal resource management. Samburu County represents a microcosm of challenges faced by pastoralist communities globally. High food insecurity rates and reliance on livestock make it an ideal setting to study the relationship between animal productivity, socio-economic factors and climate change adaptation strategies.

1.2 Problem Statement

Food insecurity is a persistent and critical issue in Samburu County, driven by recurrent droughts, low agricultural productivity and socio-economic vulnerabilities. The county consistently records some of the highest malnutrition rates in Kenya, particularly affecting children and lactating mothers (NDMA, 2023). This chronic food insecurity contributes to health issues such as stunted growth in children and increased vulnerability to infections (Thorne-Lyman et al., 2010). For many households in Samburu, limited income, poor infrastructure and constrained access to markets restrict the ability to secure adequate and nutritious food. Addressing these localized challenges is essential to improving food and nutrition outcomes in the county. Food insecurity is primarily caused by poverty since it limits people's capacity to buy enough food (Beacom et al., 2020). Furthermore, disruptions to food production and supply systems resulting from environmental changes, such as climate change, can heighten food insecurity. Severe weather events have the potential to harm crops and lower yields, hence intensifying pre-existing vulnerabilities (Ramp, 2014).

Several studies have been conducted on the factors affecting food security in Kenya, addressing various dimensions such as socioeconomic status, climate change, agricultural practices and community dynamics. While Digo et al. (2014) explored the role of women's groups in enhancing household food security in Kaiti Division, their study is based in a predominantly agricultural and culturally distinct setting. The socio-economic dynamics, gender roles and livelihood strategies in Samburu's pastoralist communities differ significantly. As such, while the positive influence of women's group participation on food security is notable, its applicability to Samburu requires caution. Gebre and Rahut (2021) examined the prevalence of household food insecurity in East Africa, linking food access to climate vulnerability. Their research highlights that climate change significantly impacts food security by affecting agricultural productivity and access to food resources. Their study found that higher education levels correlate with improved food security, as educated individuals are better equipped to navigate economic challenges and make informed dietary choices. Ochieng et al. (2016) studied the effects of climate variability on agricultural production among small-scale farmers in Kenya. They concluded that climate change poses a significant threat to food security, necessitating adaptive strategies to enhance resilience in agricultural practices.

Although numerous studies have explored food security in Kenya, few have disaggregated findings to reflect the distinct socio-economic and ecological dynamics of pastoralist communities such as those in Samburu County. Many existing studies on food security in Kenya tend to generalize findings across regions, often overlooking the unique socio-economic and ecological challenges faced by pastoralist communities in Samburu County. Although individual factors such as climate change and poverty have been studied, there is limited research on how these elements interact to shape food security outcomes in this specific context. To address these gaps, this study focuses on the combined impact of animal productivity, socio-economic factors and climate adaptation practices on food security in Samburu County. Current literature rarely integrates the analysis of animal productivity, socio-economic factors and climate adaptation practices to provide a comprehensive understanding of food security.

There is limited understanding of how climate change adaptation strategies specifically affect food security within the Samburu context. While studies such as those by Ndiritu and Muricho (2021) indicate that climate change adaptation can enhance food security among pastoralists in semi-arid regions of Kenya, they do not delve deeply into the specific mechanisms and practices that are effective in Samburu County. Further, the unique challenges faced by Samburu pastoralist communities, such as their dependence on livestock and mobility patterns, necessitate a focused study to explore how these factors influence their ability to adapt to climate change and secure food resources.

There is a notable lack of comprehensive documentation of traditional knowledge and practices among Samburu communities, which limits the integration of indigenous strategies into formal adaptation efforts (Samburu County Government, 2023; Samburu Women Trust, 2021). This gap undermines the potential contributions of local knowledge to sustainable and culturally relevant climate resilience planning. Lengurnet and Nalugala (2022) emphasize that traditional environmental knowledge remains under-recorded, risking the loss of critical insights that could enhance food security and sustainable resource management. Addressing this gap requires greater recognition and incorporation of local knowledge systems into policy and development frameworks, supported by community-engaged research approaches that respect and reflect Samburu cultural practices.

Additionally, the economic dependency of Samburu pastoralists on livestock presents unique challenges that are not adequately addressed in current literature. Vundi (2023) discusses the historical loss of grazing lands and the pressures from population growth and conservation efforts,

which complicate the pastoralists' ability to maintain their livelihoods. However, more empirical research is needed to quantify the economic impacts of these challenges on food security and to identify viable alternatives or supplementary income sources that could enhance resilience. Lastly, while there is a growing body of literature on the effects of climate change on pastoral communities in northern Kenya, studies specifically targeting Samburu County are sparse. Research by Bruyere et al. (2018), indicates that pastoralists in similar regions face comparable challenges, yet the specific socio-ecological dynamics of Samburu remain underrepresented. This lack of localized research limits the ability to formulate effective interventions tailored to the unique circumstances of Samburu pastoralists.

This study aimed to examine the interplay and combined effects of animal productivity factors, socioeconomic factors and climate change adaptation practices influencing food security and propose policy, practice and research recommendations in promoting sustainable development in the Samburu County.

1.3 Research Objectives

1.3.1 General Objective

The primary objective of this study was to evaluate the combined effects of animal productivity, socio-economic factors and climate change adaptation practices on food security among pastoralist households in Samburu County and to provide evidence-based recommendations.

1.3.2 Specific objectives

1. To assess animal productivity factors that influence food security status of pastoralist households in Samburu.
2. To analyse socio-economic factors that influence food security status of pastoralist households in Samburu.
3. To identify climate change adaptation practices that influence food security status of pastoralist households in Samburu.

1.4 Research Questions

1. What is the relationship between livestock productivity factors (such as heard size, breed quality and animal health) and availability of food among pastoralist households in Samburu?

2. How do socio-economic factors (such as household income, education level and access to markets) influence food access and utilization in Samburu County?

3. What are the common climate change adaptation practices adopted by pastoralist households in Samburu and how they effectively influence food security?

1.5 Scope of the Study

Geographically, geographically, the study concentrated on Samburu County, located in the Rift Valley region of Kenya. Samburu was chosen due to its significant representation of pastoralist communities facing acute food security challenges. The county's arid and semi-arid lands (ASALs) made it highly susceptible to climate variability, droughts and socio-economic vulnerabilities, which are critical factors influencing food security. By focusing on Samburu, the study aimed to address a region where traditional livelihoods are under substantial threat, thereby providing valuable insights into the dynamics of food security in similar pastoralist settings.

Within Samburu County, the study targeted the Nairimirimo community in Wamba North Ward of Samburu East Sub-County. This area was predominantly inhabited by pure pastoralist households whose livelihoods were exclusively reliant on livestock herding. Selecting a pure pastoralist community allowed for an in-depth examination of factors directly affecting livestock-dependent food security. The primary population for this study comprised households residing in the Nairimirimo community, specifically those engaged in pure pastoralism. Data were collected from household heads responsible for managing livestock and making key economic decisions within the household, community leaders and members of local organizations who could provide additional insights into socio-economic and environmental factors affecting food security.

To achieve the objectives of the study, a cross-sectional research design was utilized to capture a

snapshot of the current food security status and its determinants among the target population. A multistage sampling method was adopted, which began with cluster sampling to divide the Nairimirimo community into smaller clusters based on geographic or administrative boundaries. This was followed by stratified random sampling within each cluster, where households were stratified based on specific criteria such as herd size and income level to ensure representation across different groups. The final selection of the 501 households was conducted using systematic random sampling to ensure each household had an equal probability of being included.

For data collection, a structured questionnaire was developed, encompassing sections on demographic parameters such as age, gender, education level and household size; animal productivity parameters such as herd size, breed quality, access to veterinary services and livestock by-products; socio-economic factors such as household income, education, market access and gender roles; food security indicators including availability, access, utilization and stability of food resources; and climate adaptation practices such as strategies employed to mitigate climate impacts, including drought-resistant breeds and livelihood diversification. Trained enumerators administered the questionnaires through face-to-face interviews, ensuring clarity and consistency in responses. Collected data were analysed using SPSS software. Both descriptive statistics and inferential statistics, particularly multinomial logistic regression, were employed to identify relationships between independent variables and the dependent variable.

1.6 Significance of the study

This study's significance lay in its contribution to theory, methodology, practice and policy, with the Theory of Access by Ribot and Peluso (2003) providing the central theoretical foundation. By focusing on mechanisms of access to resources, the study addressed critical gaps in understanding food security among pastoralist communities in Samburu County.

By analysing livestock productivity, socio-economic factors and climate adaptation practices through the lens of access mechanisms, the study highlighted the interplay of power, socio-economic hierarchies and institutional structures in shaping food security. The findings will inform future applications of the Theory of Access in similar arid and semi-arid land (ASAL) settings globally (Ribot & Peluso, 2003; FAO, 2022).

At the practical level, the study identified actionable strategies to improve food security in Samburu County. These included enhancing access to veterinary services, promoting gender-inclusive decision-making in resource control and scaling up community-based climate adaptation practices like water harvesting and the use of drought-resistant livestock. These practical insights were essential for reducing food insecurity in pastoralist communities affected by resource conflicts, climate shocks and socio-economic inequalities (NDMA, 2023; USAID, 2022).

The study informed policy by identifying barriers to equitable access to resources and proposing inclusive governance frameworks. It emphasized policies that supported communal grazing rights, ensured access to water points and reduced conflicts over scarce resources. Gender-sensitive policies and climate resilience investments supported infrastructure and programs that enabled pastoralists to adapt to climate variability. Studying the factors affecting food security was also crucial for achieving the United Nations Sustainable Development Goals (SDGs), particularly Goal 2, which aimed to end hunger and achieve food security and improved nutrition by 2030 (Richardson et al., 2018; Ayala & Meier, 2017). By identifying and addressing the root causes of food insecurity, stakeholders could contribute to broader efforts to promote social equity, economic development and environmental sustainability.

In summary, the chapter introduced the significance of the study in advancing theoretical, practical and policy-level solutions to food insecurity. Using the Theory of Access as its foundation, the study addressed the mechanisms by which pastoralist households in Samburu County accessed and benefited from critical resources. This study not only contributed to academic literature but also provided actionable insights for improving food security and resilience in pastoralist communities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Food security, animal productivity practices, socio-economic factors and climate change adaptation practices are interconnected elements that significantly affect the livelihoods of pastoralist communities in regions such as Samburu County, Kenya. This chapter seeks to trace the relevant theoretical literature and empirical evidence that supports the form the foundation of the study. This leads to identification of the relevant gaps that this study fills. The chapter concludes with a conceptual framework that links the relationship between the independent and the dependent variables that are tested. The operationalization of these variables is then presented to conclude the chapter.

2.2 Theoretical framework

The study of factors affecting food security is anchored in various theoretical models and frameworks that help scholars understand the complex interplay of environmental, socioeconomic, cultural and political dimensions. This study will focus on the Sustainable livelihoods framework to understand the multifaceted nature of food security and the various factors that influence it.

2.2.1 The theory of Access

This is a compelling framework for understanding the complex ways people benefit from resources. Jesse C. Ribot and Nancy Lee Peluso in their seminal 2003 paper titled “A theory of Access” published in Rural sociology. Ribot and Peluso are scholars in political ecology and natural resource governance, respectively. Their work synthesizes insights from political economy, environmental sociology and anthropology to explore resource access beyond property rights.

The theory of access expands the concept of property rights to include the broader processes, mechanisms and relationships through which individuals or groups gain, control and maintain access to resources. Access is conceptualized as a bundle of powers; it is not just determined by ownership or legal rights but also through social relations, capital, knowledge and authority. Ribot and Peluso identify mechanisms of access such as technology, capital, markets, knowledge and

identity, which enable or constrain the ability to benefit from resources. Furthermore, the theory emphasizes that access is dynamic and often contested. Individuals or groups can lose or gain access depending on shifts in political, social and economic circumstances.

Despite its broad applicability, the theory of access has been criticized in the following ways: conceptual overextension, critics argue that including a wide range of mechanisms (eg, markets knowledge and technology) risks making the theory too expansive and diffuse, potentially reducing its analytical precision

2.2.2 Adaptive Cycle Theory

This theory was developed by C.S. Holling in 1986 as a framework for understanding the dynamic nature of socio-ecological systems. It examines how these systems undergo phases of growth, stability, collapse and reorganization. It is particularly relevant for understanding the resilience and adaptability of pastoralist communities in Samburu County, Kenya, as they contend with food security challenges driven by environmental, social and economic changes. The theory was later expanded into a panarchy framework, which considers the interconnectedness of adaptive cycles across scales (Gunderson & Holling, 2002).

The adaptive cycle theory postulates that socio-ecological systems progress through four recurring phases: exploitation (r-phase), a period of rapid resource accumulation and growth; conservation (K-phase), a phase of stability where resources are stored and the system becomes more rigid; release (Ω-phase), a disruptive phase where the system experiences collapse or significant change due to accumulated vulnerabilities; and reorganization (α-phase), a phase of renewal, where innovation and adaptation occur, potentially leading to a new system trajectory. The theory predicts that systems are not static; they undergo cyclical changes driven by internal dynamics and external shocks. Adaptive capacity, or the ability to reorganize and learn, determines whether a system can successfully navigate collapse and transition. While adaptive theory provides a powerful lens for understanding system dynamics, it has been criticized for its oversimplification of complexity, as the real world may not follow neat cycles or predictable transitions and socio-ecological systems often behave in non-linear and chaotic ways.

In the context of Samburu County, the theory applies in several ways. During the exploitation phase, periods of adequate rainfall enable pastoralist communities to experience growth in livestock numbers and improved food security. In the conservation phase, as resources stabilize, communities rely on established grazing patterns and traditional resource-sharing practices. However, over-reliance on these systems may lead to vulnerabilities such as overgrazing or limited diversification. The release phase is marked by shocks like droughts, livestock disease, or market disruptions, which lead to resource depletion, livestock losses and food insecurity. In the reorganization phase, following these disruptions, communities adapt by adopting practices such as herd diversification, rotational grazing and engagement in alternative livelihoods.

The adaptive cycle theory was applied to understand livelihood dynamics in dryland pastoral systems across Africa by Sietz et al. (2017), who identified how communities transition between phases in response to climatic and socio-economic shocks. Walker et al. (2008) explored the impact of climate variability on agricultural and pastoral systems, emphasizing the role of innovation in the reorganization phase.

By leveraging these insights, the adaptive cycle theory can be adapted to map the historical trajectories of resource use and food security in Samburu, identify triggers and indicators of phase transitions such as drought onset, livestock mortality rates and market access disruptions and inform policies and interventions that enhance adaptive capacity. These may include promoting climate-smart practices, strengthening governance of communal grazing lands and diversifying livelihoods to reduce dependence on livestock.

2.2.3 Sustainable livelihood framework

The Sustainable Livelihood Framework (SLF) is a conceptual model that offers a holistic approach to understanding and assessing the diverse aspects affecting individuals' livelihoods, especially concerning poverty reduction and sustainable development. Formulated by the UK Department for International Development (DFID) in the late 1990s, the Sustainable Livelihoods Framework (SLF) underscores the necessity of including social, economic, environmental and institutional aspects to evaluate how individuals and communities may attain sustainable livelihoods. The SLF evaluates several assets (human, social, natural, physical and financial) that households employ to attain favourable livelihood results. It underscores the significance of comprehending the vulnerabilities

(e.g., climate variability) and institutional frameworks (e.g., market access) that affect these assets and livelihoods (Chambers & Conway, 1992).

Wu et al. (2023) identify the key components of the SLF as livelihood assets, vulnerability context, livelihood methods, outcomes and institutional frameworks. The SLF delineates five categories of capital that form livelihood assets: the skills, knowledge and health that empower individuals to engage in livelihoods; the networks, relationships and social cohesion that offer support and resource access; natural resources such as land, water and biodiversity that are vital for livelihoods; infrastructure and tools that enhance production and market access; and financial resources, encompassing savings, credit and income, that facilitate investment in livelihoods (Wu et al., 2023). The SLF recognizes that livelihoods are affected by external variables such as economic trends, environmental changes and social dynamics. Comprehending the vulnerability context aids in recognizing the risks and shocks that may impact livelihoods, including climate change, economic recessions, or political instability (Wang et al., 2022; Wu et al., 2023).

The framework also highlights the tactics employed by people and groups for livelihood generation. These tactics may encompass agricultural methods, diversification of income streams and participation in non-agricultural activities. The selection of livelihood strategies is determined by the accessibility of assets and the context of vulnerability (Wu et al., 2023; Su et al., 2021). The SLF emphasizes the results of livelihood strategies, encompassing improved food security, augmented income, enhanced well-being and increased resilience to shocks. The framework promotes the assessment of the impact of various policies on sustainable livelihoods and overall quality of life (Andres et al., 2022; Guo et al., 2019). The SLF acknowledges the influence of institutions and policies on the formation of livelihoods. Effective governance, service accessibility and supportive policies are crucial for empowering individuals and communities to establish and maintain their livelihoods (Shang et al., 2021; Rudiarto et al., 2019).

The SLF is important as it offers a comprehensive view of livelihoods, incorporating multiple factors that influence individuals' capacity for self-sustainment. This method is especially pertinent in developing nations, where livelihoods are typically complex and shaped by several circumstances. The SLF aids in identifying the risks confronted by households and the tactics they utilize to mitigate these risks by examining the vulnerability context. This comprehension is essential for formulating therapies that bolster resilience and mitigate vulnerability (Scoones, 2009;

Tolossa, 2010). Moreover, the SLF functions as an essential instrument for policymakers and practitioners to evaluate the efficacy of initiatives designed to enhance livelihoods. It advocates for the formulation of policies that tackle the fundamental causes of poverty and foster sustainable development (Shang et al., 2023; Yang, 2023). The paradigm is versatile and applicable across multiple sectors, such as agriculture and food security, natural resource management and urban development. This adaptability facilitates its deployment in many scientific and practical contexts (Barbieri, 2023; Reed et al., 2013).

The SLF is an essential instrument for examining the determinants of food security, especially in emerging economies like Africa. This paradigm highlights the need to comprehend the diverse assets and tactics households utilize to ensure their livelihoods, while also acknowledging the external vulnerabilities they encounter. The SLF classifies assets into five categories: human, social, natural, physical and financial capital. Each of these assets is essential in assessing food security. Makate et al. (2016) emphasize that crop variety promotes production, stabilizes revenue and improves food supply. This suggests that improving human and natural capital via varied agriculture practices can result in improved food security results. The SLF underscores the significance of comprehending the vulnerability context, encompassing external elements like climate change, economic shocks and social dynamics. Connolly-Boutin and Smit (2015) demonstrate the effects of climate change on food security in sub-Saharan Africa, influencing the livelihoods of rural communities. Through the analysis of these vulnerabilities, researchers can ascertain the hazards that jeopardize food security and formulate solutions to alleviate them.

