DYNAMICS TOWARDS SUSTAINABLE FOOD SECURITY IN ARID AND SEMI-ARID PARTS OF EAST SHEWA ZONE IN OROMIA REGIONAL STATE, ETHIOPIA

BY

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DECLARATION

Declaration by Candidate

This research thesis is my original work and has not been presented for the award of any degree in any University. No part of this thesis may be produced without prior written permission of the author and/or Moi University.

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ABSTRACT

Sustainable food security remains a major global concern despite the various strategies being undertaken. Currently, fragile ecosystems can no longer sustain themselves because of the numerous factors acting against each other. This study therefore, sought to examine the dynamics towards sustainable food security in Arid and Semi-Arid parts of East Shewa zone in Oromia Regional State of Ethiopia. The study objectives were to: analyze the food security situation, assess the factors determining food security and examine the challenges towards sustainable food security in the study area. The study was informed by vulnerable livelihood approach and political ecology explanation. It adopted pragmatism philosophical underpinning that lays emphasis on mixed method research. Using multistage and systematic random sampling techniques, a sample size of 397 comprising of pastoral and agro-pastoral households was generated from 58,632 target household population of the study area. The instruments of data collection were questionnaire, focus group discussion guides, structured interview guides, and observation schedules. The collected data was subjected to Rasch Model and SPSS, and analyzed descriptively and inferentially. Frequency, percentage, average, and charts were used to display the data and binary and ordinal logistic regression models were applied for inferential analysis to determine association between variables. The qualitative data was transcribed, categorized into themes and analyzed to provide depth to the quantitative results. Arising from the research findings 22% of the households were food secure while 78% fall in food insecure category indicating the food situation in the study area was not sustainable as the majority failed to produce or access food. From the regression analysis undertaken it was found that household socioeconomic factors such as respondent’s non-farm income (P-value=.006), crop farm/irrigation (P-value=.021), family size (P-value=.029) government support (P-value=.008) and livestock owned (P-value=.001) played significant roles in determining household food (in)security (P-value < 0.05). In relation to the dynamics towards food security sustainability, the regression analysis showed that there was a statistically significant negative correlation between soil fertility decline (P-value=.000), land degradation (P-value=.031), biodiversity loss (P-value=.001), shortage of water (P-value=.027), restricted mobility (P-value=.000), poor market facilities (P-value=.022) conflict (P-value=.000) and household food security at P-value <0.05. Emerging from the study findings, livestock food shortages, crop failure, farm inputs, market dynamics, conflicts, asset decline, and shortage of food were pronounced as the major challenges facing the study area. In conclusion, the dynamics observed in these parts demonstrate that even in challenging environments, a multifaceted approach of integrating socioeconomic development, environmental conservation and institutional reform can unlock significant potential for sustainable food security. In recommendation, the study advocates for collaborative efforts involving responsible national, regional, and local governments as well as non-government organizations in enhancing food security, awareness raising, and implementation of policies for sustainable management and accessibility to natural resources within the study area.

DEDICATION

To my late parents, my father Taffesse Mossissa and my mother Amalo Bultum whose humble origins in a rural village could not confine their boundless dreams and unwavering support during the previous years of my education. My mother's unwavering belief in me, despite the confines of illiteracy, was a testament to the boundless power of maternal love and intuition. As I pursued my Ph.D. studies on foreign shores, just as she foresaw, her belief and vision has steered me through every challenge. My late father's encouragement to seek knowledge and embrace education has laid a solid foundation for my academic journey. I dedicate this dissertation to them, as a tribute to their enduring love, wisdom, and the profound impact they have had on my life.

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ACRONYMS AND ABBREVIATIONS

ASAL	Arid and Semi-arid Lands
DFID	Department for International Development
EEA	Ethiopian Economics Association
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FI	Food Insecurity
FIES	Food Insecurity Experience Scale
HLPE	High Level Panel of Experts
IGAD	Intergovernmental Authority on Development
IFAD	International Fund for Agricultural Development
MDG	Millennium Development Goal
OFSP	Other Food Security Programmes
PDC	Planning and Development Commission
PSNP	Productive Safety Net Programme
SDGs	Sustainable Development Goals
UN FAO	Food and Agriculture Organization of the United Nations
UNICEF	United Nations Children’s Fund
UN CESCR	United Nations Committee on Economic, Social and Cultural Rights
VoH	Voice of Hunger
WFP	World Food Programme
WHO	World Health Organization

OPERATIONAL DEFINITIONS

Agro-pastoralists: semi-nomadic people who depend on crop farming and livestock rearing

Arid Lands: Drought prone areas

Semi-Arid Lands: Subtype of dryland, occur as transition zones between the arid and subhumid belts

Dynamics: the complex interactions, processes and changes within the food system caused by both external forces and the internal feedback structure of the system that influence it's functioning and evolution over time

Farmer(s): sedentary communities who cultivate the same piece of land continuously over extended period

Food Insecurity: when people fail to get sufficient amount of nutritious food needed for healthy and active life.

Food System: The processes and activities involved in food production, actors, strategies involved and the outcomes.

Household head: The individual (male or female) who holds primary responsibility for decision-making and management within a household.

Kebele: the lowest strata of government administration organ responsible for all political, social and economic matters in its span of control.

Pastoralism: food production strategy in the arid and semi-arid parts based on communal land use and or moving from place to place in search of livestock food and water

Sustainable Food Security- consistent access to nutritious food, resilient food production systems, and equitable distribution, promoting long-term well-being without compromising environmental sustainability.

Sustainability: development that meets the need of the present without compromising the ability of the future generation to meet their own needs

Tropical Livestock Units (TLUs): Livestock numbers converted to a common unit; Household Per capita livestock owned.

CHAPTER ONE: INTRODUCTION

1.1 Overview

This chapter articulates key aspects that lay the foundation to the study namely; background to the study, statement of the problem, objectives of the study, scope of the study, justification for the study, significance of the study and limitations of the study.

1.2 Background of the Study

The 1948 International Declaration of Human Rights is the signpost to raise the concern for food by asserting that every individual has the right to get sufficient food (UN, 1948). However, ensuring every individual's consistent access to sufficient, safe and nutritious food in the midst of dynamic changes that affect the food system remains an unabated global challenge. Different efforts were made at different times by different parties to tackle the challenge. For instance, the 1974 First World Food Conference brought the food security agenda to the global level and pledged a global level commitment to end hunger and malnutrition (UN, 1975). More commitments followed by the 1996 UN World Food Summit and the Millennium Development Goals (MDG), which aimed at reducing the proportion of people suffering from hunger by half by 2015 (FAO, 1996; UN, 2015a; Degefa, 2005). Building on this, the current Sustainable Development Goals particularly SDG goals 2.1, 2.3, 2.4 and 10.3 envision ending hunger, achieving sustainable food security through promoting sustainable food production system, and reducing inequalities (UN, 2015b).

In the same vein, African countries have tried at various times to tackle food insecurity problems. The 2003 Maputo Declaration, the 2004 Sirte Declaration, the 2006 Abuja Food Security Summit Declaration, and Malabo Declaration signify the Continent's devotions to food security commitments (AU, 2015). The Framework and Guidelines on Land Policy in Africa for instance aimed to improve access to land resources for farmers to improve food security through improved agricultural productivity (AU, 2010). Almost all African countries implement social security programmes of various types including the Productive Safety Net programme, which in Ethiopia and other African countries has targeted at improving food access and reducing poverty and inequality (AU, 2015). The African Union Agenda 2063 framework (AU, 2015) has also aimed at regional market integration as a strategy to enable farmers to connect to local, national and regional markets, though it is still far from realization.

Despite all the promises, plans and actions, nonetheless, food insecurity has remained one of the major challenges that affect the lives of many people in every country of the world. Recent statistics show that more than 2.37 billion (about 26%) of the world population did not have consistent access to sufficient, safe, healthy and nutritious food for their dietary needs and preferences for an active and healthy life in 2019. In Africa, 54% of the population was food insecure, severely in East Africa where more than one in four people were experiencing acute food insecurity during the same year (FAO, 2020).

Global food security policies since the 1970s focus on increasing food production through improved agricultural productivity. However, less explicit actions have been taken to address the other goals of food security such as access and sustainability, both of which remain the major challenges for the 2 billion food insecure world individuals. Integrating sustainability issues into the concept of food security is essential, particularly in ASAL regions where socioeconomic challenges are significant besides the harsh environmental conditions. The increasing impact of climate change, the accessibility and availability of natural resources, social dynamics and rising socio-economic inequality have threatened the food production system in these regions (HLPE, 2017).

Studies also show that government politics have affected food security in many countries through unequal distribution of power to access and control over natural resources, poor food security policies, governance systems and its many other social, economic, political and environmental components that affect food security (Akbari *et al.,* 2022; Blaikie, 2016; Scoones, 2020; & Degefa, 2005). For instance, many development policies that follow capitalistic resource distribution undermine the right of the vast majority of the rural poor to access livelihood resources, and this affects sustainability in food access (Scoones, 2016; Blaikie & Brookfield, 2015). Food shortage in many countries turned into famine disasters due to lack of governments' timely responses (FAO *et al.*, 2021; Sen, 2001).

In many developing countries of the world, inequality in access to and poor management of natural resources heightened degradation of natural resources, soil fertility decline, biodiversity loss, and water problem all of which have negatively affected food production and utilization (Blaikie & Brookfield, 2015; FAO *et al*., 2021; HLPE, 2020; WFP, 2019; & Rettberg *et al*., 2017). The 2005 Millennium Ecosystem assessment estimated about 70 percent of the land faced some form of degradation, and biodiversity was facing many risks (NRC, 2011). At the global level, about 4 billion people face water scarcity; decline of farm animal species; and about 75% of food plants' diversity was lost in the 20th century alone (HLPE, 2020).

Poverty and the wide social and economic inequalities in resource access and control that exist within societies have negatively affected their food production and access. Smallholder farmers' farmland size per person is diminishing, and indigenous communities often have limited access to land resources. In many developing countries, rural people face challenges in accessing education, healthcare, and basic infrastructure like roads as well as limited opportunities for income generation. These factors collectively weakened the communities' coping capacities to shocks and stresses leaving them particularly vulnerable to food insecurity (Behnassi, Pollmann & Kissinger, 2013).

Technological innovations to enhance high-level productivity have grown during the last decades through the help of research in the fields of agro ecology and biotechnology. It has made significant contributions to food security in production, transportation, marketing and consumption. However, its productivity is determined by various factors such as farmers' financial capacity to afford and their capability to utilize the technology and therefore, there are debates as to what extent these innovations have contributed to the vast majority of poor smallholder farmers' sustainable food security (Godfray, 2015).

Increased global market integration has made the food chains grow longer, which indicates a large number of the global people depend on international markets for their food security (HLPE, 2020). Thus, market functionality has become decisive to meet the required demand for the current global food production system (NRC, 2011).

The Arid and Semi-Arid Lands (ASALs) cover about 26% of the world's total land area, and 18.4% of the total global population live in this part of the world. These parts are the most affected areas by the global climate change and recurrent drought, rainfall variability, and the spread of human and livestock disease that disrupt food production (Rettberg *et al.*, 2017; Devereux, 2001). Productivity of agriculture (crop farming) has limitations in these dry regions due to longer drought seasons requiring extra investment in irrigation facilities and infrastructure and use of adequate reservoirs to complement periods of high rainfall variability (Mortimore, 2009; Mulugeta & Habtemariam, 2011).

The ASALs are predominantly inhabited by pastoral and agro-pastoral communities, and mobility is a strategy to adapt to the scarce resources in these dry land parts. Livestock production in ASAL areas significantly contributes to the national economy and export trade of many countries (IFAD, April 2016). However, in recent decades, government policies have promoted sedentarization and crop farming, disrupting traditional food production systems and exacerbating natural resource degradation in these arid environments (Behnke and Mortimore,2016; IFDA, April 2016; De Haan, 2016). Additionally, the expansion of farming and irrigation activities has restricted pastoral mobility leading to a decline in livestock production. The lack of policy attention towards pastoral communities in these regions, coupled with economic marginalization, has heightened pastoral poverty, pushing the majority into chronic food insecurity and dependency on aid (Rettberg *et al.*, 2017).

Comprising about 70% of the total Africa's land surface (the proportion of ASAL makes about 83% in the eastern part of the region) more than 24% of the region's population drive their livelihood from ASAL parts of Africa (Robe, 2006; Sivakumar, Das & Brunini, 2005). These parts of Africa are characterized by chronic food insecurity and widespread poverty (Robe, 2006; Sivakumar, Das & Brunini, 2005). De Haan (2016) indicates that 85% of the pastoralists and 77% of the agro pastoralists in the ASAL parts of Africa live below the poverty line. He claims that from 9% to 28% of the livestock in the region is owned by only one percent of the richest pastoralists, which shows a high degree of inequality in the pastoral areas.

Various factors that contributed to chronic food insecurity in ASAL parts of the region have been captured by previous studies, which claim that government land use policy change implemented in most ASAL parts of Africa, and dynamic ecological and environmental changes that followed have weakened the communities' livelihood sustainability (De Haan, 2016; Fraser *et al.*, 2011 page 9 citing Sendzimir, Reij & Magnuszewski, 2011; Mulugeta & Habtemariam, 2 011). The rights of ASAL parts communities to access land resources have been consistently undermined in many of Africa's ASALs. This circumstance has increased ASAL parts communities' exposure to various shocks including drought, diseases, conflict, and food insecurity (IFDA, April 2016; De Haan, 2016). Besides, pastoralists were not benefiting from the opportunities such as rising livestock market prices due to various constraints (Little, Dejene & Waktole, 2014).

Despite the Ethiopian government's efforts through the implementation of various food security policies and programs, FAO indicated that 20% of the country's population were in chronic undernourishment in 2019. Similarly, 36.8% and 7.2 % of the children under the age of five were affected by stunting and wasting respectively during the same year, which indicates serious malnutrition in the country (FAO *et al*., 2020). Ethiopia is the most food insecure country in the East African region with 8.47 million in need of urgent action followed by South Sudan 6.45 million, and Sudan 6.25 million before COVID-19, in 2019 (IGAD, 2020). The country's global hunger index (GHI) score was 29.1 in 2018, which shows a serious level of under-nutrition (WFP, 2019). About 25% of the households in the country fall below the poverty line with the highest poverty rates in the ASALs parts (WFP, 2020).

The situation in Ethiopia's ASAL parts is not different from that of Africa's ASAL. Ethiopia's ASAL parts consist of vast rangeland areas with huge potential for irrigation farming, although only 28% is currently utilized. These areas also contribute significantly to national livestock production. The pastoral and agro-pastoral communities in these regions have adapted to the harsh climate, but they face numerous challenges. Fragile ecosystems, scarce resources, and marginalization are significant issues. Government development policies have consistently undermined the rights of these communities to access land resources. Additionally, poor social services and infrastructure, conflict, and lack of market integration further exacerbated the problem. As a result, poverty and persistent food insecurity remains a significant issue in these parts of the country (Allen & Prosperi, 2016, and Esayas, Solomon & Girma, 2019).

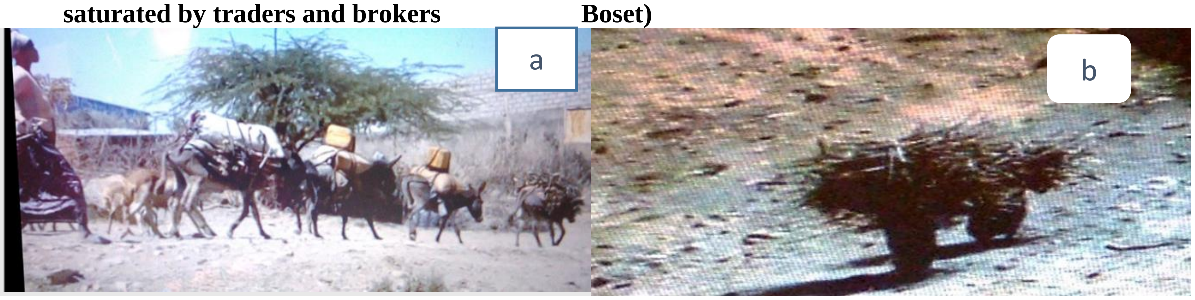
The study areas, Fantale and Boset districts in Eastern Shewa zone of Oromia, lie in the eastern part of Ethiopia's ASAL areas. Food insecurity is severe in the districts due to similar dynamism prevailing in the other Ethiopia's ASAL parts discussed above. Unequal access to land resources due to expropriation of pastoral grazing areas for mega projects that restricted pastoral mobility affected the communities' food production activities. Land degradation, shortage of pasture, loss of dry season grazing areas to farming and other activities and biodiversity decline caused shortage of forage and household herd size has declined below the threshold for food security (Adugna *et al.*, 2022; Abera & Aklilu, 2012; Fekadu *et al.,* 2016).

Figure 1.1 below shows the study areas fragile dry land, irrigation attempts, the Government's initiatives dominated by investors (Fantale), Matahara livestock market (Fantale), and poorly developed infrastructure (Walanchiti town, and Boset saturated by traders and brokers- all of which manifest elusive development efforts at the study areas.

A. Study area fragile ASAL Land part **B. Irrigation (Fantale)**

Government initiatives dominated by investors (Fantalle)

C. Matahara livestock market (Fantale), saturated by traders and brokers **Poorly developed infrastructure (Walanchiti town, Boset)**



D. A woman herding donkeys carrying firewood, and other necessities (a); Women carring firewood and charchoal for sale to Walanchiti town (Boset) (b)

Figure 1.1: The Concept of Development Remained Elusive

Since the early 20th century, various dynamics in the area have reduced the communities' access to land resources (Rettberg *et al*., 2017). Ethiopian Government's development initiatives such as the promotion of sedentary farming, land privatization, and the expansion of mega projects in the ASAL parts have restricted pastoral and agro-pastoral communities' access to land resources, intensified land use, and led to natural resource degradation and conflict. Despite crop farming practices, studies indicate that harvests remain low due to harsh climatic conditions of this dry land, particularly in the Fantale district (Adugna *et al*., 2022). The Government's introduction of an irrigation project has faced complex challenges and failed to significantly improve the food security situation (Yohannes & Mahmmud, 2015; Tefera & Ayalew, 2023). Non-farm income sources are limited to low income activities, such as firewood and charcoal selling, and offering little economic relief. Additionally, the scarcity of social services and alternative economic opportunities has left the districts grappling with severe food insecurity. Asset loss and poverty are widespread, with many households relying on aid (Rettberg *et al*, 2017; Abera & Aklilu, 2012; Tefera & Ayalew, 2023).

Whereas the global, regional, national and local level various food security promises, policies and programs along with the implementation efforts have laid foundations for food security awareness and actions, achieving sustainable food security has become an unattainable wish primarily in fragile ecosystem parts where complex internally and externally induced dynamics influenced the communities' livelihood strategies.

Evidently, therefore, a number of dynamics interacted and negatively affected achievement of sustainable food security in the ASAL parts of Ethiopia. The increasing global, regional, national and local dynamisms affected all spheres of human life including food security. In addition to the global dynamics, the recent complex dynamic interactions in Ethiopia's ASAL parts have negatively affected food production activities, and sustainable food security in the area.

There are traditional linear approaches of food security endeavors typically focusing on isolated factors such as conflicts, natural disasters, drought, climate variability and resource scarcity, or livelihood strategies and market volatility factors that can quickly destabilize food security (FAO, 2006; Allen *et al.*, 2018; Ericksen, 2008a; HLPE, 2020). Studies, however argue that food security efforts must not be limited to just such immediate threats but more integrated approach that considers the entire food system and the interplay of conflicting factors that drive food insecurity (Bene, 2020; HLPE, 2020; Ingram, 2011a; Allen & Prosperi, 2016). By assessing household food situations, examining the broader dynamics towards sustainable food security, and identifying the challenges faced in the ASAL parts of Ethiopia, this study aimed to understand the multifaceted dynamics that influence household food security sustainability in the study areas.

1.3. Statement of the Problem

As highlighted in the background sub-section, achieving sustainable food security remains a major global challenge due to the interplay of various complex factors, despite the numerous policies and interventions made. The scenario is even worse in some regions due to the varying dynamics from one region to another. In the ASAL parts, the combination of these complex factors acting against each other has made it difficult to achieve sustainable food security. The difficulty is manifested in most ASAL parts of Africa including that of Ethiopia.

Hence, unless addressed effectively, the enduring and exacerbating dynamics surrounding sustainable food security will continue to pose major global challenges.

In the Ethiopian ASAL parts, the complex interconnected dynamics such as poverty, environmental degradation, climate variability, and socio-economic and institutional constraints have exacerbated food insecurity, posing a formidable barrier to sustainable development. As a result, populations in these vulnerable areas spend substantial time and resources merely trying to secure food, diverting attention and effort away from other critical development activities. Understanding these dynamics is crucial, as it allows for the identification and articulation of key attributes beyond the mere improvement of agricultural sustainability. Addressing these constraints is essential for eliminating hunger and poverty and for empowering communities socially, economically, and environmentally. Such empowerment is vital to enhance the resilience and capacity of people living in these regions to achieve long-term food security and stability. Therefore, there is an urgent need for comprehensive research to thoroughly understand and address the factors that hinder sustainable food security in Ethiopia's ASAL parts.

Many of the country's efforts to achieve food security have been narrowly focused on traditional linear approaches, which fail to comprehensively address the complex and interconnected nature of the issue. These efforts often overlook: a) the root causes of food insecurity; b) the interplay between environmental, social, economic, and institutional systems that are crucial for supporting sustainable food security; and c) without analyzing the food system and its uneven outcomes to understand the root causes that challenge sustainable food security in the ASAL parts (Bene *et al*., 2020; Ingram, 2011; HLPE, 2020).

Both formal studies and informal observations show that there have been minimal efforts to comprehensively assess household food security situations or to identify the dynamic drivers and challenges of context-specific sustainable food security in these vulnerable parts. More specifically, there have been insignificant concerted efforts to devise adaptation mechanisms to address the challenges of food insecurity in the ASAL parts of Eastern Shewa zone in the Oromia National Regional State of Ethiopia. This study, therefore, investigated the complex dynamics influencing food production activities and the challenges to achieving sustainable food security for households in the study area.

1.4. Objectives of the Study

The main objective of this study was to examine the dynamics towards sustainable food security in arid and semi-arid parts of East Shewa Zone, Oromia Regional State of Ethiopia.

1.4.1. Specific Objectives of the Study

The specific objectives of the study were to:

i. Analyze the food security situation in the study area,

ii. Assess the dynamics towards sustainable food security in the study area, and

iii. Examine the challenges to sustainable food security in the study area.

1.5. Research Questions

i. How is the food security situation in the study area?

ii. What are the dynamics towards sustainable food security in the study area?

iii. What are the challenges to sustainable food security in the study area?

1.6. Research Hypotheses

The research hypotheses were:

i. H_{O1}: There is no significant relationship between household socioeconomic characteristics and their food security in the study area.

ii. H_{O2}: There is no significant relationship between environmental factors and household food security sustainability in the study area.

iii. H_{O3}: There is no significant relationship between institutional factors and household food security sustainability in the study area.

1.7. Scope of the Study

Food production shows variation based on variables such as locations and other factors. This study, therefore, focused on the ASAL parts' food security situations and dynamisms. The scope of the study is limited to Fantale and Boset districts in the ASAL parts of East Shewa Zone in Oromia Regional National State of Ethiopia taking the households as the unit of analysis. The two study districts were selected due to the long history of land use policy dynamism since the 1930s that have increased food insecurity in the region. They represent the distinct features of ASALs socioeconomic, cultural and ecological factors. Out of the 62 rural *kebeles* in the two districts, 25 *kebeles* were sampled for the study based on the communities' pastoral and agro-pastoral livelihood basis, with a sample size of 397 households selected from a target population of 58,632 households.

The study just addressed the food security situation, the dynamics towards sustainable food security, and the challenges to sustainable food security in Fantale and Boset districts. Based on literature review (Bene *et al.*, 2020; HLPE, 2017), and a series of deliberations with the

Oromia Agriculture and Natural Resource Development Bureau food security experts, eleven socioeconomic as well as twenty-two drivers believed to capture environmental and institutional sustainability dimensions were selected and analyzed to identify those dynamics that influence household sustainable food security in the study area.

The study did not consider cultural acceptability, food safety, nutritional value and calorie intake measures that are more related to diet and nutrition (HLPE, 2020). Moreover, household behaviors on inter-household decision-making processes, such as gender specific allocations and food preference); and issues related to food wastage, and other non-food factors such as health and sanitation, which are more of individual decisions, were beyond the scope of this study.

1.8. Justifications for the Study

Due to the fact that sustainable food security is a decisive factor for human well-being and environmental health, it has remained a global concern. The critical challenges to achieving sustainable food security in the ASAL parts of Ethiopia remained barely assessed, jeopardizing human well-being and environmental health. Without a thorough understanding of the root causes that hindered the food system influencing food security, particularly the social, environmental and institutional factors, efforts to align with Ethiopia's Growth and Transformation Plans (GTPs), Prosperity Plan, and Vision 2025 may falter. Unsubstantiated efforts could barely bear fruits and could hinder the opportunity to make informed policy decisions and implement effective interventions that could prevent worsening food insecurity in the ASAL parts of Fantale and Boset districts in the East Shewa Zone of Oromia. These Districts exemplify the unique characteristics and challenges faced by communities wherein food production systems have been most affected by complex dynamics due to internally induced challenges and continuous external pressures on the local communities' livelihood since the 1930s. It is not only Ethiopia's ASAL parts that face acute challenges in achieving sustainable food security, but also those in the neighboring countries and most parts of Africa ASALs. It is, therefore hoped that this study will also ignite thoughts towards global concern by uncovering the dynamics influencing sustainable food security in the ASAL parts.

The study asserts that while climate change plays a role, the various dynamics that interact with household food production activities is the underlying cause of unsustainable food systems and food insecurity in the study area. Investigating the dynamics in this context, therefore, will serve as a basis for insights not only for the study districts, but also to regions with similar challenges. Understanding the dynamics in the context of Ethiopia's broader development goals provides valuable insights for improving food security in other similarly affected regions. The country can easily replicate the result of the study to other regions in cognizant of the disparities that exist in terms of background and heterogeneity. Moreover, information on the underlying dynamics identified by this study will give inputs to policy makers, and pertinent stakeholders for improving the existing policies and/or for developing effective adaptation strategies.

Overall, the current study unearthed the prevailing situations, dynamisms, and challenges to sustainable food security in the ASAL parts of Fantale and Boset districts; and so also is part of the call for progress in improving agricultural productivity (SDG 2.3), enhancing resilience

(SDG 2.4), ensuring equitable development (SDG 10.3), and food security (SDG 2.1) across the vulnerable parts.

1.9. Significance of the Study

This study addresses a critical gap in understanding the multifaceted dynamics that influence household food security in the ASAL parts of Ethiopia. While previous research has often focused on individual factors affecting food security considering traditional linear approaches, this study provides a comprehensive analysis that highlights key attributes essential for achieving sustainable food security in the study area. The dynamics observed in these parts demonstrate that a multifaceted approach-integrating socioeconomic development, environmental conservation, and institutional reform- are crucial for enhancing food security. By combining these dimensions, the study fills a significant knowledge gap and offers a holistic understanding that is vital for developing effective, tailored interventions to address the unique challenges faced by ASAL regions in the study areas in particular and beyond.

The study is significant to provide several key policy-related matters related to sustainable food security; new and localized insights; and practical strategies in terms of land use, conflict resolution, market integration, environmental conservation, and the creation of inclusive institutional frameworks to ensure sustainable food security in the ASAL parts of Fantale and Boset districts. These in turn can egnite strong community engagement, boost ownership, and eventually provide essential strategies for achieving long-term sustainability. Moreover, due to the fact that these areas were underrepresented in previous food security researches, this study’s focus on their unique socioeconomic, cultural, and ecological characteristics provides valuable data that can be applied to similar contexts across Ethiopia and beyond.

Other regions facing similar challenges in ASAL environments can draw valuable lessons from the dynamics observed in Fantale and Boset districts in their pursuit for sustainable food security; and develop more holistic and effective approaches to tackle food insecurity in similar contexts, cognizant of the inevitable variations in background, and localities. The emphasis on integrated actions such as enhancing sustainable agriculture, empowering communities socially and economically and addressing land tenure issues to ensure equitable access to land for all farmers offers a comprehensive blueprint for improving food security.

Due to the fact that the current study is comprehensive, focuses on previously underexplored areas, and disseminates actionable findings and actionable insights that can improve food security, the households wellbeing and resilience in ASAL areas; its findings are significant for: a) informing the Ethiopian Government to revitalize its Prosperity Plan, and Growth and Transformation Plan and strategies; b) contributing for the broader understanding of food security, wellbeing, resilience, and sustainable development in Ethiopia and similar regions globally; c) promoting sustainable solutions tailored to the specific needs of ASAL communities; and d) offering valuable data and insights that not only guide policymakers and stakeholders in developing effective intervention strategies but also provide a foundation for future research in similar contexts and beyond.

The study also has far-reaching significance to the global contexts due to the fact that the study aligns with and supports the achievement of several Sustainable Development Goals (SDGs), including Goals 2.1 (end hunger), 2.3 (double the agricultural productivity and incomes of small-scale food producers), 2.4 (ensure sustainable food production systems), and 10.3 (reduce inequalities).

1.10. Limitations of the Study

The findings would primarily apply to the specific study areas, although it may be possible to generalize them to the other zones and regions for issues with similar outcomes. The political instability and tensions that happened in Fantale district created difficulty during data collection for movement both for security issues and low attention to the study from the side of the study population. Different strategies were used to solve the problem. The first action taken was data collection was temporarily suspended during the first critical months to wait for relatively peaceful time and continued after the problem was resolved. Opportunities such as district level meeting schedules were also used to get the participants from different *kebeles* at one place for focus group discussions.

The researcher and data collectors carried copies of official support letters from all the concerned government structures, and also from Moi and Addis Ababa Universities. Also, consent letters were secured from the regional and zonal administrative and agricultural offices to develop confidence of the local officials as well as the study population on the importance of the study and its legality. Each data collection time started with a clear explanation by reading the objective of the study supported by showing the support letters. In consultation with zonal experts and district administration, some of the insecure sites were replaced by other accessible *kebeles* for safety reasons. The number of enumerators was increased since the population settlement was dispersed over a wider area and it was difficult to reach more than 4 to 6 households per day at some places.

The problem of illiteracy and language barrier was another challenge faced during data collection. All the data collection tools were translated into the Language of the community, i.e., Afan Oromo, and the enumerators were assigned to help those respondents who cannot read and write by reading each and every question to them and filling their responses for the survey questionnaire. In addition, focus group discussions and key informant interviews that involved 20 and 13 individuals respectively were conducted to fill the gap that might have been created due to the illiteracy problem.

Notwithstanding the aforementioned limitations, which are more of external, the study also has internal limitations as it failed to assess the effectiveness of crop farming/irrigation in enhancing food security in the ASAL parts and and to evaluate the economic and environmental benefits of shifting to small ruminant livestock in the ASAL Parts so as to guarantee sustainable food security.

CHAPTER TWO: LITERATURE REVIEW

2.1. Overview

This Chapter presents relevant literature appertaining to the study, namely, the conceptions of sustainable food security, Global food security situation, dynamics towards sustainable food security, and challenges to household sustainable food security. The Chapter also presents the theoretical and conceptual frameworks for the study.

2.2. Sustainable Food Security

Sustainability is defined differently by different parties under different circumstances. The Brundtland report, for instance, is limited to environmental protection in the process of human activities for food production, emphasizing *"...*development that meets the needs of the present without compromising the ability of the future generation to meet their own needs*"* (UN, 1987: 37). FAO (2010) and some writers such as Burlingame and Dernini (2010), on the other hand, view sustainability in terms of sustainable diet along with establishing understanding of the multidisciplinary nature of sustainable food security. FAO, for instance, states "…those diets with low environmental impacts which contribute to food and nutrition security and to a healthy life for present and future generations. ... protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, and economically fair … while optimizing natural human resources*"* (FAO, 2010)*."* In this definition the issue of sustainable food is not limited to environmental and health aspects. It encompasses the economic, social and institutional aspects as mediators. The goal of environmental protection highlighted in this definition is from the point of view of its multiple contributions to food security in agricultural productivity and nutritional quality.

Bene (2020) and HLPE (2020) indicate that sustainability in the food system has four key dimensions: food security, environmental, social and economic dimensions. The environmental dimension of sustainability emphasizes minimizing negative effects of the food production system on the environment. Similarly, social sustainability in this case refers to issues of equitable access to nutritious food for every person and a food system that promotes community resilience. The existence of a viable food production, distribution, and exchange system and farmers' access to resources and efficient resource utilization ensures economic sustainability in food security. Food security emphasizes the availability and access to nutritious food for a healthy life (Ingram, 2011a; Bene, 2020; Prosperi *et al*., 2014; Pircher *et al*, 2021). From this angle, factors such as natural resource availability and access, livelihood asset bases and income, social support systems, the underlying institutional factors, and corresponding social and environmental welfare are key drivers that need focus in the analysis of sustainable food security.

The above explanation also discloses that sustainable food security is not just food availability and access alone, but it is the outcome of the food production system in the social-environmental interaction. The concept of sustainability in sustainable food security, therefore, encompasses the attainment of social equity and socioeconomic and environmental well-being as well as food security, while structures such as technologies, policies, institutions, etc., are means of achieving sustainability (SDC, 2008; Ingram, 2011a page 5, citing Ericksen, 2008a; Ericksen *et al*., 2010; Ingram, 2009).