The framework promotes the investigation of many livelihood alternatives that households employ to meet their food security. Nameere-Kivunike et al. (2022) evaluated the impact of a mobile crop health surveillance tool on the livelihoods of smallholder farmers in Uganda. Their findings indicate that enhanced access to knowledge can improve agricultural practices, therefore augmenting food security. This underscores the need of incorporating technology into livelihood measures to enhance food security. The SLF emphasizes the results of livelihood initiatives, which may encompass improved food security, higher well-being and increased resilience. Ayeb-Karlsson et al. (2016) discovered that engaging in alternative livelihood activities enhances resilience to environmental stresses, thereby bolstering food security. This highlights the necessity of assessing the efficacy of various initiatives in attaining sustainable lifestyles. Ultimately, the SLF acknowledges the

influence of institutions and policies in determining livelihoods. Ajadi et al. (2015) examined the impact of cultural norms on women's access to productive resources in Nigeria. Their research underscores the necessity for supportive policies that enable marginalized populations, especially women, to improve their livelihoods and food security.

The SLF demonstrates the interrelation of multiple factors influencing food security, which is the objective of this study. Sujakhu et al. (2019) discovered that food security is affected by various dimensions, encompassing economic, social and environmental issues. This comprehensive viewpoint is crucial for grasping the intricacies of food security and formulating appropriate interventions. The SLF is especially pertinent about climate change, as it underscores the necessity for adaptive methods. Research conducted by Peng et al. (2022) demonstrates that climate change substantially influences agricultural and livestock productivity, hence affecting food security. Utilizing the SLF, researchers can discern adaptive strategies that bolster the resilience of livelihoods against climatic unpredictability. Likewise, the SLF promotes community engagement in the formulation of livelihood initiatives. Liu et al. (2017) emphasize the significance of engaging local populations in decision-making about agricultural techniques and resource management. This participatory method can result in more efficient and sustainable food security initiatives.

The SLF offers a thorough methodology for examining the determinants of food security. By examining the interactions among different assets, vulnerabilities and solutions, researchers can get significant insights toward improving food security across many situations. The utilization of the SLF in food security research not only guides policy formulation but also advances sustainable development objectives by tackling the fundamental causes of food insecurity.

The nexus or conceptual bridge between the two theories lies in how resource use and access by systemic changes and are shaped adaptive responses. Here's a synthesis:

Theory	Focus	Contribution to Nexus
Theory of Access (Ribot & Peluso)	Social, economic, political mechanisms governing resource access	Explains *who* gets access and *how*—based on power, social identity, capital
Adaptive Cycle Theory (Holling)	Ecological and socio-economic systems' dynamics across phases	Explains *when* and *why* systems reorganize, collapse, or adapt under pressure

Both access mechanisms (from the Theory of Access) and feedback loops (from Adaptive Cycle

Theory) are influenced by these moderators: First, during reorganization (α-phase), extension services can catalyze innovation. Secondly, Access to institutional resources becomes vital after systemic collapse (Ω-phase). Finally, those with better access to extension and institutional support are more likely to regain or improve food security post-shock.

2.3 Empirical Review

Food security in pastoralist communities, such as Samburu County, is influenced by multiple factors, including animal productivity, social economic dynamics and climate adaptation practices. This empirical review evaluates existing literature related to these factors, highlighting their impact on food security and identifying research gaps that inform this study's focus.

2.3.1 Animal productivity factors that influence food security

Livestock productivity is central to food insecurity in pastoralist communities. Key indicators include herd size, breed quality, animal health and the use of by-products such as milk and meat. Larger and more resilient herds positively influence nutrition and income. Herero et al. (2013) identify improved feeding techniques and disease management as critical to productivity. By-Products (milk, Meat and Skin): Rodrigues et al. (2016) emphasize that milk and meat contribute to nutritional diversity, while sales of hides and skins supplement income.

In Samburu County, access to veterinary services and modern feeding techniques remains limited, impending animal productivity. Studies emphasize that improved veterinary care and feeding strategies, particularly in arid regions, significantly enhance livestock yields (Esquivias,2023). However, balehem et al. (2020) note that adoption of these technologies among smallholder farmers is often constrained by financial and infrastructural challenges.

The existing studies generally focus on the technical aspects of livestock productivity without fully examining the social, cultural and economic barriers to adopting modern practices in Samburu County. Additionally, there is limited research on how livestock productivity interacts with market access to influence food security in pastoralist settings.

The correlation between animal productivity factors and food security is a significant research area, especially in developing economies where livestock is essential for sustenance and nutrition. A notable subject in literature is the substantial role of cattle in enhancing food security via direct and indirect mechanisms. Hatab et al. (2021) assert that livestock supply chains are essential for

delivering livestock products that improve nutrition and support jobs and livelihoods in underdeveloped nations. Godber and Wall (2014) emphasize that cattle is an essential food resource, particularly in low-income regions, providing a safeguard against agricultural failures. This highlights the significance of livestock as both a food source and a protection against food insecurity.

Nonetheless, the investigations also disclose variations in the determinants affecting cattle productivity. Herrero et al. (2013) indicate that areas characterized by low feed efficiencies and elevated greenhouse gas emissions, such as Sub-Saharan Africa (SSA), provide significant potential for enhancing livestock output via improved feeding and management strategies. Balehegn et al. (2020) highlight the obstacles encountered by smallholder farmers in low- and middle-income countries (LMICs), noting that the inadequate adoption of technologies to enhance feed quality is a substantial limitation to livestock productivity. This suggests that although the potential for enhancement is present, the methods for attaining increased productivity may differ considerably depending on geographical circumstances and current farming practices.

Livestock productivity contributes to food security in various ways. Rodríguez et al. (2016) examine the significance of cattle production in Latin America and the Caribbean for supplying high-quality proteins and ensuring food security during economic downturns. This differs from the conclusions of Obuoyo et al. (2016), who examine the significance of cattle in small-scale mixed farming in Kenya, highlighting its impact on household income and food security via direct consumption and sales. These variances underscore the necessity for context-specific methods to augment the contribution of livestock to food security.

The study in Samburu County aims to expand upon these findings by examining the specific livestock production factors that affect food security in this distinct context. This study aims to investigate the impact of traditional and modern practices, adaptation measures and market access on livestock productivity and food security among pastoral communities. This study concentrates on Samburu to enhance comprehension of how local cultural and environmental elements influence livestock systems and their significance in food security, consequently offering insights for targeted interventions and policies.

2.3.2 The socio-economic factors that influence food security.

Socia-economic variables such as household income, education and market access significantly affect food security outcomes. Higher income levels enhance food accessibility, allowing households to diversify their diets and manage crises effectively (Mwangi et al. 2020). Education empowers households to make informed decisions about nutrition and adopt modern agricultural practices, further improving food utilization (Mutisya et al., 2016).

In pastoralist communities, gender dynamics also play a critical role. Women's control over livestock and resources has been linked to better dietary and food security outcomes (Gitungwa et al., 2021). However, socio-cultural norms in Samburu often limit women's access to resources, which exacerbates food insecurity. Social capital and traditional community networks also serve as informal safety nets, providing support during periods of food scarcity (Kiletemy & Wakhungu, 2019).

Limited research has specifically examined the interaction between these variables and the unique pastoralist livelihoods in Samburu County. Additionally, few studies have explored how gender dynamics affect food security in highly patriarchal society like Samburu. Dean et al. (2012) investigated the impact of material stress on food-related home technology in economically disadvantaged households. Families frequently encounter challenging decisions about essential needs, perhaps jeopardizing food security. This study highlights the importance of socioeconomic factors in influencing food accessibility and the capacity to sustain sufficient food supplies. Mutiah and Istiqomah (2017) further found that household size adversely impacts food security levels in Africa. Their research suggests that larger households may face challenges in obtaining sufficient food due to heightened consumption requirements, underscoring the necessity of factoring family composition into food security evaluations. Hasan-Ghomi et al. (2020) investigated the correlation between food security and socioeconomic characteristics among smallholder farmers in Northern Nigeria. Their findings indicate that variables such as income, education and household size substantially affect food security status.

Worku (2023) examined the factors influencing food insecurity in the West Gojjam zone of Ethiopia. The study determined that higher education correlates with enhanced food security, underscoring the significant importance of education in improving food access and availability. A recent study evaluated the determinants of household food security in Rwanda's rural districts and found that socioeconomic and sociodemographic variables. Mutisya et al. (2016) performed a longitudinal study in Kenya examining the impact of education on household food security within informal urban

settlements. Their research indicated that elevated education levels are associated with enhanced food security, as educated individuals had superior skills to manage economic difficulties and make knowledgeable nutritional decisions.

Numerous studies have examined socioeconomic issues affecting food security in pastoralist communities. A comparative study of these studies uncovers both similarities and differences in findings, offering insights for this research within the setting of Samburu County, Kenya. A notable consensus in the research is the acknowledgment that household income is a pivotal factor influencing food security. Mwangi et al. (2020) state that increased household income is positively correlated with food security, suggesting that affluent households have superior access to a variety of food options. Gitungwa et al. (2021) assert that households with regulated animal holdings, especially poultry, demonstrate enhanced food security, indicating that livestock ownership may act as a safeguard against food insecurity. This underscores the significance of economic resources in improving food security for pastoralists.

A prevalent issue is the significance of social capital and community networks in enhancing food security. Kileteny and Wakhungu (2019) found that social capital, encompassing traditional practices and extended family support, markedly affects food usage and security in pastoral regions. This corresponds with the findings of Anbacha and Kjosavik (2018), who emphasize the significance of indigenous social networks in mitigating food shortages and improving household food security among Borana women in Ethiopia. These studies jointly highlight the importance of social institutions in alleviating food insecurity.

Notwithstanding these similarities, significant variances exist in the issues affecting food security. Pérez et al. (2019) examine the pivotal influence of rainfall and its variability on food security, highlighting that pastoralist regions exhibit distinct dynamics relative to non-pastoralist areas. This contrasts with the findings of Abdulahi et al. (2017), which highlight maternal education and child nutrition as critical predictors of food security, especially among at-risk communities. This disparity indicates that although environmental elements, such as rainfall, are essential in certain circumstances, human capital factors, such as education, may assume more significance in others. Furthermore, the influence of livelihood diversification represents an additional area of distinction. Beyene's (2023) research demonstrates that participation in non-farm occupations and crop cultivation enhances food security among pastoral communities.

This research in Samburu County aims to enhance the existing knowledge by analysing the

socioeconomic factors that affect food security in this distinct context. It will examine the interaction among income, education and social capital. The study aims to elucidate the complexities of food security outcomes by examining the interactions of various elements, so enhancing the understanding of the issues encountered by pastoralists in Samburu. The research will also examine the influence of gender dynamics on food security, drawing on the findings of Gitungwa et al. (2021), which indicate that gendered control of livestock can differentially affect food security among families. This factor is especially pertinent in Samburu, where conventional gender norms may affect resource distribution and decision-making processes.

2.3.3 The impact of climate change adaptation practices on food security.

Climate variability poses significant challenges to food security in Samburu County, where pastoralism depends on rainfall patterns for livestock grazing. Prolonged droughts and unpredictable weather conditions reduce pasture availability and heighten animal moterlity (Ndiritu & Muricho, 2021). To mitigate these challenges, pastoralists adopt various adaptation strategies, including the diversification of livelihoods, drought-resistant livestock breeds and improved water management systems. Indigenous knowledge plays a critical role in adaptation, as evidenced by studies in south Africa and kenya that highlight the efficacy of traditional grazing systems and water conservation techniques (Rankoana, 2022). Climate-smart agriculture practices, such as rotational grazing and drought-resistant fodder cultivation, have also been shown to improve resilience (Thorton et al.,2017).

Research on adaptation practices often overlooks the integration of traditional and modern techniques. Moreover, the effectiveness of these strategies in Samburu County has not been systematically evaluated, particularly in relation to food security outcomes. This review highlights the multifaceted nature of food security determinants in pastoralist communities, particularly in Samburu County. While previous studies provide valuable insights, significant gaps remain regarding localized barriers to livestock productivity, the interplay of socio-economic factors and the integration of climate change adaptation practices. Addressing these gaps is essential for developing effective, context-specific interventions to enhance food security in Samburu County.

From a global perspective, Baldos and Hertel (2014) analyze the role of agricultural productivity and climate change in shaping global food security by 2050. Their findings indicate that climate change contributes to malnutrition and food insecurity, emphasizing the need for adaptive agricultural practices to mitigate these impacts. Ray et al. (2019) further highlights that climate change has likely

already affected global food production, with significant implications for food security in many countries. Their research indicates that climate change has increased the risk of food insecurity, in vulnerable regions. Additionally, Schnitter & Berry (2019) discuss the interconnectedness of climate change, food security and human health in Canada. They emphasize that climate change acts as a significant stressor on food systems, affecting food availability and access

Various studies have also examined the adaptation practices employed by farmers in response to climate change and their subsequent effects on food security across the continent. One of the primary adaptation strategies identified is climate-smart agriculture, which aims to enhance agricultural productivity while simultaneously addressing climate change challenges. Climate-smart practices can help meet food security goals while mitigating the adverse effects of climate change, especially in sub-Saharan Africa, where rising temperatures and erratic rainfall threaten staple crop yields and farm profitability (Thornton et al., 2017). This assertion is supported by Connolly-Boutin and Smit (2015), who emphasize that extreme weather events, such as droughts, hinder food production and necessitate adaptive measures to maintain food security.

Moreover, indigenous knowledge and innovative practices play a crucial role in adaptation strategies. Rankoana (2022), discusses how small-scale farmers in Limpopo Province, South Africa, utilize traditional knowledge to cope with climate impacts, which is essential for enhancing food availability and accessibility at the household level. This aligns with findings from Gebre et al., (2023), who note that farmers employing various adaptation strategies, such as crop diversification and improved irrigation techniques, report better food security outcomes.

Agricultural diversification also emerges as a critical strategy for enhancing food security. Waha et al. (2018), argue that diversifying crops can mitigate the risks associated with climate change, ensuring a more stable food supply and addressing nutritional deficiencies. This is particularly relevant in regions where reliance on a limited number of staple crops can lead to vulnerability in the face of climate variability. Ndiritu and Muricho (2021), further support this by demonstrating that adaptation strategies, including diversification, significantly improve food security in semi-arid regions of Kenya.

However, the impact of climate change adaptation on food security is not uniform across the African continent. For instance, studies in Nigeria indicate that while some regions may experience slight increases in crop yields due to climate adaptation practices, others face severe declines, highlighting

the need for localized adaptation strategies (Ogunpaimo et al., 2021; Durodola, 2019). Similarly, Baya et al. (2019) emphasize that the effects of climate change vary significantly across sub-Saharan Africa, necessitating tailored interventions to enhance food security (Baya et al., 2019). Moreover, the role of climate information in adaptation practices presents a divergence in findings. Nkuba et al. (2019) emphasize that access to climate information significantly influences pastoralists' decisions to adopt adaptive strategies, such as destocking or diversifying livestock. In contrast, Mayanja et al. (2015) argue that food insecurity among pastoralists is not significantly dependent on land holdings or livestock units, suggesting that other factors, such as social networks and market access, may play a more critical role. This indicates that while climate information is crucial, its impact may vary based on local contexts and existing socioeconomic conditions.

This body of research indicates that climate change adaptation practices, including climate-smart agriculture, indigenous knowledge and agricultural diversification, are vital for improving food security in Africa. However, the effectiveness of these strategies is influenced by regional climatic conditions and socio-economic factors, underscoring the importance of context-specific approaches to adaptation.

2.4 Research Gaps

While numerous studies have been explored food security in Kenya and other arid regions, critical gaps remain. Existing research often generalizes findings without addressing the unique socio-economic and environmental context of Samburu County. Where pastoralism dominates. Methodologically, limited studies have integrated animal productivity, socio-economic and adaptation factors within a single framework. Furthermore, there is a lack of localized data on the interplay between traditional and modern practices in influencing food security outcomes. These gaps underscore the need for a study that utilizes robust quantitative methods, such as multinomial logistic regression, to analyses comprehensive variables and generate insights specific to Samburu's pastoralist communities. For detailed gaps and recommendations, refer to table 2.1 below:

Table 2.1: Gaps Analysis Table

Author(s) & Year	Focus study	Gaps identified	Future direction
Amwata nayriki & Musimba (2015)	Food security vulnerability in Kajiado and Makueni	Limited focus on livestock productivity factors and food security	Explore the role of veterinary services and market access in enhancing food security among pastoralist communities
Chebuche & Wakhungu (2021)	Women's education and food security in Kakamega	Did not account for male contributions and broader socio- cultural dynamics affecting food security	Examine gender-inclusive policies to improve food security in a patriarchal setting like Samburu County
Ndiritu & Murich (2021)	Adaptation strategies among pastoralists	Limited quantitative analysis of adaptation strategies' effectiveness on food Security.	Use statistical models to measure the effectiveness of adaptation strategies in improving resilience and food security
Mutisya et al. (2016)	Education and food security in urban Kenya	Generalized findings with no focus on arid/semi- arid regions like Samburu County	Localize the study to Samburu County to understand how education impacts food security in a pastoralist setting

Benti et al. (2022)	Livestock commercialization and food security	Focused only on market interventions without examining subsistence pastoralists.	Integrate subsistence practices with market-based approaches to enhance food security in pastoralist regions like Samburu County

While some studies have highlighted the vulnerability of Samburu County to climate change (Wachira, 2024), there is a gap in research focused on effective adaptation strategies that are appropriate and sustainable. More empirical studies are needed to evaluate the effectiveness of these adaptation initiatives and to develop new strategies that are tailored to the specific environmental and social conditions of Samburu.

Many studies, such as those by Ndolo et al. (2022) and Wachira (2023), have examined broader themes such as climate change and land acquisition but have not focused specifically on the unique socio-economic dynamics of Samburu County. The existing literature have often generalized findings across different regions of Kenya without considering the specific challenges faced by Samburu pastoralists, such as their reliance on livestock and traditional practices. More localized studies are needed to capture the nuances of food security in this context. Further, While Khisa (2016) addressed livestock rustling as a factor affecting socio-economic development, there is insufficient research on how this phenomenon specifically impacts food security in Samburu County. Given that the majority of the population relies on livestock for their livelihoods, understanding the direct and indirect effects of livestock theft on food availability and access is essential. Furthermore, there is limited research on the potential for socioeconomic diversification beyond pastoralism in Samburu County. Studies like those by (2023) suggest that nomadic pastoralism is facing challenges, but there is a lack of exploration into alternative livelihoods that could enhance food security. Understanding how socioeconomic diversification can be achieved and supported in this context is crucial for building resilience.

Further, research conducted by Lengurnet & Nalugala (2022) highlights the importance of incorporating agricultural processes and technological knowledge into adaptation strategies for food security. However, there is a lack of comprehensive studies that systematically document and analyze the agricultural processes and technologies of the Samburu people and how these can be integrated into modern food security strategies. Understanding how local knowledge can contribute to sustainable practices is crucial for enhancing food security.

While there is a growing body of research on food security in Kenya, significant conceptual, contextual and methodological gaps remain in the context of Samburu County. Addressing these gaps through targeted studies will be essential for developing effective policies and interventions that enhance food security and improve the livelihoods of the Samburu pastoralists.

2.5 Conceptual Framework

The conceptual framework for this study is based on the Sustainable Livelihoods Framework (SLF). It illustrates the relationships between agricultural processes and technologies, socio-economic factors, consumption practices, climate change and food security outcomes for pastoralist households in Samburu County as independent variables. The dependent variables of food security are household food availability, nutritional status and economic stability. The impact determines the overall food security and resilience of the community.

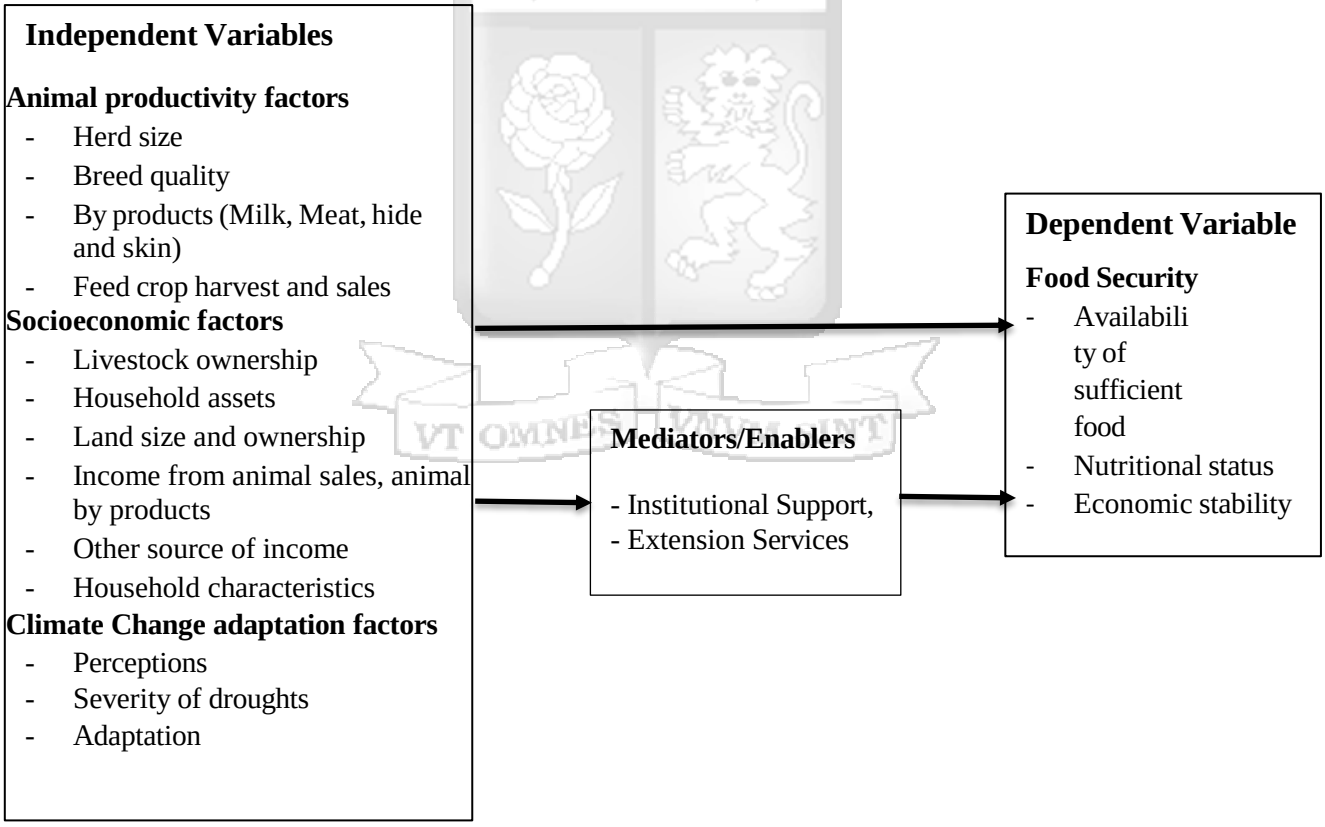

Figure 2.1: Conceptual Framework

Source: Researcher (2024)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology adopted for the study on the determinants of food security among pastoralist communities in Samburu County. The chapter began by discussing the research philosophies and paradigms that guided the study, followed by the research design that was employed. It further elaborated on the target population, sampling techniques, data collection methods and tools. Finally, the chapter discussed the data analysis techniques that were used and the ethical considerations that were adhered to during the study.

3.2 Research Philosophy

The study adopted a positivist research philosophy, which asserts that reality is objective and can be measured through empirical observation and statistical analysis. This aligns with the study's aim to identify quantifiable relationships between food security and its determinants using structured instruments and inferential statistics. The positivist stance supports the use of standardized data collection and multivariate modeling to draw generalizable conclusions."

3.3 Research Design

This study adopted a cross-sectional survey design, which was particularly suited for assessing food security determinants at a single point in time. This design was appropriate for examining relationships between independent variables (animal productivity, socio-economic factors and climate change adaptation) and the dependent variable (food security).

A cross-sectional survey design was appropriate for this study as it allowed for the collection of data from a large sample of households at a single point in time, enabling the identification of associations between food security status and multiple explanatory variables (e.g., income, livestock productivity, climate adaptation practices). While longitudinal designs are more suited to observing change over time, they were impractical due to logistical constraints and the nomadic nature of the population. Cross-sectional data, analyzed with multinomial logistic regression, offered sufficient statistical power to detect patterns and test the study's hypotheses within the resource and time constraints.

The study employed a multistage sampling strategy to systematically capture variation across Samburu

County's geographic and livelihood contexts. In the first stage, two sub-counties (Samburu East and Central) were selected based on food insecurity levels and pastoralism prevalence. In the second stage, stratified sampling was used to ensure proportional representation of pure pastoralist and agro-pastoralist households. Within these strata, households were selected using systematic random sampling, with every nth household chosen from updated household listings. This approach enhanced the generalizability of findings by ensuring diversity in ecological conditions, livelihood practices, and exposure to food insecurity

The quantitative approach was chosen as the primary method to enable the statistical analysis of data collected through structured questionnaires. This design ensured reliability, replicability and generalizability of findings. If the sample was representative, the results could frequently be extrapolated to larger groups (Williams, 2011). The study employed a quantitative approach to allow for statistical analysis of measurable variables, ensuring the reliability and generalizability of findings. Structured questionnaires served as the primary data collection tool to systematically collect data on household characteristics, food security status and contributing factors.

3.4 Target Population

The target population comprised households located in Samburu County, a semi-arid region in northern Kenya. The study focused exclusively on this county, which is representative of pastoralist communities in Kenya's arid and semi-arid lands (ASALs). According to the most recent census data, Samburu County had approximately 50,707 households (Kenya National Bureau of Statistics, 2023). Of these, an estimated 60% engaged in nomadic pastoralism, while about 30% practiced a mixed livelihood strategy combining pastoralism with limited farming (USAID Advancing Nutrition, 2023). This distribution—where roughly 90% of households rely primarily on pastoralism—was used to inform sample stratification, as outlined in Section 3.4, to ensure representation of both purely pastoral and agro-pastoral households.

3.5 Sampling Techniques

This study employed multistage sampling. According to Creswell (2014), the multistage technique entailed the researcher classifying groups within the study region into clusters and then sampling inside those clusters. A multistage sampling approach was used to ensure geographic and livelihood-based representation. Sub-counties were first selected as primary sampling units based on food insecurity risk and pastoralism levels

In the first stage, cluster sampling was applied to group households into the two sub-counties, namely, Samburu Central and Samburu East. These clusters were chosen based on geographic dispersion, population density and food security vulnerability. This method allowed for the identification of specific subgroups (e.g., pastoralists, agro-pastoralists) within the population, which provided more nuanced insights into food security factors. Secondly, within each cluster, households were stratified by livelihood type—nomadic pastoralists (60%) and agro-pastoralists (30%)—using data derived from household listings, community mapping exercises and consultations with local key informants. This approach ensured proportional representation of each livelihood group in the sample. A table summarizing household distribution by sub-county is presented in Section 3.4.

Table 3.1: Distribution of sampled households by sub county

Sub counties	Number of pastoralists households
Samburu Central	115
Samburu East	387
Total	502

Source: Researcher (2025)

Finally, from the stratified list of pastoralist households, a systematic random sampling method was used. Every nth household was selected for participation, ensuring randomization and fair representation. A probability sampling formula was used to calculate sample size based on the total population of households in the selected semi-arid regions, using a confidence level of 95% and a margin of error of 4.36%. This ensured that the findings were statistically significant and generalizable, based on the following general sampling formula. A sample size of 502 was established for the study based on sampling probability calculations.

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

Where:

- z is the Z-score
- ε (or e) is the margin of error
- N is the population sample size
- $\hat{p}$ is the estimated population proportion

$$n = \frac{1.96^2 \times 50(1-50)}{4.36^2}$$

≈ 502

3.6. Data collection Methods

A structured questionnaire was developed to collect quantitative data on various factors influencing food security. The questionnaire included: household demographic information (age, gender, education level, household size); animal production practices (herd size, breed quality, by-products such as milk, meat, hides and skins, feed crop harvest and sales); socio-economic factors (livestock ownership, household assets, land size and ownership, income from animal sales and by-products, other sources of income, household characteristics); climate adaptation practices (perceptions, severity of drought and adaptation strategies); and food security indicators (frequency of food consumption, dietary diversity scores, consumption patterns across food groups and vulnerability to food insecurity).

The study used different measurement scales depending on the nature of variables:

Table 3.2: Distribution of sampled households by sub-county

Variable type	Measurement scale	Examples
Demographic data	Nominal and ordinal scale	Gender (male/Female), Education level (None, Primary, Secondary Higher)
Household income	Ratio scale	Continuous values in KES.
Herd size and breed quality	Interval/ratio scale	Number of livestock owned
Food security level	Ordinal scale	Classified as food secure, moderately food insecure, severely food insecure
Adaptation strategies	Linkert scale(ordinal)	1= strongly disagree, 5=strongly agree

The field data were collected under the KPMD project under SAFIC.

Trained enumerators were employed to administer the questionnaires through face-to-face interviews with household heads. This method enhanced response rates and allowed for clarification of questions. Kobo Collect tools were used, which validated data types and returned errors in case of incorrect entries.

Pilot testing was conducted on the questionnaire with a small subset of respondents from the targeted population. This allowed for refinement of questions based on feedback and statistical tests to ensure reliability and validity.

To ensure the integrity and reliability of data collection, particularly in remote or pastoralist communities, robust data entry and quality check procedures were implemented. A double data entry system was adopted, whereby two independent individuals entered the same data into the database. This process helped identify discrepancies in data entry. After double data entry, cross-validation was conducted by comparing the two datasets and any inconsistencies were resolved through a review process involving the original data collectors or supervisors.

Regular audits of the data entry process were scheduled during the data collection phase. This involved randomly selecting a subset of data entries for verification against the original records. These audits helped identify patterns of errors and highlighted areas for improvement.

After data entry, data cleaning procedures were carried out to identify and correct errors such as outliers, missing values, or inconsistencies. This involved the use of statistical software to run descriptive statistics and detect anomalies. Quality checks were documented thoroughly, including issues encountered and their resolutions. This documentation served as a reference for future studies and enhanced transparency.

3.6 Data Analysis

Data collected were analyzed using statistical software, SPSS. Descriptive statistics (mean, median, mode) were used to provide an overview of the data, while inferential statistics (regression analysis) helped identify relationships between independent variables (e.g., socio-economic factors, animal productivity) and the dependent variable (food security status).

A food security index was constructed based on responses related to food availability, access and utilization. This index was used to categorize households into food secure and food insecure groups. Pearson correlation analysis was utilized to evaluate the direction and degree of correlations between the factors and food security. According to Mahariani (2023), the correlation coefficient (r) ranges from -1 to +1. Values near +1 signify a strong positive association, values around -1 indicate a strong negative relationship and values around 0 suggest no relationship.

3.6.1 Multinomial Logistic Regression Model

The study also applied the multinomial logistic regression model to estimate the probabilities of multiple possible outcomes for a categorical dependent variable based on one or more independent variables. For example, food security status was categorized into three groups: food security, moderately food insecure and severely food insecure. The study modeled the probability of each outcome based on predictor variables such as animal productivity, climate change adaptation practices and socioeconomic factors.

3.6.2 Model Equation

Food security status (Y) has three possible categories:
- Y = 0 for 'Food Secure'
- Y = 1 for 'Moderately Food Insecure'
- Y = 2 for 'Severely Food Insecure'

X_1, X_2, ..., X_k represent the independent variables (animal productivity, climate change adaptation practices and socioeconomic factors). The multinomial logistic regression model estimated the probability of each category using the following equations:

1. Model Equations

For each category j (where $j = 0, 1, 2$), the model is:

$$P(Y = j|X) = \frac{e^{\beta_{j0}+\beta_{j1}X_1+\beta_{j2}X_2+\cdots+\beta_{jk}X_k}}{\sum_{m=0}^{2} e^{\beta_{m0}+\beta_{m1}X_1+\beta_{m2}X_2+\cdots+\beta_{mk}X_k}}$$

where:

- β_{j0} is the intercept for category j.
- $\beta_{j1}, \beta_{j2}, \ldots, \beta_{jk}$ are the coefficients for the independent variables for category j.

$$P\left(Y = \frac{j}{X}\right) = \frac{}{\sum_{m=0}^{2} e^{\beta m0+\beta m1}}$$

Reference Category

One of the categories is typically chosen as a reference (e.g., 'Food Secure') and all coefficients for this category are set to zero. This means we estimate coefficients for the remaining categories relative to the reference category. Assuming 'Food Secure' (i.e., j = 0) is the reference, the equations simplify to:

$$P(Y=1|X) = \frac{e^{\beta_{10}+\beta_{11}X_1+\beta_{12}X_2+\cdots+\beta_{1k}X_k}}{1+e^{\beta_{10}+\beta_{11}X_1+\beta_{12}X_2+\cdots+\beta_{1k}X_k}+e^{\beta_{20}+\beta_{21}X_1+\beta_{22}X_2+\cdots+\beta_{2k}X_k}}$$

$$P(Y=2|X) = \frac{e^{\beta_{20}+\beta_{21}X_1+\beta_{22}X_2+\cdots+\beta_{2k}X_k}}{1+e^{\beta_{10}+\beta_{11}X_1+\beta_{12}X_2+\cdots+\beta_{1k}X_k}+e^{\beta_{20}+\beta_{21}X_1+\beta_{22}X_2+\cdots+\beta_{2k}X_k}}$$

Where the coefficients β_{ji} represent the effect of the predictor X_i on the log-odds of category j compared to the reference category. For example, a positive β_{j1} means that as X_1 (e.g., household income) increases, the likelihood of being in category j compared to the reference category also increases.

Data interpretation and reporting were done using a p-value threshold of <0.05 to determine significant relationships. The regression model was assessed using Pseudo R^2 values and likelihood ratio tests. The findings were then visualized using tables, charts and graphs for clarity purposes.

3.7 Research Quality

Ensuring high research quality was a core priority throughout the study design, data collection, analysis and reporting processes. This section discusses the strategies used to enhance validity, reliability and overall trustworthiness of the study.

3.7.1 Validity

Internal validity ensured that the study measured what it was intended to measure. It referred to the reliability of the study plan and the techniques used to arrive at the findings. On the other hand, external validity referred to how effectively study results translated to other populations, settings, or historical periods. A high degree of external validity meant that the findings could

be used outside of the specific context in which the research was conducted (Saleh & Attan, 2021). The research supervisor provided expert advice to assess the validity of the assembled and validated instrument in order to ascertain whether the questionnaire's question selection appropriately captured the idea being studied. An instrument's content validity was enhanced by the study supervisor's professional judgment (Subramaniam, Talib & Khan, 2018).

a). Content Validity

Content validity was ensured through extensive literature review and consultations with subject matter experts in food security, pastoralism and climate adaptation. The questionnaire items were aligned with internationally recognized frameworks such as the Food and Agriculture Organization (FAO) Food Security Indicators and the Sustainable Livelihoods Framework.

b). Construct Validity

Construct validity was verified by performing factor analysis on multi-item indices such as Climate Adaptation Practices and Food Security Coping Strategies. Items loaded appropriately (>0.4) onto expected factors, supporting the theoretical constructs being measured.

c). Criterion-Related Validity

The study employed known-group validation by comparing food security scores across households with different income levels and herd sizes, which were hypothesized to differ significantly based on existing research.

3.7.2 Reliability

Reliable study results were those that held up over time and under different conditions. A rerun of the study with identical conditions yielded equivalent results. Accurate data gathering tools and processes produced repeatable results (Kothari & Garg, 2016). To ensure that research equipment generated reliable and precise readings, testing its dependability was essential. Reliability was evaluated using a variety of techniques and various validated or peer-reviewed questionnaires had been created to test various constructs. The test-retest reliability method, which entailed giving the same instrument to the same group of respondents twice, was applied extensively in the study. The stability of the instrument over time was indicated by the correlation between the two sets of scores (Alfaruqhi, 2023). The Cronbach's alpha and Kuder-

Richardson formula were used to test and retest the data collection tool created for this project. The results showed the tool's dependability.

Cronbach's Alpha was applied to multi-item Likert scales such as Climate Adaptation Practices and Food Security Coping Strategies. The alpha coefficients for these constructs ranged from 0.768 to 0.812, indicating acceptable to good reliability based on established thresholds ($\alpha \geq 0.70$).

In addition, the Kuder-Richardson Formula 20 (KR-20) was utilized for binary response variables included in the instrument (e.g., Yes/No questions related to the adoption of specific coping strategies or adaptation behaviours). The KR-20 coefficient provides a measure of reliability analogous to Cronbach's Alpha but is specifically appropriate for dichotomous items. The KR-20 results exceeded 0.75, affirming the high dependability of the binary measures.

Together, the results from Cronbach's Alpha and KR-20 demonstrate that the data collection tool was internally consistent and reliable, thereby supporting the validity of the research findings derived from its use. The dependability of the instrument contributes to the overall credibility and trustworthiness of the study.