Scholars argue that analyzing sustainable food security has to focus not only on the issues of food production (availability), food access, vulnerability, government policy, and social support systems, but it also requires focus on the interaction between the political-ecological systems. They claim that it is these dynamic interactions, processes, and changes that determine food availability, access, and utilization in the food production system (Bene, 2020, HLPE, 2017, Ingram. 2011; Ericksen, 2010; Barlas, 2007). That means it has to focus on the whole food system to understand drivers of sustainable food security in the face of such environmental, social, economic, and institutional dynamics. They claim that linear model research that deals with specific issues of food security may have limitations in capturing the major social and environmental feedbacks, which are decisive drivers of sustainability (Stringer *et al*., 2017; Ingram, 2011a; Ericksen *et al*., 2009; Burlingame & Dernini, 2010; HLPE,2020). Ericksen (2008b) and Allen *et al*. (2018) claim that such more systematic analysis of food security dynamics that links food security outcomes to processes enables understanding causes of vulnerability to food insecurity. Thus, the issue of sustainable food security is not limited to environmental and food security aspects, but it includes dynamics encompassing the focal issue of food production systems with a "farm to plate" understanding and the outcomes (Ingram, 2011b; FAO, 2010; Burlingame & Dernini, 2010).

A study by Barlas (2007) claims that the complex interactions, processes, and changes within the food system caused by both external forces and the internal processes and the feedback structure of the system that influence its functioning and evolution over time affects food security sustainability. This dynamic includes the underlying forces, processes, and relationships that determine food availability, access, and utilization in the food production system.

In agricultural food production, external or internal processes influence the food system, changing the outcomes and activities of the actors in the long run. Policy changes as well as the interaction of agricultural practices, climate change, and the food value chain cause problems in productivity, resource availability, market situation, and environmental conditions, which affect household livelihoods.

In agricultural food production system, the social-environmental interaction is not a cause-effect relationship but rather has feedback (in the form of positive or negative social and environmental welfare and food security itself) from outcomes that play a key role back to the system. This implies the inherent dynamics in sustainable food security (van Berkum, Dengerink & Ruben, 2018; Gill *et al*., 2018). The dynamics, therefore, affect not only food security but also the environment, social, and economic wellbeing of people, and itself is affected by the feedback to the system. Thus, analyzing the dynamics in food security research enables us to capture their effect (the effect of policy interventions made, for instance) on the food production system from feedback to the system (Ingram, 2011a).

Scholars comprehend agro-ecosystem conditions such as temperature increase, rainfall variability, land degradation, biodiversity loss, technology, irrigation schemes, market dynamics, trade policies, disease outbreaks, and conflict that add pressure on the food system as the major drivers that affect the sustainability of the food system (Bene *et al*., 2020; Tendall, 2015; Ingram, 2011a; HLPE, 2020; FAO, 2018). Some categorize these drivers under environmental, technology and innovations, economic and market, institutional, sociocultural, and demographic (Ingram, 2011a; HLPE, 2020). In ASAL parts of the agricultural food production system, changes in policy, resource availability and access, technology, and market related problems influence household livelihood bases, their livelihood activities, and their resilience to food insecurity. In this case, the productivity of the environment depends mainly on the institutional settings to enhance households' adaptive capacity to changing conditions (Tendall *et al*., 2015). In the agricultural food production system, these dynamics have made it imperative to understand the multiple factors that interact with the food system and have the capacity to determine the outcomes, including food security itself.

Sustainable food security therefore takes into account this complex food system; food system activities, food system drivers, and food system outcomes (Bene *et al*., 2020). The food system includes both the processes and outcomes; food system activities, actors, and the outcomes of these activities, which include food security itself as well as environmental and social welfare as feedback to the system as shown in Figure 2.1 on page 25. It is the performance of the food system that determines the state of a given individual/household's food security sustainability (FAO, 2008; Ingram, 2011b). Thus, the food system approach takes into consideration both the externally and internally induced issues of food security as well as the possible feedback that may increase vulnerabilities in the future (Stringer et al., 2017; Allen et al., 2018).

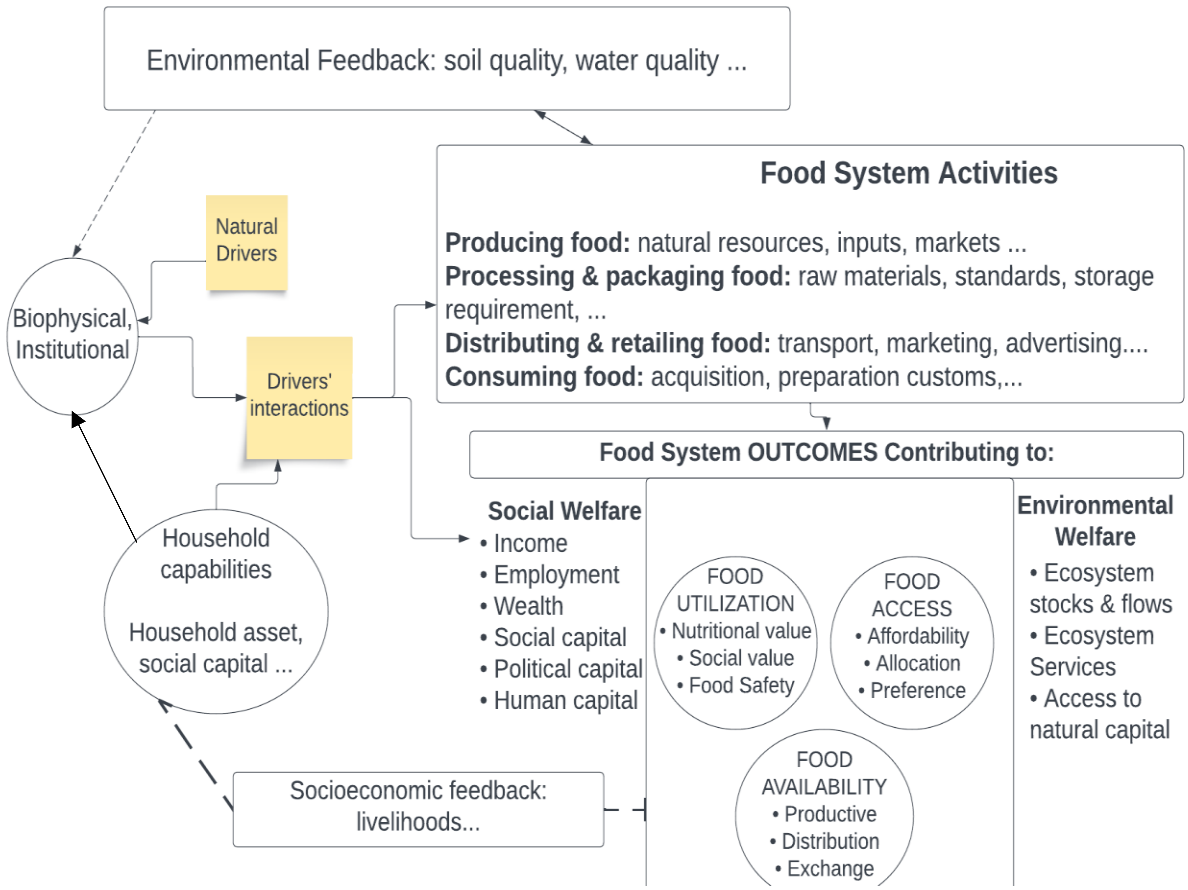


Figure 2.1: Agricultural Food System

Source: Adapted from Ericksen (2008a) and Ingram (2011b)

A food system is said to be sustainable if the activities of each actor or support provider are profitable and socially sustainable when the food system outcome benefits society's well-being. From the environmental point of view, a food system is sustainable when its activities have no negative impact on the environment. Besides, the extended food value chain involving many actors, including the producers, as well as all involved service providers such as extension agents, investors, traders in inputs such as improved seed, improved livestock breeds, or fertilizers and market related problems make the food system elements determine the sustainability of the food system (FAO, 2014).

Scoones *et al*. therefore, claim that sustainability is rather about system functions and outcomes that need to take into account the multiple objectives of poverty reduction, social justice, and environmental care (Scoones *et al*., 2007). Thus, they noted how systems respond to internal and external shocks and stresses determine a dynamic food system's sustainability and identified stability, durability, resilience, and robustness as the four sustainability properties in relation to shocks and stresses. On this basis, the four interdependent properties of sustainability in the context of the food system are shown in Figure 2.2 below.

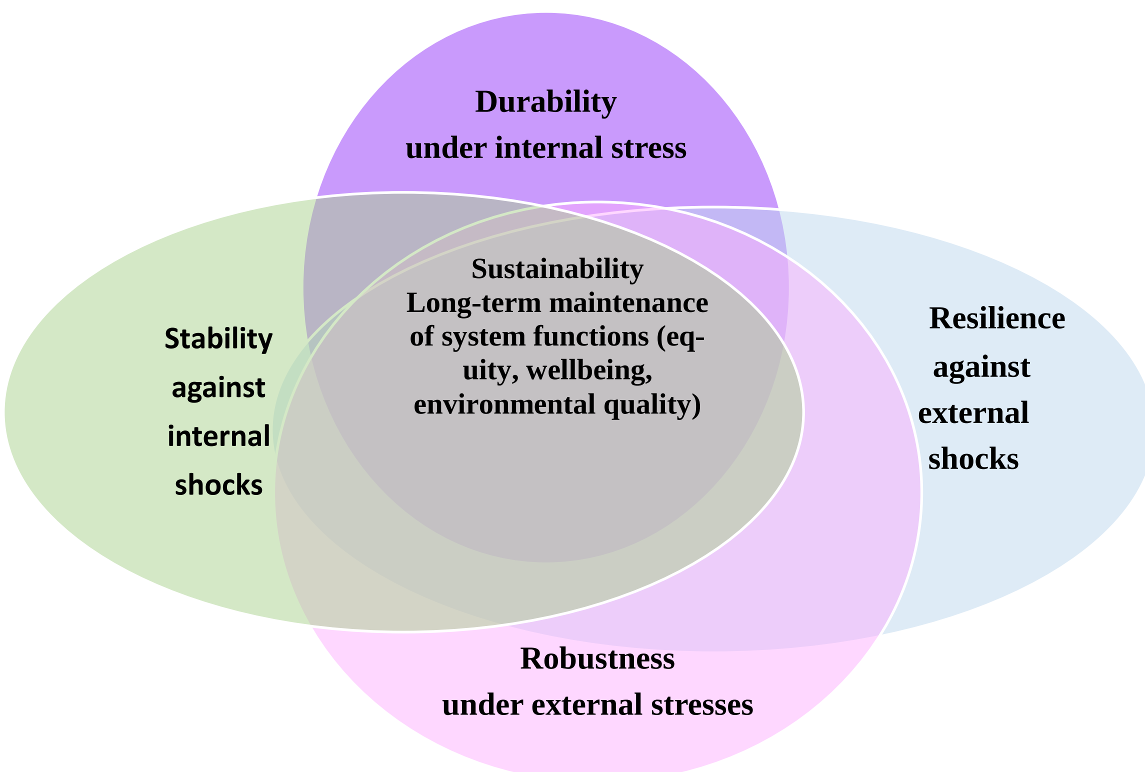


Figure 2.2: Sustainability and its Four Interdependent Properties

Source: Taken from Scoones et al. (2007, page 40)

Government intervention through market stabilization, improving income, and mitigating the impact of climate change maintains stability. Robustness refers to a system's capacity to remain productive in the face of external shocks such as temperature increases or shortages of rainfall, with a minimum negative socioeconomic and environmental outcome. Food systems that developed modern irrigation farming, livestock types that resist drought, and improved market systems that enable access to food are examples of systems that withstand various stressors without experiencing a significant loss of their ability to perform. Durability is the food system’s long-term capacity to continue functional for the present and future needs due to its sustainable agricultural practices, knowledge system, and development actions, while resilience refers to the system's adaptive capacity to absorb changes and disturbances and adapt to changes (Scoones *et al*., 2007; GFS, 2019).

Although ASAL areas food production systems such as pastoralism and agro-pastoralism show resilience in the long term, short-term instabilities due to shocks such as drought that cause livestock death, crop failure, and food shortages affect people unless timely intervention is made (Cervigni & Morris, 2016).

2.3. Household Food Security Situations

2.3.1. Food Security

The concept of food security has evolved significantly over decades, expanding to over 200 definitions through ongoing inquiries and refinements. However, the 1996 World Food Summit definition that relates to sustainability defines food security as *a* situation “…when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for active and healthy life” (World Food

Summit, 1996 cited in FAO, 1996 page 1). This definition indicates the four pillars of food security namely, availability, accessibility, and utilization which are used as indicators of food security and the stability issue (SDC, 2009).

Food availability refers to the existence of sufficient amounts and appropriate types of food supply and its consistent availability to individuals/households within their reach either through their own production, import/exchange, or food aid. The access dimension of food security refers to individuals/households physical and economic access to food, which is determined by their asset base. Utilization is concerned with the nutritional value of food and food safety (Ericksen, 2008a). Stability refers to situations in which food security is sustained during temporal dynamics such as sudden climatic shocks, economic downturns, health crises and conflicts. These factors affect all the three dimensions of food security. It also refers to seasonal food security and year-round food availability (FAO, 2006; FAO, 2009; World Bank, 1986; Ingram, 2011b; HLPE, 2020).

Ingram (2011a) and Ericksen (2008a) specified nine food security elements, which they categorized under the three pillars of food security. They identified food production, food distribution; and food exchange forms as the three food availability elements. Food production refers to the amount and kinds of food available through local production, distribution refers to ways in which food is made available and exchange is bartering or market mechanisms. Affordability (which refers to communities purchasing power relative to the price of food), allocation (refers to economic, social, and political mechanisms of accessing food), and food preference (referring to sociocultural values for certain types of food) were characterized as food access elements. While the nutritional value of food, social value of food as well as food safety for human health, were categorized under food utilization. This clearly indicates that food security is a multidimensional subject, and understanding food security demands analyzing the whole food system: the food system activities, actors, and drivers.

Food insecurity is when people fail to get sufficient amounts of nutritious food needed for a healthy and active life. Food insecurity can be classified in different ways based on duration, intensity, or individual/household experiences. Based on duration, transitory food insecurity is when individuals/households face unstable food availability and access due to various factors such as climate change, socioeconomic, or institutional changes. Studies show that transitory food insecurity happens mainly during the months before harvest. Such food insecurity situations can become chronic when failure to access food continues for a prolonged period due to lack of resources (Degefa, 2005). Devereux, 2006 (cited in Jones *et al*., 2013, p.501) for instance, classified transitory food insecurity into moderate transitory for seasonal food insecurity and severe transitory when the food insecure population is in emergency cases. Food insecurity is also classified as moderate chronic, characterized by the existence of chronic hunger, and severe chronic when high mortality rates exist based on its outcome effect on individuals/households.

FAO Voice of Hunger (2016), on the other hand, classifies food insecurity into mild, moderate and severe based on individual/household experiences. Individual/household experiences such as uncertainty and worry about not having enough food to eat and variety and quality compromise due to lack of money and resources are associated with mild food insecurity.

Experiences such as skipping a meal, reducing quantity than one expected, and running out of food expressly, and experiencing hunger and starvation characterize severe food insecurity (Ballard, Kepple & Cafiero, 2013; Ville, 2019).

2.3.1.1. Food Insecurity Measurement

Various approaches have been used to help capture food security situations at different levels. The household food energy consumption was the first household level food security measurement in the post-World War period applied to capture undernourishment and protein deficiency (Berry *et al*., 2014). The household food energy consumption uses the value of 2100 Kcal per person per day as the minimum requirement for food security, typically for developing countries, although this may increase or decrease under varying conditions like physical exercises and weather conditions (Seaman, Sawdon, Acidit and Petty, 2014 citing WHO, 1985). In Ethiopia, the minimum acceptable level per person per day is 2200 kcal (Million *et al*., 2019: 7 citing MoFED, 2002).

There are also other food insecurity measurement approaches such as income-based, expenditure-based, asset-based, and experience-based, each with their strengths and weaknesses. Food security is a construct (latent trait) difficult to measure directly. However, the experience-based food security measurement scales enable to capture individual/household subjective experiences of food security, which helps to understand challenges they face in accessing adequate food. This approach also enables the researcher to identify the level of food insecurity severity, which helps to prioritize intervention. The experience-based indicators capture household food quality (defined as micronutrient adequacy) and quantity access.

The commonly used experience-based food security measurement tools are Household Dietary Diversity Score (HDDS) (good indicator of child nutrition status), Food Consumption Score (FCS), the Household Hunger Scale (HHS), Household Food Insecurity Access Scale (HFIAS), the Latin American and Caribbean Food Security Scale (ELCSA) and the Food Insecurity Experience Scale (FIES). However, these approaches to self-reporting may have weaknesses due to inaccurate recall and failure to cover aspects such as food utilization (FIES) (FAO *et al*, 2019b; Jones *et al.*, 2013; Maxwell, Vaitla & Coates, 2014; Perez-Escamilla & Segall-Corea, 2008; Leroy *et al.*, 2015).

The Food Insecurity Experience Scale (FIES) was adapted and developed in 2013 by FAO Voices for the Hunger (VoH) project based on the US HFSSAM and Latin American and Caribbean ESLCSA through adjustments made to capture the direct experience of household's access to quality and quantity of food. FIES is a survey module to assess food security at the individual, household, national, regional or global level. The scale consists of eight basic standard item questions labeled as WORRIED, HEALTHY, FEWKINDS, SKIPPED, ATELESS, RUNOUT, HUNGRY, and WHOLEDAY. The first item of the eight FIES questions is a construct; 'WORRIED' is to assess the respondent's experiences of anxiety and worries about running out of food. Whereas items 2 and 3 ('HEALTHY, FEWKINDS') focus on respondents' experiences in accessing quality and variety food for their families and themselves, the rest of the questions were mainly concerned with food quantity (FAO, 2016).

2.3.2. Global Food Security Situation

Available sources indicate famine disaster records as early as the 4000 BC Egyptian famine and many others, including the 1315–1317 UK famine and the 1889-1892 Ethiopian famine (Johnston *et al*., 2000 cited in Degafa, 2005 page 64; Mesfin, 1984; Pankhurst, 1985; Sen, 1981). For example, in Devereux's (2000) work, 32 records of famine disasters in various countries worldwide during the 20th century are listed. These incidents led to mass moralities, including notable events such as the 1984/85 famine in Darfur/Sudan resulting in about 250,000 deaths, the 1972-75 Wollo/Ethiopia famine (with more than 200,000 deaths), the 1972/73 famine in India (causing 173,000 deaths), and the 1920/21 famine in China (which saw 500,000 deaths).

Hunger and food insecurity are prevailing in all countries in the world, and global food insecurity has been on the rise during the last decade. The proportion of food insecure people increased from 1.7 billion in 2014 to 2.37 billion in 2019 at the global level (FAO *et al*., 2020). The food insecurity situation is worse in developing countries, where a considerable number of the population goes a day or days without food, as shown in Table 2.1 below.

Table 2.1: Prevalence of Global Level Food Insecurity Severity in 2019

Regions	Severe food insecure (%)	Moderate or Severe Food insecure (%)
World	10.1	26.6
Africa	21.9	54.2
North Africa	8.8	28.9
Sub-Saharan Africa	24.9	59.9
Eastern Africa	26.0	63.4
Middle Africa	-----	-----
Southern Africa	19.2	44.3
Western Africa	19.6	54.2
Asia	9.0	22.7
Latin America & the Caribbean	10.1	31.9
Oceania	3.8	13.6
North America & Europe	1.0	7.7

Source: Summarized from FAO *et al*. (2021, page 17)

Food insecurity was highest in Africa, where 54.2% of its population was food insecure (moderate or severe). The food insecurity situation varies among the sub-regions, and the drivers of food insecurity show spatial variation, although issues such as politics, climate, and conflict are common challenges in the region (FAO, 2021). The Eastern Africa corridor is the most food insecure part of the world where 63% of its population is food insecure, with more than one in four persons going the whole day or days and probably going to bed without food (FAO *et al*., 2021). Most of this area falls under the Intergovernmental Authority on Development (IGAD) region, which includes Ethiopia, Kenya, Somalia, Sudan, South Sudan, Eritrea, Djibouti, and Uganda. This region alone receives over 40 percent of the World Food Program's (WFP's) food aid. Although food insecurity is very serious in the region, the situation is worse in the ASAL parts (IGAD, 2016). De Haan indicated that pastoralists in these parts of the region owned only 1.2-2 per capita livestock on average, which is far less than the number required to stay above the poverty line (De Haan, 2016).

FAO (2017) identified conflict, climate extremes and economic slowdown as the major underlying factors that have challenged global food security. Poverty and inequality remained the underlying structural causes of food insecurity in all parts of the world due to persistent socio-cultural and economic inequalities in land rights, limited income, and poor access to basic services such as education, health, and information technology. Particularly in many developing countries, rural people face challenges in accessing education, healthcare, and basic infrastructure like roads as well as limited opportunities for income generation. These factors collectively weakened their coping capacities to shocks and stresses leaving them particularly vulnerable to food insecurity (Behnassi, Pollmann & Kissinger, 2013).

Remarkably in Africa, agriculture is the major source of livelihood for 70 percent of the population and contributes for 25% of the continent's GDP (AfDB, 2017). The region is characterized by fast population growth and deteriorating climatic conditions. Although evidences show variation among the sub-regions, natural resource degradation, inappropriate land tenure policies and governance problems, farmers lack of financial capacity to afford farm inputs, low application of technological innovations, low investment in agriculture, conflict, high unemployment, poverty and weak linkage between research and development were mentioned among the major challenges that drive acute food insecurity in the region (Webb & Braun, 1994; FAO, 2020; NRC, 2011; UNECA, 2015; Degefa, 2005). Consequently, agricultural food production was unable to provide adequate food supply for the region's population, and Africa has remained dependent on food import, which exposed the region to the challenge of market price fluctuation (Conceição *et al*., 2016; UNECA, 2015; Degefa, 2005).

FAO (2020) indicates that in most countries of the central African sub-region, food insecurity was identified with a high poverty rate. Over 50% of the population in this region is under poverty line with high malnutrition due to poor development of social services in this part of Africa. The poverty rate in this subregion is higher than in sub-Saharan Africa (48%) and in South Africa (45%). High inequality, high unemployment, limited value addition, and low diversification are mentioned as the major challenges for food security in this sub region. This sub-region is an area of very high resource for agricultural development with only 3.7% out of the sub-region's 1.6 million hectares arable land area used for agriculture.

The world managed to produce enough food to feed the global population decades ago. Despite this accomplishment, however, millions still endure food insecurity and famine globally. The pressing challenge today lies in ensuring every individual's access to sufficient, safe, and nutritious food for his or her well-being. This necessitates employing new methods and approaches to capture the intricacies that affect food production, access, utilization, and stability thereby influencing people's sustainable food security. Understanding the underlying causes of food insecurity and devising effective strategies to address the issue are imperative in tackling this global challenge (Ingram, 2011a).

2.3.3. Food Security Situation in Ethiopia's ASAL Parts

Available literature indicates that famine occurs in Ethiopia almost every decade since the mid-16th century and even in shorter time spans in recent years (Abduselam, 2017; Sen, 1981; Beyene, 2008, cited in Fikre *et al*., 2017; Ramakrishna & Assefa, 2002; Webb & Braun 1994; UNICEF, 2015). Among the major famines in Ethiopia in the 20th century, the 1958 Tigray famine, Wag-Lasta famine in 1966, the 1972-74 Wolo famine, the 1984/5 famine, which took the lives of over one million people, and the 1993/94 famine that affected 2.5 million people can be mentioned (Fikre *et al*., 2017; Degefa, 2005). In the 21st century, the 2003 and 2004 famines that affected 3.2 million people and 7.1 million people respectively, and the 2015 famine due to climate change and El Niňo (climate change influencing temperature and precipitation fluctuation patterns) that left over 10 million people in demand of immediate food aid in Ethiopia can be cited (Guush *et al*., 2013, in Gilligan, *et al*., 2009; Pankhurst, 2004; Getachew, 2018; Philip *et al.,* 2018).

There are different explanations given for famine in Ethiopia. There are some studies that indicate different factors as causes of famine and food insecurity in the country. They held responsible socioeconomic factors such as absence of non-farm employment opportunities, poor work culture, war and instability, poor access to technologies and its inappropriate use. Others claim that environmental factors such as land degradation, animal diseases, and rain shortages were causes for the persistent hunger in the country during the 20th century (Balcha, 2001; Pankhurst, 2004). However, the majority of the scholars give political economy explanations. Amartya Sen (2001) for instance, claims that political economic problems were the cause of the 1972-74 Wollo famine in Ethiopia rather than the drought that happened in the region. He argues that food grain was abundantly available in the country at the time, but Wollo people failed to access food due to various reasons. Besides, Sen (2001) claims that the Ethiopian government's reluctance to NGOs humanitarian assistance and relief work operations worsened the devastations that occurred. In a similar manner, Degefa (2005) claims famine in Ethiopia since 1950 was mainly due to government policies' failure to resolve issues of poverty and weak humanitarian response to famine. Fikre *et al*. (2017) also claim that dynamics such as land use policy change, land fragmentation and degradation, drought, market failure, food price fluctuation, conflict as well as government irresponsiveness were major causes for famine and food insecurity in Ethiopia.

Ethiopia governments' rural development policies at different periods targeted either for the country's economic development or for political aims to strengthen administrative structures in the remote areas with little priority has been given to improve farming household livelihoods. The 1974-1971 Derg regime rural cooperativization in Ethiopia, for instance, were established for pure political objectives to implement the then socialist politics and to support the socialist party. The farmers lost all their resources when the majority of the cooperatives disintegrated following the end of the Derg regime (Bezabih, 2009). The rural villagization programme with the same political objective during the period displaced peasants without any development of the promised social services and infrastructure, which resulted in poverty and food insecurity. Thus, the outcomes of the policy interventions were loss of livelihood resources, poverty, and food insecurity instead of economic betterment and food security.

Ethiopia’s ASAL parts are characterized by chronic food insecurity, impoverishment, and dependence on food and Productive Safety Net Programme (PSNP) cash transfers. Although drought induced transitory food insecurity was common in the past, in recent years however, persistent food insecurity and dependence on aid has now become normal for many in these parts of the country (Rettberg *et al.*, 2017).

2.4. Dynamics towards Sustainable Food Security

This section synthesizes arguments in existing literature on the dynamics influencing sustainable food security, particularly in the context of Ethiopia's ASAL regions. By examining global and local factors such as climate change, socioeconomic vulnerability, and policy frameworks, this review identifies gaps in prior research and highlights the need for further study. It situates the current research within the broader academic discourse, demonstrating how these dynamics interact to challenge food security and emphasizing the importance of addressing these issues to achieve sustainability.

2.4.1. Dynamics Influencing ASAL Regions Sustainable Food Security Globally

The Arid and Semi-Arid Land (ASAL) parts of the world consist of vast rangeland areas, with 87% in arid areas and 54% in the semi-arid parts, and cultivated areas (7% in arid areas and 35% in semi-arid areas). This part of the world is rich in solar energy and biodiversity resources and contributes approximately 50% of the world's livestock production (Mortimore, 2009). The area is, however characterized by a high population growth rate, weak governance, low investment, low agricultural productivity, and unemployment. Communities in the ASAL live in high poverty and worse food insecurity situations (Stringer *et al.*, 2017). There are different explanations given by scholars regarding the worse food insecurity situation in the ASAL parts as discussed under.

2.4.1.1. Climate Change

Climate change has been blamed by many for the high rate of food insecurity in the ASAL parts of the world. Studies indicate climate change affects all dimensions of food security: availability, access, utilization, and stability. ASAL parts of the world are the most affected areas by global climate change (Mesay, Brüntrup & Daniel, 2017; Stamoulis & Zezza 2003; Webb *et al*., 2006 cited in Brady and Burton, 2017, p. 4). These areas are characterized by climatic shocks such as droughts, temperature fluctuations, rainfall decline, floods, soil erosion, and disease outbreaks in both livestock and humans that have an adverse impact on agricultural food production, which in turn affects people's food security (Stamoulis & Zezza 2003; Webb *et al.*, 2006; Brady & Burton, 2017).

Climate change events such as temperature increases and rainfall variability lead to the proliferation of pests, animal diseases, and disease-transmitting insects that affect human health and labor productivity. It also affects crop production and key factors of production such as water and animal food availability, which affect both food availability and access due to food production and income decline. Climate change could disrupt food access and stability by influencing market distribution, prices, infrastructure, transportation, and household purchasing power (Mbow *et al*., 2019).

Studies claim that the recurrent droughts in these parts of the land lead to crop failures, livestock losses, asset erosion, income decline, problems of water, and health issues, ultimately worsening food insecurity (Bohle, Downing & Watts, 1994; Gregory, Ingram & Brklacich, 2005; Mesay, Brüntrup & Daniel, 2017; Brady & Burton, 2017). They further added that drought-induced stress also affects clean water availability, sanitation, and the effective utilization of available food resources. For instance, rainfall variability influenced pastoral mobility in ASALs in China, and in Mongolia, declining grassland productivity is a major challenge for pastoral livelihood vulnerabilities (Mbow *et al*., 2019, page 456, citing Batima *et al*., 2008). In Ethiopia, drought-related livestock deaths pose a significant challenge to pastoral productivity. Approximately 90% of the 2015/16 El Niño-induced victims of drought in Ethiopia were pastoralists in ASALs (Bekele *et al*., 2014; WFP, 2019).

The climate theories of famine and food insecurity claim that increasing drought, floods, and cold that cause crop failure increase vulnerability to famine and food insecurity. Cox (1981), for instance, demarcated two global famine belts where food production failure occurs due to the damp, cold, and shortened growing area famine belt extending from British islands across

Europe and Soviet Russia to northern China and the drought-induced famine belt from Africa and the Mediterranean eastward through the dry and monsoon lands to China.

The climate-based explanation of famine and food insecurity, however, was criticized due to its failure to recognize the socioeconomic and political contexts of vulnerability that cause food insecurity and famine. Scholars argue that food production in ASAL areas faces intricate dynamics that profoundly affect people's livelihoods and undermine their adaptation strategies. These dynamics are influenced by macro-level socioeconomic and political events such as shifts in land use policies, fluctuations of market prices, delayed humanitarian responses, and increased conflicts (Scoones, 2020; WFP, 2019; Mesay, Brüntrup and Daniel (2017). The climate theory also failed to recognize the existence of ASAL regions not affected by the famine threat but experiencing the same climatic challenges as countries in the Horn of Africa and the Sahel, which are experiencing severe food insecurity. These countries in the Middle East and in other industrialized countries have adapted to the environment (Devereux, 1993). Thus, the causal link between famine, climate change, and drought was argued to be not an adequate explanation but rather livelihood vulnerability and human activities that increase environmental risks expose people to food insecurity (Devereux, 1993; Ali, 2008).

2.4.1.2. Socioeconomic vulnerability

ASALs are characterized by high population growth rates, limited resources, weak governance, inadequate investment, low employment opportunities, and high poverty rates (Stringer *et al.*, 2017). Many argued that although drought can cause crop failure and livestock death, it is livelihood system vulnerability that causes food insecurity and famine, and therefore, interventions in improving ASALs communities coping strategies and their food production can improve their food security situation (Fraser *et al.*, 2011).

Some argue that macro-level drivers such as climatic change exert only an indirect impact on household-level food security. They claim that shocks and stresses transmit their effect on household food security through their interaction with household livelihood resources and food production activities (Dilley & Boudreau, 2001; Ericksen, 2008a; WFP, 2019). Ericksen (2008a), for instance, claims that although rural households highly depend on their environment for food production, households obtain food from various sources, such as purchase and labor exchange. She further explained that the decline of livestock production as a result of changes in the environment results in a decline in household income, which causes a decline in household capacity to afford food. Nevertheless, households may diversify their income sources or depend on social welfare to cope with the situation. Therefore, sustainable food production activities (production, processing, distribution, and exchange) and household access (improving affordability and allocation) enhance food system adaptation to climate change and households' food security sustainability (Gregory, Ingram & Brklacich, 2005).

There are evidences that household access to alternative income sources, level of livelihood diversification, support from clan members, and access to social security foster people's adaptive capacity to shocks and stresses (Fraser *et al.*, 2011, page 3 citing Mendalsohn, 2007; Degefa, 2005; Mequanent & Fekadu, 2010; Connolly-Boutin & Smit, 2016). However, ASAL parts are mostly inaccessible regions where economic activities that could supplement households' livelihoods are rare in the area. These areas are characterized by socioeconomic problems such as poor infrastructure development, limited non-farm/off farm income sources, rare employment opportunities, and inadequate social services. Income generation activities are limited to a few, like the production of charcoal and firewood, and petty trading and therefore, households depend mainly on nature for additional income sources, which increase environmental degradation (De Haan, 2016). They have limited access to social services such as credit as well as access to markets for exchanging their products for food crops. These weak adaptation strategies increased their vulnerability to food insecurity (FAO, 2014; Allen & Prosperi, 2016). People in these parts of the world suffer from the highest poverty and food insecurity (Stringer *et al.*, 2017; Bene *et al.*, 2020; Allen & Prosperi, 2016; Hodbod *et al.*, 2019). It is from this perspective that Scoones (2020) claims the importance of livelihood analysis based on household-level responses to understand the underlying drivers of households' vulnerability to food insecurity.

2.4.1.3. Policies and Institutions

Many studies on ASAL parts food security have evidenced inappropriate government policies and institutional failures as the major causes of food insecurity in the region. Scholars claim that famine has political elements, either directly or indirectly. They argue that government policies that marginalize certain communities by limiting their access to resources increase their vulnerability to food insecurity (Scoones, 2020; Devereux, 1993; Wisner & Luce 1993). Baas *et al*. (2008) and Burg (2008) also argue that there are more undernourished people due to marginalization and poverty than those affected by disasters globally. Scoones (2020), for instance, argues that government development policies implemented in ASAL parts have given little attention to the pastoral and agro-pastoral communities in these regions. He claims that the introduction of mega plantation projects and the expropriation of communal land areas limited pastoralists land use rights, intensifying conflict between the land users. Similarly, Mesay, Brüntrup and Daniel (2017) noted that inefficient government intervention to mitigate drought exposed ASAL parts households to food insecurity.

Institutional weaknesses such as failure to provide farmers with climatic information and social problems such as conflict, war and displacement affect the food production system of the vulnerable communities (Sen, 2001; Degefa, 2005; Scoones, 2021; Degefa, 2005; Ali, 2008; Devereux, 1993; Wisner & Luce 1993; Watts, 1983; Bush, 1985). Studies also show that ASAL parts communities have weak government administrative functions, and little participation in decision-making processes due to their lifestyle. Government failure to intervene in times of severe food shortages contributes to vulnerability to food insecurity (Esayas, Solomon & Girma, 2019; Coppock *et al*., 2004; UNISDR, 2015; The Nairobi Strategy article 71, 2011 cited in Mesay, Brüntrup and Daniel, 2017: 12).

Interventions in the areas of social and infrastructural services such as education, roads, health services, market facilities and irrigation schemes have been developed poorly in these parts. Devereux explains this situation of poor government intervention actions in his statement, saying: "While the ability to alleviate or prevent famines has increased dramatically in recent times, the will to do so may have lagged behind…" (Devereux, 1993, page 146).

In light of the above arguments, the socioeconomic system's inability to cope with the harsh environmental conditions and political marginalization of the ASALs communities made them vulnerable to famine and food insecurity. Inadequate institutional and policy interventions that restricted households' access to various forms of resources have weakened ASAL parts communities' adaptive capabilities to shocks and stresses, exacerbating their vulnerability to food insecurity in the ASAL regions.

2.4.1.4. Resource Availability and/or Access

Households' physical and non-physical asset levels determine their potential to secure food in the face of shocks and stressors. Their access to natural resources and other resources determines their capability to transform these assets into food through production or exchange (Mequanent & Fekadu, 2010; Connolly-Boutin & Smit, 2016). Crop farming and livestock rearing are the major food provision sources for agro-pastoral and pastoral communities. Hence, the productivity and quantity of their crop farm and livestock determine a household's asset to access food (Yohannes & Mahmmud, 2015; MoA, June 2014). Access to farmland, pasture for livestock food and mobility during the drought months determine their productivity. Availability of adequate water for human consumption and livestock feed is decisive for food production activities as well as for nutritional aspects of food. Nevertheless, studies show that ASAL parts communities have limited resource availability and access (Rettberg *et al.*, 2017; Little, 2002).

Resource scarcities are assumed to limit sustainable resource access (Scoones, 2016). Economists predicted the challenge of 'diminishing returns to labour' that claims faster population growth than the per capita food production leading to food insecurity and regular famine provided the limited nature of farmland (Devereux, 1993). Malthus, for instance, explained in his "An Essay for the Principle of Population," that human population tends to grow at geometric progression while food production grows at arithmetic progression due to the limited nature of natural resources, particularly land (Malthus, 1798). However, recent scholars have a different perspective that links resource scarcity to the broader political economy, although they admit the scarcity of resources in general. They claim that the current problem of resource scarcity is not the result of an absolute limit but rather a crisis due to unequal access and therefore, must be understood politically in relation to specific patterns of production, distribution, and consumption. They further argue that resources are always built as generated by social and political processes (Moyo, Yeros & Jha, 2012; Li, 2014).

This political explanation of resource availability and access is supported by many studies that evidenced the changes in land tenure systems in the ASAL areas have constrained communities' access to essential resources, thereby resulting in decreasing household's livestock holding per capita (Rettberg *et al.,* 2017; Easdale & Domptail, 2013; Catley, Lind & Scoones, 2013; Li & Huntsinger, 2011).

How resources are distributed in the society limits resource access for some community members while allowing others to dominate access and control over resources such as land and water. In this case, the issue of resource scarcity has transformed into one of access to and control over resources, highlighting the necessity for social justice rather than solely a matter of resource scarcity.

2.4.1.5. Environmental Degradation

ASAL parts productivity is declining due to environmental problems such as land degradation, biodiversity loss, water shortages, soil fertility loss and shortage of pastures besides climate uncertainties. There are various explanations given to environmental degradation including the eco society view of the 19th century that claims demographic pressure causes land resources overuse and land degradation that in turn affects survival of human society. However, technological advancement that enabled production increase exposed the weaknesses of this explanation. Besides, the market economy explanation claims scarcity of goods leads to substitutes and new technology to increase efficiency or substitute for other goods (Robbins, 2012). Nevertheless, this view that says technology use gives solution to environmental crises through improved production has been questioned by many due to the evidences of worsened environmental problems such as soil acidity and water pollution caused by chemicals such as pesticides in developing countries following the introduction of western technologies (Akbari *et al.*, 2022; Robbins, 2012).

The contribution of climate smart agriculture (that uses adaptive practices to climate) to food security has also been less favored due to problems of adaptation, limited accessibility of such technologies to the poorest food insecure farmers, issue of healthy and safe food and its environmental effects (HLPE, 2020). Technology adaptation to improve production in developing countries may therefore, be limited by not only the outcomes such as land degradation but also challenges related to financial constraints to access such technologies and its adaptability.

Pastoralism is also blamed by some as a cause for environmental degradation, biodiversity loss, soil erosion, particularly in the ASAL parts. The proponents of the 'Tragedy of the Commons" theory claim that pastoralists ambitions to increase the number of their livestock through exploiting communally owned lands cause land degradation due to overgrazing (Hardin, 1968 cited in Salih, Dietz & Ahmed, 2001 page 42; White, 1993; Mazonde, 1994; FDRE, 2021). Nevertheless, studies show that pastoral way of food production in ASAL parts has evidenced sustainable productivity in this harsh climatic region for centuries and has remained the main livelihood in the ASAL parts (Scoones, 2020; Webb *et al*., 2006 cited in Brady & Burton, 2017, p. 4).

Many scholars however, argue inappropriate government policies as the major causes for environmental degradation in the ASAL areas. They claim that the expansion of crop farming and mega plantations projects in dry lands reduced fallow periods practiced by pastoralists through mobility, and restricted pastoralists land access. Besides, the introduction of irrigation projects disrupted flexibility of pastoral mobility patterns causing overgrazing, biodiversity loss and land degradation (Swift, 2020; Easdale & Domptail, 2013).

These political ecologists claim that the land degradation in ASALs is the environmental cost of social-ecological interaction and outcome of social marginalization that followed land use policy change in the area (Scoones, 2020; Bryant & Bailey, 1997; Blaikie & Brookfield, 2015). They further argue that with the expansion of private investors and government farm areas, the ASALs communities have lost the right to access their previous communal pastureland areas and water sources and this caused overgrazing and land degradation (Blaikie & Brookfield, 2015). Studies also show that the problem of access to land resources such as water sources and grazing areas and absence of institutional mechanisms that regulate public goods increased natural resource depletion in Africa and many other countries of the world (Watts, 1991; Agarwal, 2014).

Access to land resources is the basic source of assets for farmers, and land use policies that cause unequal distribution of access power to land resources contribute to environmental degradation in many ways. Unsustainable adaptive strategies of those farmers who were deprived of the right to access their livelihood sources may turn into actions that cause more environmental degradation.

2.4.1.6. Restricted Mobility

Communities in the dry land areas depend on livestock rearing, although some mix it with crop farming. Pastoralists use mobility during different seasons in different locations as a production system (MoA, June 2014; HLPE, 2017). Studies on food security support pastoral mobility as an effective adaptation strategy for pastoral and agro-pastoral communities in the ASALs to cope with scarce water and pasture in the uncertain ASALs environments (Scoones, 2020; Webb *et al*., 2006 cited in Brady & Burton, 2017, p. 4; Müller-Mahn, Rettberg & Girum, 2010; Swift, 2020; Shomo & Arab, 2001 in Scoones, 2020; FAO, *et al*., 2018). They argue that this way of food production has been more efficient than crop farming or other agricultural food production systems in the ASAL parts (Rettberg *et al*., 2017; Fekadu, Gadissa & Gebessa, 2020).

Pastoral mobility is indigenous knowledge that has a rich resource management system for optimizing production that enables ASAL areas communities to exploit environmental variability and remain productive in a hostile environment with many uncertainties. Through their customary institutions, they manage resources such as grazing lands and water sources and organize stock movement in a sustainable way that helps them achieve local economic benefits (Swift, 2020). Scoones claims that pastoral mobility has enabled pastoral people occupying about 25–40 percent of rangelands worldwide in more than 100 countries to produce billions of livestock in the uncertain, harsh environment they live in (Scoones, 2020).

Studies claim that a livelihood is said to be sustainable when it can cope with shocks and stresses and maintain the productivity of natural resources, and adaptive strategies based on local opportunities enhance effective resource use and productivity in specific localities (Ellis, 2000, cited in Ericksen, 2008b, p. 4; Ali, 2008; DFID, 1999). Pastoral mobility however, has been restricted by dynamics such as sedentary farming, tourism, and public and private mega projects that expropriated communal grazing land areas (Rettberg *et al.,* 2017; Robbins, 2012; ILRI, 2011). The breakdown of communal land tenure systems has resulted in the decline of traditional resource management systems in ASAL areas (Easdale & Domptail, 2013; Catley, Lind & Scoones, 2013; Rettberg *et al.*, 2017; Li & Huntsinger, 2011).

Following the indigenous farmers and pastoralists losing their tenure rights to commercial farms introduced into the ASAL parts, the traditional institutions became dysfunctional, and communal land management has deteriorated (Swift, 2020; Robbins, 2012; Thompson *et al.*, 2007). The land use shift introduced to the dry land parts caused livelihood loss for local communities and poor adaptation strategies due to restricted mobility. The indigenous communities that lost access to resources continued to struggle to produce enough food for themselves and their families.

2.4.1.7. Increased Conflict

Conflict over resources has been mentioned as one of the factors that impede ASAL parts food production in many ways. Various explanations are being given for the causes of conflict over land resources in the ASAL parts. Some claim that the conflict over land resources between peasants and pastoralists is caused by social and economic factors such as population growth, expansion of crop cultivation into grazing areas and restriction of previously open grazing land areas (De Haan, 2016). Others argue that such land-use based explanations of conflict fail to explain why one group losing their land use right to others (Rubbins, 2012; Scoones, 2021; Scoones *et al.*, 2007; Robbins, 2012). This group used a political ecology approach to analyze the cause for the conflict between the state, investors, peasants and pastoralists particularly in ASAL parts. The researcher argues the underlying cause of the conflict is the structural change; the politics of land use policy change and government development policies that encourage land use for private investors or government development projects which resulted in the dynamics of land use competition between pastoralists, farmers and the state or private holders.

The above arguments clearly show that inappropriate policy actions and the violation of the rights of local communities to access natural resources not only damaged their livelihoods but also caused conflict, insecurity, and decline of food production in the ASAL areas.

2.4.1.8. Market Dynamics

Market has a crucial place in ASAL parts communities' food security. Markets serve as one of the strategies for diversifying livelihoods. The presence of vibrant markets enables individuals to engage in income-generating activities such as retailing agricultural products, pursuing off-farm income sources, engaging in livestock trade, and operating small businesses (Davies, 1996). Yohannes and Mahmmud (2015) claim that strong market integration provides households with the opportunity to diversify their livelihoods to enhance their adaptive capacity to climate change, and to bolster their resilience to socioeconomic and environmental dynamics. However, structural factors limited the robustness of the local marketing system in ASAL parts of the world. Lack of market integration, poor market infrastructure, and taxation burden by the state limited the farmers' benefits from markets in the area (Davies, 1996; Little, Dejene & Waktole, 2014).

ASAL parts pastoralists supply a large number of livestock to both domestic and international markets and contribute about 10 to 40 percent to the gross domestic product of African countries (Yohannes & Mahmmud, 2015 page 25 citing Swift, 1998; MoA, June 2014). Pastoralists in the ASAL parts have shifted from consumption based to marketing their dairy products and they depend on the market for selling their livestock and livestock products to buy grains and other food items. For instance, about 50% of ASAL parts' pastoralists' income comes from livestock sales but livestock meat and dairy products make only 15% of their food energy consumption (MoA, June 2014). However, many studies claim that pastoralists poor market integration exposed them to the activities of traders who push down prices for farmers' products below cost of production to earn much profit in transaction (Esayas, Solomon & Girma, 2019; Little, Dejene & Waktole, 2014; Thompson *et al*., 2007; Burg, 2008; Fraser *et al*., 2011; Easdale & Domptail, 2013).

Market determines the price of both agricultural production and food commodities since households depend on the market for exchange to access other food commodities. The low market price for farmers' products relative to food price and their limited physical access to markets have impeded their food access as they obtain most food through market exchange.

Fluctuation of livestock price also influences household sensitivity to food commodities price volatility (Allen & Prosperi, 2016; Davies, 1996). Thus, poor infrastructure made access to markets very difficult for ASAL parts' people and dysfunctionality of farmers' cooperatives made rural communities bargaining power for more access and better price of food and farm inputs weak (Bindraban, *et al*., 1999 and Veldhuizen *et al*., 2020).

The impact of the global market drivers has increased with the internationalization of the food market. Studies indicate that the trade liberalization process has made a negative impact on smallholder farmers, and it increased their vulnerability particularly in developing countries. Due to the subsistence nature of their farm production and their poor market integration, smallholder farmers fail to compete in the market with giant producers, which affect small-holder farmers negatively in many ways. Most sub-Saharan African countries emerged as net food importers and dependent on global market for food commodities (Rakotoarisoa, Lafrate and Paschali, 2011 cited in HLPE, 2020 page 28 and Teklehaimanot, Ingenbleek & Trijp, 2019).

In a similar manner, technological innovations boosted production globally and the global market demands standards in terms of quantity, quality, traceability and food safety. However, studies claim that ASAL parts smallholder farmers' mode of production is not conducive for big investment for market due to possibility of greater investment losses during shocks in the absence of guarantees such as insurance services for their livestock while the global market demand focusing on single production in large amount (Easdale & Domptail, 2013 and Veld-huizen *et al*., 2020). A study conducted by Easdale & Domptail (2013) shows that trade in

ASALs products has stagnated for the last 40 years while fossil fuel based products have increased in volume and value disproportionally. Wool for instance represents only 3% of the world textile production, which has increasingly been dominated by synthetics and cotton. Thus, the current globalized political, economic and knowledge model locked the economic development of ASAL areas contributing to the vicious circle of their marginalization (Easdale & Domptail *et al*., 2007; Burg, 2008; Fraser *et al*., 2011 citing Reed *et al* 2008).

Dynamics in food system activities such as transportation, distribution and exchange and the way actors manage the food value chain in such a dynamic food market environment have affected communities' food access in many ways. Thus, the market dynamics affect all the processing, transporting, distribution and exchange activities, which play a decisive role in household food security sustainability. However, low recognition has been given to the food value chain activities that connect agricultural production to consumers that directly affect access to food.

As clearly demonstrated in the discussion above, ASAL parts are facing increasing dynamics in the areas of climate change, government land use policies, social marginalization, poverty, inequalities in access to resources, environmental degradation, restricted mobility, declining traditional food production systems, increased conflict, and market dynamics that affected all activities of the food production system in the area. The resulting socioeconomic stressors and political-ecological factors due to peoples' unsustainable livelihood activities intensified multiple negative outcomes including food insecurity., land degradation, soil fertility decline, conflict, livelihood loss affected negatively ASAL parts households' food production system and exposed them to chronic food insecurity.

2.4.2. Dynamics Influencing Sustainable Food Security in Africa's ASAL Parts

The effect of global climate change is felt in Africa ASALs more than the other parts of the region. The Eastern African region ASAL areas occupied by pastoralists and semi-pastoralists for instance has the largest number of livestock in Africa and the pastoral sector in this region contributes some US$ 10 billion to GDP. However, global climatic changes such as El Niño (temperature and precipitation fluctuation) caused drought and floods worsened the food insecurity problem and heavily damaged pastoralists in Kenya in 1997/98 and in Ethiopia in 2015/16 (IGAD, 2016; Salih, Dietz; Ahmed, 2001; Gezahegn, 2018; Little, Mahmoud, & Coppock 2001).

De Haan (2016) indicated that the average livestock owned per household has become below the threshold for food security in Africa ASAL regions, and even for the households owning large enough herd size set to be considered food secure, their total income amount was only USD 0.46 in the ASALs of Africa (Mesay, Brüntrup & Daniel, 2017). Livestock owned by household converted into standard tropical livestock unit per capita per household is used in many studies to estimate level of household food security. Accordingly, household owning greater than or equal to 4.5 Tropical Livestock Unit per capita livestock for pastoral household and greater than or equal to 2.5 Tropical Livestock Unit per capita livestock for agro-pastoral household is considered food secure (De Haan, 2016). According to UDAID (2016) less than or equal to 1 per capita livestock owned is considered poor; between 1.1–4.4 per capita livestock owned is average and greater than 4.5 per capita livestock is considered rich.

There are scholars who claim that politics and management are associated to food insecurity equally as the climate change particularly in sub-Saharan Africa (Derose *et al* 1998 cited in

Tsegaye *et al*., 2008). They argue that introduction of radical land tenure systems into African ASAL parts that have undermined the customary resource management practices that enable to use local opportunities damaged the ASAL parts food production system in many ways. Such policies restricted local communities' access to land resources and complicated their traditional food production system (Müller-Mahn, Rettberg & Girum 2010, Swift, 2020 and Shomo & Arab, 2001 in Scoones, 2020). Easdale and Domptail (2013) for instance noted that policy actions that consider grazing as threat to ecosystem and communal property and open access as low productiveness perceive pastoralism as backward. Such policies have failed to consider local opportunities and resulted in failure instead of development. Many argue that pastoralism is the most viable livelihood option for over 268 million people in ASALs of the continent and has huge economic well-being, social, and environmental input to the African continent. They claim that the mode of production is resilient to the highly variable rainfall and climatic change in the ASALs (Esayas, Solomon & Girma, 2019; WFP, 2019; Twigg, 2015; FAO *et al*., 2018a).

In Africa ASAL parts, the dynamics in land use changes and the question of access to resources and tenure rights to land have caused conflicts over resources, which affected ASALs communities' adaptation to the dry land areas. Inter-group clashes and conflict between pastoralists and the surrounding farmers over land resources most of the time develop into instability in the area. In some countries political instability due to absence of effective government administrative power in these marginal areas aggravated inter-ethnic conflict among pastoral groups, which resulted in armed conflict, livestock raid, insecure rangeland and decline of pastoral productivity (Easdale & Domptail, 2014; Scoones, 2020; Ayalew, 2001;

Getachew, 2001; The Nairobi Strategy article 71, 2011 cited in Mesay, Brüntrup & Daniel, 2017: 12; Little *et al.,* 2011).

In the Sahel, for instance, whereas farmland areas increased by 2.5%, the critical grazing areas diminished by 13% between 1961 and 2009. This affects pastoralists' food production in many ways by limiting pastoralists' access to resources such as land and pastoral mobility (De Haan, 2016; Catley, Lind & Scoones, 2013). In a similar way in Sudan, the expansion of rain fed crop farming in the dry lands in eastern and western pastoral areas resulted in conflict between farmers and herders. Investors control over pastoralists drought-grazing area in the Tana Delta wetland in Kenya caused insecurity and overgrazing due to restricted movement. Moreover, the expansion of crop farming in ASAL parts pushed pastoralists into marginal regions of the countries making them more vulnerable to climate change (FAO *et al*., 2018).

Africa ASAL parts have difficulties common to most ASAL parts such as poor infrastructure. The communities in this region lack access to market information, have limited market knowledge, and lack of market oriented production that hinder their market integration (Little, Dejene & Waktole, 2014; Rugadya, Oboikol Kamusiime, 2005; Verbeke *et al*., 2009; Barrett, 2008; Allen & Prosperi, 2016). Government restrictions on cross border animal trade and internal conflict also had adverse impact on livestock trade in Africa's ASAL parts of Africa (Kefale & Gebresenbet, 2016 cited in Esayas, Solomon & Girma, 2019: 24).

African countries have followed liberalization policy to integrate their markets with the global market (Teklehaimanot, Ingenbleek & Trijp, 2019 page 529 citing Borras, 2010; Carletto *et al*., 2010). Such globalized food system, however, involves more actors in processing, transporting and exchanging activities unlike the traditional food system in Africa's ASAL parts, which mainly involves producers and consumers (Veldhuizen *et al*., 2020). Thus, the lengthy nature of global food value chain made it difficult to benefit from the perceived market opportunities for Africa's ASAL parts communities who depend on traditional production system.

Food security in Africa's ASAL parts is therefore, mainly influenced by macro level factors such as climatic change, land use policy changes and globalization affecting market systems that impeded the food production system of communities in the area. The dynamics however, influence not only food security but also the whole food system components and people's livelihood, which negatively affects sustainability.

2.4.3. Dynamics Influencing Sustainable Food Security in Ethiopia's ASAL Parts

In the case of Ethiopia's ASAL parts, the scenario is similar to that of Africa's ASAL parts presented above. Pastoralism and semi-pastoralism are the major food production strategies in the ASAL parts of Ethiopia although crop farming and irrigation are also practiced to some extent. Communities depend on livestock and livestock products for food and as a source of income to exchange for other food commodities (Rettberg *et al*., 2017). Studies show that climate change and drought, the impact of land use policy change, ineffective government food security strategies, lack of non-farm/off-farm income sources, problem of access to farm inputs, poor market integration, and conflict are the major dynamics influencing sustainable food security in Ethiopia's ASAL parts.

2.4.3.1. Climate Change and Drought

The ASAL parts of Ethiopia are the most affected by the desertification effect, and drought is a common feature of the region (Bereket and Zeremariam, 2013). Ethiopia's ASAL parts have short months of rainfall, and there is high rainfall variability that causes shortage of water (Dagninet & Adugnaw, 2020). A review of food security studies in Ethiopia ASAL parts by Peng *et al.* (2021) claims that recurrent drought in these areas has caused crop failure and livestock loss resulting in food insecurity during the last six decades. However, many studies argue that government policies and socioeconomic dynamism are the major factors that have affected food production system influencing household food security in ASAL parts of Ethiopia (Tendall *et al*., 2015; Ali, 2008; Solomon, *et al*., 2008; Salih, Dietz & Ahmed, 2001; Yohannes & Mahmmud, 2015; Getachew, 1995 cited in Degefa, 2005 page 104; Gezahegn & Natnael, 2016; Asebe, Yetebarek & Korf, 2018).

Gezahegn and Natnael argue that food access is declining in the ASAL parts of Ethiopia due to limited access to productive resources as the result of institutional and political dynamisms in the area. They stated, *"*It is not drought, but vulnerability to drought that is eroding food security in the dry lands …. Vulnerability is in fact inherent to any system but that arises from incapacity to operate the system due to structural changes triggered by external forces, internal adjustments or disasters*"* (Gezahegn & Natnael 2016: 20 citing Tran, 2011).

2.4.3.2. The Impact of Land Use Policy Change

The increasing political dynamics in ASAL regions of Ethiopia have had profound impacts on local communities' access to land resources consequently affecting their food production and access in various ways. Studies revealed that policy actions such as government plantation projects in the ASAL parts of the country since the mid-20th century particularly in the study areas, have given little recognition to subsistence producers and disfavor ASALs pastoral production system considering it as less productive (Rettberg *et al*., 2017; Degefa, 2005).

Furthermore, the subsequent land privatization policy introduced to ASAL regions of the country since the 1970s resulted in the expropriation of communal grazing areas, which largely interrupted the pastoral food production system. Although the 1995 Ethiopian constitution entitles pastoralists to access free grazing land (Article 41 sub article 8), and Article 89 sub-article 4 of the Constitution grants affirmative actions for the marginalized people of Ethiopia that includes the ASAL parts communities (FDRE, 1995), intensified expropriation of the previously communal grazing areas has continued even after 1995.

Ethiopia's governments also promote resettlement in ASAL regions from degraded highlands areas since the 1970s as a strategy for households' food security and continued migration into the region has increased pressure on scarce resource (Esayas, Solomon & Girma, 2019; Mulugeta & Habtemariam, 2011; Lemenih and Kassa, 2011).

The 1974 land privatization proclamation even worsened the situation of pastoralists as it weakened the communal land ownership, which was the major resource use and management system of communities in the ASAL regions (Adugna *et al*., 2022). The recent land ownership certification has also limited pastoralists' access to land and their mobility. Certification guarantees ownership rights only on the certified plot area but it limits tenure rights on the rest of communal land, which the government can use for investment or other purposes. The certified privately owned land is also used or kept by the certified owner only and restricts other community members access over such areas at all (Fekadu, Gadissa and Jabessa, 2020).

The country's policy documents including the 2002-2005 Sustainable Development and Poverty Reduction Program, the 2006-2012 Plan for Accelerated and Sustained Development to

End Poverty, the 2015 Livestock Master Plan and the current Growth and Transformation Plan (GTP I & II) emphasize on pastoral sedentarisation as a strategy for improving livelihood of the ASAL parts population (Esayas, Solomon & Girma, 2019; Mulugeta & Habtemariam, 2011). The second Growth and Transformation Plan documents (GTP-II) also promote large-scale land investment policy as a strategy for pastoral areas development (FDRE, 2010; FDRE, 2016). In a similar way, the Pastoral and Agro-Pastoral Development Policy and Strategic Framework developed in 2018 by the Ministry of Federal and Pastoral Development Affairs is also criticized for lacking clarity on how to maintain pastoral mobility to access moisture adequate areas to enhance pastoral productivity although the policy recognizes pastoralism as a way of life in ASAL parts (Esayas, Solomon & Girma, 2019).

Asebe and Korf (2018) claim that the Ethiopia's governments ASAL parts land use policies since 1974, including the current constitution disfavor pastoralists as they violate communal land ownership, and weakening traditional land management systems. Many previous studies have also shown that inappropriate government development policies, weak governance, and conflicts leading to livelihood vulnerability were sources of famine (Degefa, 2005; Derze & Sen, 1989).

Researchers criticized sedentarization and crop farming practices introduced to these dry land areas for lack of sustainability. Many argue that crop farming failed in most cases due to poor rain, lack of irrigation facilities and small land size and it hardly improved ASAL parts households' livelihood in most countries like Ethiopia. Besides, they indicated that adaptation strategies such as dry land farming in pastoral areas intensify natural resources overuse damaging sustainability of these fragile environments (Coppock *et al*., 2004, FAO *et al*., 2018a, Yohannes & Mahmmud, 2015 and Asebe, Yetebarek & Korf, 2018).

The irrigation schemes were also criticized for not being effective to support the livelihood of the smallholder farmers. Yohannes and Mahmmud say the irrigation system is mostly unproductive due to high rain variability and recurrent drought in the area. They also claim the irrigation schemes introduced into the ASAL parts of Ethiopia as a development pathway to sedentary farming attracted many investors to the area and the indigenous pastoral and agro-pastoral communities benefited little from the scheme as individuals from other places who were grabbing the communal land for illegal businesses dominate the irrigation activity. The project attracted individuals to continue to privatize parts of the communal land areas, which became the source of conflict as privately owned land enclosures increased at the expense of communal land. Land is an asset that has high value and competition for land increased with the expansion of urbans into the area (Yohannes & Mahmmud, 2015).

The policy interference also led to natural resources decline due to mismanagement of land, water and pasture and land degradation and agricultural productivity decline in the area. Social structures of pastoral communities deteriorated as the result of the structural changes (Kefale and Gebresenbet, 2016, cited in Esayas, Solomon & Girma, 2019: 24). The diminishing of communal grazing land together with weak resource management strategies caused overgrazing, permanent encroachment into mountain and forest lands and environmental degradation (Fraser *et al*., 2011 citing Reed *et al*., 2008 and Scoones, 2020). Such dynamics in the area have influenced food production activities as well as outputs and socioeconomic changes widened the inequality gap aggravating the food insecurity situation of households (Ericksen, 2008b; & UNEP, 2010).

Ethiopia has implemented a series of development strategies including the Growth and Transformation Plans and the current 2021-2030 Prosperity Plan (FDRE PDC, 2020; FDRE, 2010; FDRE, 2016). Ethiopia's Growth and Transformation Plans (GTP I 2010-2015 and GTP II 2016-2020) emphasize sustainable development, with a strong focus on improving agricultural productivity and ensuring food security, particularly in vulnerable regions like the ASAL parts of Ethiopia. The country's Vision 2025 focuses on becoming the leading manufacturing hub in Africa and prioritizes industrialization, economic diversification, and sustainable development. Vision 2025 focuses more on industrialization, it also indirectly supports food security through economic development and poverty reduction. A sustainable food system is foundational for a thriving workforce and stable economic growth (FDRE PDC, 2020).

Ethiopia's Prosperity Plan is the current strategic framework guiding Ethiopia's economic and social policies. This plan builds on the previous Growth and Transformation Plans (GTP I and II) and aims to sustain Ethiopia's progress toward becoming a middle-income country by 2030. The Prosperity Plan focuses on key areas, including economic diversification, improving agricultural productivity, enhancing infrastructure, and ensuring sustainable development.

The key pillars of the Prosperity Plan relevant to this study have been briefed hereunder.

Sustainable Agriculture and Food Security: The Prosperity Plan emphasizes the importance of transforming the agricultural sector to ensure food security and reduce poverty. It aims to increase agricultural productivity, promote sustainable farming practices, and enhance food security, especially in vulnerable regions like the ASAL parts of Ethiopia.

Resilience to Climate Change and Environmental Management: Recognizing the challenges posed by climate change, the Prosperity Plan includes strategies for improving environmental management and increasing the resilience of communities to climate-related shocks. This is particularly relevant to the ASAL regions, where environmental factors significantly impact food security.

Institutional Strengthening: The plan also focuses on enhancing the capacity of institutions to deliver services effectively, including those related to agriculture, market access, and social safety nets, which are crucial for supporting sustainable food security (FDRE PDC, 2020). However, there is failure to give adequate recognition to the ASAL parts unique characteristics in these policy strategies.

2.4.3.3. Government Food Security Strategies

The country's food security strategy developed in 1996 (revised in 2002) includes resettlement and the Productive Safety Net Progtammes (PSNP). In 2009/10 for instance, 91,317 households were resettled and 730,494 households in 290 districts in the country benefited from the safety net programme.

The PSNP was first introduced in 2005 to address food insecurity problems (FDRE, 2010). The programme provides an equivalent value of 20kg (15kg cereal and 4kg pulses) per month during the seasons of food gaps from 6-12 months in cash or food based upon household preferences to the beneficiary household as a support to livelihood strengthening. Since 2010 this program was supplemented by Other Food Security Net Progtammes (OFSP) that provides financial and technical support for the rural food insecure households to encourage income generation and asset building of the households through diversification of income sources and improved agricultural production (Bezawit et al., 2020; MoA, 2014, Esayas, Solomon & Girma, 2019). The programme was first framed for settled agriculturalists but later in 2010 in the third phase, it was adjusted and ASAL parts pastoral population were included (MoA, 2014; Gilligan, *et al*., 2009).

The policy strategy was also criticized due to its failure to fit into the ASAL parts reality and its poor implementation. For instance, the Ethiopian Socioeconomic survey 2012 and 2014 indicates that the PSNP did not improve household dietary diversity, calorie, and iron or protein intake nor reduce child stunting. (Bezawit *et al*., 2020 citing Tagel & Castilla, 2018). Similarly, the government support system through the OFSP failed to recognize the local realities of the ASAL parts, thus becoming less effective in improving farmers' asset base and food security (Getu, Duncan & Van Dijk, 2022; Rettberg *et al.*, 2017).

Studies argue that the programmes were based on economic dimension only and failed to entertain sociocultural, environmental and political factors that contribute to food insecurity.

They claim that policy strategy lacks practicality due to failure to involve the vulnerable people and their perspectives and realities (Rettberg *et al.*, 2017; Bindraban, *et al*., 1999; Degefa, 2005). Thus, the food security policies failed to capture local challenges and potentials of the specific communities to consider strategies for ensuring sustainable food security while challenges and opportunities are specific to the environments.

As clearly established from studies presented above, Ethiopian governments' effort through land use policy change, sedentarization, crop farming, PSNP, and other development policies as mechanism for food security enhancement hardily eased poverty and food insecurity in the ASAL parts of the country (Getu, Duncan & Van Dijk, 2022; Esayas, Solomon & Girma, 2019; Mulugeta & Habtemariam, 2011; Yohannes & Mahmmud, 2015; Feed the Future, 2018; WFP, 2019).

2.4.3.4. Lack of Non-farm/Off-farm Income Sources

Like in the other countries of Africa, ASAL parts of Ethiopia are marginal areas with limited non-farm economic activities, poor infrastructures and employment opportunities. Most households who were forced to dropout from pastoralism and agro-pastoralism have migrated to towns or became dependent on non-farm activities such as charcoal making, selling firewood, fodder sell for sources of their income which intensified environmental degradation (FAO *et al*., 2018a; Solomon *et al*., 2008; Yohannes & Mahmmud, 2015; Asebe, Yetebarek & Korf, 2018). Credit services are limited in this part of the country. The Oromia Cooperative Bank was established to provide credit to farmers. However, the credit system of the Bank has significant limitations, particularly for communities in ASAL regions, as it does not offer credit based on livestock, which is a primary asset for these communities. This lack of an appropriate credit market has exposed ASAL farmers to highly exploitative traders within the traditional value chain, where traders purchase livestock from farmers at low prices and sell them at other locations for high profits without adding value (Reardon, 2015). This situation weakened their adaptation strategies and made them more vulnerable to the harsh environmental conditions (Misselhorn *et al*., 2012; UNISDR, 2015; Feed the Future, 2018; WFP, 2019; de Haan, 2016; Easdale & Domptail, 2013).