3.8 Ethical Considerations

Participants' informed consent was obtained by the researchers prior to data collection. This entailed giving participants comprehensive information about the goals, methods, possible dangers and advantages of the study so they could decide whether to participate (Mahmood & Ejaz, 2019). It was also critical to safeguard participants' privacy and anonymity. The study guaranteed the confidentiality of participant data and the reporting of data in a manner that prevented participant identification (Williams, 2011). Additionally, precautions were taken during the study to reduce any risk to participants' physical, psychological, or emotional health. This entailed being considerate of the subjects covered and aiding participants who were in distress (Sharma et al., 2023).

Participation in the study was voluntary and individuals could opt out at any moment without incurring any penalties. The researcher refrained from using coercive methods that could put participants under duress (Mahmood & Ejaz, 2019). Additionally, the researcher respected and acknowledged the potential impact of cultural variations on participant experiences and

responses. Understanding cultural norms was part of this. Furthermore, it was the researcher's ethical responsibility to guarantee the integrity and correctness of the data gathered. According to Lotfi et al. (2021), this involved abstaining from the fabrication, falsification, or misrepresentation of data. The investigator presented their results in an open and truthful manner, recognizing any constraints and possible biases in the research. This enhanced the research process's credibility and fostered confidence. Lastly, to ensure the study complied with ethical guidelines and safeguarded participants' rights, the researcher requested approval from the university's ethics committee before starting the research (Sharma et al., 2023).

CHAPTER FOUR

PRESENTATION OF RESEARCH FINDINGS

4.1 Introduction

This chapter presents the findings of the study on the determinants of food security among pastoralist households in Samburu County. The chapter first looks at response rate followed by household demographics. The descriptive analysis section is then organized according to the thematic areas as outlined in the research objectives: animal productivity factors, socioeconomic factors and climate change adaptation factors. The chapter then presents inferential statistics through correlation analysis and multinomial logistic regression to identify relationships between the independent variables (animal productivity, socio-economic and climate adaptation factors) and food security outcomes.

4.2 Response Rate

All targeted households successfully participated in the survey, yielding a 100% response rate. This high participation was attributed to strong community engagement, the use of trained local enumerators and the trust built with respondents during pre-survey mobilization. The response is representative of the target population and provides a reliable basis for generalizing the findings, in line with the 70% threshold recommended by Kothari (2004).

Table 4.1: Response Rate

Response	Frequency	Percentage
Yes	502	100.00%

Source: Field Survey Data (2025)

A total of 502 households were sampled, and all completed the survey, resulting in a 100% response rate. This was achieved through extensive community sensitization efforts, involvement of local leaders, and flexible scheduling, which enabled enumerators to revisit initially unavailable households. The high response rate was also facilitated by the structured presence of enumerators who were recruited from within the community, ensuring cultural and linguistic familiarity that enhanced trust and participation.

The majority (75.9%) were drawn from Samburu East, followed by respondents from Samburu

Central (24.1%). Regional distribution is crucial as geographic factors, such as infrastructure and access to services, significantly influence food access and household resilience in arid lands (USAID, 2023). Table 4.2 shows the results.

Table 4.2: Distribution of Sampled Households by Sub-County

Sub-County	Frequency	Percentage
Samburu East	381	75.9.1%
Samburu Central	121	24.1%
Total	502	100.0%

Source: Field Survey Data (2025)

4.3 Social Economic factors

This section presents the social economic factors influencing the food security among pastoralist households in Samburu County. These factors play a critical role in determining the ability of households to access, afford and utilize sufficient and nutritious food. Understanding these dynamics provides essential context for identifying structural drivers of vulnerability and resilience within the pastoralist food system.

4.3.1 Household Characteristics

It begins with the geographic distribution and duration of residence, followed by information on household composition, gender, age, marital status, education and occupation. These variables provide essential context for understanding household structures and their potential influence on food security dynamics.

4.3.1.1 Gender of Household Respondent

The respondents nearly evenly split by gender, with 51.2% of respondents identifying as male and 48.8% as female. This gender balance is vital for ensuring inclusiveness in analysing food access, resource control and decision-making dynamics within pastoralist households. In Samburu's patriarchal context, gender roles influence how resources like land, livestock and income are managed. While men traditionally dominate livestock ownership, women play a critical role in food preparation, nutritional decisions and increasingly in income-generating activities (Gitungwa et al., 2021; FAO, 2022). Figure 4.1 shows the results.

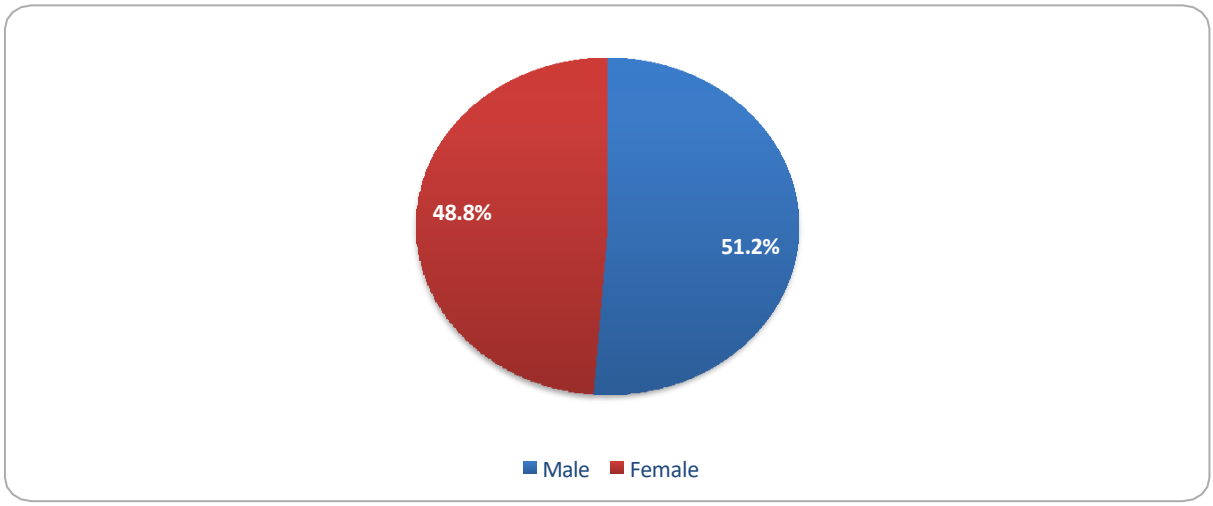

Figure 4.1: Gender Distribution of Household Respondents

4.3.1.2 Age Distribution of Household Heads

The majority of household heads fell within the 36–50 age bracket (42%), followed by those aged 26–35 (28%), with the least being above 65 years (5%). This suggests that the primary economic decision-makers are within the active working-age population. This age group is essential for driving household livelihood activities and adopting food security interventions (ILO, 2021). The results are as shown in Figure 4.2.

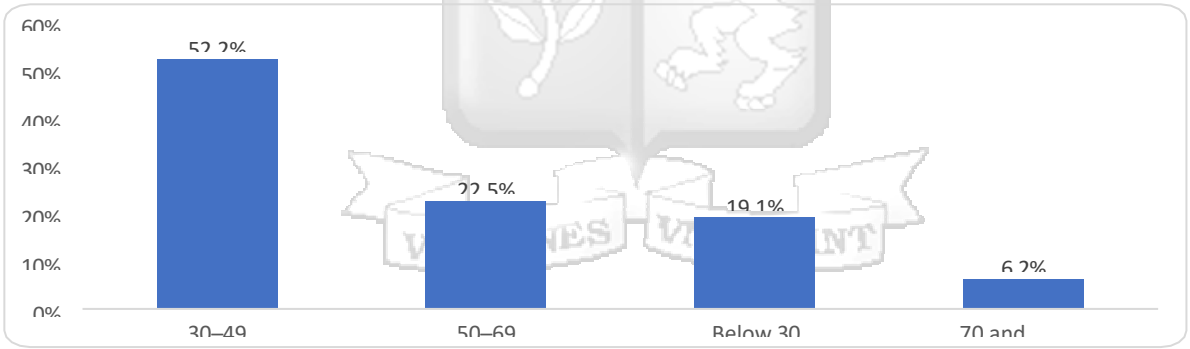

Figure 4.2: Distribution of Households by Age Group

4.3.1.3 Marital Status

The majority of respondents (79.9%) reported being married, followed by widowed (12.5%) and single individuals (5.8%). Marital status plays a key role in shaping intra-household responsibilities, labour division and access to social support systems all of which influence food access and overall resilience (Mutisya et al., 2020). All household-level responses were collected from the designated household head—typically the person responsible for managing livestock and making key economic decisions. Their marital status was recorded to understand demographic influences on food security. Figure 4.3 shows the marital status of respondents.

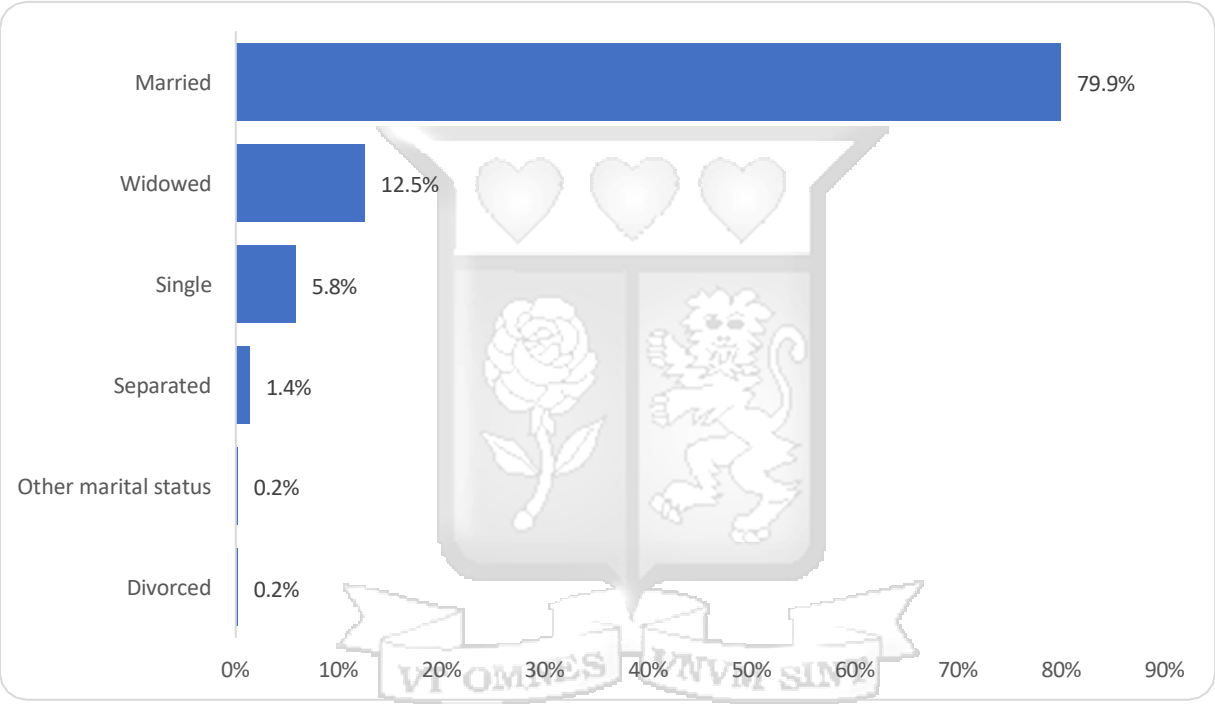

Figure 4.3: Marital Status of Respondents

4.3.1.4 Education Level and Decision Making

Among the household heads, 85.4% had no formal education, 9.6% had primary education, and only 5% had secondary or higher. This overwhelmingly low educational attainment highlights significant challenges in the dissemination of written agricultural and climate information. It also aligns with the regression findings where education was not a statistically significant predictor—suggesting that other factors (e.g., traditional knowledge or household income) play stronger roles in influencing food security.

The findings indicate that most food and resource-related decisions are made by individuals with

limited formal education. Therefore, for food security interventions to be effective, they must be tailored to this context, using visual and oral communication channels, peer-led training and culturally relevant messaging. Additionally, targeted adult education and functional literacy programs could enhance the capacity of household heads to understand early warning systems, engage with livestock markets and adopt modern production or adaptation technologies (USAID, 2022).

Table 4.3: Education Levels of Respondents

Education Level	Frequency	Percentage
Uneducated	342	68.1%
Primary school (grade 1–8)	46	9.2%
Degree holder and above	38	7.6%
Diploma holder	34	6.8%
Secondary school (grade 9–12)	33	6.6%
Able to read/write only (without formal education)	9	1.8%
Total	502	100.0%

Source: Field Survey Data (2025)

4.3.1.5 Household Size

Household size plays a key role in determining food needs, consumption patterns and vulnerability levels. In this study, the majority of households had 4 or 5 members (41.0%), while the average household size exceeded five people. Larger households often face greater pressure on limited resources, which may compromise dietary diversity, nutrition and overall food security especially in low-income, pastoralist settings (Workie et al., 2020). On the other hand, the data revealed that over half of the sampled households had seven or more members, which is consistent with the extended family structures typical of pastoralist societies. In such settings, large households are often a strategic adaptation, providing labor for herding, flexibility during seasonal migration, and a form of social security. These dynamics challenge traditional food security models that assume smaller, nuclear family units, and call for adaptation in both policy design and aid delivery. These insights are crucial for tailoring food assistance and livelihood support programs. Table 4.4 shows the distribution of households by size.

Table 4.4: Distribution of Household Size

Household Size Category	Frequency	Percentage
1–3 members	45	9.0%
4–6 members	157	31.3%
7–9 members	222	44.2%
10 or more members	78	15.5%
Total	502	100%

Source: Field Survey Data (2025)

4.3.2 Household Income Sources

Pastoralist households in Samburu County reported varying levels of income, with livestock remaining the most important economic contributor. Income from large ruminants accounted for a substantial share, averaging KES 81,317.11, underscoring their role as high-value and economically vital assets. Small ruminants also generated a notable mean income of KES 38,683.06. Supplementary earnings from livestock-related sources such as fodder sales and animal by-products (e.g., milk, meat, hides) yielded average incomes of KES 29,125.00 and KES 12,682.67 respectively. These livestock-linked streams not only reinforce household resilience but also reflect the embedded reliance on animal production systems in securing livelihoods. Beyond livestock, other income sources showed wide variation. Miscellaneous sources yielded the highest mean income at KES 92,216.84, though with a considerable standard deviation of KES

138,547.70, indicating significant disparities across households. Non-farm or non-pastoral income averaged KES 12,519.72, marking the lowest earnings stream, yet its large standard deviation suggests it plays a major role for some. The overall average household income was KES 44,424.07, revealing modest earnings alongside high inter-household variability as shown Table 4.5. These patterns affirm the importance of both livestock and diversified income strategies in safeguarding food access and economic stability, especially in a context shaped by climatic shocks and market uncertainties (WFP, 2021; FAO, 2023).

Table 4.5: Income Brackets from Livestock (KES)

Variable	Mean	Std. dev.
Total income from Small Ruminants	38,683.06	28,076.95
Total income from Large Ruminants	81,317.11	51,933.22
None farm/pastoral income	12,519.72	24,142.65
Income from miscellaneous sources	92,216.84	138,547.70
Income from fodder sales	29,125.00	11,825.37
Income from products	12,682.67	28,605.95
Total average income	44,424.07	47,188.64

Source: Field Survey Data (2025)

4.3.3 Gender Roles in Resource Management

Decision-making within households reflects underlying social norms and power dynamics that affect resource allocation and food security. As shown in Table 18, household heads were the primary decision-makers in all key areas assessed. Specifically, 89.64% of decisions on children's education and 85.06% of income and expenditure decisions were made by the head of household. For veterinary services, 83.07% of decisions were also made by the head.

Spouses had the second-highest influence, particularly in income/expenditure decisions (11.16%) and education (6.57%). Sons were more involved in veterinary-related decisions (6.77%), while daughters and other household members played minimal roles across all areas, each accounting for less than 3% in any decision domain. The results are as shown in Table 4.6.

These findings highlight the dominance of heads typically male in managing household resources in Samburu pastoralist communities, while also pointing to modest but important roles played by spouses. There is scope for more inclusive approaches to decision-making that empower other household members, especially women and youth, to participate more actively in managing resources. Such inclusion has been linked to improved resilience and equitable development outcomes in pastoral systems (FAO, 2022; USAID, 2021).

Table 4.6: Household Member Responsible for Key Decisions

Decision Area	Head (%)	Spouse (%)	Daughter (%)	Son (%)	Other Members (%)
Education	89.64	6.57	1.00	2.39	0.40
Veterinary Services	83.07	6.57	1.00	6.77	2.59
Income/Expenditure	85.06	11.16	0.60	2.19	0.99

Source: Field Survey Data (2025)

4.5.4 Land Ownership

Access to land remains a critical enabler of livestock production, feed cultivation and household resilience in pastoralist communities. According to the survey findings, the average land size owned by households in Samburu County was approximately 12.8 acres, with a high standard deviation of 24.56 acres and a range between 1 and 180 acres. This wide variation suggests a highly uneven distribution of land holdings, where a small proportion of households own substantially larger tracts, significantly raising the mean.

Table 4.7: Household Land Size Distribution

Variable	Obs	Mean	Std. dev.	Min	Max
Land Size (Acres)	314	12.80796	24.55555	1	180

Source: Field Survey Data (2025)

4.4 Animal Productivity Factors

4.4.1 Herd Size by Livestock Type

Livestock herd size remains a vital indicator of household wealth, food access and economic resilience in pastoralist communities like those in Samburu County. According to Table 4.8, goats had the highest average ownership across surveyed households, with a mean of 34.04 animals, followed by sheep (19.69) and poultry (11.24). Cows (5.74), camels (4.87) and calves (3.02) were also commonly kept, though in smaller average numbers. These figures reflect species diversification strategies typical of arid and semi-arid lands (ASALs), where households manage mixed herds to spread risk and ensure year-round productivity.

The high standard deviations, such as 39.97 for goats and 22.16 for sheep, suggest significant disparities in livestock ownership across households — some owning large herds and others very few or none. This skewed distribution highlights inequality in livestock assets, which has implications for food security, income generation and climate resilience. Additionally, smaller stock like goats and poultry tend to dominate due to their shorter reproductive cycles, lower maintenance costs and suitability for quick liquidations during emergencies. Understanding these patterns provides critical insights for designing tailored livestock support interventions, improving veterinary outreach and promoting species-specific productivity programs in ASAL regions.