2.4.3.5. Access to Farm Inputs

Farm input related problems were also identified by many as one of the causes for poor farm production in the ASAL parts of Ethiopia. Studies claim that farmers' lack of access to fertilizer, improved seeds and improved livestock breeds weakened their adaptation capacities and agricultural productivity (FAO, 2014; Veldhuizen *et al*., 2020). Tefera & Ayalew (2023) indicated that Ethiopia ASAL parts farmers hardly access farm technology mainly due to high poverty in the area and due to poor farm input supply system. The major suppliers are traders who put high prices for the farm inputs to maximize their profit that most farmers cannot afford. Besides, Ribot and Peluso (2003) indicated that farmers' knowledge limitations have constrained their gain from the technologies as noted. In a similar way, Gebeyanesh *et al* claim that technologies such as improved seeds and livestock breeds require knowledge of the right procedures and management systems which most of both the manufacturers and the farmers lack that result in poor productivity. They added; even if farmers get the right to access these technologies, lack of appropriate knowledge constrains them from benefiting from such resources (Gebeyanesh *et al*., 2021).

2.4.3.6. Poor Market Integration

Government market intervention system is very weak in the case of ASAL parts of Ethiopia and the fragile nature of ASAL parts, poor infrastructure, lack of access to market information, lack warehouse have hindered lively trade in the area (Esayas, Solomon & Girma, 2019; Moges & Gebeyehu, 2006, Getnet & Mehrab, 2010, Eleni & Wolday, 2003). Esayas, Solomon & Girma (2019) claim Ethiopian pastoralists are less market integrated. Poor infrastructure has severely limited market access for people in ASAL parts, and traders control of the market system has made it difficult for individual households to obtain fair prices for their farm products (MoA, June 2014). Some projects initiated by USAID to facilitate value chain actors and improve market access in the Oromia region were unsuccessful due to interrupted implementation by conflicts in the areas (Esayas, Solomon & Girma, 2019). In a similar way, the cooperatives established to enhance market linkage have faced problems of poor implementation and government control on cross-border trade, limited access to livestock market and price. Conflicts that cause road security problems also hinder access to livestock markets (Edjeta, 2006; Ericksen, 2008b; Okyere, Daniel & Elias, 2013).

In their study on market integration of Ethiopian pastoralists, Teklehaimanot, Ingenbleek and Trijp (2019) claim that pastoralists lack the mindset orientation and economic activities of producing livestock for market values besides the physical infrastructures problems such as roads and lack of market places facilities that hinder their market integration. The researchers indicated that Ethiopian pastoralist's understanding of the livestock market is limited to regular market days held at fixed physical market places where sellers and buyers meet for transactions. But they have little understanding of the market as mechanisms where different actors play roles to facilitate transactions between trading partners. The researchers also claim that pastoralists' mobile way of life also limited their access to updated information of the market environment and pastoral communities tend to build herd size to gain livestock products and for up keeping their social status. They sell livestock to fulfill their wants but give less consideration to the needs of the buyers thus they fail to keep standards and information that facilitate livestock sale. Such factors and their limited knowledge about the market environment and the value chain actors made them less integrated into the livestock market.

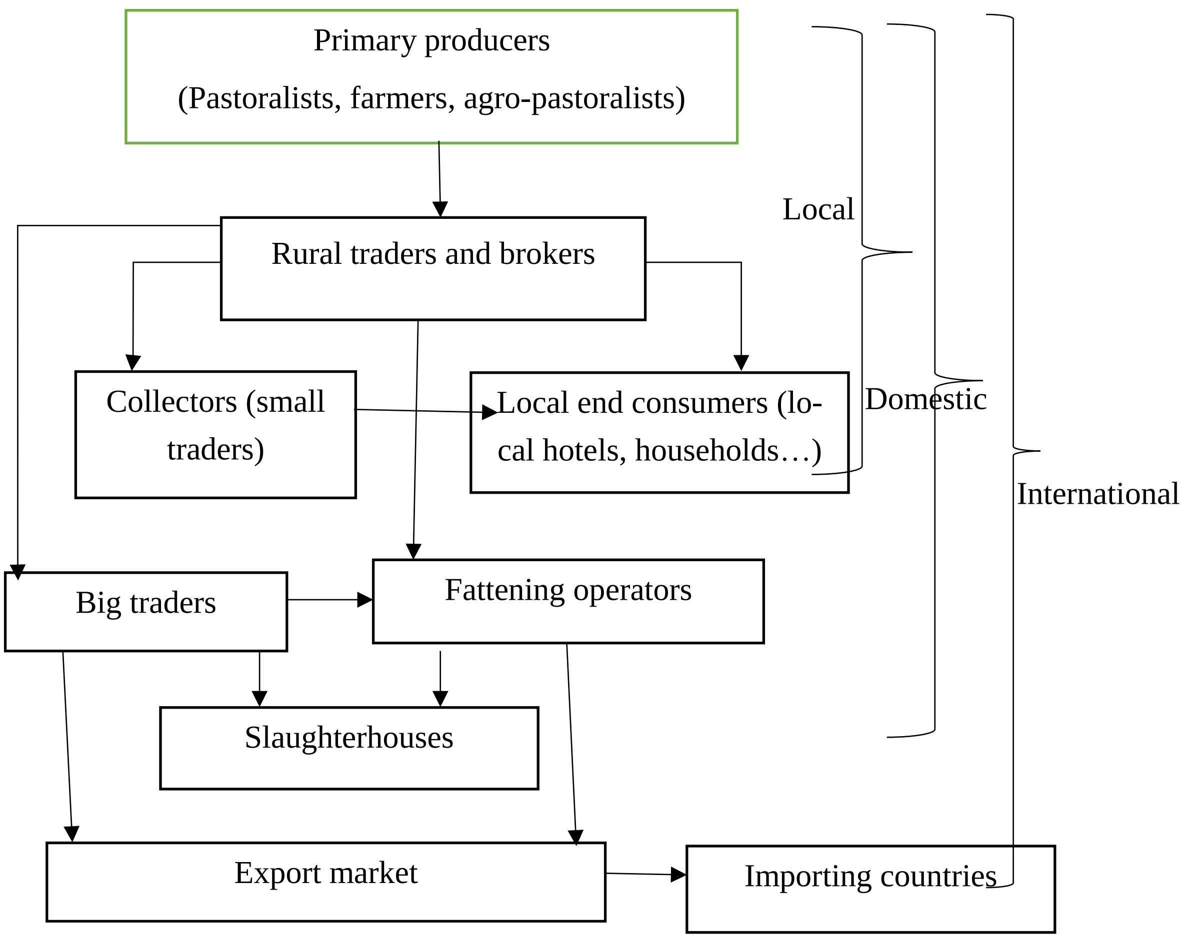


Figure 2.3: Ethiopian Livestock Market Value Chain

Source: Taken from Teklehaimanot, Ingenbleek & Trijp (2019, page 537).

From Figure 2.3 the primary producer farmers in Ethiopia are less market integrated. In livestock trade in Ethiopia, the value chain actors such as traders, those who work on fattening animals and exporters have specific attributes for the animal they want to buy. Pastoralists failed to recognize the problem caused by their failure to be aware of the changing preferences of the traders, exporters and fattening operators that caused low price and rejection of their livestock in market due to poor quality and they continue to blame traders and brokers for low price. Thus, what the pastoralists assume best and bring to market to sell at higher price may not satisfy the demand from buyers, they suffer rejection of their animals at market place and low price offers. Brokers and traders exploit pastoralists through different deceptions to keep the price of livestock very common. In a similar way, studies indicated traders, exporters and fattening operators also suffer to collect sufficient volume they require due to low supply of wanted quality and standard. Pastoralists sell livestock only when they need money and lack of the muscularity, age, type, health and genetic such as Boran cattle that fit for the purpose they buy as the importers have strict health and quality of the livestock which the producers have no record about (Teklehaimanot, Ingenbleek & Trijp, 2019; Barrett, 2008).

Studies show that urban areas expanding into the hinterlands at proximity to urban centers experience increased food value chain, and more diversification of activities in the areas of non-farm activities related to the midstream segments (Reardon, 2015). According to Mulugeta and Habtemariam (2011), the changing mode of life in ASAL parts from nomadic pastoral to agro-pastoral and sedentary farming system encouraged rapid villagization and emergence of urban centers which increased demographic pressure in the area. Thus, expansion of urban centers in the localities and the growing demand for livestock products such as meat and milk makes pastoral production potential for more economic activities. Catley, Lind and Scoones (2013) claim opportunities of income multiplayer activities such as animal fattening, fodder production and livestock trade have attracted non-pastoral people to be involved in the area. However, studies show that pastoral communities in ASAL parts are not involved in much of such emerging opportunities as such and remain disadvantaged (Esayas, Solomon & Girma, 2019 page 30 citing Coppock *et al.*, 2004).

Strong market integration opens an opportunity for households to diversify their livelihood through small trading activities, off-farm income sources, and other food production activities. Moreover, access to credit and support systems improves household's capability to access food. This develops households' food system adaptive capacity to shocks and stresses and improves their resilience to socioeconomic and environmental dynamics. However, in the absence of such opportunities, the current changes such as land tenure policy change and sedentarization program in Ethiopia's ASAL parts that caused productivity decline mainly due to dynamics such as land degradation, shortage of water, biodiversity loss and soil erosion formed a vicious circle of food insecurity and poverty (Yohannes & Mahmmud, 2015).

2.4.3.7. Conflict

The displacement and loss of traditional communal land areas increased land disputes in Ethiopia's ASAL regions intensified conflict over access to and control over land. Private enclosure and the expansion of dry land farms into former communal grazing areas increased conflict due to competition for resources between crop farmers and pastoralists, and neighboring tribes and cross border (MoA, June 2014; Esayas, Solomon & Girma, 2019). Intergroup clashes and conflicts over resources sometimes that develop into armed clashes have created instability in these areas exacerbating food insecurity. It exposed households to multiple shocks such as disruption of production, blockage of market access, looting, raids, displacement, asset loss, and insecurity. Such social crises weakened their asset bases and coping capacities, increasing the vulnerability of livelihoods to poverty and food insecurity in the ASAL parts of Ethiopia (Soboka, 2018).

Overall, the failure of government initiatives to integrate local ecological conditions and community perspectives has resulted in various dynamics within the Arid and Semi-Arid Land (ASAL) regions of Ethiopia (Rettberg *et al*., 2017). These dynamics encompass increasing deprivation of land access rights particularly for pastoralists and agro-pastoralists, natural resource decline, livelihoods loss, and increased poverty. Subsequently, the livelihood strategies that people in these parts of Ethiopia employed as a means of survival caused multiple socio-economic and environmental crises such as land degradation, soil erosion, biodiversity loss, and conflict that have resulted in poor food production, thereby influencing food security. Moreover, constraints such as limited income sources, inadequate infrastructure, fluctuating market dynamics, and insufficient access to farm inputs weakened communities' adaptation strategies, further exacerbating the food security unsustainability in the ASAL regions (Fekadu, Gadissa and Jabessa, 2020; Asebe, Yetebarek, & Korf, 2018; Asebe & Korf, 2018).

Located in Ethiopia's ASAL parts within the Eastern Shewa zone, the study area communities of Fantale and Boset districts have become increasingly vulnerable to food insecurity, confronting similar trends observed in other ASAL areas across the country. Despite the

Ethiopian government's efforts to transform ASAL regions and guarantee food security through implementation of various development initiatives, many households in ASAL areas continue to struggle with food insecurity. The government's development policy particularly in Fantale district favors a sedentary farming with mega plantation projects developed to increase economic benefits from this region. The privatization of land for farming, and expansion of mega projects at the expense of communal grazing land areas have resulted in shortage of livestock food, a decline in livestock production, and depleted benefits to local pastoral and agro-pastoral communities (Adugna *et al.,* 2022; Rettberg *et al*., 2017).

The expansion of Awash sugarcane plantation, cotton plantation, Matahara sugar factory, Sodare recreational area and Awash National Park took huge part of former communal land in this area and use of river banks for irrigation limited pastoralists' access to grazing land and water sources. The sugar plantation for instance included about 245,000sq km of the previous pastoral grazing areas. Such policy shifts has violated pastoralists land rights, limited their access to livestock grazing areas and water and put pressure on ASAL parts pastoral and agro-pastoral food production in various ways. The diminishing communal grazing land areas and restricted pastoral mobility as the result of shrinking communal land parts caused overgrazing and land degradation in these parts of the country, which weakened local communities' adaptation capacities and increased their vulnerability to food insecurity (Gray and Moseley, 2004 and Desai and Potter, 2014; ILRI, 2011). Livestock holding which is the major economic source and social capital for the communities in ASAL parts of Ethiopia has declined affecting their food security due to income decline (Rettberg *et al*., 2017).

None of these mega projects, however, was designed to support the pastoral pathways for equitable development whereas their encroachment into pastoral grazing lands is causing diminishing resources and decline in pastoral production (ILRI, 2011). De Haan also argues that the expansion of private and government plantation farms along river valleys such as the plantation farm along Awash River in Ethiopia not only restricted pastoral people's access to dry season grazing area but endangered pastoral mobility that caused failure of the pastoral food production system. He claims that pastoral production, however, proved more economic return than the state cotton plantation in the area (de Haan, 2016 page 61 citing Behnke & Kerven, 2013).

These parts of the country are fragile lands with poor resource endowment, poorly developed infrastructure, market related problems, and weak government administrative functions. Employment and income earning opportunities are restricted to activities like selling charcoal, firewood, sand, animal dung, fodder as well as engaging in daily labor and petty trade. Nevertheless, these opportunities often do not generate sufficient income to mitigate the growing shocks and stresses resulting from dynamic changes in the areas thus impeding their capacity to meet their food needs. Hence, food insecurity, poverty, destitution and dependence on aid have increased in these ASAL districts as the food production system failed to support households' food demand (Müller-Mahn, Rettberg & Girum, 2010; Bezawit *et al*., 2020; Solomon *et al*., 2008; MoA, 2014). Despite the intended graduation from the Productive Safety Net Program (PSNP) after a five-year period, most households in the surveyed 'Kebeles' within these districts have remained reliant on the program since 2005, as their food insecurity persists (MoA, June 2014).

In the two districts alone, 13,662 households (11,709 in Boset and 1,953 in Fantale) were facing severe food shortages and have been supported through the Productive Safety Net Program (PSNP). This underscores the severity of food insecurity in the study area and the high dependence of households on aid (Oromia Bureau of Agriculture PSNP Phase 5 Report, 2021; Bezawit *et al*., 2020).

2.5. Challenges to Household Sustainable Food Security in ASAL Parts

Different sources show that there are environmental, institutional, and socioeconomic challenges that threaten households' sustainable food security in ASAL parts of the world.

2.5.1. Environmental Challenges

FAO (2019b) indicates that climate and natural disasters drove 29 million people into acute food insecurity. Climatic shocks such as droughts, temperature fluctuations, and rainfall decline affect all the four pillars of food security particularly in the ASAL parts of the world.

In many developing countries of the world, inequality of access to natural resources and poor management increased degradation of natural resources, soil fertility decline, biodiversity loss, and water problem all of which have negatively affected food production and utilization (Blaikie & Brookfield, 2015; FAO *et al*., 2021; HLPE, 2020; WFP, 2019; Rettberg *et al*., 2017). The 2005 Millennium Ecosystem assessment estimated about 70 percent of land faced some form of degradation and biodiversity that caused many risks (NRC, 2011). At the global level, about 4 billion people faced water scarcity, decline of farm animal species; and about 75% of food plants' diversity was lost in the 20th century alone (HLPE, 2020).

2.5.2. Institutional Challenges

Inappropriate policies, governance systems and its many other social, economic, political and environmental components affected food security in many developing countries (Akbari *et al.,* 2022; Blaikie, 2016; Scoones, 2020; Degefa, 2005). For instance, many development policies that follow capitalistic resource distribution undermine the right of the vast majority of the rural poor to access livelihood resources, and this affects their food access sustainability (Scoones, 2016; Blaikie & Brookfield, 2015). Smallholder farms on less than two hectares of land make up 84% of the global farms. Their dependence on rain-fed agriculture as a livelihood basis and their limited access to factors of production such as farmland as well as to farm inputs due to financial constraints affected their productivity and food insecurity remained a persistent situation (Lowder, Skoet & Raney, 2016; HLPE, 2020; FAO, 2017; FAO *et al*., 2021). Webb and Braun (1994) claim that '*famine acts selectively not universally even in the same family*', and it is those that have access to resources who can survive.

Governments' development policies and the failure of governments to mitigate famine incidences in certain countries around the world have resulted in famine disasters in the past. Food shortage in many countries turned into famine disasters due to lack of governments' timely response (FAO *et al.,* 2021; Sen, 2001). The 1958–61 Chinese famine that followed the 'Great Leap' economic policy and the 1984 Ethiopian Famine that followed the post-1974 government collectivization program were mentioned as examples of inappropriate government policies (Devereux, 1993). Similarly, many scholars argue that the 1972–74 Wello famine in Ethiopia was a government intervention failure. The then imperial government neglected to make timely interventions and showed reluctance in informing international aid organizations of actions that could have mitigated the impact of the famine disaster (Mesfin, 1984; Devereux, 1988; Webb & Braun, 1994; Dawit, 1989 cited in Degefa, 2005 page 118).

In the case of the West African sub-region, FAO identified institutional challenges such as tenure insecurity, lack of development in farming practices; value chain, poor market integration and weak linkage between research and development hindered agricultural productivity and affected the sub-region's food security (FAO, 2020).

Market situation is also mentioned as one of the major institutional driving factors that impede global food insecurity. FAO claims that the globalization of the food system and the recently changing food supply chain have increased the influence of the market on food security. Healthy diets are becoming unaffordable due to several factors related to food production situations, food value chains, demand increases, and pandemic diseases (FAO *et al*., 2021). The World Trade Organization (WTO) indicates that the value of the world food trade increased from USD 315 billion to 1.5 trillion between 1990/91 and 2017, and low and middle-income countries account for one-third of this trade. This indicates that a growing number of their population rely on the global market for their food security (WTO, 2018; HLPE, 2020).

The improved transportation and long food value chains made food consumption possible at a distance from its production (Teklehaimanot, Ingenbleek & Trijp, 2019 page 529, citing Borras, 2010; Carletto *et al*., 2010). Thus, rural communities' dependence on the market for food has increased rapidly as the share of their purchased food in their diet has increased, which makes them vulnerable to the rising food price. For instance, a study indicates that the proportion of food purchased was 80% in rural Bangladesh and Indonesia, 72% in rural Vietnam, and 58% in Nepal (Reardom, 2015). The same study indicates that the growth of the prepared food market in restaurants in urban areas and in some rural areas is another food processing activity in the food value chain.

The 21st century food security situation has deteriorated due to global changes such as increased oil prices, pandemic diseases and conflicts that are pushing up the cost of life. The COVID-19 pandemic exacerbated the global economic slowdown. The pandemic that hit the most vulnerable poor class of population due to food supply decline and loss of income affected their food security. The pandemic also affected the supply side, restricting the movement of productive labor and food commodities (Akbari *et al*., 2022; FAO, 2022; HLPE, 2020). The subsequent war between Russia and Ukraine added fuel to the already igniting food price due to blockages of food commodities, and fertilizers imports. This was mainly due to the fact that Russia and Ukraine are among the major producers and exporters of food commodities in the world. The two countries make 80% of the world's sunflower oil, and Russia is the world’s leading fertilizer exporter (FAO, 2022). Thus, besides the challenges of sustainable food production, diverse economic, political and social dynamics that put pressure on the global food system resulted in increased food insecurity worldwide.

Conflict was the primary global food insecurity driver for around 74 million people, two-thirds of whom faced acute food insecurity in 2018 while economic shocks were causes of food insecurity for 10.2 million people during the same year. More than half of the food insecure population lives in countries with conflict and insecurity problems (FAO, 2019b; FAO, 2017; HLPE, 2020).

2.5.3. Socioeconomic Challenges

ASAL parts are marginal areas characterized by limited resources, weak governance, inadequate investment, low employment opportunities, insufficient social services, and high poverty rates (Stringer et al., 2017). For pastoralist communities in these regions, livestock holdings are the primary assets, crucial for household food security, income generation, and social capital. However, the lack of diverse income sources, widespread poverty, high levels of illiteracy, and persistent food insecurity remain major challenges. A significant portion of the population consists of mobile pastoralists whose livelihoods have been further undermined by the decline of traditional food production systems, driven by political dynamics in these regions, particularly in Africa. Consequently, many have become increasingly dependent on food aid due to a widespread loss of resilience, resource degradation, and subsequent food insecurity. Poverty and destitution are pervasive throughout these areas (Rettberg, 2017).

2.5.4. Challenges to Household Sustainable Food Security in Ethiopia's ASAL parts

Whereas the challenges to the general ASAL parts' household sustainable food security also apply to the Ethiopian case, specifically environmental, institutional, and socioeconomic challenges are the major threats to household sustainable food security in the ASAL parts of Ethiopia.

2.5.4.1. Environmental Challenge

Studies claim that recurrent drought in the ASAL parts of Ethiopia caused crop failure and livestock loss resulting in food insecurity (Peng *et al.*, 2021; Rettberg et al., 2017). Besides, people's unsustainable strategies to cope with the dynamic land use policy changes in ASAL parts of Ethiopia have resulted in manifold unsustainability drivers such as soil erosion, land degradation, and biodiversity decline resulting in poor productivity and food shortage (Rettberg *et al.*, 2017; Adugna *et al.*, 2022).

2.5.4.2. Institutional Challenges

Studies show that various government development efforts and modernization initiatives such as sedentary farming and the expansion of mega plantation projects that were implemented in the ASAL parts of Ethiopia limited local people's access to natural resources and interrupted their traditional food production system. The studies demonstrated that tenure insecurity and challenges of development such as environmental degradation and conflict over resources resulted in poor productivity in the area despite of the successive governments' development efforts for more than seven decades (Rettberg *et al.*, 2017; Easdale & Domptail, 2013; Adugna *et al.*, 2022; Yohannes & Mahmmud, 2015; Soboka, 2018). The introduction of sedentary farming, expansion of mega projects and dry land farming have negatively affected the livelihood of the ASAL area pastoral and agro-pastoral communities in many ways. The expansion of farming restricted pastoral mobility, which resulted in decline of traditional resource management systems and increased overgrazing. Shortage of livestock food and water resulted in livestock asset loss. Livestock production and herd sizes per household have diminished, leading the majority of pastoralists to impoverishment (Rettberg *et al*, 2017).

Market plays a decisive role in access to food in the ASAL parts' food production system. ASAL parts pastoral and agro-pastoral communities highly depend on markets to generate income and for exchange of livestock and livestock products for cereals and other food commodities. However, Ethiopia's ASAL parts' communities have weak market integration due to poor infrastructure, limited access to market information, dominance of traders and brokers who control market price and government firm cross-border restriction policies that have limited farmers' incomes (Esayas, Solomon & Girma, 2019; Aklilu & Catley, 2014).

2.5.4.3. Socioeconomic Challenges

Livelihood diversification strategies are poorly developed, employment opportunities are rare and income sources are limited in these marginal land parts of the country, which have increased the communities' vulnerability to food insecurity due to poor adaptation capacities (Rettberg *et al.,* 2017; Scoones, 2020). Social services and market infrastructure are not well developed and the role of cooperatives, which aimed to enhance the market in the ASALs was insignificant because of poor organization (Edjeta, 2006). Hence, poverty, destitution and dependence on aid increased in the area (Rettberg *et al*, 2017). The productivity of sedentary farming has also been challenged by poor irrigation schemes and farm input related to financial constraints (Rettberg *et al.,* 2017; Easdale & Domptail, 2013; Catley, Lind & Scoones, 2013; Adugna *et al.*, 2022; WFP, 2019).

2.6. Emerging Issues from the Literature

Food security in the ASAL parts of Ethiopia has been subject to research by many scholars who have contributed valuable insights on macro level issues such as famine, government policies, climate change, and drought effects. Similarly, micro level studies have focused on issues such as household coping strategies, determinants of household food security, livelihood vulnerability, and food security indicators. However, these studies often present fragmented findings on food availability, access, or household resources without fully considering their interconnection to the underlying root causes and broader food production system contexts. Consequently, there is a scarcity of comprehensive research that captures the complexities surrounding sustainable food security in the ASAL parts.

This study aims to address a significant gap in understanding the complex interplays among dynamics factors that affect household food security sustainability in the ASAL parts of Eastern Shewa zone in Oromia Regional State of Ethiopia. While previous research has explored individual elements of food security, there has been a limited focus on how these factors collectively influence sustainable food security in the unique context of ASAL areas. This study, therefore, provides a comprehensive analysis of how these factors interact with household food production systems and influence food security sustainability, offering a more holistic understanding that is crucial for developing effective interventions.

The study contributes new knowledge specific to the ASAL parts of Ethiopia, an area that has been underrepresented in food security research. By focusing on Fantale and Boset districts, the research offers valuable insights into the challenges and opportunities unique to these areas, which can be applied to similar regions across Ethiopia and beyond. While there has been general discussion on land use policies, this study specifically examines how government land use policies impact local food production systems and contribute to food insecurity. This targeted analysis fills a gap in understanding the policy-environment-food security nexus in ASAL regions. Besides, the research expands on the understanding of how socioeconomic factors, such as limited income sources and market infrastructure influence food security in resource-limited settings. It provides empirical evidence on how these factors, combined with environmental stressors, affect the sustainability of food security. By addressing these gaps, the study not only contributes to academic knowledge but also provides practical insights that can inform policy, guide future research, and support the development of more effective food security strategies in ASAL regions and similar contexts globally.

Understanding people's experiences and perceptions of their food security, and outlining the local realities to capture the dynamic processes influencing food system activities helps to contextualize sustainable food security. Assessing livelihood resources and food provision sources enables us to identify "What household characteristics determine households' food security status in the study areas? Additionally, analyzing people's experiences, activities, and perspectives on the local realities; along with environmental and institutional processes that influence the food system activities, helps understand "what dynamics influence sustainable food security in the study area?" And, identify specific household challenges.

The food system has been analyzed holistically to understand the dynamic socioeconomic, environmental, and institutional factors that cause vulnerability, rather than focusing solely on symptoms such as food shortage or access problems. This approach also captures potential social and environmental outcomes as feedback to the food system across space and time, which may increase vulnerabilities, in addition to food security dimensions.

This multidimensional approach fills the gap in literature that fails to fully integrate contextual factors and individual household vulnerabilities, offering a holistic understanding of sustainable food security in the ASAL parts. Analyzing the determinants driving households' vulnerability to food insecurity adds information to the existing knowledge. The households' experiences, activities, perspectives and perceptions of the food production system and food security outcomes contribute new information to the literature on sustainable food security. Examining sustainable food security from the perspective of studying households' food production system is significant for understanding ASAL parts food security challenges. Moreover, the research attempts to address the gap in achieving SDG Goal 2.1, 2.3, 2.4 and 10.3 by addressing the multidimensional issues of food security sustainability, productivity, resilient agriculture, and inclusiveness that require an integrated food system approach.

2.7. Theoretical Framework

Studies on food security have generated a number of theories each with different explanations of food security based on different assumptions and perspectives (Devereux, 1993; Veyda & Walters, 1999; Degefa, 2005). In relation to this study, two major theories, vulnerable livelihood theoretical framework and political ecology theory were applied to explain households' food security situation and dynamics influencing sustainable food security and challenges to sustainable food security in the study areas. The use of two different theories was preferred to address the manifold aspects of food security that a single theory may not explain adequately. Specifically, the livelihood approach was utilized to analyze the multidimensional aspects of vulnerabilities among households that contributed to household vulnerability to food insecurity in the study areas' contexts. Since the livelihood vulnerability framework cannot explain the causes of environmental change in the ASAL parts, political ecology theory was utilized to understand the underlying power dynamics, resource governance structures, and policy frameworks that shape food security outcomes in the ASAL parts.

2.7.1. The Vulnerable Livelihood Framework

The Vulnerable livelihood framework is based on the view that it is not exposure to external hazards and stressors alone that cause vulnerability, but also the level of sensitivity and resilience of the people to the hazards. This approach shifts the emphasis for food security analysis from natural causes to the social causality model (Jesse, 1995). The framework helps to examine livelihoods and understand how the interaction between people, environment and policies influence livelihood strategies and their food security (Degefa, 2005). Specifically, this study utilized vulnerable livelihood frameworks to understand how socio-economic, environmental, and institutional factors influencing household livelihood strategies in food production interact to affect the sustainability of food security.

Chambers (1989) introduced a livelihood approach in food security analysis. Scoones (1998), Ellis (1998), Devereux (2001) and others such as Downing (1990), Dilley and Boudreau (2001) applied the approach as a theoretical framework in their studies. However, a vulnerable livelihood approach has developed through the contribution of many scholars. Many including Maxwell (1991), Scoones (1996), Yero (2004), Adger (2006), and Turner *et al* (2003) applied this approach to analyze livelihoods vulnerabilities in food security studies. Degefa (2005) for instance applied the livelihood vulnerability approach in his study on rural livelihood, poverty and food insecurity in Ethiopia to analyze the interaction between people, their environment, and government policies that affect livelihood strategies.

Household food (in)security is determined by interplay of various components in the household food production system as shown in the livelihood vulnerability framework in Figure

2.4. These components include livelihood resources, environmental context (shock and stress factors), food production activities, adaptive strategies, sensitivity, exposure, and livelihood outcomes (Scoones, 2021; Scoones, 1998; Degefa, 2005). The framework shows real-world situations and ways of their interconnection and interaction in the food production system.

Livelihood resources: are assets that enable households to employ livelihood strategies for food production (Adugna *et al*., 2021). The sustainable livelihood approach directly relates to people's access to food to their control over a range of capital assets (human, natural, social, financial, and physical) and ability to convert the resources effectively through production or purchase under varying climatic conditions (Ericksen, 2008a). Human capital refers to a person's health, education and labor supply. Factors such as access to land, soil quality and forest make up the natural capital. Social capital refers to networks with friends or relatives and income benefits from the networks such as claims and gifts. Financial capital includes access to credit and saving service or income and physical capital refers to wealth in kind and accessibility of infrastructure such as roads, market etc. (Fraser *et al*., 2011 page 3 citing Scoones, 1998; Bebbington, 1999; Maxwell, Vaitla and Coates, 2014). Household resource is the potential to respond to changes and decides adaptive capacity (Ericksn 2008; prosperi, *et al*., 2014; Sen, 2001).

Shock and stress factors: refers to macro-level events such as droughts, floods, disease outbreaks or conflicts. While such hazards clearly affect food security, understanding their relationship to food security requires specifying how their effects are transmitted through the economic, social and physical systems through which people obtain food. This requires disaggregating general hazard impacts into specific shock factors or causes. For example, a natural event drought may cause livestock deaths, which affect income for small-scale farmers that have immediate effects on access (Davies, 1996; Dilley & Boudreau, 2001).

Food system activities: are those activities related to food provision including production, processing, distribution, exchange and consuming in the case of agricultural food production (FAO, 2008; Ingram, 2011b).

Adaptive strategies: are the various activities people undergo to obtain their livelihood goals such as crop farming, pastoralism, trade, etc. It is developed for ensuring income source or food security in the face of future uncertain changes. Livelihood strategies are determined by access to resources and institutional policies that influence use of assets (Alinovi *et al*., 2010).

Exposure: is the degree to which a system is subjected to changes. Exposure to external threat, shock or stress, is one chance for vulnerability of individuals and households (McCarthy *et al*., 2001). Turner *et al*. (2003) listed exposure, sensitivity and adaptive capacity as components of vulnerability to environmental and socioeconomic stresses.

Sensitivity: the likelihood of experiencing different magnitudes of consequences of exposure to stress or perturbation. Sensitivity is dependent on the inherent character of the system and the shocks and stresses faced. Both sensitivity and adaptive capacity are determined by access to assets but policy and institutional context and environmental change may constrain adaptive capacity (Ericksn 2008; Prosperi, *et al*., 2014; Sen, 2001; Turner, *et al*., 2003).

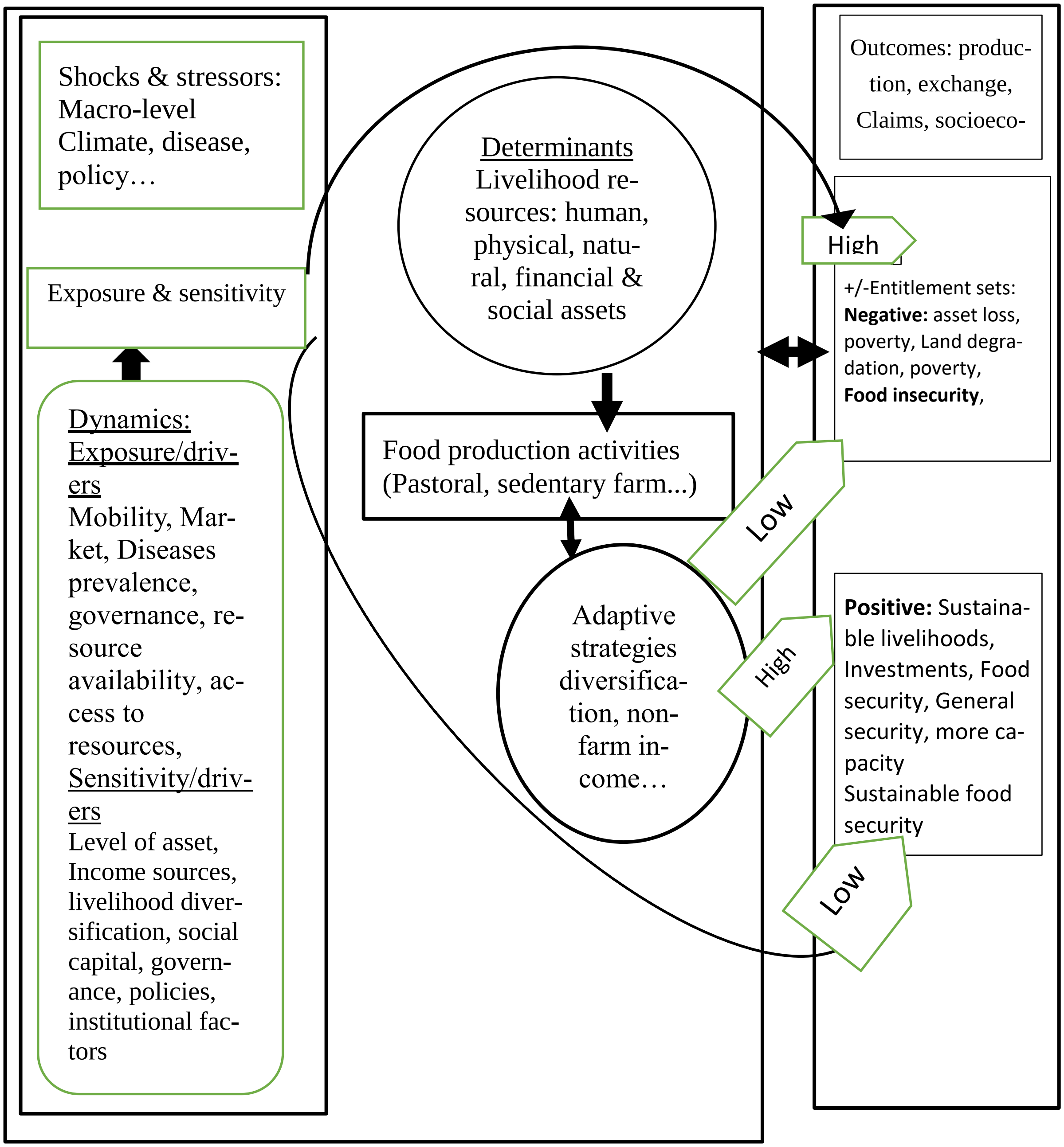


Figure 2.4: The Vulnerable Livelihood Framework

Source: Adapted from Yaro (2004, p. 34); Degefa (2005 p. 89); de Haan (2016 page 4); & Scoones (2021, P.84).

Outcomes: Food system activities produce positive or negative outcomes in the form of food security, social and environmental welfare as feedback to the environment (Adugna *et al*., 2021). Externalities such as land degradation, soil erosion, biodiversity loss, water problem, natural resource depletion, asset loss, productivity decline, and food insecurity may occur to the reverse as feedback in the food production system. Such pressures from environmental and socioeconomic conditions limit well-being of the community, the future productivity of the environment, and result in unsustainability of food security. Such negative impact of human-nature interaction in the process of food production is recognized globally as one of the major drivers of environmental change, which is a major challenge in the effort to provide sufficient and safe and nutritious food for healthy life now and in the future. In this case, productivity of the environment depends mainly on the structural settings to enhance food security and households' adaptive capacity to the changing conditions (Tendall *et al*., 2015 & UNEP, 2010).

The main advantage of the livelihood vulnerability framework in food security study is it focuses more on people's situation than the shocks and stressors affecting their lives. It also helps to analyze the dynamic in people's livelihood activities and their strategies that resulted in livelihood changes. The other advantage of this framework is it helps to identify where vulnerability arises in the people's activities to suggest adaptation mechanisms for policy makers to enhance food security. Thus, vulnerability analysis framework helps to examine the whole food system to understand socioeconomic changes and strategies that help to build livelihood resilience for sustainability (Degefa, 2005; Fraser *et al*., 2011; Adger 2006; Ericksen, 2008b; Misselhorn *et al*., 2010). However, the vulnerability analysis approach to food security research has weaknesses due to its failure to identify the events that can cause harm, susceptibility to specific shocks and likelihood of an undesirable outcome (Dilley & Boudreau, 2001).

2.7.2. The Political Ecology Approach

The political ecology theory emphasizes analyzing the influence of the complex political and environmental dynamics such as ecological change and power dynamics that shapes access and control over resources in food security research (Blaikie, 2016; Nancy & Vandergeest, 2001; Scoones, 2021; Blaikie & Brookfield, 2015). This approach helps to emphasize the inequalities that exist in society; the political and social-nature dimensions and their complex interaction that drives environmental change-unlike the human and cultural ecology approach, which blame local based factors such as poor land management, demographic pressure and technology use for environmental crises (Paulson, Gezon & Watts, 2003; Vayda & Walters, 1999).

The term political ecology originated the field of human geography by Frank Thone in 1935. Later in early 1970s, the anthropologist Eric Wolf and others applied the term to understand the complex interrelations between resource access and control and ecological crises such as land degradation and soil erosion to develop model for conservation and sustainable livelihood (Wolf, 1972; Roberts, 2020). Watts and Blaikie were proponents of this theory and they adopted it to study causes of famine in different contexts. Watts (1991) in his study entitled "Entitlements or empowerment? Famine and starvation in Africa", utilized this theoretical approach in his study to show how power relations influence access to resources. Wisner *et* *al.* (2003) applied political ecology approach in their study on the causes of famine disasters in which they claimed that such disasters are not only natural product but influenced by policies and powers as it has different effect on different groups of people and hence it is the result of social, political and environmental outcomes. They claim that although the social environment of people has diverse challenges, opportunities and resources for their food production activities, broad political and economic patterns such people's asset level, income and access to resources determine their unequal opportunities and their exposure to hazards.

Blaikie (2016) applied a political ecology approach to explain the human-nature interaction effect on vulnerable classes living in vulnerable areas such as the ASAL parts in his study entitled 'The political ecology of soil erosion in developing countries." The researcher claims that the political dynamism in the rangeland ecosystem and replacement of food crops by cash crop caused farmers and pastoralists income decline, food insecurity and land degradation. The basic supposition here is that the environment affects society members differently based on their respective spatial and temporal variations and therefore, approaches to livelihood strategies have to be in harmony with such variations (Scoones *et al*., 2007). Many scholars including Little (2002), Adger (2006), Ali (2008) and Scoones (2021) adopted this approach to study environmental change and food security in various contexts.

Little (2002) mainly used this approach to analyze how the social and political pressure affected environmental issues such as land degradation and soil erosion as the result of loss of land by the farmers and the immediate cause such as rainfall variability, inappropriate land use and overgrazing. His main focus was on politics (access), the nature of resource management (allocation) and ecological impacts and processes of the resource systems under uncertainties. In his explanation, he claims that access to resources is determined by many factors such as wealth level while social norms and community-based institutions decide resource allocation and management and variations in classes influence both access to resources and allocation. The nature of access to and allocation of the natural resources affect the ecology in the system of feedback to the environment and the outcome in turn affects both access and management. The hypothesis of this approach is that limiting indigenous people's access to resources may drive ecological change (Agarwal, 2014). Little summarized the interaction of the three elements as shown in Figure 2.5 below.

Political	**Social and economic**	**Ecological**
1. Access to resources	2. Allocation and management of resources	3. The physical impact and the feedback to 1 and 2

Figure 2.5: Basic Elements in Political Ecology Approach

Source: Little, 2002.

Thus, this approach to food security study enables us to analyze how political, socio-economic and ecological dynamics influence different groups of the communities' food security situation of a specific area differently.

This study utilized political ecology approach to understand how unequal distribution of power in access to natural resources and power dynamics (access to and control over the various resources such as irrigation, farm inputs), and political-economic systems (land privatization, property rights, market mechanisms) drive social and environmental vulnerability in the study areas. This helps to uncover underlying root causes rather than merely addressing surface-level symptoms. However, the political ecology approach has some weaknesses such as its complex nature that may be challenging to understand and require a mixed method approach.

2.8. Conceptual Framework

The study analyzed aspects of the study area food system impact of institutional changes to identify key determinants of food security sustainability focusing primarily on four key elements: household socioeconomic, environmental, institutional dynamics and food production system feedback.

Food availability has production, distribution and exchange elements. In the case of ASALs area production therefore, environmental drivers such as availability and access to natural resources including livestock food and water, soil fertility, biodiversity and farm inputs improve productivity determine food availability besides the climatic condition. Environmental shocks and decline of natural resources that emerge as the result of food production activities may damage the biophysical environment causing poor productivity. Thus, analysis of environmental capacity to remain productive in household food production activities, and climate changes helps to understand the dynamics that influence the sustainability of food security in ASALs areas.

Household socioeconomic resources were analyzed to understand the key factors that determined household food access in the study area.

The interaction between household food production activities and institutional mechanisms affects the food production system outcomes (which includes positive or negative food security, socioeconomic and environmental welfare). Thus, policy actions determine households' adaptation strategies and their socioeconomic and environmental positions through feedback to the system from the outcome. The outcomes may have negative feedback to the environment and society in various forms. Whereas government policy actions such as change in land tenure system that determine household access to resources affect household adaptation strategies, human production activities such as overgrazing, the use of fertilizers, pesticides, dry land farming, etc and natural resources mismanagement result in land degradation, soil erosion, biodiversity loss etc., eventually resulting in poor productivity and unsustainable food security.

Building on the preceding discussion and literature review, which explored the socioeconomic, environmental, and institutional dynamics that shape and are shaped by the food system, influencing the sustainability of household food security, as well as the theoretical framework outlined in Section 2.7, a conceptual model (Figure 2.6 on page 96) was developed for this study.

The theoretical frameworks guiding this study; vulnerable livelihoods and political ecology, highlight that the absence of inclusive policies has exacerbated the livelihood vulnerabilities of communities in arid and semi-arid lands (ASAL). These vulnerabilities, in turn, have intensified environmental degradation within the human-environment interaction in the food production frontier, adversely affecting the sustainability of food security. The vulnerable livelihoods theory underscores how socio-economic and environmental stresses, compounded by inadequate policy interventions, undermine community resilience and adaptability. Meanwhile, the political ecology perspective provides a critical lens to understand how power dynamics, resource access, and environmental governance influence the sustainability of food systems in ASAL regions. Together, these frameworks elucidate the complex interplay between policy, environment, and livelihoods, which shapes the dynamics toward achieving sustainable food security. This conceptual model integrates these interconnected factors to provide a comprehensive understanding of the dynamics affecting sustainable food security in the ASAL regions.

Quarter I of the model stands for ASAL parts household access elements. It indicates variables of household assets; human, physical, financial, and social capitals that determine their capabilities to access food. Age, gender, education, and household size represent human assets. Land represents natural assets while livestock and crop farm/irrigation represent physical assets. Income represents financial assets and supports represent social capital or non-physical assets. Their access to income earning opportunities, education and social services improve their resilience to environmental shocks and stresses that may cause food insecurity and hence determine their access to adequate food. Non-physical assets such as support from clan members and community support, government and non-government support to access assets to secure food for the have nots (those made vulnerable to poverty) community members determine a household's resilience to food insecurity in the phase of shock factors. This makes it important to get the household socioeconomic characteristics to measure the consequences of a given shock.

Quarter II in model represents the context; the trends and shocks in the external environment of the household food production activities. Households transform their natural and other resources endowment into food entitlement through production or trade. Environmental dynamics such as soil fertility, water availability, and biodiversity affect household's food production. Thus, analysis of the environmental dynamics that influence household food production activities helps to understand the dynamics and challenges to sustainable food production in these ASAL parts.

The arrows indicate direction of influence and linkage from one component to the other in the agricultural food production system. The bi-directional arrow running from quarter I to II indicates individuals/households interactions with their environment (human-environment interaction) in food production activities based on the strategies they employ. Households can increase their options to obtain food (improve their resilience) using their adaptive/coping capacities; by diversifying their livelihood or rearranging their intrinsic characteristics with respect to the external shock factors that put them at risk even when the shocks remain constant.

Quarter III represents the existing institutional mechanisms that determine household capacity to transform the assets into capabilities to secure food. Market efficiency promotes the linkage between multiple actors such as farmers, cooperatives and traders and or improved farm practices. Besides, societies' knowledge and behavior in natural resource management and proper use of these resources to sustain its productive capacity enhance sustainable food security. Each of these features shapes the productivity and resilience of the ASAL parts food production systems and household's adaptive capacity to the dynamic environment.

The arrow running from quarter III to I represents institutional actions influence (positive/negative) to individual/households livelihoods activities. The other one running from quarter III and IV depicts the existence of positive/negative influence of institutional dynamics on food security outcome.

Quarter IV represents the various components of the food system outcomes. In food production the outcomes include +/- food security, +/-social welfare such as income, employment and health and +/- environmental welfare such as biodiversity, soil fertility loss, water availability and land degradation in the form of feedback to the food system. The arrow with broken lines running from quarter IV across I to quarter II and back to the quarter IV represents the feedback of the food production systems to the different subsystems. The arrow that runs from quarter I to IV across II and III depicts the complex food system interlink and the resulting feedbacks.

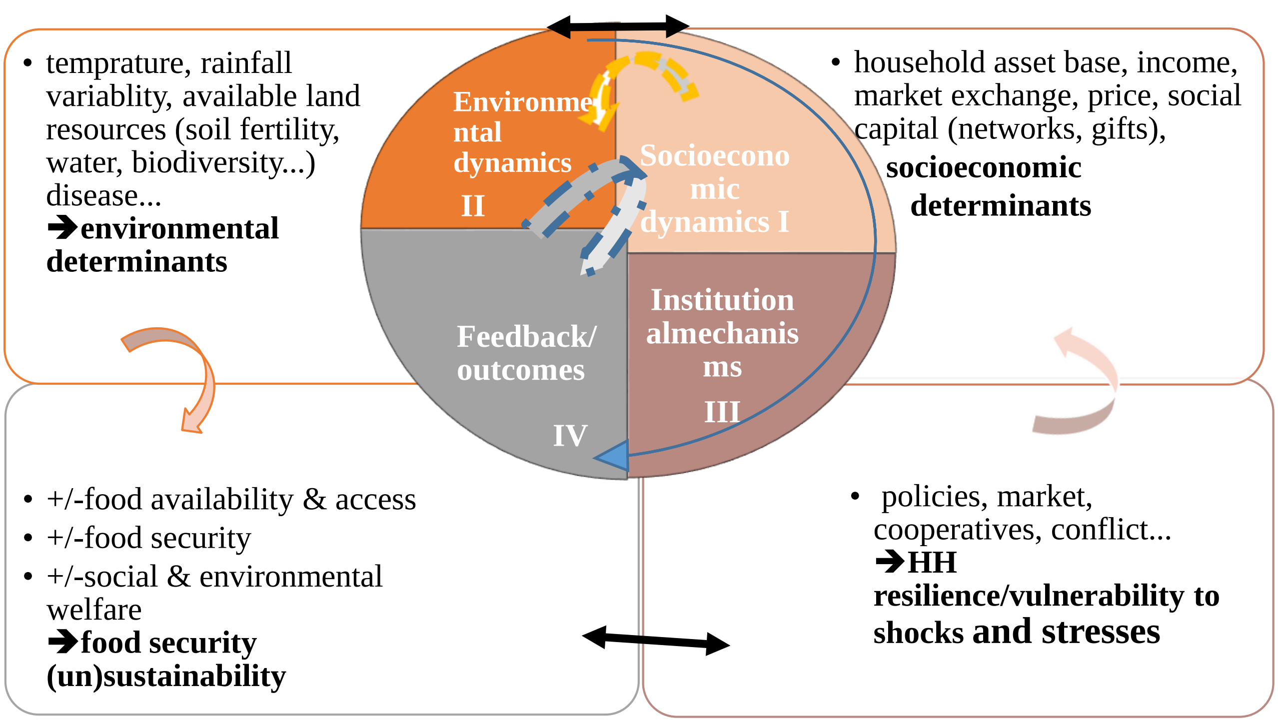


Figure 2.6: Conceptual Model of Food System Dynamics and Outcomes in ASAL Regions
Source: Developed by the researcher based on expert opinion with reference to Bene, 2020; Ingram, 2019; Fraser, 2011; Ericksen, 2008a, Scoones, 2000 and Hodbod et al., 2019.

The conceptual model tries to show the study areas' food security determinants as the internal household capacities, external drivers such as environmental and moderating institutional factors as well as the feedbacks as internal to the system as presented in the squares of the matrix. The model helps to understand drivers of ASAL parts food security (un)sustainability through thorough analysis of the food system; the dynamics of both the external and internal drivers that interact with household food production activities. It enables capturing sustainability factors such as disparities in resource access, as well as the environmental and socioeconomic dynamics in human-environment interaction, from the outcomes and feedback back to the system. Thus, it illustrates the systemic and multidimensional nature of sustainable food security issues, which require addressing each factor separately, but also necessitate a holistic approach to analyzing the system to identify the key drivers and challenges of sustainable food security in the area. The following conceptual framework (Figure 2.7 on page 98) has been developed based on the literature review, theoretical frameworks, and the above model guided the study.

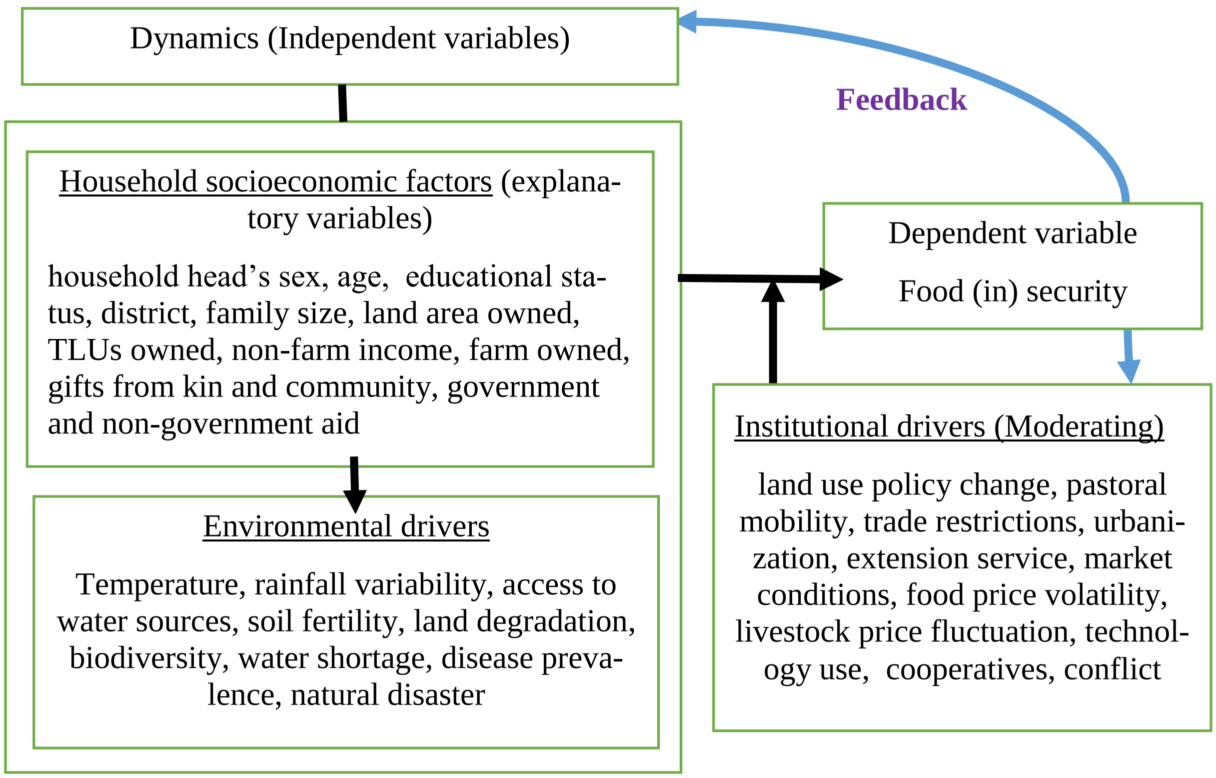


Figure 2.7: Conceptual Framework
Source: Based on experts' inputs and literature review

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Overview

The chapter focuses on the process involved in data collection, presentation and analysis as based on the set objectives. The key areas include the research design, methodology, study area, target population, sample size, sampling procedure and data sources, instruments of data collection, methods of data analysis, validity of the study, reliability of the instruments, and ethical considration.

3.2. The Research Design

This study employed a convergent research design guided by a pragmatic philosophical underpinning that emphasizes mixed method research (Creswell & Creswell, 2018). Pragmatic was suitable for this research because its flexibility allows me to use different methods and tools that are best suited to answer the research questions and also my study focuses on addressing specific problems of food security.

A mixed method approach was used in this study. This approach allows the researcher to collect both qualitative and quantitative data to help develop complete understanding of the research problem and to draw detailed explanation based on the research objectives. Both qualitative and quantitative data was collected simultaneously, but analyzed separately and the information in the interpretation was merged. This approach has been chosen for this study as an appropriate approach due to its advantages for: i) generating supplementary information for triangulation and/or examining contradictory ideas, ii) The qualitative data helped to explain the quantitative database and provided a comprehensive analysis of the problem under study (Creswell & Creswell, 2018; Dick, 2002: 2), iii) choosing the methods that best fit freely, and iv) adapting it to local contexts and use many approaches to collect and analyze data (Cohen, Manion & Morrison, 2007), v) Creswell and Creswell (2018) note collecting both quantitative and qualitative data provide more in-depth understanding of the problem under study from the very study subject people and it also neutralize the weaknesses each data may have. From this point of view, the study relied not only on the respondents experience as data sources but also on the districts' circumstances as well. The approach also enabled the researcher to consider the various social, economic, environmental and political contexts and to use multiple data analysis techniques (Creswell & Creswell, 2018).

The data was collected from both primary and secondary sources. Household survey was the major source of quantitative data. Specific and detailed information was obtained through qualitative data from structured interviews and focus group discussions. Document analysis was used to obtain data on demographic, land tenure records, asset basis and climatic change. Observation and reconnaissance were also made to understand the general environment, socioeconomic activities, and social services in the study area.

Households were selected as the unit of analysis due to their central role in the experience and management of food security. Household in this study refers to the smallest social unit in which members live in the same house and share meals as defined by Shaner, Philipp & Schmehl (1982). The household members cooperate as a unit in activities to produce their livelihood outputs. The unit makes decisions together in areas such as what coping/adaptive strategies to employ to handle a certain stress or risk condition. The outcomes of their activities and the decisions they make affect their outputs and many areas of their life including their food security. Food security is typically experienced at the household level, by all members of the household. Household is therefore a component of food system as a sub-system and best entry point to food security study (Alinovi *et al*., 2010; Jones et al., 2013).

The use of household as a unit of analysis allows for a comprehensive assessment of various socio-economic factors, such as income, employment, education, and household size, all of which are typically assessed at the household level. Studying households allowed the researcher to capture the interplay of these factors and their collective impact on food security (Maxwell, 2001). In many societies, food production, procurement, preparation, and consumption are organized around the household and most food security programs and policies are designed and implemented at the household level. Therefore, the household is the most appropriate unit for capturing the social practices that affect food security. By focusing on households, the study aligns with established methodologies and facilitates the collection of data that is directly relevant for policy and intervention design (Burchi & De Muro, 2016). The household-level analysis also ensures that the findings are comparable with other studies and can inform broader food security strategies (Cafiero et al., 2018).

Data was collected from 397 selected household heads in sample k*ebeles*, although analysis was done also at individual levels to estimate food insecurity situation in the general study population. The study tried to investigate ASAL parts specific issues such as household asset basis, sources of household food provision, household food security situation, dynamics that drive household food security sustainability, and challenges of sustainable food security. From this point of view, the study depend not only on the respondents experience as a data source but also the districts' circumstances as well.

3.3. Study Area

Ethiopia is a country that has diverse culture and climate and endowed in natural resources. High plateaus and mountain ranges cover large area of the country and there are plenty of rivers including the major ones such as Abay (the Blue Nile), Tekeze, Awash, Omo, Wabi Shebele, Baro and Akobo with numerous other tributaries. The rivers have very high potential for irrigation, fishing and electric power due to the topography of the land. In Ethiopia, agriculture is livelihood basis for over 80 percent of the country's population majority of whom are rural smallholder farmers. The sector is the major economic pillar of the country's economy contributing 32.8% of the country's GDP. However, smallholder farmers' high dependence on natural resource and rain fed farming made them more vulnerable to climate change and their productivity is low due to the traditional nature of the agriculture system using oxen plow on fragmented farmland (FDRE, 2016; FDRE PDC, 2021).

Ethiopia has traditional agro-ecology classification zones suitable for production of diverse crops and livestock (Hirko *et al*., 2020). The central and eastern cool highland areas (*Baddaa*) above altitudes of 2,300 meters, central and eastern mid-highland areas (*badda-daree*) with 1,500-2,300 meters elevation, Rift Valley, eastern, western, southern semi-arid lowlands humid and moist low land zone between 500-1500 meters altitudes and eastern and west arid areas hot and dry low land zone with lower than 500 meter altitude (*Gammoojjii*). Communities' livelihood in Ethiopia is highly related to the country's natural geographical location and this affects their food security situation (FDRE, 2022; Hirko *et al*., 2020).

Barley, wheat, highland oil seeds and highland pulses are the main crops grown in the cool highland areas. The mid-highland area inhabited by four-fifth of the country's population and this area is suitable for the growth of variety of tropical, sub-tropical and temperate crops such as teff, maize, sorghum, chickpeas, filed peas, haricot beans, barley, wheat, coffee, and tea. Pastoralists and agro-pastoralists occupy the ASAL parts (dry lowlands and humid/moist lowlands of the country and livestock raring is the major livelihood base in these areas. In the humid and moist lowland zone people grow crops such as finger millet, maize, sorghum, sesame, cowpeas, ground nuts, coffee, spices, sugarcane, and root crops while maize, sorghum, and root crops are grown in the dry lowland areas (Degefa, 2005; Degefa & Baudouin, 2004; FDRE, 2016; TGE, 1994; IFDA, April 2016; FDRE, 2022).

Food insecurity is highly linked to rainy seasons in Ethiopia and the months before rainy season are periods of high food shortage. The months October to February are period of crop harvest in high lands which is high food availability period in the areas depending on the *Ganna/Kiremt* (June-September) rainfall. Depending on the March-May rainfall, the *Arfaasaa/Belg* harvest comes in June-July in the ASAL parts of the country. Rainfall decline and variability during the *Arfaasaa/belg* season leads to poor crop productivity and decline of food availability and food access in the ASAL parts. Inter-annual and intra-annual rainfall variability is high in Ethiopia and the mean yearly variation in rainfall is around 25% in the country. In recent years recurrent droughts, low and uneven rainfall and consequent shortage of water and land degradation increased constraints on food production (Hirko *et al*, 2020; Anderson & Farmer, 2015).

Although the country's contribution to global GHG emission estimated to 0.04% currently, which is minimal, Ethiopia is one of the most vulnerable countries to climate change due to its agrarian economy that is highly dependent on rainfall and natural resources and the country's location (Crippa, 2019 cited in FDRE, 2021; Zeremariam & Bereket, 2013). The country's GTP II has set climate resilient green economy as one of its strategic pillars to adhere to the Paris Agreement goals of containing the global average temperature increase below 2°C efforts to limit temperature increases to 1.5°C. However, climate change remained the major factor for food insecurity for more than 6 decades in the country (FDRE, 2021). Temperature has increased by about 1% at national level since 1960s and high yearly rainfall variability, drought and flood increased the food insecurity situation in the country (FDRE, 2021).

ASAL parts make about 60% of Ethiopia's total land area and more than 12-15% of the country's total population lives in these parts of the land. The ASAL area of Ethiopia stretched from the northeast, eastern, south and southwestern peripheries of the country. The ASAL parts of Ethiopia have hot climatic condition with erratic rainfall unreliable for agricultural activities (Behnassi, Pollmann and Kissinger, 2013, Gezahegn & Natnael, 2016 & WFP, 2019). These parts have a huge potential for irrigation farming. Existing sources indicate the existence of about 1,673,000 hectares of land suitable for irrigation in these parts of Ethiopia (Esayas, Solomon & Girma, 2019). Livestock and livestock product is the major source for food and income means for the population in ASAL parts although they also do crop farming activities (Soboka, 2018, Müller-Mahn, Rettberg and Girum 2010, Anderson & Farmer, 2015; Feed the Future, 2018; WFP, 2019; Mulugeta & Habtemariam, 2011). Pastoral and agro-pastoral communities in the ASAL parts of Ethiopia have traditional resources management practices that enable them to turn the dry land into economically viable land and they contribute 42% of the total national livestock in the country (IFDA, April 2016). Food insecurity is severe in the area due to policy dynamics and changing ecological factors that affected communities' food production activities. Pastoralists make the majority of the food insecure population in the country (Esayas, Solomon, & Girma, 2019; Dagninet & Adugnaw, 2020). The ASAL parts of Ethiopia shaded in yellow color in Figure 3.1 below was indicated as the 'famine prone' region of the country by most previous food security studies (Webb & Braun, 1994, Mesfin, 1984).

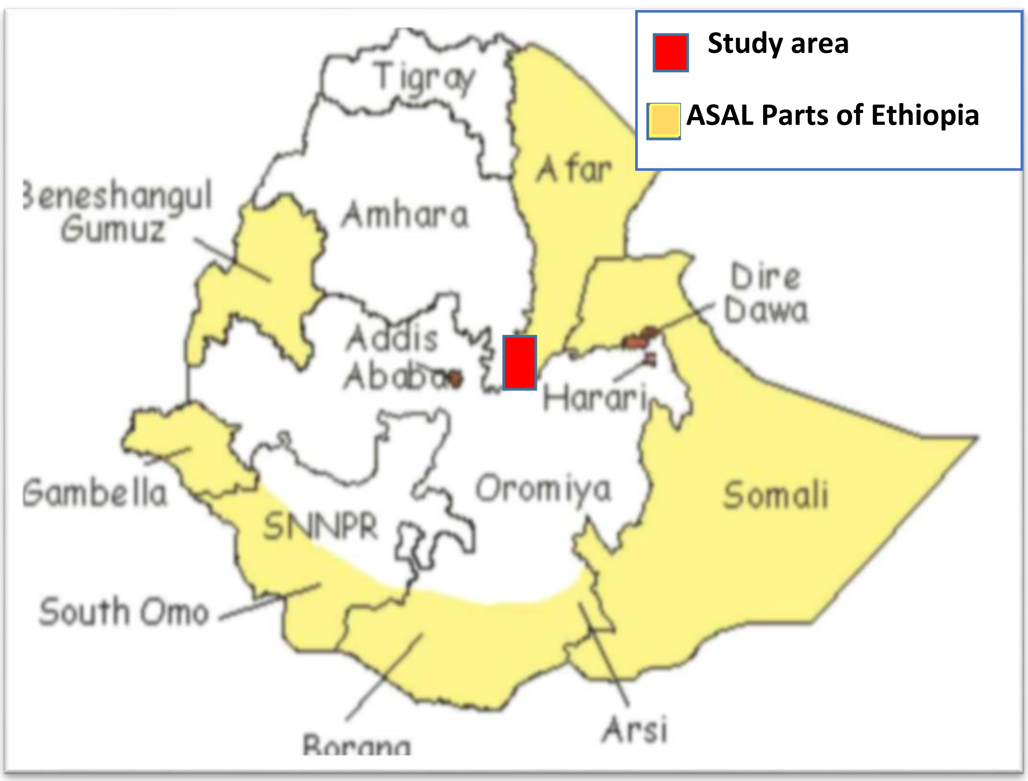


Figure 3.1: ASAL Regions in Ethiopia Indicated in Yellow

Source: Dagninet and Adugnaw 2020 page 4

Oromia is the largest Regional State in Ethiopia with 353,690 square kilometers of land area (32% of the country's land area) and estimated population of 40,524,973 (34.8% of the country's population) according to the 2021 Oromia Demography and Health (EDH/ODH). The region is divided into 17 zones, 245 districts, 36 town administrations and 6,500 sub-districts/villages known as *kebeles* (EDH, 2021). The Oromia National Regional State (ONRS) of Ethiopia is the most food insecure region. For instance, ONRS constitutes 44% of the 8 million people facing severe food shortage in the country in 2020, followed by Somali region (22%) and Southern Nations and Nationalities and Peoples Region (13%). Amhara, Afar and Tigray regions account for 10%, 5% and 5% respectively (Peng *et al.*, 2021).

More specifically, the study area focused on Arid and Semi-Arid Fantale and Boset Districts in East Shewa Zone of Oromia Regional State of Ethiopia. Fantale and Boset districts are located in Eastern part of Ethiopia's ASAL part in the Great Rift Valley region. Besides the stresses related to global climatic changes that perpetually affect these ASAL parts of Ethiopia and the frequent drought, dynamics due to land use policy change made the food insecurity situation in the districts more complicated (De Haan, 2016; Mulugeta & Habtemariam, 2011; Zeremariam & Bereket, 2013; Yidneckachew, Wisborg & Cochrane, 2023).