Table 4.8: Household Herd Size Distribution

Livestock	Mean	SD
Goats	34.04	39.97
Sheep	19.69	22.16
Hen/chicken	11.24	9.94
Cows	5.74	6.08
Camel	4.87	6.40
Calves	3.02	2.57
Heifer	2.98	2.94
Donkeys	2.83	2.62
Young bulls	2.62	3.09
Bulls/oxen	1.78	1.47
Other livestock	39.00	114.56
Total	16.15	28.02

Source: Field Survey Data (2025)

4.4.2 Breed Quality (Local, Improved, Exotic)

Breed quality directly influences livestock productivity, including milk yield, growth rate and resistance to disease. In the current study, 63.5% of households reported keeping local breeds, which are known for their drought tolerance and adaptability to the harsh climatic conditions of ASAL regions like Samburu. A smaller proportion of households (24.1%) reported keeping improved breeds, while only 12.4% owned exotic breeds, often associated with higher productivity but greater vulnerability to climate stress and disease.

The dominance of local breeds underscores the community's reliance on resilient animal genetic resources that are well-suited to semi-arid grazing systems. Nevertheless, the gradual uptake of improved and exotic breeds signals a transition toward productivity enhancement albeit at a cautious pace due to resource limitations and climatic risks. Integrating selective breeding with indigenous knowledge systems could offer a balanced pathway to improving livestock outputs while safeguarding adaptability.

Table 4.9: Distribution of Breed Quality Among Households

Breed Type	Frequency	Percentage
Local	319	63.5%
Improved	121	24.1%
Exotic	62	12.4%
Total	502	100.0%

Source: Field Survey Data (2025)

4.4.3 Access to Veterinary Services and Vaccination Rates

Access to veterinary care is critical for maintaining livestock health, productivity and ultimately household food security, particularly in pastoralist communities like Samburu (FAO, 2021). As shown in Table 4.9, nearly all households (98.8%) reported having access to veterinary services, indicating strong coverage in the region. Furthermore, 93.0% of respondents confirmed that their livestock had been vaccinated. These high rates reflect a proactive approach to animal health management, likely supported by local veterinary initiatives and community-level awareness.

Such widespread access to animal healthcare reduces risks related to disease outbreaks and supports sustainable livestock production, which is a cornerstone of resilience in arid and semi-arid regions (USAID, 2022). Table 4.10 shows the results of access to veterinary services and vaccination rates.

Table 4.10: Access to Veterinary Services and Vaccination Rates

Variable	Frequency	Percentage
Access to veterinary services		
Yes	496	98.81%
No	6	1.19%
Total	502	100.00%
Vaccination of livestock		
Yes	467	93.03%
No	35	6.97%
Total	502	100.00%

Source: Field Survey Data (2025)

4.4.4 Livestock By-Products Production and Sales

The production and sale of livestock by-products serve as a crucial component of pastoral livelihoods in Samburu County, offering both dietary value and supplementary income. Among the surveyed households, goat milk was the most commonly produced by-product, reported by 70.3% of respondents, reflecting its importance in pastoral diets due to its availability and adaptability to harsh climatic conditions. Cow milk was also a significant output, produced by 37.7% of households, followed by camel milk at 18.5%, which is particularly valued in arid regions for its resilience during dry seasons and higher nutritional content.

In contrast, meat production was reported by only 20.3% of households, suggesting that while livestock is primarily reared for milk and wealth storage, it is less frequently slaughtered. Hides and skins were reported by 13.2%, indicating limited commercialization of animal by-products beyond subsistence. The production of eggs (8.6%) and cheese (1.0%) was minimal, while butter or yoghurt was reported by just one household (0.2%) and honey was entirely absent. These low figures may reflect gaps in value addition skills, limited equipment, or cultural preferences that constrain diversification. Table 4.11 shows the results.

Overall, the data highlights both the dependency on fluid dairy products and the underutilization of potentially profitable processed by-products. These patterns suggest a critical opportunity for interventions focused on building capacity in value addition, storage and market access to enhance food security and income resilience in pastoralist communities.

Table 4.11: Livestock By-products Produced and Sold by Households

By-Product	Yes		No		Total
	f	%	f	%	
Meat (excluding live animals)	102	20.32%	400	79.68%	502
Hides/Skins	66	13.15%	436	86.85%	502
Butter/Yoghurt	1	0.20%	501	99.80%	502
Camel Milk	93	18.53%	409	81.47%	502
Cow Milk	189	37.65%	313	62.35%	502
Goat Milk	353	70.32%	149	29.68%	502
Cheese	5	1.00%	497	99.00%	502
Eggs	43	8.57%	459	91.43%	502
Honey	0	0.00%	502	100.00%	502

Source: Field Survey Data (2025)

4.5 Climate Change Adaptation Factors

4.5.1 Perceptions of Climate Change

Perceptions of climate change are critical in shaping household readiness, risk awareness and response behaviours. In this study, respondents were asked whether they had observed any changes in climate over time. As summarized in Table 4.12, a vast majority of households (91.8%) reported perceiving noticeable changes in climate patterns, while only 8.2% indicated they had not observed such changes.

This high awareness level aligns with the lived experiences of pastoralist communities in Samburu, who rely heavily on natural weather patterns for grazing, water access and livestock health. Commonly cited changes include delayed rainfall, increased drought frequency and unpredictable weather events. These perceptions are important as they often drive local adaptation responses even in the absence of formal climate data (Ajuang et al., 2021; Ngaina & Mutua, 2020).

The strong recognition of climate change among respondents indicates a readiness to engage in adaptation strategies and presents an opportunity for policymakers to build on indigenous knowledge systems while integrating scientific early warning mechanisms and support programs tailored to these communities.

Table 4.12: Household Perception of Climate Change

Response	Frequency	Percentage
Yes (Perceives change)	461	91.8%
No (No observed change)	41	8.2%
Total	502	100.0%

Source: Field Survey Data (2025)

4.5.2 Frequency of Drought Experiences

Understanding the recurrence and severity of droughts is essential for assessing the vulnerability and resilience of pastoralist communities. In Samburu, where livelihoods are predominantly dependent on livestock and rain-fed ecosystems, drought episodes have profound implications for food security, income and migration patterns.

Respondents were asked how many times they had experienced drought shocks in the past five years. As shown in Table 4.13, nearly half (49.4%) of households reported experiencing drought two to three times, while 20.9% indicated they had endured drought four or more times. Only 29.7% reported experiencing drought once or not at all. These findings underscore the chronic nature of drought in the region and its cumulative stress on households.

The high frequency of droughts reported suggests an urgent need for enhanced climate resilience planning. Early warning systems, sustainable water harvesting, feed storage strategies and drought-resistant livestock breeds are among the measures that can mitigate adverse effects. These results align with findings by Opiyo et al. (2022), who emphasize that recurrent droughts in ASAL (Arid and Semi-Arid Lands) regions in Kenya are increasingly linked to climate variability and limited adaptive capacity.

Table 4.13: Frequency of Drought Experiences in the Past Five Years

Number of Times Experienced Drought	Frequency	Percentage
0–1 time	149	29.7%
2–3 times	248	49.4%
4+ times	105	20.9%
Total	502	100.0%

Source: Field Survey Data (2025)

4.5.3 Coping Strategies

The study assessed the range of strategies employed by households to cope with climate-related shocks. Table 4.14 presents the results. The most commonly reported strategy was migration to areas with pasture and water, employed by 70.7% of households, reflecting the mobile nature of pastoralism. Livelihood diversification, such as engaging in small-scale trade or wage labour, was also significant (65.3%), indicating growing pressure on traditional livestock systems. Additionally, water harvesting and storage (42.2%) and feed preservation (38.6%) were employed as preparatory measures to reduce vulnerability.

Notably, early warning systems and insurance uptake were much less adopted, at 7.8% and 2.6% respectively. This low uptake may reflect gaps in awareness, availability, or affordability of such modern adaptation tools. Use of both indigenous and modern coping mechanisms points to the dynamic nature of adaptation in the region and underlines the need for policy and programmatic support tailored to local contexts (Ngaina et al., 2021; FAO, 2022).

Table 4.14: Household Climate Change Adaptation Strategies

Adaptation Strategy	Frequency	Percentage
Migration to areas with pasture/water	355	70.7%
Livelihood diversification	328	65.3%
Water harvesting and storage	212	42.2%
Feed preservation	194	38.6%
Use of drought-tolerant animals	103	20.5%
Agroforestry	59	11.8%
Early warning systems	39	7.8%
Uptake of insurance	13	2.6%
Others	12	2.4%
Total Respondents	502	100.0%

Source: Field Survey Data (2025)

4.7 Food Security Status Analysis

This section provides a comprehensive assessment of food security among pastoralist households in Samburu County by analysing multiple indicators of food consumption and vulnerability. It begins with an evaluation of household meal frequency, dietary diversity and the consumption of different food groups to gauge the nutritional adequacy and quality of diets. It further explores how food security varies by gender of household head, offering insights into intra-household dynamics. The analysis then highlights key vulnerability indicators, including seasonal hunger patterns and major causes of food shortages such as drought and high food prices. Finally, the section outlines the construction of a Food Security Index used to classify households into food secure, moderately food insecure and severely food insecure categories, providing a basis for deeper statistical analysis in subsequent sections.

4.7.1 Food Consumption Patterns

4.7.1.1 Meal Frequency per Household

Meal frequency serves as a proxy for food availability and access at the household level, reflecting daily consumption patterns. As shown in Table 4.15, the majority of households (54.2%) reported consuming meals twice per day, while 30.7% consumed three meals daily generally considered optimal for food security. A smaller share, 14.5%, reported consuming only one meal per day, potentially indicating food stress or limited access to sufficient food resources. Just 0.6% of households indicated four or more meals, suggesting relative food abundance in a few cases.

The prevalence of two meals per day implies seasonal or economic factors limiting consistent access to diverse, sufficient meals. These findings are consistent with previous food security assessments in arid and semi-arid regions of Kenya, where climatic shocks and market volatility frequently influence food availability (KNBS, 2021; FEWS NET, 2022). Understanding meal frequency patterns provides essential input for tailoring nutrition-sensitive interventions targeting household vulnerability.

Table 4.15: Frequency of Daily Household Meals

Meal Frequency	Frequency	Percentage
One Meal	73	14.54%
Two Meals	272	54.18%
Three Meals	154	30.68%
Four or More	3	0.60%
Total	502	100.00%

Source: Field Survey Data (2025)

4.7.1.2 Dietary Diversity and Food Consumption Scores

Dietary diversity is a key indicator of household nutrition quality and food access. The survey examined which household members consumed diverse diets in the past week. As shown in Table 4.16, women were most likely to consume more diverse diets (25.1%), followed by children (16.7%). This may reflect targeted nutritional efforts or cultural norms prioritizing women and children in food allocation.

Conversely, children also featured prominently among those consuming less diverse diets (21.1%), highlighting possible inconsistencies in food access or seasonal constraints affecting their nutrition. Men accounted for 10.4% of less diverse consumers, while the elderly (4.0%) and disabled (1.6%) also reported lower dietary variety, which may signal marginalization in food distribution.

Notably, 4.6% of respondents indicated that all household members consumed diverse diets equally, pointing to more equitable food access in those households. The data underscores the need for tailored food and nutrition programs that address intra-household disparities in dietary diversity, especially among vulnerable groups such as children, the elderly and persons with disabilities (WFP, 2021).

Table 4.16: Dietary Diversity and Food Consumption Scores

	More Diverse		Less Diverse	
Household Member	Frequency	Percent	Frequency	Percent
Children	84	16.73	106	21.12
Women	126	25.1	84	16.73
Men	33	6.57	52	10.36
Elderly	6	1.2	20	3.98
Disabled	3	0.6	8	1.59
All members equally	23	4.58	17	3.39
Others	2	0.4	4	0.8

Source: Field Survey Data (2025)

4.7.1.3 Consumption by Food Groups

Understanding household food consumption patterns provides critical insight into dietary diversity and nutritional adequacy within pastoralist communities. In Samburu County, cereals emerged as the most commonly consumed food group, with 84.7% of households reporting intake. This underscores their central role as a staple in household diets and a key source of daily energy. Pulses and nuts followed closely, consumed by 75.3% of households, contributing valuable plant-based proteins to local diets. Beverages and stimulants—including tea and locally brewed drinks—were consumed by 82.5% of households, suggesting their cultural and nutritional relevance.

While these staple groups reflect a moderate baseline of dietary consistency, the consumption of vegetables and animal-sourced foods was notably lower. Only 45.6% of households reported eating vegetables and just 48.6% consumed meat, poultry, or fish—figures that raise concern given the role these groups play in providing essential vitamins, minerals and proteins. Fruits were consumed by only 19.3% of households, indicating limited access to sources of micronutrients critical for immune function and child development. Tubers and stems were reported by 36.5% of respondents, reflecting more occasional inclusion in diets, possibly linked to seasonal availability or market access.

Consumption of nutrient-dense or value-added food groups such as unprocessed seeds (0.2%) and cheese (reported elsewhere) was negligible. These patterns suggest that while households maintain basic dietary staples, their access to a broader range of food types remains constrained. This limited dietary diversity could impact nutritional outcomes, particularly for vulnerable groups such as children and the elderly. The findings call for interventions that enhance access to fruits, vegetables and animal-sourced foods—through improved market infrastructure, kitchen gardening, or livestock product utilization—to support more balanced and resilient food systems in pastoralist settings. Table 4.17 presents the distribution of food group consumption across sampled households.

Table 4.17: Household Consumption by Food Group (Past 7 Days)

Food Group	Yes		No		Total
	f	%	f	%	
Cereals	425	84.66%	77	15.34%	502
Pulses & Nuts	378	75.30%	124	24.70%	502
Seeds (Unprocessed)	1	0.20%	501	99.80%	502
Vegetables	229	45.62%	273	54.38%	502
Fruits	97	19.32%	405	80.68%	502
Tubers & Stems	183	36.45%	319	63.55%	502
Meat, Poultry & Fish	244	48.61%	258	51.39%	502
Beverages & Stimulants	414	82.47%	88	17.53%	502

4.7.1.4 Gender of Household Head and Food Security

The study also assessed food security outcomes by the gender of the household head. A cross-tabulation of household head gender against reported food insufficiency revealed that 36.7% of female-headed households did not experience food insufficiency compared to 35.8% of male-headed households. Conversely, 64.2% of male-headed households reported insufficient food, slightly higher than the 63.3% observed among female-headed households. These results indicate that, although the difference is marginal, female-headed households demonstrated slightly better food security outcomes than their male counterparts. This finding contributes to the broader discourse on gender dynamics and resilience in pastoralist communities and may reflect different livelihood strategies or coping mechanisms employed by women in managing household resources. Table 4.18 shows Food Security by Gender of Household Head.

Table 4.18: Food Security by Gender of Household Head

Gender of Household Head	No Food Insufficiency	% within Gender	Food Insufficiency	% within Gender	Total
Female	76	36.7%	138	63.3%	214
Male	81	35.8%	148	64.2%	229
Total	157	—	286	—	443

Source: Field Survey Data (2025)

4.7.2 Vulnerability Indicators

4.7.2.1 Seasonal Hunger Months Experienced

Understanding seasonal patterns of food scarcity is vital in assessing household vulnerability and planning interventions. As shown in Table 4.19, hunger was most commonly experienced between March and July, with April (49.6%), May (48.2%) and March (45.0%) identified as peak months of food shortage. These months typically coincide with the lean season, where household food reserves are depleted and market prices for staple foods are elevated due to low supply.

A noticeable drop in food insecurity was observed between August and December, with less than 10% of households reporting hunger in September (7.6%), October (5.4%) and November (5.2%), suggesting relative food stability during and immediately after the harvest period. The seasonal nature of hunger highlights the reliance of pastoralist communities on rainfall patterns and market fluctuations. It also signals an opportunity for targeted food aid or resilience programming in the most vulnerable periods (WFP, 2021; FEWS NET, 2022).

Table 4.19: Months Households Experienced Seasonal Hunger

Month	Frequency	Percentage
April	249	49.6%
May	242	48.2%
March	226	45.0%
June	196	39.0%
July	191	38.0%
August	118	23.5%
January	107	21.3%
February	101	20.1%
September	38	7.6%
December	32	6.4%
October	27	5.4%
November	26	5.2%

Source: Field Survey Data (2025)

4.7.2.2 Key Causes of Food Shortages

Understanding the drivers of food shortages provides critical insight into the underlying vulnerabilities of pastoralist households. Table 4.20 presents the most cited causes of food insecurity in the study area. The most frequently mentioned factor was drought and unpredictable rainfall patterns, affecting 78.3% of households. This finding aligns with Samburu's classification as an arid and semi-arid land (ASAL), where food systems are highly sensitive to climatic variability (FEWS NET, 2022).

Livestock diseases were cited by 59.6% of respondents, highlighting the direct link between animal health and food access in a livestock-dependent community. Other significant causes included high food prices (51.4%), limited access to markets (38.6%) and insecurity/conflict (24.3%), all of which contribute to restricted availability and affordability of food. Although less frequently mentioned, poor infrastructure (13.7%) and crop failure (11.2%) still pose challenges, particularly for agro-pastoralist households.

These findings underscore the need for climate-smart agricultural policies, improved veterinary services, market access infrastructure and drought mitigation measures. Strengthening household resilience in the face of environmental and market shocks is essential to addressing chronic food insecurity in the region (FAO, 2023; IPCC, 2021).

Table 4.20: Key Causes of Household Food Shortages

Cause of Food Shortage	Frequency	Percentage
Drought/Unreliable Rainfall	393	78.3%
Livestock Diseases	299	59.6%
High Food Prices	258	51.4%
Limited Market Access	194	38.6%
Insecurity/Conflict	122	24.3%
Poor Infrastructure	69	13.7%
Crop Failure	56	11.2%
Others	16	3.2%

Source: Field Survey Data (2025)

4.7.3 Construction of the Food Security Index

To assess overall household food security status, a Food Security Index (FSI) was constructed by aggregating key indicators under four dimensions of food security: availability, access, utilization and stability. Using a scoring approach based on validated household responses across meal frequency, dietary diversity, seasonal hunger and coping mechanisms, each household was classified into one of three categories: Food Secure (households meeting dietary needs consistently across all dimensions), Moderately Food Insecure (households with occasional shortfalls, limited diversity, or seasonal hunger), Severely Food Insecure (households with chronic food shortages, inadequate meals and poor dietary diversity).

The classification approach aligned with FAO (2021) and WFP (2022) food security analysis frameworks, adapted to the context of pastoralist livelihoods in Samburu. Table 4.26 shows the distribution of households by food security status. A majority (54.6%) of households were moderately food insecure, while 31.7% were classified as severely food insecure. Only 13.7% of households were considered food secure. This distribution indicates that while food may be generally available, consistent access and utilization remain challenging, particularly due to environmental variability, market access issues and low dietary diversity. The data reflects a community vulnerable to shocks, requiring interventions that strengthen resilience across all four food security pillars.