Fantale district is located at 7°12'-9°14'N latitudes at the distance of 190km from Addis Ababa; the capital city of Ethiopia. The district is pastoral area in the arid zone of the country although irrigation and crop farming has been introduced recently. Fantale district is bounded by Amhara region in the northwest, Boset district in the west, Marti district in the south and west Hararghe zone in the east (Edjeta, 2006; Hirko *et al*., 2020; Sileshi, 2017). Its yearly maximum temperature ranges from 32.0 to 42.0 degree centigrade while the minimum temperature ranges from 9.6 to 22 degree centigrade. The mean annual rainfall of the district is 553 millimeters and rainfall is very erratic and scarce, occurring 2-3 times yearly. The largest total rainfall of the area occurs during June-September and minor rainy season occurs between February and May (Beyene & Gudina, 2009; Edjeta, 2006).

According to data obtained from East Shewa Zone Irrigation and Pastoral Development Office, the total population of Fantale district was 102,262 (53,710 male and 48,552 female) in 2013 E.C. (2021/22) with a total land area of 133,964.66 hectares. Out of this land area 8,440 sq. km (5.97%) is privately owned farmland, 66,373 sq. km (46.91%) is grazing area, forest 450sq. km, communal grazing area 12,642 sq. km (8.94%), and others make up 53,987sq. km. The district has two big rivers, Germamaa and the Awash River. The Awash River, which is the second longest river in Ethiopia, drains both Fantale and Boset districts (Abule, Snyman, & Smit, 2005; Getachew, Degefa & Negussie, 2018). The river is used for irrigation (Edjeta, 2006; East Shewa Zone Irrigation and Pastoral Development Office unpublished manuscript).

There were 427,100 cattle, 333,890 camels, 486543 goats, 298654 sheep, 30,666 donkeys, 409 horses, 8 mules in the district in 2020/21 (East Shewa Zone Irrigation and Pastoral Development Office report). The district has 1 hospital, 4 health centers and 18 health posts. There are 6 commonly used small ponds cleaned and used to accumulate water from rain catchment which can be used for 3-4 months during dry seasons. The district drinking water coverage is 64%, livestock health service coverage 70%, and 16 pastoral training centers on 16 hectares of land. There are also 12 water wells for common use. Only 8 sub districts out of

20 have access to electric power and only one sub-district has a land telephone line (East Shewa Zone Irrigation and Pastoral development office unpublished manuscript).

Boset district is located at 8°39'59.99" north latitude and 39°29'59.99" east latitude on GPS, in the northeastern part of East Shewa zone in Oromia at distance of 125 kms from Addis Ababa. The district has a semi-arid type of climate; erratic, unreliable and low annual rainfall averaging between 649-900 mm. The minimum and maximum annual temperatures of the district have variation in the dry and hot lowland (arid) which makes about 89% of the district land and mid-highland area which makes 11% of the district land is 25°C -38°C and 15°C -20°C, respectively (Hirko et al., 2020; Getachew, Degefa & Negussie, 2018). The district is bounded by Fentale district in the East, Adama district in the West, Amhara region (Minjar district) at Norheast and Arsi Zone at South. Data obtained from Boset district Finance Office shows the district has 217,132 people (118,676 male and 96,456 female) in 2016. Yadeta and Yosef indicated that there were 243,459 cattle, 64,893 sheep, 189,516 goat, 10,050 horse, 758 Mule, 42,555 donkey, 28,980 Camel and 110,307 poultry in the district. Pastoralism, agro-pastoralism and crop farming are the main livelihood systems in the area. Major crops in the district (in order of importance) are maize, tomatoes, onions and ‘teff’ (Yadeta and Yosef, 2020).

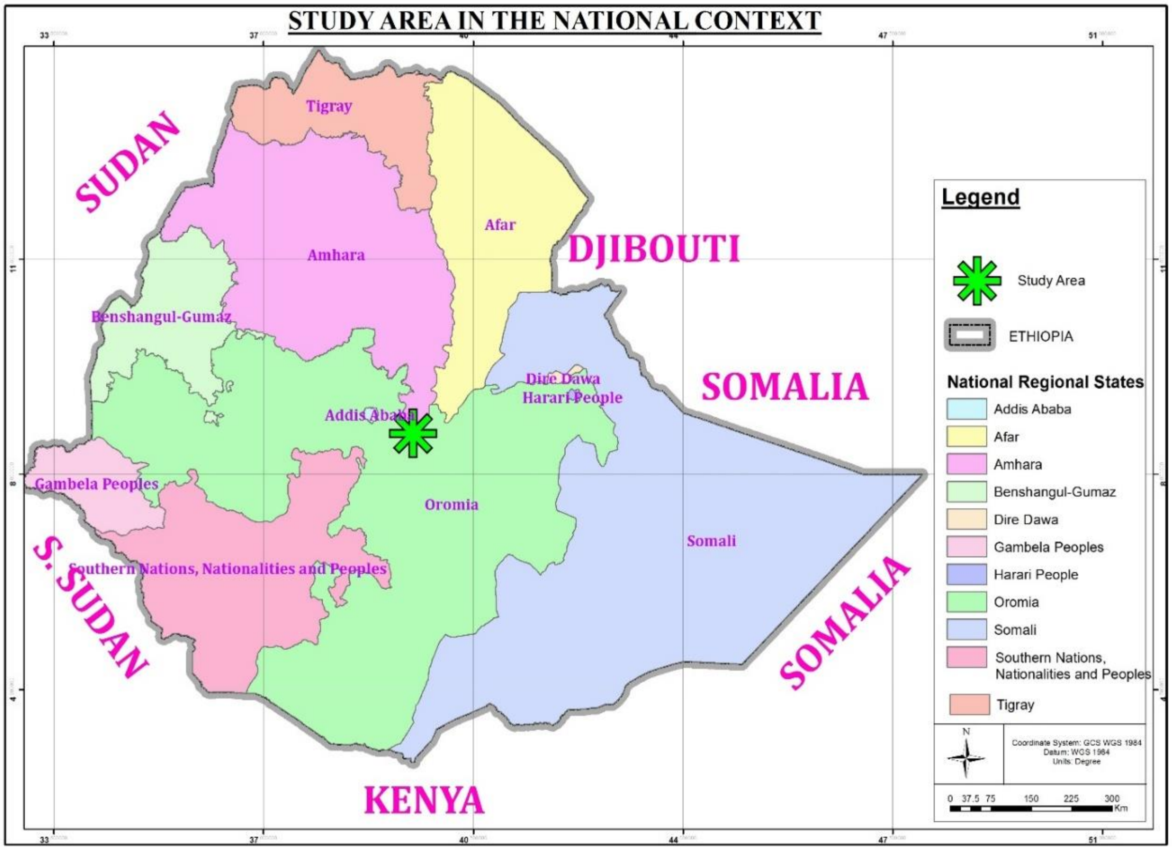


Figure 3.2: Map of the Study Area within the National Context

Source: Taken from DIVA GIS; https://www.diva-gis.org/Data and modified

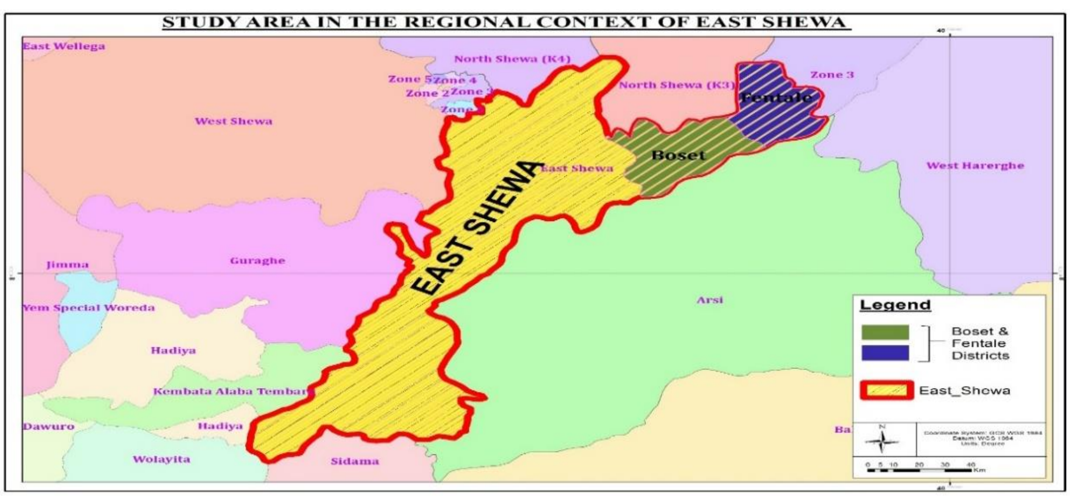


Figure 3.3: The Study Area in the Regional Context

Source: Taken from DIVA GIS, https://www.diva-gis.org/Data and modified

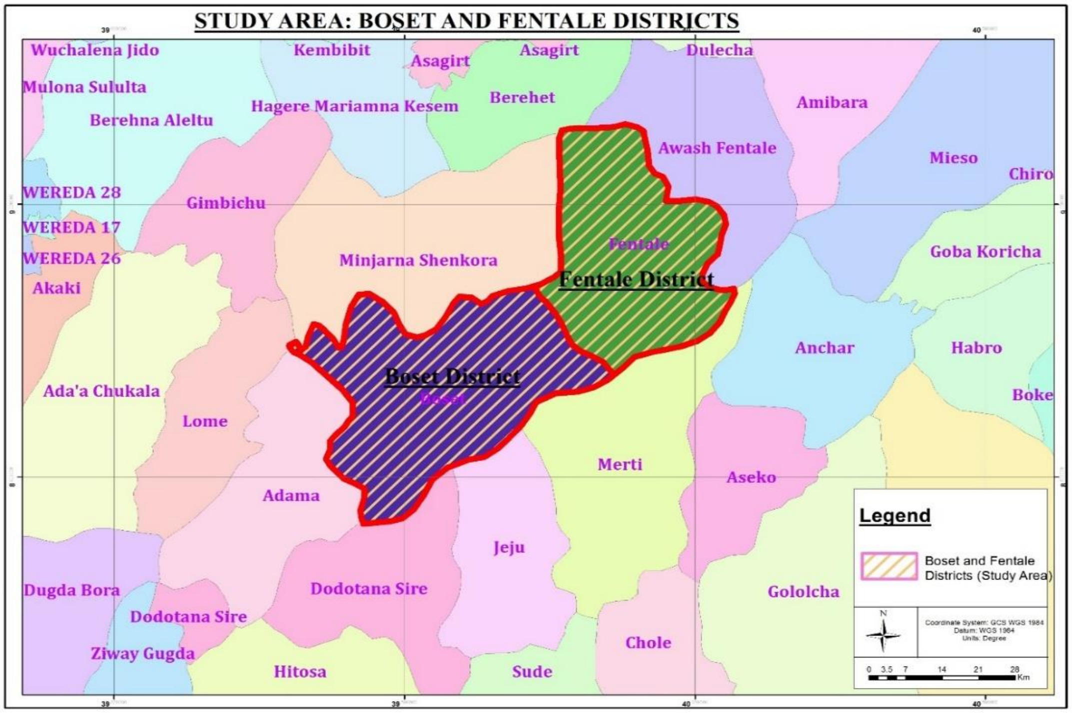


Figure 3.4: The Study Area; Boset and Fantale Districts

Source: Field Survey between Nov. 2021 and May 2022

In Fantale district, pastoralists make 80% of the population and only 20% are semi-pastoral. Karayuu mobile pastoralists occupy Fantale district predominantly but both agro-pastoral communities and crop farmers occupy Boset district. The Karrayyu clan pastoralists are one of the major nomadic pastoralists in Eastern Ethiopia and they belong to the Cushitic ethno-linguistic group (Edjeta, 2006; MoA, June 2014; Müller-Mahn, Rettberg and Girum, 2010; Fekadu *et al.*, 2016).

The Karayyu pastoral communities in Oromia region have indigenous knowledge system which provides the community with rich resource management system for optimizing production in the challenging dry land environments. The communities are organized in 'Gada System', an indigenous Oromo social structure that guides the socio-cultural, political and religious life of the clan (Asmarom, 2000; Firdissa, 2022). They depend on rainfall and natural resources for their livestock production (Müller-Mahn, Rettberg & Girum, 2010). However, recent political-ecological dynamics that caused land degradation, deforestation, drought, rainfall variability, and market failure aggravated food insecurity in the area besides the problem caused due to recurrent drought in the area and majority of the community in the districts depend on productive safety net programme (PSNP) (Easdale & Domptail, 2013, Mulugeta & Habtemariam, 2011; Sivakumar, Das & Brunini, 2005; De Haan, 2016).

3.4. Target Population

The study was carried out in Fantale and Boset districts in ASAL parts of East Shewa zone, Eastern part of Oromia region in Ethiopia. Fantale district has 20 *kebeles* (smallest administrative unit/villages) with 19,426 households (Data source obtained from East Shewa Zone Irrigation and Pastoral Development Office). Boset district has 42 *kebeles* with 39,206 households (See appendix 13 for the detailed list of number of households in each kebele). The target population for this study was all the 58,632 households in 62 *kebeles* in main localities that comprises rural setup.

The two districts were selected for the survey based on their geographical location in the ASAL parts, the increasing dynamics that have negatively influenced the food production system and the deteriorating food security situation. A large number of households depends on government aid in the two districts. In the past few years, frequent hazards and stresses such as drought, rainfall variability and flooding affected many *kebeles* in Fantale and Boset districts (MoA, June 2014). Besides the climatic challenges, there were increasing socioeconomic, environmental and institutional changes that affected food production systems of the pastoral and agro-pastoral communities in the two districts. Restricted access to land resource, restricted pastoral mobility, land degradation and conflicts over scarce resources affected household food production in this hostile part of the country and the pastoral and agro-pastoral communities in the area were the most vulnerable to food insecurity.

Table 3.1: Target Population

District	Number of Rural ‘kebeles’	Number of Households
Fantale	20	19,426
Boset	42	39,206
Total	62	58,632

Source: Boset District Finance Office and Fantale District Irrigation and Pastoral Development Office (2021)

3.5. Sample Size and Sampling Procedure

3.5.1. Sample Size

Sampling procedure was considered to make the sample accurate estimate representative of the population for inference. The sample size for the study was determined using Israel (2012) criteria and mathematical formula as shown below. A commonly used margin of error 5% and 95% confidence level was assumed to decide the sample size.

Therefore, the formula used to calculate the sample size of the study was:

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

Where

n = the sample size for the study

N = designates the total number of households in the districts which is = 19,426 (Fantale) + 39,206(Boset) = 58,632 HHs

e = designates the margin error or maximum variability which is = 0.05

1 = the probability of a household being selected

Using the above formula 397 sample rural households were selected for the study and a questionnaire was dispatched to all.

3.5.2. Sampling Techniques

The study sites were selected based on the agro climatic zones and people's livelihood basis. Purposive sampling, multistage cluster sampling and simple random probability sampling techniques were used in this study. Purposive sampling method was employed to select two typical arid and semiarid districts in East Shewa Zone of Oromia Regional National state, having large number of households depend on government aid, and dynamics such as land use policy change. Thus, Fantale (arid) and Boset (semiarid) land areas were selected from among the 10 districts in the Zone based on indicator of interest- their agro-ecological conditions being located in arid and semiarid area and dynamism situations. This strategy helps to gain greater insight to explore cases of typical arid and semiarid area household food insecurity situation (Kumar, 2011).

There are crop farming, pastoral and agro-pastoral areas in the districts (Fekadu *et al.*, 2016; Hirko *et al*., 2020). Multi-stage cluster sampling technique was employed to select the sample *kebeles*, and then corresponding households from each *kebele* (Bryman, 2012). The sample *kebeles* were categorized considering geographical regions and the people's livelihood basis on pastoral, agro-pastoral activities. Other factors such as security situation and accessibility were also taken into consideration in selecting the *kebeles*. In the case of Boset district the *kebeles* were clustered into primary sampling units. Then the clusters were selected based on the availability of pastoral, and agro pastoral then sample households were selected from each.

Accordingly, eight pastoral *kebeles*; Dhakaa Eddu and Xuxuxii, Galcha, Ebiti, Ilalaa, Sarana, Weba and Gara Dima were randomly selected from Fantale district for this study. In a similar way 17 agropastoral *kebeles* from Boset district; Sifa Bate, Kombe gugsa, Nura Hase, Marko Oda Laga, Rukecha Bokore, Tadacha, Geri Nure Dera, Borochota, Buta Bedeso, Buta Dongore, Dongore Chale, Dongore Furda, Hurufa, Dongore Xiyo, Golbo Bitimiti, Chamiri Jawis and Qawa Hara Mirkesa were selected at random from Boset district.

Finally, simple random probability sampling was employed to select sample households from the 25 selected *kebeles* using the household list provided from each district as a sampling frame. Respondents were selected using the table of random numbers procedure (Kumar, 2011) for each *kebele* based upon the list of households provided by the districts. This approach is helpful to ensure representativeness of sample and in case when the study population are scattered over a large area like Karayyu pastoral population (Banning, Camstra & Knottenrus, 2012 and Kothari, 2004). The optimum allocation of sample size was used to draw samples from Boset district due to the highly dispersed agro-pastoral households. To make the data unbiased due to non-proportional sample households' selection to size, sampling weight was calculated and incorporated in data analysis (Stukel, 2018).

Table 3.2: The Sample Size of the Study

District	Area	Total number of rural *kebeles*	cluster	Sample *Kebeles*	Number of sample households
Fantale	Arid	20	4	8	150
Boset	Semi-arid	42	3	17	247
Total		62	7	25	397

Source: Field Survey, Oct. 2021-April 2021

3.6. Instruments of Data Collection

Four major instruments of data collection were involved: focus group discussion guide, Key informant interview guide, survey questionnaire, and observation.

3.6.1. Focus Group Discussions (FGD)

This data collection method was used to explore participants' perceptions on their communities' food security situation and their observation of the dynamic changes that affected their food security sustainability and food security sustainability challenges in their districts (Kumar, 2011). Open-ended questions based on the objectives of the study were set and used to guide the focus group discussions. The focus group discussion was conducted for 25 minutes. The size of each group was limited to 10 participants for both FGD (one at each district) to make the group proportional and manageable as proposed by Cohen, Manion and Morrison (2007) size limit between 4 and 12 participants. The participants were representatives from farmers (3), elder (1), women (2), youth (2), district administration representative (1) and district agriculture/irrigation office representative (1). Their being residents in the study area for the last fifteen years was used as a inclusion exclusion criteria used to select FGD participants. Opportunities such as district level meeting schedule was used to get the participants from different *kebeles* at one place.

Farmer, elder, women and youth representative individual participants were selected purposively by drawing knowledgeable people from among men and women household heads and youth groups who had lived in the *kebeles* for at least 15 years and had information on food security issues. Elders are knowledgeable local community members who play many social roles in the village and in the case of Kararryu tribe they have religious and administrative roles according to the Gada System.

The assistant data collectors facilitated the focus group discussions. Recording, note taking and observation methods were used during the focus group discussions (Creswel & Creswel, 2018). Efforts were made to make the discussion participatory by encouraging each participant to give their view on each question. Participants' interaction with each other rather than with the interviewer was also encouraged so that views of the participants can emerge. This helped the researcher to capture the group's view (Cohen, Manion, & Morrison, 2007) on the food security situation, climatic, environmental, institutional and socioeconomic changes that affect their food production activities, their adaptation strategies and challenges to sustainable food security in the study area.

3.6.2. Key Informant Interview

Thirteen individuals from different regional, zonal and district levels offices including Agriculture and Natural Resource Development Buroeu and Irrigation and Pastoral Development office team leaders and food security experts were selected for interview. The key informants were interviewed face-to-face to get clear information and insights for data on food security situation in the study area, policy, social, economic and environmental issues as well as challenges faced to enhance sustainable food security in the study area. Structured questions were prepared to keep the uniformity of the data gathered so that it could be summarized easily (Bordens & Abbott, 2011).

Table 3.3: Regional, Zonal and District Offices Key Informants and FGD Participants

Bureau/Office	location	Position	Code
Key informants			
Oromia Regional State Agriculture and Natural resources Bureau	AA	Food security team leader	OANRBKI 1
		transfer & PW expert	OANRBKI 2
		Market development agency	OANRBKI 3
		Seed analyst	OANRBKI 4
Oromia cooperatives development agency	AA	2 marketing experts	OCDAKI 1 OCDAKI 2
Oromia Irrigation & Pastoralist Development Bureau	AA	Pastoral Development Team Leader	OIPDBKI 1
		Senior expert	OIPDBKI 2
East Shewa Zone Irrigation and Pastoral development Office	Adama	Team Leader	ESZPDIOKI 1
Fantale district agriculture Office	Matahara	Expert	FDAOKI 1
Boset district Agriculture Office	Walanchiti	expert	BDAOKI 1
Focus Groups			
Focus Group 1 Fantale District	Matahara	Representatives of agricultural office, elder, youth, women and farmers	FGDF1 youth representative FGDF2 youth representative FGDF3 District pastoral office FGDF4 District administration FGDF5 women's representative FGDF6 elder FGDF7 farmer FGDF8 women's representative FGDF9 Farmer FGDF10 Farmer
Focus Group 2 Boset District	Walanchiti	agricultural office representative, elder, youth representative, women's representative, farmers	FGDB1 Youth representative FGDB2 youth representative FGDB3 District administration FGDB4 district agriculture office FGDB5 women's representative FGDB6 farmer FGDB7 elder FGDB8 women's representative FGDB9 farmer FGDB10 farmer

Source: Produced by the researcher based on field survey and consultation with responsible bodies

3.6.3. Household Survey Questionnaire

A total of 397 questionnaires were administered to household heads of the sample households to solicit demographic information and household socioeconomic status to be used to validate the findings and to generate quantitative data on respondents' food insecurity experiences as well as socioeconomic, institutional and environmental dynamics that affected their food security sustainability, and challenges faced due to climate change, land use policy change, introduction of sedentary farming, restricted mobility and market dynamics in their districts. This tool was selected due to its advantages of greater chance to obtain accurate information and being a cost effective way survey a large sample number of individuals to generalized the finding. In areas where wider information was required, open-ended questions were included in the survey questionnaire to provide the respondents chances to express their opinion without being conditioned by the choices given by the researcher (Kumar, 2011).

Food Insecurity Experience Scale (FIES) questions with yes/no responses were included in the survey questionnaire to assess individual/household level food insecurity situation (see Appendix 1a Section 3). Household heads were asked to rely on their past twelve months experiences of their household food situation before the survey administered with the aim to capture household's dietary quantity and quality food access. The twelve month time length was selected to avoid bias that may occur due to seasonal variations (Ballard *et al*., 2014). In order to adapt to local situation and to avoid cultural and linguistic influences on how the questions may be understood by respondents (Ballard *et al*., 2014), the standard FIES questions were translated into local language *Afan Oromo* with care to maintain their original meaning and were included in the household survey questionnaire.

The FIES survey module was selected due to the many advantages it has. One of the major advantages of the scale is, it can indicate food insecure individuals or households and identify the severity level. It also provides estimates of food insecurity comparable across countries, cultures, sub population etc. The module captures the quality and quantity components of food access. It attends directly to the affected people's voice, can be administered in 5-10 munities, and it has been standardized and is valid to use in different settings. By using statistical models, it is also possible to improve the validity and reliability of FIES data. This survey module allows direct measure of people's food access through their lived experiences compared to the traditional indirect assessment of food security through food availability, signs of poor diet or malnutrition. Besides, when used with socioeconomic indicators, FIES data provides better understanding determinants and consequences of household/individual level food situation in specific contexts to inform effective action. FIES is also a tool used for SDG 2 global undernourishment monitoring (FAO, 2016; Ballard *et al*., 2014; Leroy *et al.*, 2015).

3.6.4. Observation

This method was used to gather information by listing and watching things in the study area. Observation of socioeconomic activities, infrastructure development and the situation of the natural environment were used to supplement the data gathered using different tools. Deliberations were conducted with government officials, experts and community representatives to back up the data using their inputs to the findings. Both the observation and the deliberations helped me to better understand what was happening environmentally, socially and economically at the study areas' households and the environmental and socioeconomic aspects of the community.

Secondary data obtained from government offices were used to gather background information on human and livestock population, land use, social support, issues of drought, climate change, rainfall, land tenure systems, farmers' socioeconomic organizations and other economic activities in the study area.

3.7. Validity and Reliability of Research Instruments

The validating process has been a continuous endeavor within the journey of the dissertation work. It mainly took place at critical stages and has remained part of the monitoring and evaluation processes. This is because validation can be fruitful when it is formative venture for the realization of new potentials rather than appearing as summative point in a program that leads to closure (McNiff, 2002). Consequently, the following deliberative activities were undertaken at different stages.

3.7.1. Triangulation

The different data collection instruments were used to triangulate and counter check the information gathered. Triangulation was used for quantitative validity. The survey questions were edited and commented on by colleagues who have expertise, professionals in the field and experts and the necessary corrections were made on the data collection tools before they were administered.

3.7.2. Cronbach Alpha Coefficient for Internal Validity

To increase its external validity, the theoretical analysis was included and the necessary care were taken to make the data collecting tools based on the generated theoretical arguments (Bryman, 2012).

Cohen, Manion, and Morrison (2007) reveal that internal consistency of a questionnaire can be found in the Cronbach alpha also referred as Alpha coefficient of reliability. According to them, Cronbach alpha gives a coefficient of inter-item correlations, that is, the average correlation among all the items in the survey questionnaire. Therefore, a Cronbach Alpha of above 0.7 is deemed reliable to test the reliability of the survey questionnaires and this was calculated to test the reliability among multi-item scales. Accordingly, the Cronbach alpha for the data sets of this study was calculated and was found 0.719 for eight FIES questionnaire to estimate household food security, and 0.73 for the 22 environmental and institutional survey questions, both of which are above o.7, and therefore they indicated that both sets of the questionnaire have internal consistency.

3.7.3. Pre-Testing of Instruments

Pre-Testing of the instruments was done at two stages. First, the instruments of data collection (the questionnaire, FGD and the interview guides) were given to three professionals (two food security, and one assessment professional) working at the Addis Ababa University. Whereas one of the food security professionals had reviewed the instruments and made face-to-face discussions with me, the other one returned all the instruments with some corrections and editorial works. The assessment professional, on the other hand, made a thorough review, made suggestions to remove some redundant questions, made some editorial works, and returned all the instruments. This stage served as a reconnaissance to enhance the clarity of the questions and to identify item content problems (Devellis, 2017).

All the three types of data collection tools were given to the assistant data collectors and enumerators at the two study districts (12 people) before the main data collecting process started.

Then discussion was made on each item in the questionnaires and FGD and interview guides. It was learnt from the discussions that there were problems of item clarity, simplicity, organization, and relevance to the objectives with some items.

Based on the professional inputs, and the lessons from the discussions, necessary refinements, modifications, and corrections were made on the instruments before the main data collection.

3.7.4. Assistant Data Collectors Training

Reliability can be improved by standardizing the condition under which data is collected. One of such methods research identified was training the assistant data collectors and enumerators to improve their reliability (Cohen, Manion, & Morrison, 2007, page 148 citing Schindler, 2001). Accordingly, four assistant data collectors and eight enumerators were selected carefully depending on their knowledge of the study site and community's language and culture as well as their experience in data collection. Both male and female enumerators were selected and sent in pair. Intensive orientation training was given on all the data collection tools and procedures of conducting the data collection process to reduce errors that might be committed during data collection (Kothari, 2004). The researcher dealt with the respondents that were willing to participate at their own convenient time so as to obtain the most reliable information. The survey objective was explicitly explained to the respondents to avoid response bias due to expectation of receiving food aid assistance (Ballard *et al*., 2014) from government or non-government bodies.

3.8. Data Cleaning and Analysis Processes

3.8.1. Data Cleaning Process

The questionnaire included both structured closed ended questions and open-ended questions. The data collected using the questionnaire was entered into SPSS version 26 and analyzed both quantitatively and qualitatively. Each of the properly filled and returned copies of the questionnaire was coded. Fifty-six replicated response papers were rejected but were in fact, refilled correctly and replaced in order to keep the sample size. Empty spaces counted as missing values were cleaned and all the other missing values were made 0 by taking corrective measures referring to the response papers or contacting the enumerators as well as through other statistically advised methods. There were also some skipped questions by respondents due to the instructions such as, 'If your answer to question 10 is "no," skip question 11,' which created missing data. These issues were corrected by adjusting the data entry process. Outliers that appeared unfit to the data such as age of respondent, size of land owned in hectare, number of horses owned, etc., were also filtered using frequencies to avoid non-logical values. These were replaced by mean values or by contacting the agriculture office of the districts for supportive information.

3.8.2. Quantitative Data Analysis

The Quantitative data were analyzed using descriptive and inferential statistics to draw empirical facts. Frequencies, percentages, averages, charts, tables and cross tabulations were used for descriptions of statistical summaries for demographic and socioeconomic characteristics variables of the study such as age, educational status, family size, geographic locations, occupation, income, livestock owned and land area owned. The data obtained using Food Insecurity Experience Scale (FIES) was used to analyze household food security situations.

Inferential statistics were used to statistically determine whether there exist a significant association between the socioeconomic, environmental and institutional variables and household food security sustainability as well as testing the hypotheses. Binary logistic regression model was used to determine the relationship between eleven hypothesized household socioeconomic factors, and the binary outcome of being food secure or food insecure (household food security situation). To assess the dynamics influencing sustainable food security in ASAL parts of East Shewa zone in Oromia Regional State of Ethiopia, ordinal logistic regression model was was applied to examine the association of the ten environmental variables and twelve institutional factors with household food security sustainability. The standard P-value <0.05 was utilized as an indicator for the existence of association between the dependent and independent variables. The use of these regression models allowed for a comprehensive analysis of how these socioeconomic, environmental, and institutional dynamics interact affecting the ability of households in the ASAL parts to achieve and maintain sustainable food security.

The effect of independent and moderating variables on the dependent variables was tested using three different regression analysis models (H_{o1}, H_{o2}, and Ho_3). For the first model (H_{o1}), the effects of the continuous and categorical independent household socioeconomic variables on their food (in)security (binary dependent variable) was tested using a binary logistic regression model. Both H_{02} that focused on determining the effect of the independent environmental variables and H_{03} for the moderating institutional variables, were tested using ordinal logistic regression model.

3.8.2.1. FIES Data Validity Test (Rasch Model Fit Assessment)

Nord (2014) noted that FIES data has to be assessed for its consistency with the Item Response Theory (IRT) also assumptions known as Rasch model test before using for estimating household or individual food security. FIES data that does not meet Rasch model assumption is not valid to estimate food security. The Rasch model was first developed to analyze response data obtained through tools such as students' tests, and attitude scales to obtain information on the difficulty of the questions and individuals' level of latent trait at the same time (Thorpe and Favia, 2012). The Rasch model has been widely applied by many researchers in food security studies to assess constancy of the survey data with assumptions of the model (Cafiero, Viviani & Nord, 2018; Gordon, 2015; FAO, 2016; Wambogo *et al*., 2018; Kharisma and Abe, 2019; Onori, *et al*., 2021).

In this study, the Rasch model was used to fit the FIES data set collected for estimating household food security in the study area by calculating Infit and Outfit statistics as well as Residual correlation values.

Infit and Outfit statistics help to compare observed and expected responses for each item to assess how well each FIES item discriminates compared to Rasch Model standard. This identifies the items that do not fit the model assumptions or that do not contribute much information to take measures for refining to fit better (Gordon, 2015).

The Rasch model assumption is that all items discriminate equally so Infit value 1 indicates good discrimination power of the item while value above 1 indicates the item is less sharper than the average of all the other items in discriminating. Infit value below 0.7 indicates the item is more associated with the condition being measured (food insecurity in this case). The standard possible value for good Infit is between 0.7 and 1.3, although high values between 1.3 and 1.5 can also be kept. Higher values indicate unexpected response patterns and hence poor item performance. Smaller fit values indicate the existence of multiple items that measure the same level of food insecurity. Such items have less value to the overall food insecurity measure and can be dropped from the scale if causing bias, otherwise be retained given the Infit is acceptable. Therefore, the items that may not fit the standard have to be dropped from the scale but to the minimum number of items not less than six (Nord, 2014).

Statistically;

$\text{Infit}_{(i)} = \text{SUM}\ [(X_{i,h} - P_{i,h})^2]/\text{SUM}[P_{i,h} - P_{i,h}^2]$

Where:

SUMs = taken for the item across all non-extreme cases

$X_{i,h}$ = household h response to item i

$P_{i,h}$ = the probability of an affirmative response by household h to item i (Nord, 2014).

Outfit values indicate any deviance from the assumption and unexpected responses given due to poor understanding of the question or translation problem that caused erratic responses and outliers in the data and are calculated by comparing the actual response to the expected responses to each item. For FIES data with eight item questions outfit value >2 is considered high. The expected pattern is “Yes”, to the less severe item followed by “No” to the more severe item but the reverse response pattern is unusual (FAO, 2016; Nord, 2014).

Thus,

$\text{Outfit}_i = \text{SUM}\ [(X_{i,h} - P_{i,h})^2 / P_{i,h} - P_{i,h}^2\ )]\ /N$

Where:

SUM = Item across all non-extreme cases

$X_{i,h}$ = Observed response of household h to item i

$P_{i,h}$ = the probability of an affirmative response to item i by household h

N = number of households (Nord, 2014).

Residual correlation value between pairs of FIES items in the matrix with multidimensionality of the items was also assessed to check for item independence. Correlation value greater than |0.4| between a pair of items indicate they are not independent of each other, and lower correlation (≥ 0.25 - < 0.4) between three or more adjacent items shows the items measure multiple traits. When the residual correlation assessment result shows such values of dependent and multidimensionality for the data, it indicates the scale are overlapping in meaning and the items have low capacity to measure the different behaviors they were supposed to measure. Hence, the model is less accurate measure of the latent trait. This might be due to the way the respondent understood the questions or cultural experiences (Nord, 2014).

The Rasch model has advantages compared to other statistical techniques because the model uses the probability concept to estimate the probability level for each item, which facilitates the generation of results for across samples and items.

Accordingly, the fit values for data obtained using FIES tools to estimate food security in this study area were calculated to evaluate the performance of the items; their association and consistency to measure the trait they were supposed to measure and checked with the Rasch model standard values. The results for Infit, Outfit and Residual correlation values showed that the FIES survey data set was fit to the model.

After validating the model fit, the sum of affirmative FIES responses was used to estimate the severity of household food insecurity based on FAO-defined thresholds (FAO, 2016). Households with a sum score of zero were categorized as food secure, while those with scores from 1-4 were classified as mildly food insecure, 4-6 as moderately food insecure, and 7-8 as severely food insecure (Ballard, Kepple & Cafiero, 2013; Ville, 2019). Similarly, the individual level food insecurity severity was calculated using a minimum threshold of affirmative row score 4 for food insecure ($FI_{mod. + Sev.}$), and minimum affirmative row score of 7 for severe food insecure ($FI_{sev.}$) based on suggestions from various food security studies (Ballard, Kepple & Cafiero, 2013; Wambogo *et al*., 2018; Smith, Rabbitt & Coleman-Jensen, 2017) to obtain information on the progress towards Sustainable Development Goals (SDG 2.1) for ending food insecurity by 2030. This approach was expected to ensure a robust and valid assessment of household food security status in the study area.

3.8.2.2. Binary Logistic Regression Model

In this study, eleven household socioeconomic variables were hypothesized to have association with their food security based on literature review (FAO, 2016, Maxwell *et al*., 1999 & Akbari, *et al*., 2022). Table 3.4 on page 130 shows a binary dependent variable (food secure and food insecure) and the hypothesized household socioeconomic explanatory variables used in the analysis.

Table 3.4: Variables used in the Binary Logistic Regression Model

Variables	Description
Dependent variable	
Food security status	1 if respondent is food insecure 0 otherwise
Independent variables	
District	1 if Fantale 0 if Boset
Sex	1 if the respondent is male otherwise 0
Age	Households age category
Educational status	1 if the respondent is literate otherwise 0
Household family size	Household's family size category
Land owned in hectare	Household's land owned category
Non-farm/off farm income	Non-farm/off farm income category
Household's per capita livestock owned	Household's per capita livestock owned category
crop farm/irrigation	1 if yes otherwise 0
Support from family, relatives, community	1 if yes otherwise 0
Government and non-government support/aid	1 if yes otherwise 0

Source: Based on literature review

Binary logistic regression was selected because it is appropriate to model the relationship between binary dependent variable and one or more predictor continuous or categorical variables (Austin & Steyerberg, 2012). A number of food security studies including Fekadu and Mequanent (2010), Kharisma and Abe (2019), Khan, *et al*. (2022), Ngema, *et al*. (2018) and Getachew, Degefa and Negussie (2018) have employed this model to assess the association of socioeconomic factors with household food security.

Each household food security status was coded as 1 if the individual experienced mild, moderate or severe food insecurity (sum of FIES row scores from 1-8) and 0 otherwise if food secure and the dependent variable food security status was transformed into a binary measure for use of statistical analysis in this study. Except the dummy ones, the explanatory variables were also categorized in order to make them fit to the selected empirical data analysis method.

The logistic regression model was utilized to estimate the log-odds of a household being food insecure based on the 11 socioeconomic variables identified as predictors. The model allows to assess how each of these factors contributes to the likelihood of a household being food (in)secure. Binary Logit model assumes linear relationship between the odds ratio and each explanatory variable. When expressed in terms of log odds; to model the relationship between household food security status and the independent variables hypothesized to have influence on food security, the log odds of the probability that a household is food secure (P_i) (for the binary outcomes value of 1 = food insecure and 0 = food secure responses). The Hypothesis was modeled as:

Null Hypothesis (H_{01}) : There is no significant relationship between household socioeconomic factors and their food security in the ASAL parts of East Shewa zone.

The hypothesis states that none of the explanatory variables (X_1, X_2,…,Xn) have a significant effect on the probability of a household being food secure. In the context of this study, this means that changes in the household socioeconomic variables do not affect the log-odds of food insecurity.

This implies that changes in the predictor variable (socioeconomic factor) Xn do not affect the log-odds of the outcome Y (household food security status).

The Model Equation is:

$$\text{Log}\ [P/1\text{-}P] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \_\ \_\ \_ + \beta n X n,$$

Where:

- P is the probability that the household is food secure
- 1-p is the probability that the household is food insecure
- β_i is coefficient of explanatory variable to be estimated and
- $X_i \ldots X_n$ explanatory variables (Kharisma and Abe, 2019 and Perraillon, 2019).

Alternative Hypothesis (H_1): There is significant relationship between household socioeconomic characteristics and their food security in the ASAL parts of East Shewa zone. This states that at least one of the explanatory variables ($X_1, X_2, \ldots, Xn$) does have a significant effect on the probability of a household being food insecure. This means that there is at least one socioeconomic factor where changes in that factor do affect the log-odds of food insecurity.

3.8.2.3. Ordinal Logistic Regression Model

Ordinal logistic regression was employed because respondents' ratings, of the influences of environmental and institutional drivers on their food security sustainability using a 5-point Likert scale, are ordinal, meaning they have a natural order (from low impact to very high impact) but the intervals between the categories are not necessarily equal.

Ten environmental and twelve institutional variables were identified based on literature review (Béne, *et al*., 2019; Tendall, *et al*., 2015; Akbari *et al*., 2022), and in consultation with experts at Oromia regional state Natural Resource and Agricultural Development Bureau.

Temperature variability, rainfall variability, soil fertility decline, land degradation, biodiversity loss on privately owned land, biodiversity loss on communal land, livestock disease, natural disaster such as wildlife and flood, shortage of water and human disease were hypothesized for environmental dynamics that influenced food security sustainability in the study area. Land use policy change, expansion of urban areas, restricted mobility, lack of access to credit, trade restriction, food price volatility, livestock price fluctuation, poor market facilities and infrastructure, lack of access to extension services, lack of technology use, conflict, and cooperatives involvement in market were hypothesized to be key environmental and institutional dynamics that drive household food production activities and influence household food security. These factors are critical dynamics that can either enhance or hinder a household's ability to achieve and maintain food security. For instance, land Use Policy Change might affect household access to farmland or grazing areas influencing food availability.

The primary focus here was to explore environmental and institutional factors in the dataset that could further explain the associations identified so far. This technique enabled the researcher to predict the dynamics (environmental and institutional) that were interacting with household food production activities to determine the outcomes (household food security as well as social and environmental welfare).

The hypotheses were modeled as:

H_{02}: The environmental factors have no significant effect on the sustainability of household food security in the ASAL parts of East Shewa zone.

H_{03}: The institutional factors have no significant effect on the sustainability of household food security in the ASAL parts of East Shewa zone.

This implies that changes in these variables do not influence household food security sustainability.

The Model Equation is:

$\text{Log } P(Y \leq j)/P(Y>j) = \alpha_j - (\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n)$

Where:

- Y is the ordinal outcome (level of influence on household food production activities)
- α_j are the thresholds or intercepts for each cumulative response. They are specific to each category j of the ordinal outcome variable Y
- β_i are the coefficients for each moderating variable
- X_i are the moderating variables (Hosmer, Lemeshow & Sturdivant, 2013).

Alternative Hypothesis (H_2): There is significant relationship between the environmental factors and household food security in the ASAL parts of East Shewa zone.

Alternative Hypothesis (H_3): There is significant relationship between the institutional factors and household food security in the ASAL parts of East Shewa zone.

This hypothesis suggests that at least one of the institutional factors does have a significant impact on the sustainability of household food security. This means that certain factors may increase or decrease the likelihood of a household achieving and maintaining sustainable food security.

3.8.3. Qualitative Data Analysis

Thematic analysis was employed to analyze the qualitative data collected through focus group discussion, open-ended questions and key informant interview (Kumar, 2011). The themes and subthemes were developed from transcripts of qualitative data collected based on the objectives of the study. Thematic analysis helps to examine the variables based on insights of the respondents for in-depth understanding. The qualitative data were mainly used for triangulation to improve the validity and reliability of the variables under study.

3.9. Ethical Considerations

In the journey of the study, efforts were made to protect the research participants and maintain ethical standards. Since the study has involved many individuals in different capacities: as respondents, informants, and focus group duscussion paricipants; utmost efforts were made to protect the identities and moral values of these research participants.

Informed consent: In the first place, all the necessary explanations were given to the respondents before delivering the questionnaire and clear information about the purpose of the study were provided for specific data collection tools. The same procedure was followed during the interview and FGD sessions as well. This was also clearly stated in survey questionnaire and FGD as well as interview guide (see Appendices 1a, 1b and 1c). The approximate time investment to answer the questions and the envisaged confidentiality of the responses were clearly articulated.

Anonymity: utmost efforts were made to maintain the anonymity of the research participants. The information the research participants provided by no means could reveal their identities. This was done in the first place by politely warning the respondents not to write their names on any page of the questionnaire. Second, the identities of the respondents were concisely coded against numbers. The returned copies of the questionnaires were also consecutively numbered and matched with the already assigned codes, and then the lists relating the two were kept in an entirely safe place. In a similar way for interviewees and focus group members, names were disassociated from responses during the coding and recording process (see Table 3.3 on coding for informants and FGD). Codes were used for individuals to protect the identities of participants (creswell & Creswell, 2018).

Confidentiality: Efforts were made to protect the research participants' rights to privacy. This was adhered to a promise statement, which was made on the data collection tools (see Appendices 1a, 1b & 1c).

Procedural Rigor: Care was taken to maintain the rigor of the procedures in relation to preparing and administering the tools for data collection, in selecting appropriate participants, in collecting data, in meticulously sorting out and analyzing the data, and validating the findings.

The researcher also obtained support letter from Moi University, Addis Ababa University and the government structures at three levels (see Appendices 14-19); the regional, zonal and district level agriculture and natural resources and irrigation and pastoral development offices to gain attention of *kebele* level government structures and community including the study areas clan leaders and study community. To reduce invalidity the researcher made a clear introduction by explaining the purpose of the data collection as stated on each questionnaire (see Appendices 1a, 1b & 1c) to avoid bias. Formal and clear self-introduction was made by showing the research permit letter and clarification of the purpose of the study at each level starting from the regional, zonal and district level agriculture and natural resources and Irrigation and pastoral development offices to build trust.

Overall, utmost possible ethical rules have been considered to ensure that the research is conducted in an ethical manner maintaining consent, respect/moral principle, anonymity, confidentiality, and procedural rigor. This was done among others, through coding the data collection tools, responses, and anonymously maintaining the identities of individuals and groups, and in making the codes exclusive, exhaustive, and consistent; in systematically handling deviants and those who refused to participate as data sources without offending and/or embarrassing them.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1. Overview

This section deals with data presentation, analysis, and interpretation based on the research objectives, questions, and hypothesis.

4.2. Response Rate

Out of the 397 copies of the questionnaire dispatched to the respondents, 374 (94.2%) were correctly filled in and returned, which graded excellent to use the data for generalization according to Mugenda (Mugenda, 2008 cited in Gatobu, 2021 page 92). The high response rate was achieved by explaining the benefits of the questionnaire, the strategy using enumerators who contact each respondent and help filling the questionnaire as majority of the respondents can not read and write and collect the response papers at the same time or wait until the respondent fills and collect the response papers right away.

4.3. Respondents' Demographic and Socio-economic Characteristics

An attempt has been made to analyze the demographic and socioeconomic characteristics of the respondent households in the study area to have a general overview of the study population and to understand their socioeconomic characteristics. The descriptive analysis results of the household characteristics are presented below.

4.3.1. Respondent's Gender

A comparison of the respondents' gender, male and females have been presented in Table 4.1. The Table shows majority (78.4%) of the respondents were males, whereas just 21.9% were female. This could be due to the fact that the data were collected from household heads.

Table 4.1: Respondent Household Head's Gender

District	Respondent's Gender	
	% of Male	% of Female
Boset	77.7	22.3
Fantale	79.1	20.9
Both	78.4	21.9

Source: Field Survey between Nov. 2021 and May 2022

Table 4.1 further shows that from the two districts, the percentage of women household heads was higher in the agro-pastoral area of Boset (22.3%) as compared to that of the pastoral district of Fantale (20.9%), which probably could be due to the limitations in resource access and security issues for women in the case of ASAL parts pastoral production style. The finding of a study conducted by Little *et al* (2011) in pastoral areas of East Africa indicated that violence during conflict and livestock raids in pastoral areas affect more female herders than male ones.

4.3.2. Respondent's Age

The respondents' age was solicited, and the results have been presented in Table 4.2 showing range, average, and percentages. As can be seen from the Table, the majority (66%) of the respondents were in the adulthood age range (40-64 years), which is the working age category, followed by the age range of 22-39 years (23.3%) designating the young age category. Only 10.7 % of the respondents were 65 years and older, which is the retirement category according to the country's work force age structure. This indicates that the study area had work force resources for further economic activities in the area, and the availability of the young age group is an opportunity to diversify the economic activities for climate resilience.

Table 4.2: Respondent Household Head's Age

Age Range	Both Frequency	%	Fantale Frequency	%	Boset Frequency	%
Average	48		44.7		50.2	
22-39	87	23.3	50	33.8	37	16.4
40-64	247	66	90	60.8	157	69.5
>64	40	10.7	8	5.4	32	14.2
Total	374	100	148	100	226	100

Source: Field Survey between Nov. 2021 and May 2022

Studies claim age as a factor for better productivity among livestock keeping communities in Ethiopia due to the benefit of accumulated knowledge and experience for the traditional pastoral production system (Tagesse *et al*., 2021; Amwata, Nyariki & Musimba, 2015). In the pastoral area of Fantale 33.8% of the respondents were in the age range 22-39, 60.8% were in the 40-64 years age range and only 5.4% were more than 64 years of age (Table 4.2 above). In the case of Boset district 16.4%, 69.5% and 14.2% were in the age range 22-39, 40-64 and more than 64 years old respectively. In this case, the majority of the study area population seemed to lack the maximum skill and knowledge for pastoral productivity.

4.3.3. Average Household Size

Through a field survey between November 2021 and May 2022, the average number of children per household in the study area was secured, as can be seen from Table 4.3 below.

Table 4.3: Average Household Size and Labor Contribution per Household

District	Average household size	Average labor contribution per household
Boset	5.7	3.41
Fantale	6.9	3.45
Both	6.2	3.43

Source: Field Survey between Nov. 2021 and May 2022

As can be depicted from Table 4.3 on page 140, the average number of children per household in the study area was 6.2, which is higher than the national average, which was 4.05 (WDAE, 2020). The majority of households (57.5%) have between 5-8 children (see Appendix 5). The average number of children in the study area was found to be larger for Fantale pastoral households (6.9 for Fantale and 5.7 for Boset). In the same vein, the average labor contribution for the study households was 3.43 which nearly equals half the average household family size. This means the number of non-working members of the household was very high which indicates a high dependency ratio.

4.3.4. The Respondents' Literacy Rate

As can be seen from Table 4.4 below, the literacy rate for the study population was lower than the national level average for adults (50%). It shows 30% of the respondents in the study area had basic literacy skills (can read and write). Boset district had a better (i.e. 39%) adult literacy rate than that of Fantale district, which was far below (i.e. 17%) than that of Boset and the national average. A possible explanation for this very low literacy level for the district could be the fact that Fantale pastoralists' mobile way of life limited their access to education and other social services.

Table 4.4: Literacy Rate of Respondent Household Heads'

District	% of respondent Household head literacy rate	
	can read & write	can't read & write
Boset	39	61
Fantale	17	83.9
Both	30	70

Source: Field Survey between Nov. 2021 and May 2022

The available source also indicates that the enrolment rate in pastoral areas was 74%, 16% and 14% for primary (grades 1-6) upper primary (grades 7 and 8) and secondary (grades 9-12) schools, respectively while the percentage was higher for schools in non-pastoral areas; 99%, 97% and 25% for the same grades (FDRE PDC, 2021). Rettberg *et al (*2017) claim that although investment in social infrastructure in areas such as education and health improved during the last decade, the school enrolment rate in the ASAL parts of Ethiopia has remained lagging behind the national average.

4.3.5. Respondents' Average Age in Years, Number of Children and Literacy Rate

The quality of life indicators for the study households were examined by way of securing data on the respondents' average age in years, number of children, and literacy rate as can be seen from Table 4.5 below.

Table 4.5: Respondents Average Age in Years, Number of Children and Literacy Rate

District		Fantale	Boset	Both	National*
Average age in Years		44.7	50.23	48	65.5
Av. number of children per household		6.9	5.7	6.3	4.05
Literacy Rate	Can read and write	17	39	28	50
	Can not read and write	83	61	72	50

✱ FDRE PDC, 2021; WDAE, 2020

Source: Field Survey between Nov. 2021 and May 2022

As can be seen from Table 4.5 above, the average age in years of the respondents was 48 years (44.7 and 50.23 for Fantale and Boset, respectively) which was lower than that of the country, which was 65.5 years of age in 2019 (FDRE PDC, 2021). Wealth (income), knowledge (number of years in schooling) and health (life expectancy at birth), indicate human development as utilized by UNDP. Although the indicators in Table 4.5 on page 142 may not indicate human development, which is more indicated by income level, they show low quality of life for the study area population, and as Sen also indicates, life expectancy and illiteracy are in fact connected to low income and could indicate low human development indirectly (Sen, 2001). Thus, Table 4.5 indicates low quality of life in the study area and could indicate low human development indirectly. Thus, life expectancy was lower in the pastoral area of Fantale relative to agro pastoral area of Boset district. In the same vein, fertility was found to be high in Fantale District (6.9) while it was 5.7 for Boset District and the adult literacy rate for Fantale was 17% as compared to 39% for Boset district and 50% at the national level. In general, the result shows that the quality of life indicators for the study area households were worse than the national average.

4.3.6. The Respondents' Religion

As can be seen from Table 4.6 on page 144, the majority (81.8%) of the pastoralists were Muslims, just one (0.7%) orthodox, and no protestant pastoral household. This indicates that the pastoralists who were predominantly Muslims, are highly preservative communities due to the role of long aged 'Gada System' that maintained both socioeconomic, religious, and cultural system for centuries. *Waqefata* is an indigenous and Cultural and social asset of the Oromos aimed to adhere to the earlier Oromo religious practices as a symbol of unity for all Oromo tribes.

Table 4.6: Respondent's Religion by Occupation

Religion	household's livelihood basis/occupation			Total count	Percent
	Agropastoralist	Farmer	Pastoralist		
Muslim	37(17.13%)	6(28%)	112 (81.1%)	155	41.4
Orthodox	72(33.3%)	7(33%)	1(0.73%)	80	21.4
Protestant	62(28.7%)	5(23.8%)	0 -	67	17.9
Waqefata	45(20.8%)	3(14.3%)	24 (17.5%)	72	19.3
Total	216	21	137	374	100

Source: Field Survey between Nov. 2021 and May 2022

The table further shows that the majority (155, i.e. 41.4%) of the respondents were Muslims, followed by 80(21.4), 72(19.3%), and67 (17.9%) orthodox, protestant, and *Waqefata* respectively.

4.3.7. Occupation

Occupation wise, it can be seen from Table 4.7 on page 145 that the majority (57.8%) were agro pastoralists followed by pastoralism (36.6%) as the major livelihood basis in these ASAL parts in spite of land policy change and decades of effort to replace these livelihood systems with sedentary crop farming, which remained practiced by an insignificant number (5.6%). Out of the 20 farmer respondents, 15 were from Boset and only five were from Fantale district. This implies that Ethiopian government’s effort to replace farming as a livelihood pathway in the ASAL parts for about the last five decades was not much accepted among the pastoral and agro- pastoral communities despite all the constraints they were facing.

Table 4.7: Household's Occupation by Respondent's District

Household's occupation	District		Both
	Fantale	Boset	
Agropastoralist	5 (3.4%)	212 (93.8%)	217(57.8%)
Farmer	6 (4.1%)	14 (6.2%)	20 (5.6%)
Pastoralist	137 (92.6%)	-	137 (36.6%)
Total	148(100%)	226 (100%)	374 (100%)

Source: Field Survey between Nov. 2021 and May 2022

A study conducted by Feyera in 2021 in Mieso district, West Hararghe Zone, Oromia Regional State in Ethiopia on the “Effects of climate change and adaptation strategies among pastoralists and agro-pastoralists” has come out with almost similar livelihood patterns in the area, with pastoralists making 65.76%, agro-pastoralists 28.4% and other businesses such as petty trade 5.7%. The variation for the existence of households’ occupation in non-farm activities in this part could be due to the existence of cash crop and the areas proximity to Djibouti through which smuggling activities are common.

Pastoralists have cultural and social ties to their traditional food production system and delay adapting to the linear pathways such as settled farming and irrigation, as showed in Table 4.7 above. Farming is considered inferior among pastoral communities, and it is related to the loss of livestock assets, which is the expression of economic position in that community. Thus, the Karayyu communities have respect for pastoral ways of life and strive to maintain their traditional occupations, and livestock rearing is still the major livelihood basis in the ASAL parts of Ethiopia (Abera & Aklilu, 2012).

Previous studies by Sandford and Habtamu (2000) indicates that Ethiopian pastoralists have less involvement in non-pastoral activities such as petty trade, and they gain a low level of income. Similarly, Abera and Aklilu (2012) indicate pastoralists have started petty business and livestock trading in the village. They buy and sell within the village or in the district town, and women have started selling butter and milk when available to purchase household utensils as a response to climate change that caused shocks and droughts, but Karayyu had no business center in the district town or elsewhere. Nevertheless, key informants of this study indicated that recently a very few well-to-do pastoralists have started businesses in towns, including hotel construction, as an additional income source.

The situation in the study area shows development impetus that could stimulate the ASALs communities' economic diversification has not developed yet in these areas, and the traditional livelihood activities remained sole economic activities of the people. From personal observation, the researcher also realized economic activities are mainly based on traditional ones and natural resources based, such as selling firewood and charcoal. Therefore, extending amenities to foster local product-related economic activities and provide income diversification opportunities could improve household coping capacities against food insecurity (Wekwete, 1988).

4.3.8. Occupation by Respondent's Gender

Table 4.8 on page 147 further shows that the majority of the pastoralists were male household heads, indicating that women have limited access to livestock rearing, which is the major economic activity in the area. The possible explanation could be the existing gender biased cultural influence on women and challenges such as conflict and animal raid that could affect females more, as discussed in the previous section under Table 4.2 although further investigation is needed.

Table 4.8: Occupation by Respondent's Gender

Household's occupation	Household head/respondent's Sex		
	male	Female	Total
Agropastoralist	170 (78.7%)	46 (21.3%)	216 (57.8)
Farmer	16 (76.2%)	5 (23.8%)	21 (5.6%)
Pastoralist	108 (78.8%)	29 (21.2%)	137 (36.6%)
Total	294(78.6%)	80 (21.3%)	374 (100%)

Source: Field Survey between Nov. 2021 and May 2022

4.3.9. Household Owned Land Size

As can be seen from Figure 4.1 on page 148, the descriptive analysis of the household socio-economic data disaggregated by district shows 50% of the households in Fantale district owned less than 0.25 hectares of land in 2021. This shows land fragmentation. However, the majority of households in Boset district owned land size larger than 1.75 hectares during the same year, although the trend showed a decline from 58% of households in 2004/5 to 52% of the households in 2020/21. In Fantale district, only 4% of households owned above 1.75 hectares. Privately owned land size increased by 0.26 between 2004/5 and 2017/18 but has remained almost the same during the last four years. The average area of land owned increased from 0.98 to 1.24 hectares per household between 2004/5 and 2017/18 but has remained 1.24 hectares between 2017/18 and 2020/21 (see Appendix 6). The average holding per household in the study area was larger than 0.84 hectares of the national average for rural households in Ethiopia (EFDR CSA, 2021). Adugna *et al.* (2021) who conducted a study on "Large scale land investment and food security in agro-pastoral areas of Ethiopia" indicated that the average land size owned per household was 0.9 hectares, which is smaller than the land size owned by the households in this study.

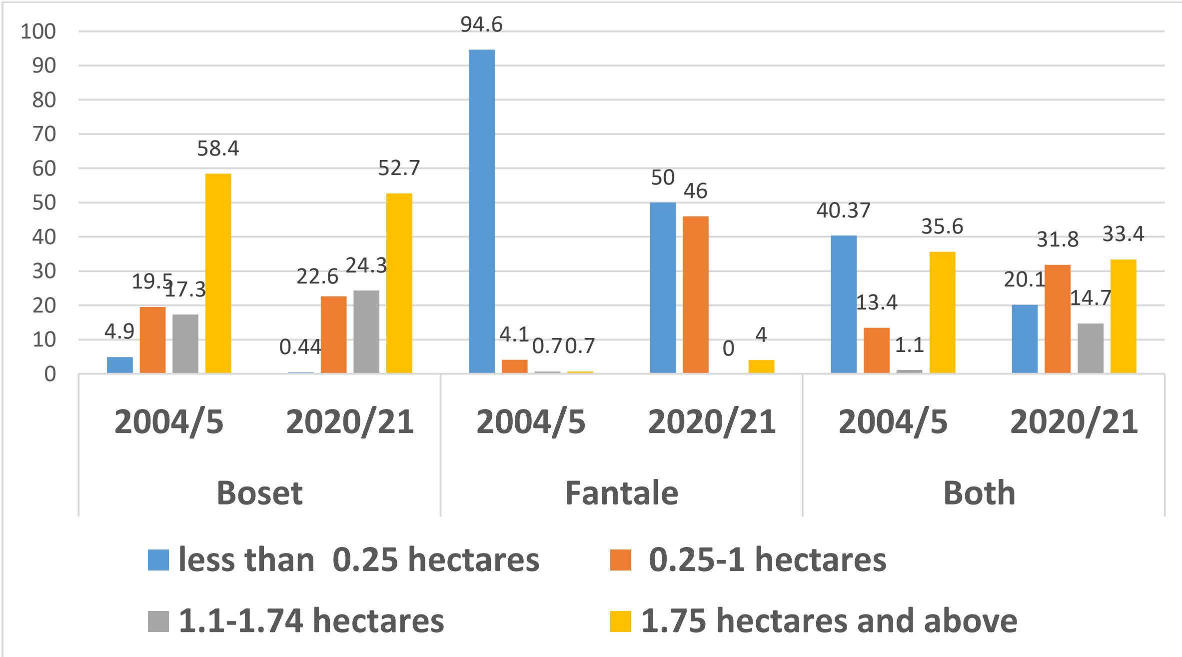


Figure 4.1: The Ternd of Privately Owned Land Size in Hectares (2005 & 2021).

Source: Field Survey between November 2021 and May 2022

Figure 4.1 above shows that privately owned land size by a household has improved in both districts over the last 15 years (increased by 0.13 and 0.39 in Boset and Fantale districts, respectively) and the number of households who have no land decreased from 139 in 2005 to 74 in 2020/21 in Fantale district. However, the majority of the households owned land size less than 0.25 hectares and disparity in the size of land owned among the households has remained very wide in both districts.

4.3.10. Household Access to Communal Grazing Land

As can be seen from Figure 4.2, the size of communal grazing land area declined dramatically during the last couple of decades. It declined by 52% (62% for Fantale district) during the last

15 years. Evidence from a recent study by Adugna *et al*. (2021) indicated the decline of pastoral grazing land size in Fantale district from 150,000 hectares, to only 40,000 hectares supporting this finding.

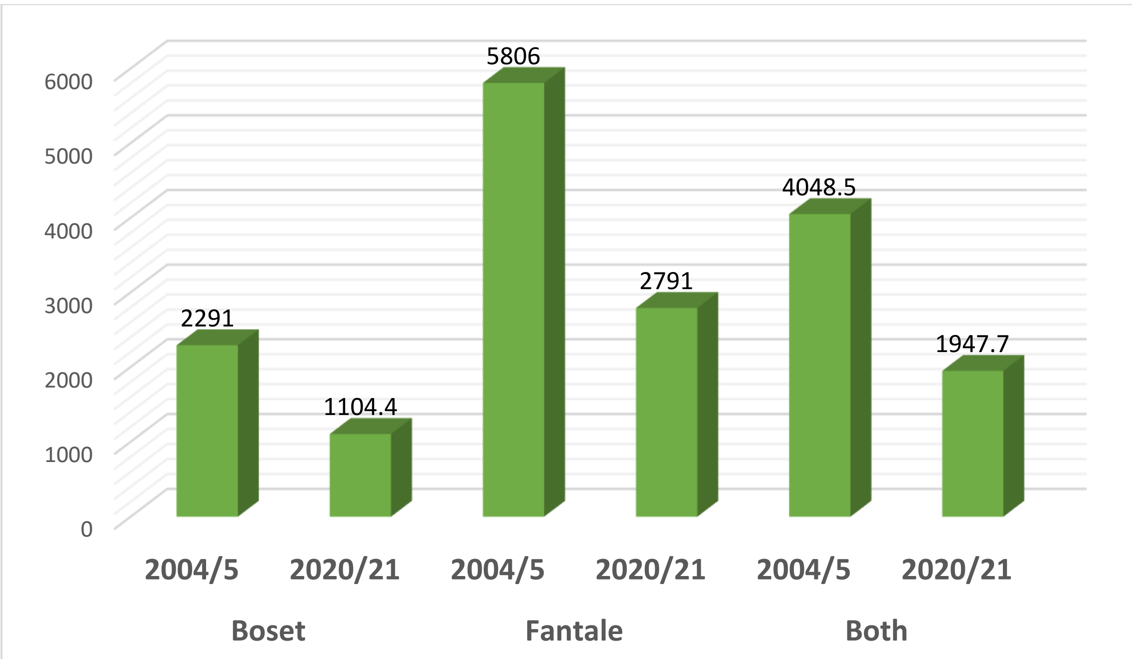


Figure 4.2. Trends in Estimated Average Communal Grazing Land (2004/05-2020/21)

Source: Field Survey between November 2021 and May 2022

4.3.11. Livestock Owned by Household

As can be seen from Figure 4.3 on page 150, the trend of livestock production for cattle, sheep, and goat was declining. Camels and equine animals showed a slight fluctuation, and poultry production continued to increase throughout the last 15 years.

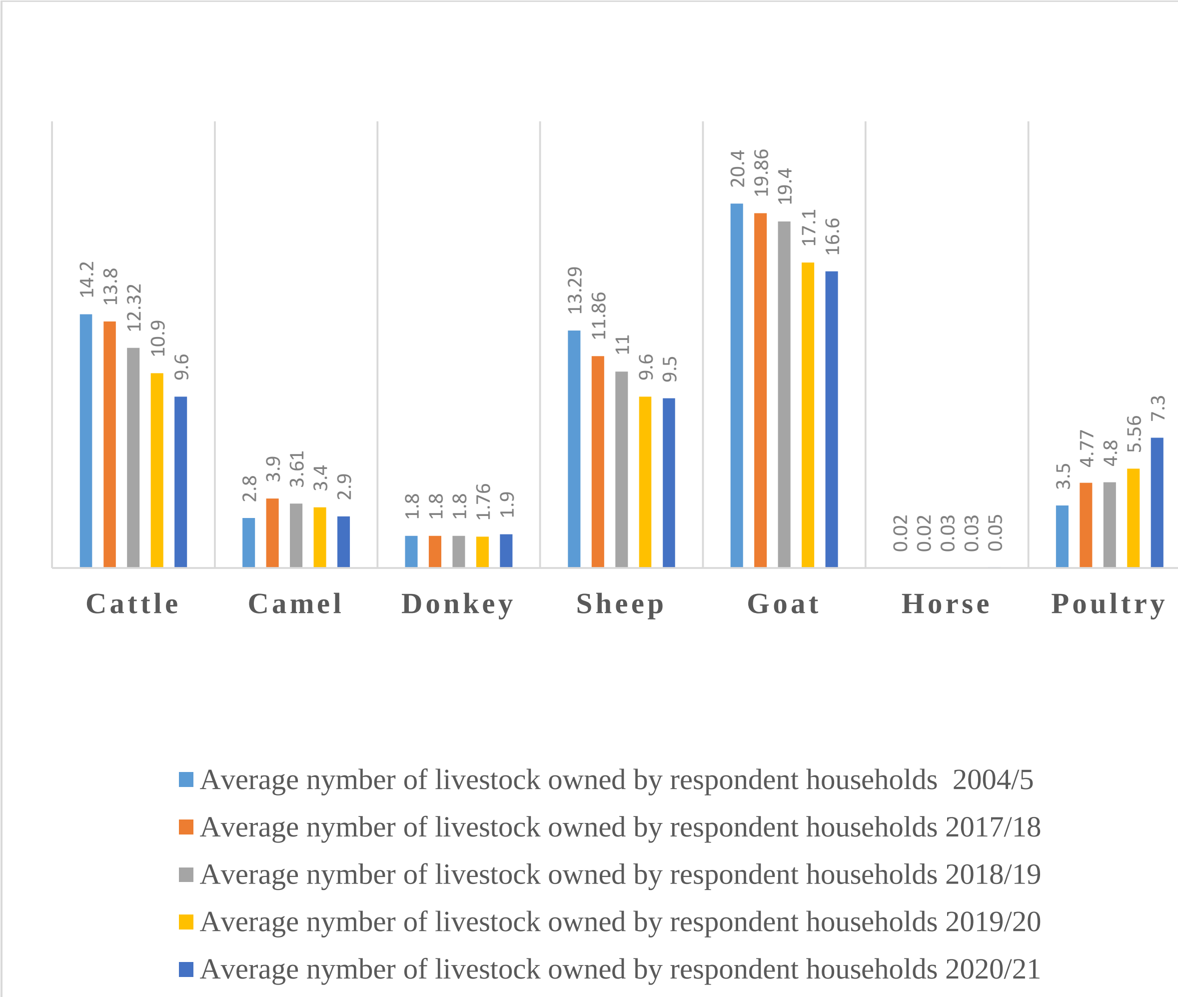


Figure 4.3: The Trend of Average Number of Livestock Owned by the Study Household (2004/5-2020/21)

Source: Field Survey between November 2021 and May 2022

One possible explanation for declining livestock numbers per household could be the diminishing communal land area, as can be seen in Figure 4.2 on page 149. In their response to open ended questions, respondents indicated that a shortage of livestock food forced them to reduce their livestock size to a manageable number to keep around home on their privately owned land plot. They also indicated that the continuous drought situation in the area led to livestock losses.