Table 4.21: Household Food Security Index Classification

Food Security Status	Frequency	Percentage
Food Secure	69	13.7%
Moderately Food Insecure	274	54.6%
Severely Food Insecure	159	31.7%
Total	502	100.0%

Source: Field Survey Data (2025)

4.8 Multinomial Logistic Regression

4.8.1 Fitting the Regression Model

To assess the factors influencing food security among pastoralist households in Samburu County, a multinomial logistic regression model was applied. The dependent variable, food security status, was categorized into:

1. Food Secure
2. Moderately Food Insecure
3. Severely Food Insecure (reference category)

The model analysed the marginal effects of predictors grouped under animal productivity, socio-economic status and climate change adaptation practices.

Table 22: Multinomial Logistic Regression

	Food Secure		**Moderately Food Insecure**		**Severely Food Insecure**	
	dy/dx	std. err.	dy/dx	std. err.	dy/dx	std. err.
Animal productivity factors						
Number of animals owned	0.088***	0.004	0.025**	0.007	-0.008***	0.041
Quantity of livestock byproduct produced in Kgs	0.451*	0.001	-0.005	0.001	-0.004	6.730
Produced own feeds for livestock in the farm	-0.001	0.148	0.260	0.004	-0.006	0.148
Breeding on livestock	0.083**	0.137	0.005	0.016	0.083	0.136
Access to water for livestock	0.064	0.150	0.001***	0.035	-0.060***	0.150
Socioeconomic factors						
Household assets average value	0.063***	0.024	0.005	0.007	-0.069***	0.025
Land owned in acres	0.003*	0.002	-0.002	0.004	-0.003	0.002
Total household income from livestock sales and by products in ksh	0.049***	0.018	0.002*	0.004	-0.052***	0.019
Gender of the household head 1=Male 0= Female	0.077	0.166	-0.056	0.034	-0.021	0.165
Education level of the household head	-0.027	0.024	0.001	0.006	0.026	0.024
Age of the household head	-0.168	14.64	0.309	25.131	-0.140	10.487
Climate Change adaptation & perception factors						
Household faced a drought shock over the past five years	-0.084	0.072	-0.006*	0.020	0.090*	0.072

Temperature is increasing these days	-0.037	0.030	-0.007*	0.006	0.044**	0.029
Rainfall change is decreasing	0.056***	0.031	0.004	0.008	0.052***	0.031
Floods variability is increasing	-0.038	0.035	-0.016*	0.009	0.054**	0.035
Change in temperature has affected livestock production health	0.030	0.036	0.015*	0.013	-0.045	0.036
Climate change has affected feed availability for livestock	-0.028	0.046	0.004	0.014	0.024	0.045
Climate change has increased livestock mortality	-0.092***	0.045	0.018*	0.016	0.073**	0.044
Climate change has reduced water availability	-0.045*	0.045	0.012	0.016	0.032	0.045
Climate change has reduced milk production	0.036	0.048	-0.003	0.014	-0.032	0.047
Climate change has reduced the weight of animals	-0.008	0.049	-0.004	0.012	0.011	0.048
Climate change has reduced animal growth rate	-0.113**	0.058	-0.004	0.017	0.109**	0.058
Best adaptation is migration to other areas in search for pastures and water	0.003	0.009	0.001	0.002	-0.004	0.008

dy/dx	Marginal effect – the change in the probability of a food security outcome for a one-unit change in the independent variable.
std. err.	Standard error – the estimated standard deviation of the marginal effect; reflects the precision of the estimate.

Source: Field Survey Data (2025)

4.8.2 Interpretation of Results

The marginal effects from the multinomial logistic regression provided deeper insights into the key variables influencing household food security status across three categories, food secure, moderately food insecure and severely food insecure (used as the reference group).

4.8.2.1 Animal Productivity Indicators Marginal Effects

The number of animals owned by a household was found to significantly influence food security status. Specifically, each additional unit in herd size increased the probability of a household being food secure by approximately 8.8% (*dy/dx = 0.088, p < .001*) and moderately food insecure by 2.5% (*dy/dx = 0.025, p < .01*), while decreasing the likelihood of being severely food insecure. This illustrates the centrality of livestock as both a food source and an asset base in pastoralist economies like Samburu. The findings corroborate previous literature which associates larger herd sizes with improved resilience and access to nutritional resources (FAO, 2021).

Similarly, households that reported higher production volumes of livestock by-products such as milk, meat and hides showed a significantly higher probability of being food secure (*dy/dx = 0.451, p < .05*). By-product utilization not only enhances dietary diversity but also contributes to household income and economic stability, supporting evidence from WFP (2022) that emphasizes the multifunctional role of livestock in food-insecure regions.

Furthermore, engagement in livestock breeding practices also positively influenced food security. Households actively involved in breeding were 8.3% more likely to be food secure (*dy/dx = 0.083, p < .01*). This suggests that productivity-focused livestock management improves household resilience, particularly when breeding leads to stronger, more drought-tolerant, or high-yielding animals.

4.8.2.1 Socio-Economic Characteristics Marginal Effects

Economic wellbeing, as proxied by household asset value, emerged as a statistically significant predictor of food security. An increase in asset holdings was associated with a 6.3% higher likelihood of being food secure (*dy/dx = 0.063, p < .001*), reinforcing the role of asset accumulation in buffering households from shocks and enabling access to food and essential services (Mutisya et al., 2016).

Total household income from livestock sales and by-products also exhibited a strong positive effect, increasing the probability of being food secure by approximately 4.9% (*dy/dx = 0.049, p < .001*). This result emphasizes the importance of livestock commercialization and the monetization of animal products in enhancing household purchasing power and food access.

Additionally, land ownership in acres was a modest but statistically significant factor, with each additional acre owned increasing the probability of being food secure by 0.3% (*dy/dx = 0.003, p < .05*). This aligns with the theory that access to productive land facilitates fodder production and income diversification.

In contrast, the education level of the household head and their gender were not statistically significant in this model. While education is generally expected to influence decision-making and access to information, the findings suggest that in this pastoral context, practical experience and other livelihood assets may outweigh formal education in determining food security outcomes. Similarly, gender of the household head did not significantly alter food security status, indicating

a possible equalization of roles in resource-constrained environments.

4.8.2.1 Climate Change Adaptation and Perception Marginal Effects

Households that had experienced drought shocks in the past five years were 8.4% less likely to be food secure (*dy/dx = -0.084, p < .05*), highlighting the disruptive impact of climate variability on pastoralist livelihoods. This is consistent with evidence that prolonged droughts erode asset bases and limit access to pasture and water (NDMA, 2023).

Conversely, households that perceived rainfall as decreasing were 5.6% more likely to be food secure (*dy/dx = 0.056, p < .001*). This suggests that households aware of shifting climate trends may adopt proactive coping strategies, such as early migration, feed preservation, or diversification.

Critically, households that reported increased livestock mortality due to climate change had a significantly lower probability of being food secure (*dy/dx = -0.092, p < .001*). This reflects the direct link between environmental stressors and food insecurity, particularly when animal losses are not mitigated by insurance or restocking mechanisms.

4.8.4 Summary of Findings

The multinomial logistic regression analysis highlighted several significant determinants of food security among pastoralist households in Samburu County. Key findings are summarized across the three thematic domains: animal productivity, socio-economic characteristics and climate change adaptation and perceptions.

Animal productivity factors showed the strongest and most consistent influence. The number of animals owned significantly increased the probability of being food secure (dy/dx = 0.088, p < 0.001), affirming livestock ownership as a core livelihood pillar in the pastoral economy. Similarly, households that produced higher quantities of livestock by-products—such as milk or meat—were significantly more likely to be food secure (dy/dx = 0.451, p < 0.05), underscoring the value of maximizing output from existing herds. Participation in livestock breeding also had a statistically significant positive effect (dy/dx = 0.083, p < 0.01), suggesting that households investing in herd productivity gain resilience against food insecurity.

Under socio-economic factors, household asset value was positively associated with food security

(dy/dx = 0.063, $p < 0.001$), reinforcing the role of asset accumulation in enhancing resilience. Income derived from livestock and by-product sales further improved food security outcomes (dy/dx = 0.049, $p < 0.001$), highlighting the importance of commercialization. Land ownership also had a modest but significant effect (dy/dx = 0.003, $p < 0.05$), indicating that access to land contributes to fodder production or diversified livelihood options. Notably, education level and gender of the household head did not show significant effects in this model, suggesting that food security in Samburu may be more dependent on tangible resources and climate coping mechanisms than on demographic characteristics alone.

In terms of climate change adaptation and perception, households that experienced drought shocks in the past five years were significantly less likely to be food secure (dy/dx = -0.084, $p < 0.05$), highlighting the destabilizing effects of climatic stress. Interestingly, households that perceived a decrease in rainfall had a higher likelihood of food security (dy/dx = 0.056, $p < 0.001$), possibly reflecting a more proactive adoption of adaptation strategies. Most critically, households reporting increased livestock mortality due to climate change had a significantly reduced probability of being food secure (dy/dx = -0.092, $p < 0.001$), emphasizing the severe impact of environmental pressures on livelihood stability.

Lastly, the results affirm that improving animal productivity, supporting livestock-based income and enabling effective climate adaptation are key pathways for addressing food insecurity among pastoralist households in Samburu County.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the discussion, conclusions and recommendations arising from the study on the determinants of food security among pastoralist households in Samburu County. The chapter synthesizes the results presented in Chapter Four and discusses them in relation to the study objectives and existing literature. Key conclusions are drawn and policy and practice recommendations are provided. The chapter also outlines limitations and suggests areas for future research.

5.2 Summary of Findings

This study examined the determinants of food security among pastoralist households in Samburu County, focusing on three interrelated domains: animal productivity, socio-economic characteristics and climate change adaptation strategies. By employing descriptive statistics and multinomial logistic regression analysis, the study captured a comprehensive portrait of food security dynamics and the multifaceted vulnerabilities shaping pastoralist livelihoods.

Animal Productivity Factors were found to be central to food security outcomes. Livestock ownership, particularly herd size, significantly influenced household food security. Goats were the most kept animals with a mean of 34.04, followed by sheep, poultry and cows—highlighting species diversification as a risk-spreading strategy. Households with more livestock were significantly more likely to be food secure, with each additional animal increasing the likelihood of food security by 8.8%. Similarly, households producing higher volumes of livestock by-products, especially milk, had higher odds of being food secure ($dy/dx = 0.451$, $p < 0.05$). Goat milk was the most widely produced by-product (70.3%), followed by cow and camel milk. However, commercialization of other by-products like hides, eggs and cheese remained low.

Breed type also emerged as a critical factor: 63.5% of households reared local breeds, favoured for their resilience in arid conditions, while only a quarter had improved breeds. Access to veterinary services (98.8%) and livestock vaccination (93%) was widespread, reflecting positive

investment in animal health. Participation in breeding practices further increased the probability of being food secure by 8.3%. Yet, production and preservation of animal feed remained underdeveloped, with only 38.6% of households preserving feed and even fewer producing it themselves. This gap exposes households to forage shortages during dry seasons. Access to water for livestock also proved significant in the regression model, highlighting infrastructure needs for sustained productivity.

Socio-Economic Characteristics played a complex role. The gender of the household respondent was nearly evenly distributed (51.2% male, 48.8% female), but decision-making remained male-dominated, with over 83% of decisions on education, income and veterinary services made by male household heads. While education of the household head was not statistically significant in the regression model, descriptive results showed stark disparities in educational attainment—85.4% of heads were uneducated, compared to only 33.1% of non-head household members. This has implications for the uptake of innovations and information critical to food security.

Household size was another critical factor. Most households had 4 to 5 members, with larger households facing higher food insecurity due to resource strain. Income analysis revealed livestock as the dominant source, with large ruminants contributing the highest average income (KES 81,317.11), followed by small ruminants and by-products. However, non-farm income remained low and unevenly distributed. Asset ownership, measured through household possessions and land, was significantly associated with food security. Households with higher asset values were 6.3% more likely to be food secure ($p < 0.001$) and land size also had a modest positive effect. Despite this, land ownership patterns showed high inequality: average household land size was 12.8 acres, but with vast disparities (1–180 acres), suggesting resource concentration among a few. Most land was under communal use, further constraining individual investment in land development or feed cultivation.

Climate Change Adaptation and Perception were widespread but unevenly applied. An overwhelming 91.8% of households observed changing climate patterns and nearly half had experienced drought two to three times in the past five years—demonstrating high exposure to recurrent climate shocks. Coping strategies varied: migration in search of pasture and water (70.7%) and livelihood diversification (65.3%) were most common. However, modern adaptive

tools such as early warning systems (7.8%) and insurance uptake (2.6%) were poorly adopted. Households that experienced drought were 8.4% less likely to be food secure, while those who perceived decreasing rainfall trends were more likely to be food secure—possibly due to proactive behavioural responses. Critically, households reporting increased livestock mortality due to climate change had a significantly lower probability of being food secure ($dy/dx = -0.092$, $p < 0.001$), underscoring the need for climate resilience strategies.

Food Security Outcomes revealed that only 13.7% of households were food secure, while the majority (54.6%) were moderately food insecure and 31.7% severely food insecure. Most households consumed two meals per day (54.2%), while 14.5% had only one meal, indicating chronic food inadequacy. Dietary diversity was limited—cereals (84.7%) and pulses (75.3%) were staples, while only 19.3% consumed fruits and 45.6% consumed vegetables. Meat, poultry, or fish were accessed by less than half of the households. Vulnerable household members, including children, women, the elderly and persons with disabilities, experienced varying levels of dietary access, with many reporting less diverse diets.

Food insecurity was also seasonal, peaking between March and July—the lean period preceding harvest. April (49.6%) and May (48.2%) were the worst-hit months. Primary causes of food shortages included drought (78.3%), livestock disease (59.6%) and high food prices (51.4%). Other contributing factors included limited market access, insecurity, poor infrastructure and crop failure. These systemic challenges underscore the interlinked vulnerabilities facing Samburu's pastoralist households and highlight the need for multisectoral interventions.

5.3 Discussion of Findings

5.3.1 Animal Productivity as a Driver of Food Security

The findings of this study reinforce the central role of animal productivity in shaping food security among pastoralist households in Samburu County. Livestock remains the primary livelihood asset in this arid and semi-arid region, serving multiple functions as a food source, a store of wealth and a buffer against economic and climatic shocks. The multinomial logistic regression analysis confirmed that the number of animals owned was a significant and positive determinant of food security: each additional animal increased the likelihood of a household being food secure by 8.8%

and moderately food insecure by 2.5%, while decreasing the chances of being severely food insecure. These results echo existing literature on pastoral systems, where herd size is not only an indicator of economic status but also a critical means of ensuring household sustenance and resilience (FAO, 2021; WFP, 2022).

Further, the production of livestock by-products—especially milk—was found to be strongly associated with improved food security outcomes. Households producing larger quantities of milk and related products were significantly more likely to be food secure ($dy/dx = 0.451$, $p < 0.05$), underscoring the importance of productive animals in meeting nutritional and financial needs. Goat milk, in particular, emerged as the most frequently produced and consumed by-product, highlighting its adaptability and nutritional significance in dryland diets. However, the limited commercialization of value-added products such as cheese, yoghurt and hides points to underexploited income opportunities within the livestock value chain. Addressing this gap could support both diversification and resilience, especially during market disruptions or drought-induced supply constraints.

Breed quality also played a notable role in determining livestock output. While a majority of households (63.5%) kept local breeds due to their hardiness and adaptability to harsh climates, a smaller portion (24.1%) had adopted improved breeds. The relatively low uptake of improved and exotic breeds reflects both cautious risk management in the face of climatic variability and limited access to breeding programs or extension services. Importantly, households engaged in active livestock breeding were 8.3% more likely to be food secure, signalling the value of productivity-enhancing practices within traditional pastoral systems.

Access to veterinary services and livestock vaccination was near-universal, with 98.8% of households reporting availability and 93% indicating that their animals were vaccinated. Despite this, livestock disease remained the second most cited cause of food shortages (59.6%), suggesting either limitations in the quality, timing, or frequency of veterinary care, or challenges in managing disease outbreaks in expansive rangelands. This finding aligns with previous studies that emphasize the need for mobile veterinary outreach and community-based animal health worker models in ASAL contexts (USAID, 2022).

However, a critical vulnerability lies in feed availability and preservation practices. Only 38.6% of households reported preserving feed and even fewer produced their own fodder. This shortfall is particularly concerning given the recurrent drought cycles in the region and the strong link between seasonal feed scarcity and declining livestock health. Although regression results did not find feed production to be a statistically significant factor, the descriptive findings indicate a clear need for capacity building in pasture management, community fodder banks and feed preservation techniques. Strengthening these systems would contribute to more stable animal productivity and, by extension, more consistent food availability at the household level..

5.3.2 Socio-Economic Factors Influencing Food Security

The study revealed that socio-economic characteristics significantly shape the food security landscape among pastoralist households in Samburu County. While the education level of the household head was not found to be statistically significant in the multinomial regression model, descriptive data painted a compelling picture of structural inequalities in access to education. In regard to education, 85.4% of household heads were uneducated, compared to only 33.1% of non-head members. The educational gap between household heads and other members also implies limited intra-household knowledge transfer and decision-making capacity, further constraining adaptive strategies and livelihood diversification. These findings underscore the need for targeted adult literacy programs, visual and oral communication tools and culturally appropriate training materials tailored to low-literacy populations in pastoralist contexts.

Economic status emerged as a stronger and more direct determinant of food security. The study found that household asset value was significantly associated with increased likelihood of food security ($dy/dx = 0.063$, $p < 0.001$), supporting the notion that asset accumulation provides a buffer against shocks and enhances access to essential goods and services. Similarly, income derived from livestock and related by-products had a significant positive impact on food security ($dy/dx = 0.049$, $p < 0.001$). Descriptive analysis revealed that income from large ruminants was the most substantial, averaging KES 81,317.11, while small ruminants and fodder also contributed meaningful amounts. Despite this, overall household income showed high variability, with an average of KES 44,424.07 and a large standard deviation, indicating inequality in economic resilience across the community.

Land ownership also contributed positively to food security, albeit modestly ($dy/dx = 0.003$, $p < 0.05$). The average landholding was 12.8 acres, but wide disparities in land access (ranging from 1 to 180 acres) suggest a skewed distribution of productive resources. While most households operate under communal land tenure systems, individual ownership was rare, limiting long-term investment in land improvement or fodder production. These patterns reflect the broader challenge of resource security in pastoral areas, where land remains a shared but contested asset.

Household size was inversely associated with food security. Most households had between four and five members, but larger households—particularly those exceeding six members—faced greater food insecurity, likely due to increased consumption pressure and dependency burdens. Though not explicitly quantified in regression outputs, the descriptive data aligns with existing evidence linking larger family sizes to reduced dietary diversity and per capita food availability in low-income settings (Workie et al., 2020).

The study also highlighted persistent gender asymmetries in household decision-making. Male heads were reported as the primary decision-makers in over 83% of cases across key areas such as children's education, income and expenditure and veterinary services. Spouses—primarily women—played secondary roles, especially in financial decision-making (11.2%), but their influence was minimal in other domains. Sons had slightly more involvement in veterinary-related decisions, while daughters and other members were largely excluded. These dynamics reinforce the patriarchal structure of Samburu households and suggest that food security interventions must be deliberately gender-inclusive. Empowering women and youth through participatory budgeting, joint decision-making frameworks and leadership training could enhance household resilience and food security outcomes.

5.3.3 Climate Change Adaptation and Food Security

The study findings reaffirm that climate change is not a distant concern for pastoralist households in Samburu County—it is a lived reality. A vast majority of respondents (91.8%) reported observing significant changes in climate patterns over time, particularly in the form of delayed rainfall, prolonged dry spells and unpredictable weather events. Nearly half of the households (49.4%) had experienced two to three drought episodes within the past five years, while an

additional 20.9% had faced four or more, underscoring the chronic nature of climatic shocks in the region. These experiences align with existing literature that documents increasing climate variability and frequency of extreme weather events in arid and semi-arid lands (ASALs) in Kenya (Opiyo et al., 2022; Ngaina & Mutua, 2020).

The regression results indicated that climate shocks have a measurable negative effect on food security. Specifically, households that had faced drought shocks were 8.4% less likely to be food secure ($p < 0.05$), reflecting the disruptive impact of drought on livestock health, feed availability and household resilience. Furthermore, households that reported increased livestock mortality due to climate change had a 9.2% lower probability of being food secure ($p < 0.001$), reinforcing the direct link between environmental stress and household vulnerability. These findings highlight the severity of climate risks and the urgent need for adaptive mechanisms that reduce exposure and sensitivity to such shocks.

Despite the high exposure, household responses to climate change were largely driven by traditional coping strategies. Migration in search of pasture and water was the most commonly reported adaptation strategy (70.7%), consistent with the mobile nature of pastoralist livelihoods. Livelihood diversification, reported by 65.3% of households, reflects a gradual shift toward more mixed-income strategies, including small-scale trade and wage labour. Other significant responses included water harvesting and storage (42.2%) and feed preservation (38.6%), demonstrating proactive but resource-constrained efforts to manage seasonal scarcity.

However, the uptake of modern adaptation tools remained low. Only 7.8% of households had access to early warning systems and a mere 2.6% had adopted livestock insurance. These statistics suggest systemic barriers such as limited outreach by service providers, poor infrastructure, affordability constraints and possibly a lack of trust in formal institutions. Although not explicitly quantified in regression terms, the descriptive data points to a gap between climate awareness and institutional support—a divide that places the burden of adaptation disproportionately on households with limited means.

Perceptions of climate change were not uniformly disempowering. Households that perceived a decrease in rainfall were statistically more likely to be food secure ($dy/dx = 0.056$, $p < 0.001$), suggesting that heightened risk awareness may motivate proactive behaviour, such as early migration or fodder preservation. Nonetheless, this adaptive potential remains constrained by resource availability, institutional support and access to real-time information.

The findings portray a dual reality: on the one hand, pastoralist households are highly aware of and responsive to climate change, often relying on indigenous knowledge and lived experience. On the other hand, formal adaptation mechanisms remain underutilized, limiting the scope and sustainability of household-level responses. Bridging this gap requires investment in community-based resilience programs that integrate scientific and local knowledge systems. Specific interventions could include expanding access to real-time weather forecasting through mobile platforms, promoting drought-tolerant livestock breeds, establishing subsidized livestock insurance schemes and strengthening climate-smart extension services tailored to mobile and low-literacy populations.

5.4 Conclusion

The socio-economic profile of pastoralist households in Samburu County reveals structural vulnerabilities that limit food security. Most household heads (85.4%) were uneducated, which may constrain their ability to access information, interpret early warning systems and adopt innovative practices. Decision-making was highly patriarchal, with over 83% of key decisions made by male heads, although women played a notable secondary role in expenditure-related choices. Larger households faced greater food insecurity, likely due to consumption burdens that outweigh production capacity. Income was predominantly derived from livestock, with large ruminants generating the highest earnings, but overall income levels remained modest and unevenly distributed (mean KES 44,424.07). Households with greater asset ownership and land access were significantly more food secure, though disparities in landholding (ranging from 1 to 180 acres) and communal tenure systems limit individual investment in productivity.

Livestock remains the backbone of household food systems in Samburu and animal productivity is a decisive factor in determining food security. Households with larger herd sizes were significantly more food secure, with each additional animal increasing the odds of food security by 8.8%. Milk production—especially goat milk—was common and positively associated with improved food access, while value addition of other by-products such as cheese, hides and eggs was minimal. Households engaged in breeding practices also had a higher likelihood of being food secure (dy/dx = 0.083), indicating the benefits of productivity-oriented livestock management. Although 98.8% of households reported access to veterinary services and 93% had vaccinated their animals, livestock disease remained a top cause of food shortages, suggesting that quality and timing of care may still be inadequate. Additionally, poor adoption of feed production and preservation practices continues to threaten animal health and productivity during dry seasons.

Climate change is a major stressor for pastoralist households, with 91.8% reporting observed changes in climate and nearly 70% experiencing two or more droughts in the past five years. Traditional coping strategies such as migration (70.7%) and livelihood diversification (65.3%) were widely used, indicating reliance on indigenous adaptation. However, formal resilience tools remain underutilized—only 7.8% used early warning systems and 2.6% had insurance coverage. The regression analysis confirmed that exposure to drought and climate-induced livestock mortality significantly reduced the probability of being food secure by 8.4% and 9.2% respectively. Interestingly, households that perceived decreasing rainfall were more likely to be food secure, suggesting that climate awareness can motivate proactive behaviour. Overall, while pastoralists are adapting, the lack of institutional support and low uptake of modern tools hinder sustainable resilience.

Food security remains a serious challenge, with only 13.7% of households classified as food secure. The majority (54.6%) were moderately food insecure and 31.7% severely so. Most households consumed two meals per day, while 14.5% had only one, pointing to chronic undernutrition. Diets were largely cereal- and pulse-based, with limited access to fruits, vegetables and animal protein, particularly among vulnerable groups like children, the elderly and persons with disabilities. Seasonal hunger peaked between March and July, coinciding with the lean period, while drought (78.3%), livestock disease (59.6%) and high food prices (51.4%) were the most cited causes of food shortages. These outcomes highlight a food system that is heavily influenced

by environmental shocks, limited income and fragile support structures. Addressing these multidimensional challenges will require integrated interventions across agriculture, health, markets and climate adaptation systems.

5.5 Recommendations

The findings from this study point to several targeted actions that can be taken at both policy and practice levels to address food insecurity among pastoralist households in Samburu County. The recommendations are organized into two sections: those intended for policy makers and county-level institutions and those that can be implemented by practitioners, development partners and community-based organizations working in ASAL regions.

5.5.1 Recommendations for Policy

First, strengthening animal health systems in Samburu is critical for improving food security. Although 98.8% of households reported access to veterinary services, less than 40% practiced feed preservation, indicating gaps in service quality. Multinomial regression results showed that livestock productivity was a top predictor of food security—each additional animal increased the likelihood of being food secure by 8.8%. To address this, county governments should invest in mobile vet clinics, enhance disease surveillance, expand vaccination drives, and build cold chain capacity. These interventions will reduce livestock losses and stabilize food access in pastoralist communities.

Secondly, although over 60% of households earn income from livestock, most remain in subsistence systems with limited access to formal markets (Table 4.5). The multinomial logistic regression analysis showed that income from animal sales and by-products significantly increased the probability of being food secure (Table 22). Despite this, only a small percentage of households reported participation in structured value chains or access to financial services. To address this, county governments should:

- Establish aggregation centers and auction yards,
- Improve rural road infrastructure,
- Support producer cooperatives and digital platforms linking pastoralists to buyers and credit.

Enhancing market access will increase household income, strengthen resilience, and encourage investment in animal productivity, thereby improving food security.

Third, With 91.8% of households reporting perceived climate change and over 70% experiencing multiple droughts in the past five years, the study highlights a critical need to expand adaptive

interventions. Despite this vulnerability, only 7.8% accessed early warning systems and 2.6% had insurance, indicating minimal uptake of formal climate tools. Notably, the adoption of multiple adaptation strategies increased the probability of being food secure by 33%. To build resilience, county governments should prioritize technologies such as rainwater harvesting**,** feed conservation units (e.g., silage pits), and drought-resistant livestock breeds, supported through pastoral development plans and dedicated climate finance mechanisms.

Fourth, the findings on education as a key predictor of food security especially the fact that households led by tertiary-educated individuals were 4.3 times more likely to be food secure underline the importance of enhancing access to adult and informal education. County governments and development partners should integrate adult literacy and numeracy programs into livestock extension services. Particular focus should be placed on targeting male household heads, who make the majority of key decisions in the household. Equipping them with functional education will improve uptake of agricultural innovations, climate information and health services.

Lastly, to achieve inclusive and sustainable progress, there is an urgent need to support gender-inclusive land and resource rights. The study found that land ownership was predominantly communal and male-controlled, with only 5.6% of households reporting individual land titles. Policy reforms that promote the issuance of joint land titles, community sensitization on women's land rights and legal support for women to access and inherit land can significantly improve women's ability to contribute to household food security. When women have secure access to productive assets, they are more empowered to participate in decision-making and livelihood diversification, both of which are essential for household resilience.

5.5.2 Recommendations for Practice

1. Scale Feed Preservation and Pasture Management through CBOs

Given that only 38.6% of households practice feed preservation and even fewer produce their own fodder, there is an urgent need to strengthen community-level capacity for livestock feed management. Community-based organizations (CBOs) should be empowered to lead training on affordable feed preservation methods (e.g., hay baling, silage pits) and rotational grazing to mitigate forage scarcity during drought. With 85.4% of household heads being uneducated, training should be delivered through visual aids, vernacular radio, pictorial flipcharts and on-site demonstrations. This approach respects local literacy levels while building practical knowledge. CBOs can also serve as anchors for establishing communal fodder banks and pasture cooperatives that enable bulk feed storage and equitable distribution during lean seasons.

2. Establish Financial Inclusion Models for Pastoralists

The study found wide disparities in income and asset ownership, with most households relying solely on livestock and having limited cash flow to invest in animal health or productivity inputs. Strengthening or establishing pastoralist-friendly savings and credit cooperatives (SACCOs) is therefore critical. These SACCOs should offer flexible loan products tailored for drought preparedness (e.g., for water tanks, fodder, vaccines) and allow collective saving models suited for mobile populations. Development partners and financial institutions can provide loan guarantees, training in basic financial literacy and introduce mobile-based savings tools that work offline. These models will enable households to smooth consumption, invest in livestock systems and build resilience.

3. Leverage Mobile Phones for Climate and Market Information

Although only 7.8% of households currently access early warning systems, the widespread use of mobile phones in rural Kenya presents an opportunity to close this gap. Mobile platforms can be used to disseminate timely and localized alerts on rainfall forecasts, drought warnings and livestock market prices. These services should be voice- or SMS-based, available in Samburu language and co-developed with local communities to ensure content relevance and trust. Collaboration between the Kenya Meteorological Department, NGOs and telecom providers is

essential to ensure coverage, affordability and sustained usage. By improving access to actionable information, households can better time migration, sale of livestock and feed stocking, thereby enhancing food and income security.

4. Target Food Support and Nutrition Programming During Lean Seasons

Food insecurity peaks between March and July, with over 48% of households experiencing hunger in April and May. To cushion households during this lean season, implementers should synchronize targeted interventions—such as school feeding, emergency cash transfers and household food rations—with these critical months. These programs should prioritize households with young children, the elderly and persons with disabilities, who were found to have limited dietary diversity. Additionally, complementary nutrition education, coupled with support for small kitchen gardens using drought-tolerant crops, can diversify household diets and reduce overdependence on cereal-based staples. This will also enhance utilization and stability dimensions of food security beyond short-term food aid.

5.6 Suggestions for Further Research

While this study offers valuable insights into the determinants of food security among pastoralist households in Samburu County, several critical gaps warrant further investigation to inform more nuanced policy and programmatic responses.

First, there is a need for deeper exploration of the role played by institutional support systems—particularly livestock extension services and community-based training mechanisms—in shaping food security outcomes. Although 98.8% of respondents reported access to veterinary services, the study found low uptake of advanced practices such as feed production, preservation (38.6%) and climate-responsive livestock management. This suggests that mere access does not guarantee behavioural change. Future research should examine how the quality, frequency and contextual appropriateness of extension services influence adoption of resilience-enhancing practices. It would also be useful to assess the extent to which institutional trust, delivery models (e.g., peer-led, mobile, or government-driven) and communication methods affect uptake. A comparative study across counties with differing extension coverage could identify scalable models for enhancing pastoralist engagement with formal support systems.

Second, the study highlighted a critical disconnect between high climate change awareness

(91.8%) and the minimal use of formal early warning systems (7.8%). Further research is needed to unpack the barriers limiting the use of early warning and risk communication tools among pastoralists. These may include factors such as low digital literacy, language barriers, limited access to mobile networks, or mistrust in government-issued information. Future research should adopt participatory approaches that directly involve pastoralist communities in mapping their information needs, preferred communication formats and trusted sources. Investigating how locally adapted, real-time weather and market information can be effectively integrated into decision-making processes could lead to the development of more responsive and inclusive early warning systems.

Third, the study established that each additional climate adaptation strategy adopted increased the odds of being food secure by 33%, yet the financial feasibility and sustainability of these strategies remain unclear. There is a pressing need for cost-benefit analysis of key adaptation practices such as fodder preservation, water harvesting, drought-tolerant livestock breeds and livestock insurance. Future studies should explore the affordability, return on investment and scalability of these practices under different socio-economic and environmental conditions. Research should also evaluate the role of enablers—such as access to credit, subsidy programs, or public-private partnerships—in increasing uptake and long-term sustainability. Understanding these dimensions can help policymakers and development actors prioritize high-impact, economically viable interventions that are responsive to pastoralist realities.

5.7 Limitations of the Study

Geographic and contextual scope posed a significant limitation. The study was conducted exclusively in Samburu County, a region categorized as arid and semi-arid land (ASAL). While the findings offer valuable understanding of food security dynamics in pastoralist communities, they may not be generalizable to high-potential agricultural zones or urban populations in Kenya. Livelihood strategies, infrastructure and access to services differ markedly across regions, limiting the transferability of conclusions beyond similar ASAL contexts.

Temporal limitations also apply due to the cross-sectional nature of the research design. Data was collected at a single point in time, which restricts the ability to capture seasonal variations in food security—such as lean season hunger spikes or post-harvest surpluses—as well as long-term trends in adaptation and resilience. As a result, the study cannot fully reflect the temporal dynamics of

food availability, consumption and climate-related shocks that may vary significantly over months or years.

Measurement constraints further affected the study. The reliance on self-reported data introduces the potential for recall bias, especially in variables related to past food consumption, drought experiences and income estimation. While enumerator training and pre-testing of tools helped reduce this risk, some inaccuracies may persist, particularly where respondents lacked records or had difficulty recalling quantities or timelines. In addition, several intangible factors—such as trust in institutions, intra-household power dynamics and cultural norms influencing food distribution—were not directly measured, although they likely affect food security outcomes.

Design limitations include the inability to infer causal relationships. Although multinomial logistic regression was used to identify associations between predictor variables and food security outcomes, the study's design does not allow for determination of causality. Longitudinal or experimental designs would be better suited to explore how changes in livestock ownership, income, or adaptation behaviours influence food security over time.

Finally, the absence of qualitative data limited the study's capacity to unpack the lived experiences, perceptions and motivations behind household decisions. While the quantitative data provided robust statistical patterns, qualitative insights would have enriched the analysis by revealing why certain strategies were adopted or rejected, how households interpret climate risks and what social norms guide food sharing and consumption. Future studies should consider integrating mixed-methods approaches to provide a more comprehensive and nuanced understanding of food security in pastoralist settings.

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APPENDICES

Appendix I: Research Questionnaire

QUESTIONNAIRE FOR STUDIES ON

ASSESSMENT OF THE DETERMINANTS OF FOOD SECURITY IN PASTORALIST COMMUNITIES: SOCIOECONOMIC, AGRICULTURAL and CLIMATE DYNAMICS IN SAMBURU COUNTY, KENYA.

DATE OF INTERVIEW: Date_____Month_____Year_____

SUPERVISOR: [SUPNAME]_____Name of Enumerator_____

REMARKS [REMARK] _____

TO THE RESPONDENT: The general objective and purpose of this survey is to understand food security among pastoralists households in Samburu County. Your responses will help to inform policy recommendations to improve food access and resilience and used by researchers at the Strathmore Business School. All responses and data obtained will be kept confidential and will only be used for research purposes Thank you!

Section 1: Household Profile

1A.GPS coordinates of the respondent's primary residence ALTITUDE_____

LATITUDE _____LONGITUDE_____

1B. Are you the household head: _____(1) Yes… (0)No…1B.1. If No, Name of the household head_____Gender_Male._____. Female_____

2B Educational Level: ☐ No formal Education ☐Primary Education ☐Secondary Education ☐ Tertiary education

1C: Marital Status: ☐ Single ☐Married ☐ Widowed ☐ Divorced

1C. Mobile No.: Zero is not reflecting_____

1D. County _____1E. Sub-County:_____

1F. Ward/Zone: _____

1G. How many years have you lived in this village (PA)/locality? _____Year/s

CODE A	CODE B	CODE C	CODE D
Head=1 Spouse (Wife/Husband/Partner Head)=2; (Step) Son/(Step) Daughter=3; Grandchild =4; Father/Mother =5; Father(In-Law)/Mother(In-Law)=6; Sister(In-Law)/Brother(In-Law) =7; Nice/Nephew = 8; Uncle/Aunt =9; Son/Daughter-In-Law=10; Grandparents=11; Other Relatives =12; Servant =13; Tenant =14; Other Unrelated Person =15	Single Married=1; Polygamous=2 Single=3 Divorced=3 Separated=4 Widowed=5 Other specify=6_____ __	uneducated=1; able to read and write only (without formal education)=2 primary school (grade 1-8)=3 secondary school (grade 9-12)=4 diploma holder=5 degree holder and above=6	Agriculture ..... 1 Personal Services. ..... 10 Mining..... 2 Education..... 11 Manufacturing. ..... 3 Health..... 12 Professional/scientific/ Technical activities .....4 Public administration… 13 Electricity ..... 5 Housewife .....14 Construction ..... 6 Unemployed ..... 15 Transportation ..... 7 Pastoralist ..... 16 Buying and selling.....8 Agro pastoralism .....17 Financial services ..... 9 Other specify=6

2A. Overall livelihood:

2A.1. What are the main farming system of the household:

1. Crop only …… 2. Livestock only ……3 Mixed farming ……4 Pastoral ……5Agro pastoral ……6 Other (include landless) only

2B: Land ownership and utilization.