4.3.12. Tropical Livestock Unit (TLU) Per capita Owned by the Household

Figures 4.4 and 4.5 show only 14% and 17% of the households in Fantale and Boset districts, respectively, were food secure based on the 4.5 and 2.5 livestock owned per capita considered by most food security related researchers as a standard to keep pastoral and agro-pastoral households above the poverty line (De Haan, 2016). The average per capita for Fantale district households was 2.8, and that of Boset households was 1.5, which was much lower than the standard. The figure also shows 17% and 14.4% of the households as wealthy, 41% and 66.9% as middle, and 42% and 19% in poverty class in Boset and Fantale districts, respectively according to the standard wealth classification of households based on livestock owned per capita.

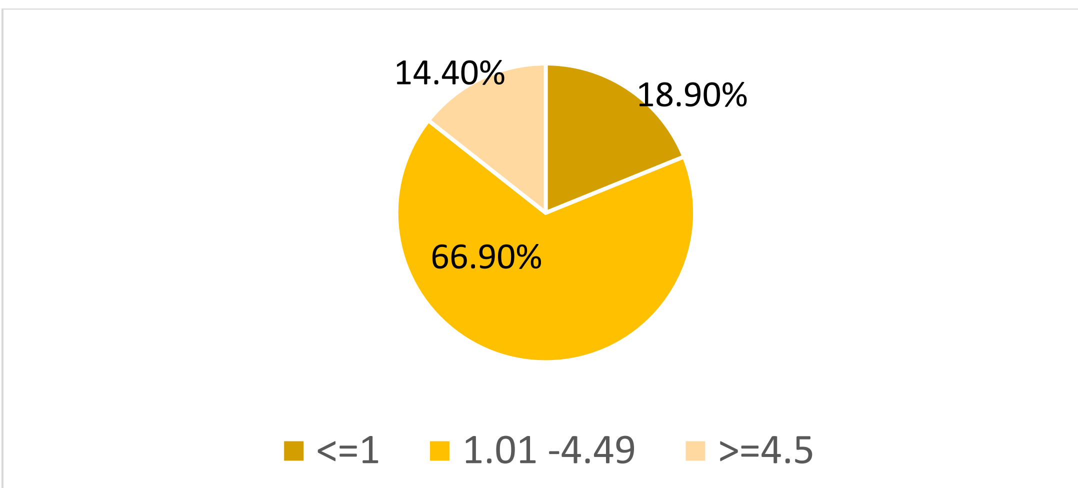


Figure 4.4: Fantale District Household Per Capita Livestock Owned in 2020/21

Source: Field Survey between November 2021 and May 2022

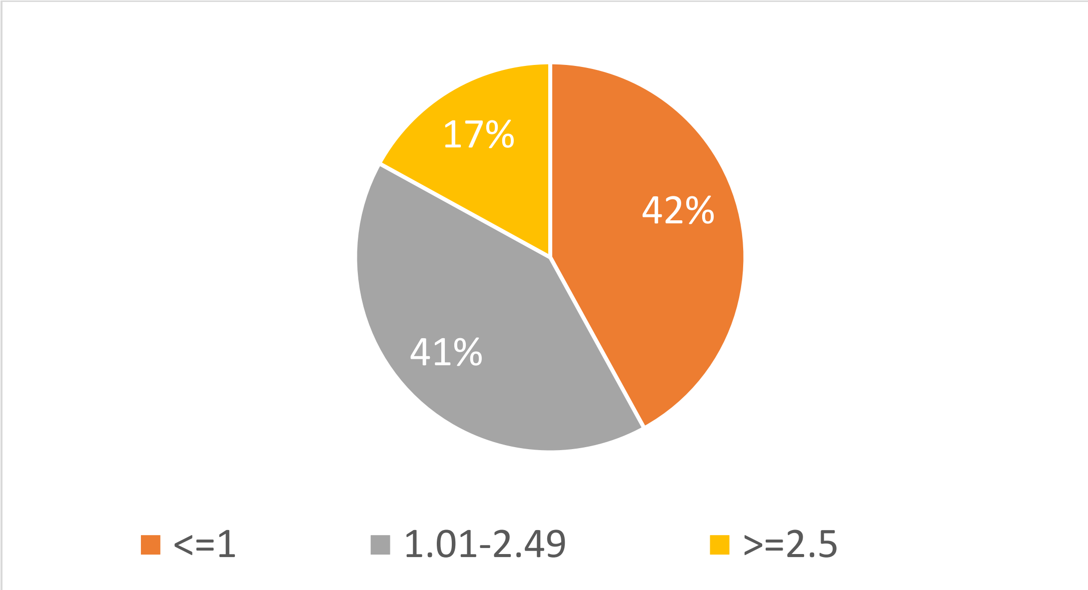


Figure 4.5: Boset District Household Per Capita Livestock Owned in 2020/21

Source: Field Survey between November 2021 and May 2022

4.3.13. Household Crop Production

Although crop production increased steadily in Boset district during the last 15 years, the trend in Fantale district shows decrease in the last three years, as can be seen from Table 4.9 below.

Table 4.9: Annual Average Crop Production Trend per Household in Quintals

		District		
	Year	Fantale	Boset	Both
crop produced in quintals	2004/5	2	15	8.5
	2017/18	8.1	17.6	13
	2018/19	9.2	17.7	13.5
	2019/20	9	18.2	13.8
	2020/21	7.8	24.6	12.2

Source: Field Survey between November 2021 and May 2022

4.3.14. Household Estimated Annual Non-farm/Off-farm Income

Asked to indicate their average annual non-farm/off-farm income, about 59% of the respondent households replied that they had a minimal or no non-farm/off-farm income, as indicated in Figure 4.6 below. About 26% of the respondents reported that they earn an average annual non-farm/off-farm income of greater than 195 USD in this study area, whereas 15% reported that their non-farm/off-farm income was between 2 USD and 195 USD. The average annual non-farm/off-farm income for the study area household was 123 USD, which is minimal by all standards.

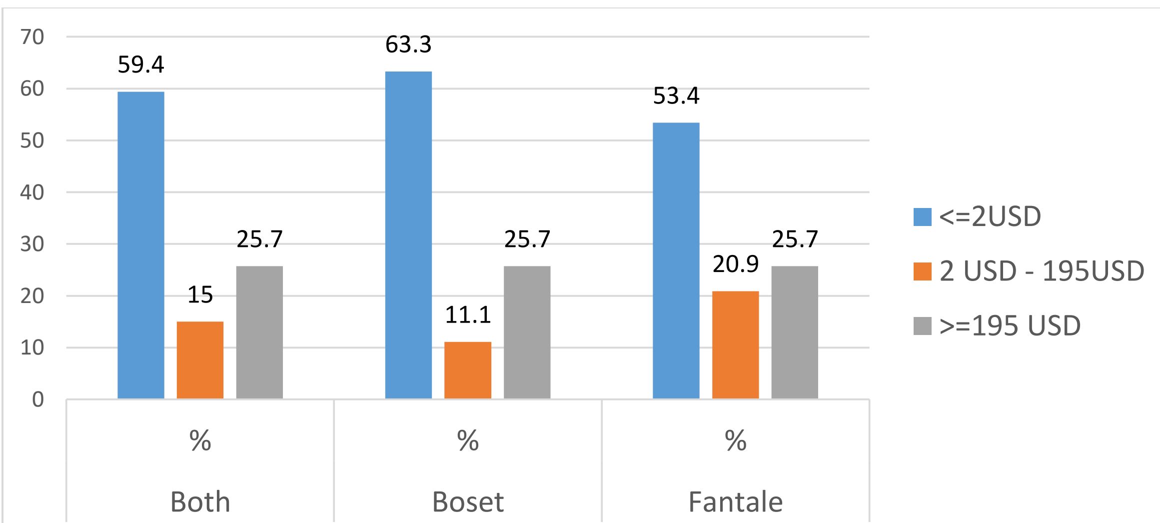


Figure 4.6: Household Estimated Annual Non-farm/Off farm Income

Source: Field Survey between November 2021 and May 2022

The focus groups highlighted lack of non-farm income sources (absence of firms like industries for employment opportunity) in Boset district and absence of conducive environment for non-farm activities such as petty trade except for activities such as selling firewood and charcoal in Fantale district as major determinant factors. This could be an indication of the absence of economic activities that could have created opportunities for income sources diversification and hence traditional livelihood activities that highly depend on nature remained households' sole source of food provision and means of survival in the study area. This situation is damaging the environment due to over exploitation and misuse, as all the focus group discussions stated repeatedly.

4.3.15. Household Food Provision Sources

Like households in the other parts of rural Ethiopia, farming households in the study area depend mainly on their own food production (crop farm, livestock). However, they also depend on markets for livestock and livestock products in exchange for other food commodities such as cereals. Poverty is high in this part of the country, and there are a considerable number of households that depend on government support and food aid (Daniel *et al.,* 2023; Fekadu, Gadissa & Jebessa, 2020). Pastoral communities also have a culture of families, kinship and community support for underprivileged community members (Fekadu *et al.,* 2016).

Livestock and livestock products exchange remained the major source of household food provision for 96% of the households in Fantale district and 95% of the households in Boset district although a considerable number of respondents in Fantale district (68.9%) reported crop farms as the source of their household food provision, as shown in Figure 4.7.

In conformity with this finding, the FGD participants from Fantale *kebeles,* for instance indicated that market dynamics such as livestock price fluctuation and food price volatility, as well as limited livestock market days, highly affect household's entitlement to food that they obtain through exchange. This indicates household's high dependence on the market for livestock and livestock products to exchange for grain and other food commodities, which may cause economic distress due to the influence the "exchange entitlement challenge" as Sen (1981) mentioned it.

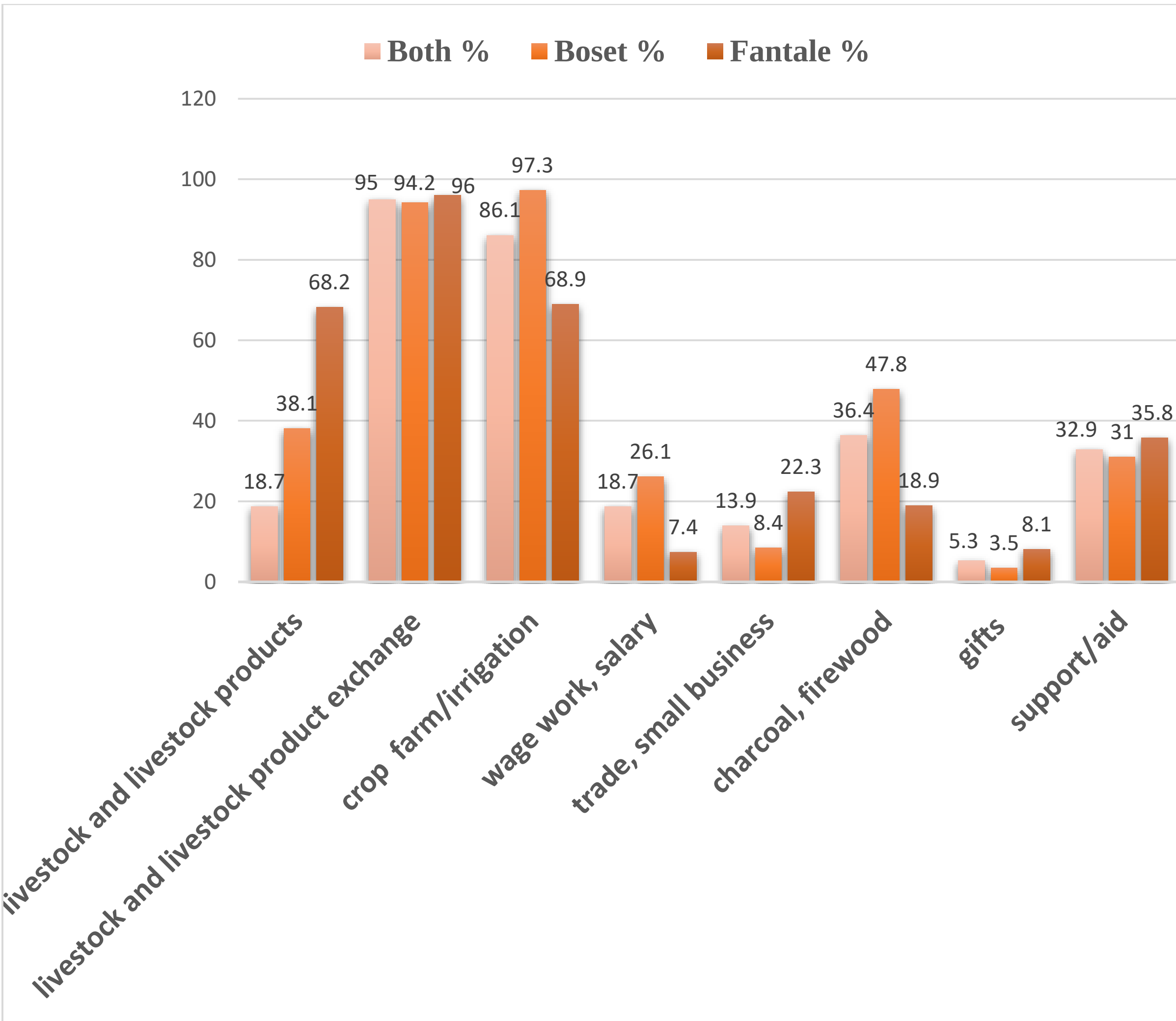


Figure 4.7: Major Sources of Household Food Provision

Source: Field Survey between November 2021 and May 2022

Considerable number of households (36.4%) reported that natural resources based activities such as selling firewood and charcoal were the third major source of income for household food provision next to livestock and livestock products and food crop and vegetable farm as can be seen from Figure 4.7. The Figure shows that about 48% in Boset and 19% in Fantale district affirmed that they depend on firewood and charcoal sell and sand extraction. This has negative reparations on the environment as mentioned repeatedly in the focus group discussions. Government support/aid was found the fourth major source of household food provision as 35.8% of respondents from Fantale district and 31% from Boset district affirmed.

Participants in one of the focus group discussions mentioned firewood and charcoal trade as source of income for most community members to survive although they said they were aware of the resulting environmental damages their actions were causing. The participants indicated that increased dependence of households on the natural environment for survival caused deforestation to the point where no tree to cut for firewood and charcoal in some areas by then. The focus group members mentioned their worries when rain is coming due to high flooding as the result of deforestation effects. The participants also said government aid was the only option to survive for many households for those who did not have trees for selling firewood and charcoal (FGDB7).

Figure 4.7 further shows that support from family, relatives and clan members was more practiced among Fantale households than in Boset. This could be explained due to the existence, at Fantale, of the Gada system elements; the sociocultural, religious, and political system among the Karayyu pastoral communities that encourages sharing resources to the poor members of the community and particularly care for the elderly (Firdissa, 2022). The existence of such non-physical assets that allow individuals access to assets needed to secure food has significance in reducing vulnerability (Fekadu and Mequanenet, 2010).

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Figure 4.7 also shows that nonfarm/off-farm income sources, such as wages from employment opportunities, were very limited in Fantale district as compared to Boset. About 26.1% of the respondents from Boset district and only 7.6% from Fantale district indicated they had income from wage and salary as the source for their household food provision. On the other hand, 22.3% of households in Fantale district mentioned petty trade and other businesses as the sources of income for their household food provision, but only 8.4% of the households in Boset indicated this as the source of their household food provision. This indicates pastoralists are involved in petty trade more, and the activity could be fertile ground to strengthen income diversification in this area. This could even have a double benefit, as it may also help to improve the availability of livestock markets in the district if well managed. However, Figure 4.7 clearly indicates that non-farm income activities such as wage work, salary (18.7%), trade and small business (13.9%) were minimal in the study area in general. This indicates that the traditional food production activities have remained the major sources of household food provision, and coping strategies such as small businesses, trade and employment were less developed in the study area. From personal observation, the researcher also has realized economic activities are mainly based on traditional ones and natural resources, such as selling firewood and charcoal.

Asked if their current household food provision was better than fifteen years before, 63% of the respondents reported their household food shortage situation was worse than fifteen years before. Out of those respondents who replied their household experience was worse, 54% mentioned increasing food prices, 20.9% said declining productivity, 20.5% said income decline, and 4.5% mentioned others such as lack of access to social support programs and untimely rain as factors that limited their access to food. The findings of studies conducted in pastoral and agro-pastoral regions, which shows income decline and productivity decline as the major cause for communities' poor resilience to food insecurity in these ASAL parts (De Haan, 2016; Daniel *et al.,* 2023) concur with the finding of this study. This confirms the prevalence of problems of both food availability and entitlement decline in the study area.

A study conducted by Feyera in 2021 in Mieso district, West Hararghe Zone, Oromia Regional State in Ethiopia on the "Effects of climate change and adaptation strategies among pastoralists and agro-pastoralists" indicated an almost similar livelihood pattern in the area, with pastoralism making 65.76%, agro-pastoralism 28.4%, and other businesses such as petty trade accounting for only 5.7% of the livelihood activities in the study area. The variation in existence of petty trade as households' occupation in non-farm activities in this part could be due to the existence of cash crops and the areas proximity to Djibouti where smuggling activities are common.

4.4. Study Area Household Food Security Situation

As discussed in the methodology section, before using the data obtained from household heads through the FIES standard eight questions (Appendix 1a, Section 3) to estimate household food security status in the study area, the validity of the FIES data was assessed using the Rasch model. This assessment involved statistically analyzing the Infit and Outfit statistics, as well as item correlations for the dataset, as discussed below.

4.4.1. FIES Data Validity Test

As can be seen from table 4.10 below, the infit value for six items was between 0.7 and 1.3, and one item whole day has a value of 1.39, which is still acceptable. Only one item, Hungry, has a lower value of .613, but this is still preserved since a low infit value upto 0.5 is acceptable (Owino, Wesonga & Nabugoomu, 2014). Table 4.10 further shows that the outfit value for each item fit the Rasch model assumption (values <2) along with respondent severities and measurement errors.

Table 4.10: Rasch Model Infit and Outfit Statistics

Item	sev.	St.err.	Infit	Outfit
Worried	-0.8154347	0.1381597	0.9112818	1.0963763
Healthy	-1.7992437	0.1593135	1.0439615	1.4728149
FewFoods	-2.0509374	0.1683998	1.1868862	1.2922535
AteLess	0.8092061	0.1426747	1.0286867	1.2754908
Skipped	-1.1083513	0.1423470	0.9480372	0.9556280
RunOut	0.6784511	0.1404901	0.7202666	0.5722835
Hungry	1.6420276	0.1639357	0.6129835	0.4266583
WholeDay	2.6426824	0.2032182	1.3999914	1.9543397

Source: Field Survey between November 2021 and May 2022

The item residual correlation assessment result of FIES data (See appendix 9) has shown conditional independence of the items as the majority have paired items residual correlation value less than |0.4|. Two pairs of items (Skipped & Hungry, RunOut & Hungry) had significant correlation with the value > 0.4. However, no values indicating item multidimensionality and correlation between three or more adjacent items of the data were found.

The data was, therefore found valid for use to estimate the study area food security, all infit, outfit, and items residual correlation were found corresponding to the Rasch model assumptions, and no item was removed as displayed in Tables 4.11 and 4.12.

4.4.2. Food Insecurity Experience Scale (FIES) Item Severity Order

The item severity level for each FIES items was calculated from the affirmative responses and the result was compared with the FAO Voice of Hunger item severity level standard (FAO, 2016) to assess any variation that may exist. According to FAO Voice of Hunger, the item severity level for FIES data from least to highest is WORRIED, HEALTHY, FEWKINDS, SKIPPED, ATELESS, RUNOUT, HUNGRY and WHOLEDAY. As we can see from Table 4.11 on page 162, the severity level for items 1 and 3-6 showed variation in this study from the level they were intended to measure by FAO Voice of the Hunger.

Table 4.11: FIES Item Severity Parameter (as in FAO VoH FIES Module)

	Descriptive Statistics			
	Items	N	Sum	Mean
1	You were **worried** you or your family members would run out of food because of a lack of money or other resources?	374	220	.59
2	You or your family members were unable to eat **healthy** and nutritious food because of a lack of money or other resources?	374	278	.74
3	You or your family members ate only a **few kinds** of foods because of a lack of money or other resources?	374	291	.78
4	You or your family members had to **skip** a meal because there was not enough money or other resources to get food?	374	113	.30
5	You or your family members **ate less** than you thought you should because of a lack of money or other resources?	374	240	.64
6	Your or your family members **ran out** of food because of a lack of money or other resources?	374	120	.32
7	You or your family members were **hungry** but did not eat because there was not enough money or other resources for food	374	72	.19
8	You or your family members were **whole day** but did not eat because there was not enough money or other resources for food	374	37	.10
	Valid N (list wise)	374		

Source: Field Survey between Nov. 2021 and May 2022

Table 4.11 above thus, shows that the household severity level rating remained the same with the order expected by FAO only for items 2, 7 and 8 in this study.

Based on the study households' responses, items severity order was done by switching the least severe items to the top as in Table 4.12. However, these disordering of the items does not affect the overall measurement of food insecurity for this study since the least items 1-4 were considered as food secure, and food insecure was examined as dichotomous moderate food insecure, and severe food insecure variable when used to assess the study area food security situation from the view point of SDG.

Table 4.12: Item Severity Order as Indicated by Respondents' Affirmative Responses

	Items	Respondents District					
		Fantale		Boset		Both	
		No	%	No		No	%
1	You or your family members ate only a **few kinds** of foods because of a lack of money or other resources?	129	87	162	%	291	78
2	You or your family members were unable to eat **healthy** and nutritious food because of a lack of money or other resources?	134	90.5	144	71.68	278	74
3	You or your family members **ate less** than you thought you should because of a lack of money or other resources?	123	83	117	63.72	240	64
4	You were **worried** you or your family members would run out of food because of a lack of money or other resources?	126	85	94	51.77	220	59
5	Your or your family members **ran out** of food because of a lack of money or other resources?	92	62.16	28	41.59	120	32
6	You or your family members had to **skip a meal** because there was not enough money or other resources to get food?	83	56.08	30	12.39	113	30
7	You or your family members were **hungry** but did not eat because there was not enough money or other resources for food?	54	36.49	18	13.27	72	19
8	You or your family members went without eating for a **whole day** because of a lack of money or other resources?	17	11.49	20	7.96		8.85

Source: Field Survey between Nov. 2021 and Aug. 2022

The respondents of this study affirmed that item 'FewKinds' was the least severe item experienced by most households (78%) in both districts, as can be seen from Table 4.12 (although it was ranked 3rd in FAO FIES module as in Table 4.11 on page 162). Therefore, this finding indicates the majority of pastoral and agro-pastoral people were not eating the right nutritious food. Poor crop production and market problems were indicated by key informants as the reasons for 'FewKinds' (FDAOKI 1) which indicate problems related to food availability and access among the study households besides a lack of appropriate knowledge on balanced diet mentioned by key informants.

One of the key informants indicated the existence of 16 pastoral training centers located in each sub-rural district on 16 hectares of land in Fantale alone to train farmers on various areas of life, including nutrition and food security. The informant indicated that the training method had a gap because the communities' culture and practices were not integrated and the trainings lacked practical demonstrations and were not effective because farmers have not acquired adequate knowledge. The informant added, "even if they were given training on the health benefits of a balanced diet, how to prepare a balanced diet is one problem, but more than that was access to get the food items" (BDADOKI 1).

The findings of this study with regard to household rating "FewKinds" of food as the least severe item is supported by previous studies on food security conducted by Amwata, Nyariki & Musimba (2015), Wambogo *et al*. (2018) and Sheikomar *et al*. (2021) who used the same module, FIES measurement. However, these studies give the explanations on pastoral communities' high dependence on "FewKinds" of food in the cultural eating pattern of the people rather than food availability and access issues. They claim that pastoral households have high dependence on a few kinds of food, such as milk and milk products, while the FIES tool was set to measure food security in view of the right nutritious food. Sheikomar *et al.* (2021) for instance, the claims that the possible reason for low severity (high response) of item 'FewKinds' was an indication of people's cultural eating pattern rather than food insecurity. Nevertheless, in this study, the majority of the respondents indicated they depend on market exchange for their households' food provision, as discussed under the previous section 4.3.16. Therefore, further investigation could help to identify the causes for pastoral and agro-pastoral households' dependence on "FewKinds" foods.

Table 4.12 on page 163 also shows that reducing the amount of food (ATELESS) was confirmed by 64% of the respondents as the third less severe item among the study households, and skipping meals was the fourth least severe item affirmed by 30% of the respondents. Focus group discussion participants also mentioned rationing food by reducing the amount and skipping meals and reducing from three to twice a day to reserve food for the next day were common practices of households as survival mechanisms (FGDF7). They went on to mention, *"They go the whole day without food at times when no income source to buy food or support from government through the Productive Safety Net program" (FGDB 7)*. Studies also show that food rationing was a common practice among farmers in India and Sudan as a coping strategy during food shortage not to sell their asset but preserve for future (Jodha, 1975; De Waal, 1989, cited in Devereux, 1993 page 77).

On the other hand, households' response to "WORRIED" about running out of food experience was rated more severe by respondents (ranked 4^{th}) in this study than the model assumption (item 1) which was also supported by previous food security studies using FIES in many developing countries. In a similar way, another FIES validation study by Wambogo *et al*. (2018) using data obtained from 36 sub-Saharan African countries, including Ethiopia, also revealed a similar severity level, and item 3 (FewKinds) was the least severe experience by sample households. The study also revealed 'Worried' about running out of food was found to be more severe (mostly ranked 3^{rd} or 4^{th}) for most developing country respondents, which was explained in people's religious belief in divine provision.

In general, the result of FIES data analysis for the item severity parameter for this particular study showed a similar result with previous food security studies in many developing countries conducted using the same scale for data collection. A food security study conducted by Sheikomar *et al*. (2021) based on FIES data from 18 League of Arab States (including 9 African countries), for instance, indicated similar level change for items 1-5.

4.4.3. Estimated Household Level Food Security Situation for the Study Areas

After approval of the FIES data validity and reliability using Rasch Model analytics (as discussed under section 4.4.1) the data was used to estimate the study population food insecurity severity level.

Looking at the food security situation in the study areas, the descriptive analysis of respondents' affirmative row scores to the eight FIES questions revealed that only 21.4% of the study population were food secure, while the majority (78.6%) were food insecure (mild+moderate+severe) as shown in Table 4.13 below. The table also has shown nearly 90% of the households in the arid Fantale district were food insecure as compared to 71.2% households in the semi-arid Boset district. The variations are because of the moderating variables.

Table 4.13: Household Food Security Situation

FOOD SECURITY SITUATION	Fantale		Boset		Both	
	No	%	No	%	No	%
Food Secure	15	10.12	65	28.8	80	21.4
Food insecure (Mild+ moderate+ severe)	133	89.9	161	71.2	294	78.6

Source: Field Survey between November 2021 and May 2022

Looking at the severity level, 21.4%, 21%, 38.5% and 19% of the respondent households were food secure, mild food insecure, moderately food insecure and severely food insecure respectively in the study area as can be seen from Figure 4.8. Food insecurity was more prevalent among the arid Fantale district households where 10.12%, 7.8%, 47.3% and 35.12% were found food secure, mild food insecure, moderately food insecure and severe food insecure respectively as compared to the semi-arid Boset district households where 28.8%, 30%, 33% and 8% food secure, mild food insecure, moderately food insecure and severely food insecure respectively. The possible explanation for these differences could be the varying degrees of vulnerability to climate change and differences in level of diversification (97% of households affirmed they depend on their crop farm for household food provision in Boset, compared to 68% in the Fantale district as indicated in Figure 4.7 on page 155). Studies show that the dynamics due to government land use policy changes have affected more negatively the pastoral communities of Fantale (Fekadu, Gadissa & Jebessa, 2020; Abdi, 2015). The poverty, declining living standards, and deteriorating security as the result of increased dynamics in the district together with underdeveloped social services weakened communities' adaptation capacity to the harsh environment (Daniel *et al.*, 2023).

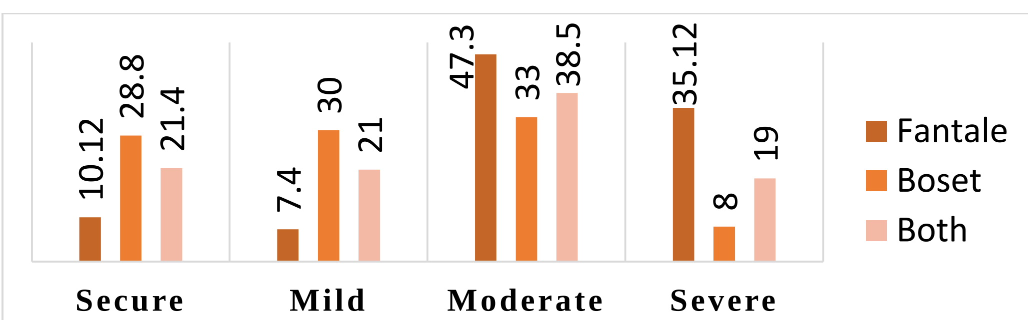


Figure 4.8: Household Food Insecurity Severity Level of the Study Area

Source: Field Survey between November 2021 and May 2022

In the same vein, the focus group discussion (FGD) participants underlined food insecurity was prevalent in their *kebeles*. In the FGD at Boset a participant narrated; "…the time we get government support we are happy, the time we do not get the support most of us go the whole day without food and eat the time we get something to eat. That is how we are now (FGDB7)."

The finding of this study corresponds with previous studies conducted in ASAL parts of Ethiopia using various food security measurement tools. The finding of a survey study conducted by Feed the Future (2015) in Borena and Jijjiga pastoral and agro-pastoral areas in Ethiopia employing HFIAS (Household Food Insecurity Access Scale) showed 39% of the households were moderate food insecure and 32% severe food insecure for Borena while 20.5% moderate food insecure and 45.8% severe food insecure for Jijjiga households.

Another survey study among Afar pastoralists conducted by Idris & Adam (2013) reported that 65.8% of sample respondents were food insecure, while just 34.2% were food secure. Shishay, Gebrehaweria & Alem (2020) conducted a study among pastoral and agro-pastoral households in arid districts in Afar region of Ethiopia. The finding of their study indicated that 72.7% of the households were food insecure.

One assumption for the slight increase of food insecurity prevalence for the respondents in this particular study could be the effect of COVID-19 as all the studies mentioned above were conducted before the pandemic while data for this one was collected in 2020/21 when the influence of the pandemic effect was still prevalent. As can be seen in the forthcoming discussions, the respondents identified pandemic disease as one of the significant variables that negatively affected their food security. Studies in different countries of Africa support this finding that the COVID-19 has affected people's food security mainly due to shortage of food supply chains (Aliyu *et al*., 2021). However, there could be other more factors accounting to the measurement scales used, which need further investigation.

4.4.4. Food Security Status by Household Head's Gender

To ascertain the association of food the security situation with the respondents' gender, descriptive analysis was made using cross tabulation, and the result is shown in Table 4.14 below.

Table 4.14: Cross-Tabulation of Food Security Status by Household Head's Gender

			Household head/respondent's Gender		
			female	male	Total
food security status	food secure	Count	37	135	172
		% within Household head/respondent's Gender	46.3%	45.9%	46.0%
	Food insecure	Count	43	159	202
		% within Household head/respondent's Gender	53.8%	54.1%	54.0%
	Total	Count	80	294	374
		% within Household head/respondent's Gender	100.0%	100.0%	100.0%

Source: Field Survey between November 2021 and May 2022

Table 4.14 shows that households with female heads were slightly better food secure than male-headed households in the study area. This finding concurs with a study conducted in similar areas by Amwata, Nyariki & Musimba (2015) and another study by Tasokwa (2011). The explanation given by these studies is that women are more likely to prioritize their income for family food than their male counterparts are, while men tend to prioritize other expenditures over household food. This could hold true for this particular study. Another explanation that could be given is the fact that livestock, which is the major income source in the study area, is a physical asset controlled by men (their husbands) and women have limited control over such assets due to violations of rights. In this case, female household heads have more access to exchange livestock for food commodities and can have a better food secure household.

4.4.5. Food Security status by Occupation

The study showed that 66.4% of the agro-pastoralist and 60% of the farmers were food secure, and just 33.6% and 40% were food insecure respectively, whereas only 11.7% of pastoralist were food