2B.1. Does your family own land? _____ (1) Yes (0) No

2B.2. If yes, who owns the land _____ (1) male (2) Female (3) Both 4 (communal owned)

Note to enumerators: Please convert local land units to acres

2B.3. How much total land does your family own? _____acres

2B.4. Does your current land have allotment letter/title deed certification? _____1) Yes 0) No23B.5. Do you have any other land with allotment letter/title deed? _____ 1) Yes 0) No

2B.6. Under who was the allotment letter/title deed issued for the other land? (1) male

(2) Female (3) Both 4 (community owned)

2B.7.Do you expect any kind of land transferred from the group ranch in the coming five years?

_____ 1) Yes 0) No

2B.8. Are you concerned that somebody might dispute/claim your ownership/use rights to part or all of your land? Yes…1 No….2

3A. Consumption-Food aggregates

	3A1.	3A.2.	3.A3.
Food ID	Over the past one week (7 days), did you or others in your household Consume any [ITEM]? (Include food both eaten communally in the household and that eaten separately by individual household members). Code: YES…..1 NO…… 2 ► NEXT FOOD	How much in total did your household consume in the past week?	Unit codes 1. Kilogram 2. Liter (liquid) 3. Pieces (for bread) 4. Bottles (for beer, soft drinks, etc) 5. Number (for eggs)

		CODE	QUANTITY	UNIT CODE
	CEREALS			
1	Maize			
2	Wheat			
3	Rice			
5	Sorghum			
6	Millet			
7	Other cereal (SPECIFY)_____			
pulses & nuts				
8	beans			
9	green peas			
10	chick pea			
11	lentils			
12	green gram			
13	ground nuts			
14	other pulse or nut (specify)_____			
seeds (unprocessed)				
15	Niger seed			
16	linseed			
17	other seed (specify) _____			
vegetables				
18	onion			
19	kales (sukuma wiki			
20	cabbage			
21	indigenous vegetables			
22	tomato			
23	other vegetable (specify) _____			

fruits				
24	banana			
25	orange			
26	other fruit (specify) _____			
tubers & stems				
27	potato			
28	caladium			
29	carrots			
30	sweet potato			
31	yam			
32	cassava			
33				
34	other tuber or stem (specify) _____			
meat, poultry, & fish				
35	goat & mutton meat			
36	beef			
37	poultry			
38	fish			
other				
39	Milk			
40	cheese			
41	butter/ghee			
42	oils (processed)			
43	eggs			

44	sugar			
45	salt			
beverages & stimulants				

46	coffee			
47	tea			
48	soft drinks/soda			
49	beer			
50	coco			
51	chat / kat			
others				
52	purchased maize floor			
53	purchased bread or biscuits			
54	pasta/maccaroni			
55	other prepared food and consumed at home			

How many meals does your household consume per day on average

☐ One meal ☐ two Meals ☐ Three Meals

4B. Vulnerability to nutrition security

4B.1. Do all household members eat roughly the same diet? 1. Yes 2. 0.No	4B.2. If no to 7B.1., Who in the household eats more diverse variety of foods 1.the husband 2.the wife 3.the children 4.Adult male members 5. Adult female members	4B.4. If no to 8B.1., Who in the household eats less diverse variety of foods 1.the husband 2.the wife 3.the children 4. Adult male members 5. Adult female members	4B.5. In the last 12 months, have you been faced with a situation where you did not have enough food to eat?	4B.6. If YES, Which months did you experience this situation? [Multiple responses possible]	4B.7. Rank the top three causes of this situation? Inadequate household stocks due to drought/poor rains. .....1 Inadequate household food stocks due to crop pest damage .....2 Inadequate household food stocks due to small land size..... 3 Inadequate household food stocks due to lack of farm inputs.... 4 Inadequate household food stocks due to lack of farm tools/drought animals, plough etc .....5 Food in the market was very expensive ..... 6 Not able to reach the market due to high transportation costs.. 7 Market very far from the village 8

																No food in the market ..... 9 Floods/water logging/hailstorm ..... 10 Others (Please specify) _____ 11 List up to 3 answers by order of importance		
Yes No			Yes No	J	F	M	A	M	J	J	A	S	O	N	D	1st	2nd	3rd

5, Climate change, perception, drought and adaptation

5A. Climate change perceptions

5A.1 Has the household faced a drought shock over the past five years? 1. Yes

0. No

5A.2 If yes, number of times _____

5A.3 If a drought is to occur in your area how likely is your household to rely on the support of family and friends to reduce the immediate impact of drought shock a) Very unlikely b) Unlikely c) Neutral d) Likely e) Very likely

5A.4a Number of Relatives that you can rely on for critical support in times of drought within this village ……..

5A.4b Number of Non-Relatives that you can rely on for critical support in times of drought within this village ……..

5A.5. Farmers' perception of impacts of climate change on livestock production in the study area.

Climate change perceptions	Codes: 1. Strongly disagree with 2. Disagree 3. No change 4. Agree 5. Strongly agree
1. Do you think that the temperature is increasing these days	
2. Do you think that rainfall change is decreasing these days	
3. Do you think that rainfall variability is increasing these days	
4. Do you think that change in temperature has affected livestock production health	
5. Climate change has affected feed availability for livestock	
6. Climate change has affected feed quality for livestock	

7. Climate change has increased livestock disease susceptibility	
8. Climate change has increased morbidity of livestock	
9. Climate change has increased livestock mortality	
10. Climate change has reduced water availability	
11. Climate change has increased disease and parasite incidences	
12. Climate change has reduced age o**f** first mating	
13. Climate change has reduced age at first parturition	
14. Climate change has r**educed** milk production	
15. Climate change has reduced t**he weight of** animals	
16. Climate change has reduced animal growth rate	

6B. Adaptation strategies

17. Do you believe that there is climate change? Yes… No…

18. If YES, Rank the top 5 adaptation strategies adopted to reduce the impacts on livestock in the area

1.Migration to other nearby areas 2. Water harvesting 3. Reducing livestock number 4. Different livestock species 5. Diversification 6. Change livestock species 7. Vaccination 8. Conservation of feed, 9. Supplementary feeding 10. Forage production 10. Changed to mixed farming 11) Planted supplementary feed; 12) Other (Please specify) _____

19. Rank the following barriers to adaptation in order of severity. 1st_____, 2nd_____, 3rd_ 4th_____5th_____

1) Lack of information; 2) Lack of credit, 3) Shortage of labour, 4) Land tenure system, 5) Poor grazing land.

Appendix II: Consent Form

SECTION 1: PARTICIPANT INFORMATION SHEET

1. Introduction

You are invited to participate in a research study on food security among pastoralist communities in Samburu County. This study is being conducted by **David Nkisalash Lesamana** as part of a **Master of Public Policy Management** degree at **Strathmore University**. The study seeks to understand the factors influencing food security and provide recommendations for improving food security policies and interventions.
Your participation is voluntary and this form provides information to help you make an informed decision about whether or not to participate.

2. Purpose of the Study

- The purpose of this study is to assess the combined effects of:
- Animal productivity factors (e.g., herd size, breed quality and by-products)
- Socio-economic factors (e.g., household income, education, market access, gender roles)
- Climate change adaptation strategies (e.g., drought-resistant breeds, diversification, water management) on food security in Samburu County.

The findings will inform policy recommendations for improving food security among pastoralist communities.

3. Who Can Participate?

- You are eligible to participate if you:
- Are a household head in the **Nairimirimo community, Wamba North Ward, Samburu East Sub-County**
- Engage in **pastoralism or agro-pastoralism** as a livelihood
- Are **18 years or older** and willing to provide informed consent

You **cannot** participate if you:

- Are below 18 years old
- Do not engage in pastoralist or agro-pastoralist activities
- Are unable to provide informed consent

4. What Does Participation Involve?

If you agree to participate, you will:

- Be asked to answer a structured questionnaire on food security, livestock management, socio-economic conditions and climate change adaptation.
- The survey will take approximately **30–45 minutes** to complete.
- Your responses will be collected by trained research assistants.

5. Risks and Benefits of Participation

Potential Risks:

- Some questions may involve sensitive topics such as income and food insecurity.
- If you feel uncomfortable, you **may skip any question** or **withdraw at any time**.

Potential Benefits:

- While there are no direct personal benefits, your participation will contribute to **valuable research** that can inform **policies and programs** aimed at improving food security in pastoralist communities.

6. Confidentiality and Data Protection

- All responses will be **kept strictly confidential**.
- Your data will be **stored securely** in password-protected databases.
- Your name will **not** appear in any reports or publications.
- Only the **research team** will have access to the data.

7. Voluntary Participation and Right to Withdraw

Participation in this study is **entirely voluntary**.

- You are **free to decline** participation without any consequences.
- If you choose to participate, you can **withdraw at any time** without needing to provide a reason.
- Your withdrawal will **not** affect any services, benefits, or support you may receive.

8. Who to Contact for More Information

If you have any questions or concerns about this research, please contact:

Researcher: David Nkisalash Lesamana
Institution: Strathmore Business School, Nairobi
Email: David.lesamana@strathmore.edu
Phone: 0723316696

Supervisor: Prof. Simon Ndiritu Wagura
Institution: Strathmore Business School
Email: **sndiritu@strathmore.edu**

For Ethical Concerns: Strathmore University Institutional Ethics Review Board
Email: ethicsreview@strathmore.edu

SECTION 2: PARTICIPANT CONSENT FORM

Statement of Consent I, **Participant's Name**_____, confirm that:

- I have **read and understood** the study information provided above.
- I have had the opportunity to **ask questions** and receive satisfactory answers.
- I understand that my participation is **voluntary** and I can withdraw at any time.
- I understand that my information will be kept **confidential**.

Please tick the boxes that apply:

☐ **I AGREE** to participate in this research study.

☐ **I DO NOT AGREE** to participate in this research study.

☐ **I AGREE** to allow my completed questionnaire to be stored for future research analysis.

☐ **I DO NOT AGREE** to allow my completed questionnaire to be stored for future research analysis.

Participant's Signature: _____Date: ___/ ___/ _____

SECTION 3: RESEARCHER DECLARATION

I, **Investigator's Name**..... confirm that:

I have provided all necessary information to the participant.

The participant understands the study and has consented voluntarily.

Investigator's Signature: _____Date: ___/ ___/ _____

Appendix III: Data Collection, Analysis and Reporting Budget

Research Topic: Determinants of Food Security in Samburu County, Kenya

Duration: 14 days (including travel and reporting)

Team: 2 Data Researchers and a data analyst

Item	Unit Cost (KES)	Quantitv/Days	Total Cost (KES)
1. Data Collection Costs			
Transport to/from Samburu (Round Trip)	0.00	2 researchers	0.00
Local Transport (Motorbikes, Public Transport)	0.00	10 days	0 00
Accommodation (Budget Hotel/Guesthouse)	0.00	10 days x 2 researchers	0.00
Per Diem (Meals and Miscellaneous)	0.00	10 days x 2 researchers	0.00
Research Assistants (If needed)	0.00	2 assistants x 5 davs	0.00
Printing of Questionnaires & Materials	0.00	1 batch	0.00
Mobile Data Collection Software (e.g., ODK)	0.00	2 licenses	0 00
Mobile Phone Airtime & Internet	0.00	2 researchers	0.00
Subtotal (Data Collection)			0 00
NB: The Data collection expenses will not be incurred as the data has been collected by SAFIC under KPMD pro2ram			
2. Data Analysis & Reporting Costs			
Data Cleaning and Entry	5,000	I time	5,000
Data Analysis Software (STATA/SPSS)	15,000	1 license	15,000
Research Report Writing, editing and proof reading	5,000	1 report	5,000
Printing and Binding of Reports	2,500	2 copies	5,000
Miscellaneous (Unforeseen Exoenses)	5,000	1	5,000
Subtotal (Analysis & Reoortin2)			**35,000**
Total Estimated Bud2et			**35,000 KES**

Notes:

1. Costs may vary based on actual field conditions, accommodation options, and transport availability.
2. This budget assumes the use of mobile data collection tools to reduce printing costs.
3. If additional training for research assistants is required, it may increase costs.
4. Miscellaneous costs provide flexibility for unforeseen expenses.

Appendix IV: Work Plan

Chapter	Activity	Start Date	End Date	Duration	Responsible Party
Research Proposal	Concept development and Background research	8th July 2024	9th Sept, 2024	2 months	Researcher and Supervisor
	Literature review	16th Sept, 2024	16th Oct, 2024	1 month	Researcher
	Methodology and Approach	21st Oct, 2024	8th Nov, 2024	3 weeks	Researcher
	Supervisors review, Corrections and approval	11th Nov, 2024	22nd Nov, 2024	2 weeks	Researcher and Supervisors
Research Proposal Defense	Defense of research proposal	20th December 2024	20th December 2024	1 day	Researcher
	Corrections submissions and approval	14th Jan, 2025	11th Feb, 2025	3 weeks	Researcher and Supervisor
	Application for Ethical Approval from IRB	3rd March 2025	17th March 2025	2 weeks	Researcher & Supervisor
Data Collection	Get Data from SAFIC	15th March, 2025	17th March, 2025	2 days	Researcher & SAFIC Data Analysts
	Data Entry and Data Cleaning (into SPSS)	18th March, 2025	21st March, 2025	1 week	Researcher & Data Clerks
Data Analysis	Perform descriptive analysis (means, frequencies, distributions)	24th March 2025	28th March 2025	1 week	Researcher
	Conduct inferential statistical analysis (Multinomial Logistic Regression)	31st March 2025	4th April 2025	1 week 4 days	Researcher
	Interpret findings and extract key insights	7th April 2025	11th April 2025	5 days	Researcher
Report Writing	Draft preliminary report (Introduction, Methodology, Results)	14th April 2025	21st April 2025	1 week	Researcher
	Review and revise based on supervisorâ€™s comments	23rd April 2025	25th April 2025	3 days	Researcher and Supervisor
	Finalize and format research report	26th April 2025	29th April 2025	3 days	Researcher
Presentation and Submission	Prepare PowerPoint slides for defense	30th April 2025	6th May 2025	1 week	Researcher
	Present findings to Strathmore Review Panel	7th May 2025	7th May 2025	1 day	Researcher
	Submit final thesis to Strathmore University	8th May 2025	9th May 2025	1 day	Researcher

Appendix V: Ethical Review Certificate

Strathmore UNIVERSITY

14th March 2025

Mr. David Lesamana,
david.lesamana@strathmore.edu

Dear Mr. Lesamana,

RE: Determinants of Food Security Among Pastoralist Communities in Kenya. The case of Samburu County.

This is to inform you that SU-ISERC has reviewed and **approved** your above **SU-masters** proposal. Your application reference number is **SU-ISERC2748/25.** The approval period is from **14th March 2025 to 13th March 2026.**

This approval is subject to compliance with the following requirements:

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

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

Yours sincerely,

Mr Ambrose Rachier,
Chairperson; SU-ISERC

Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu

Appendix VI: Research Introduction Letter

Ole Sangale Rd, Madaraka Estate
P. O Box 59857 - 00200, Nairobi, Kenya
Cell: +254 703 034 414/6/7
X/Twitter/Tiktok: @SBSKenya
Facebook/Linkedin: Strathmore University Business School

Email: **sbsinfo@strathmore.edu** or visit **www.sbs.strathmore.edu**

Strathmore UNIVERSITY BUSINESS SCHOOL

20 Years of Developing Great African Leaders

Tuesday, 18 March 2025

To Whom It May Concern,

RE: FACILITATION OF RESEARCH – LESAMANA DAVID NKISALASH

This is to introduce David Lesamana who is a **Master's in Public Policy and Management** (MPPM) student at Strathmore University Business School, admission number MPPM 138394 As part of our MPPM Program, David is expected to do applied research and undertake a project. This is in partial fulfilment of the requirements of the MPPM course. To this effect, he would like to request for appropriate data from your organization.

David is undertaking a research paper on **"Determinant of Food Security among Pastoralist Communities in Kenya. The Case of Samburu County."** The information obtained from your organization shall be treated confidentially and shall be used for academic purposes only.

Our MPPM Program seeks to establish links with industry, and one of these ways is by directing our research to areas that would be of direct use to industry. We would be glad to share our findings with you after the research, and we trust that you will find them of great interest and of practical value to your organization.

We appreciate your support and shall be willing to provide any further information if required.

Yours Faithfully,

Njoki Kiagiri.
Manager – Graduate Programs.
Strathmore University Business School

Appendix VII: Authorization to Use SAFIC_KPMD Data

Strathmore UNIVERSITY
Agri-Food Innovation Center (SAFIC)

Date: 03/03/2025

To Whom It May Concern,

Dear David Lesamana,

RE: Authorization to Use SAFIC_KPMD Data for Research Purposes

On behalf of the Strathmore Agrifood Innovation Center (SAFIC), we are pleased to grant you authorization to access and use the **SAFIC_APMT** dataset for your research on the determinants of food security among pastoralist communities in Kenya, the case of Samburu County.

As a part of the research team involved in the data collection, and a Master of Public Policy and Management (MPPM) student at Strathmore University, your request aligns with the objectives of SAFIC to support evidence-based research in agrifood systems and food security.

This authorization is granted under the following conditions:

1. The data shall be used **strictly for academic research purposes** related to your study.
2. The confidentiality and integrity of the dataset must be **maintained at all times**, ensuring compliance with ethical research standards and data protection regulations.
3. Proper **acknowledgment and citation** of SAFIC_APMT as the data source must be made in any publications, reports, or presentations derived from this research.
4. No unauthorized **sharing, reproduction, or distribution** of the dataset shall occur without prior written approval from SAFIC.

Should you require any further clarifications, do not hesitate to contact us at sndiritu@strathmore.edu or 0722590559

We wish you success in your research and look forward to the insights your study will generate in advancing food security policies in Samburu County.

Sincerely,

Prof. Simon Wagura Ndiritu
Director
Strathmore Agri-food Innovation Center (SAFIC)
Strathmore University
sndiritu@strathmore.edu

Appendix VIII: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **209037**

Date of Issue: **01/April/2025**

RESEARCH LICENSE

This is to Certify that Mr.. David Nkisalash Lesamana of Strathmore University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Baringo, Embu, Kericho, Kiambu, Kirinyaga, Kisii, Kisumu, Kitui, Laikipia, Machakos,
Makueni, Meru, Migori, Mombasa, Muranga, Nairobi, Nakuru, Nandi, Narok, Nyeri,
Taita-Taveta, Tanariver, Turkana on the topic: Determinants of Food Security Among Pastoralist Communities in Kenya. The case of Samburu County. for the period ending : 01/April/2026.

License No: **NACOSTI/P/25/417384**

209037

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions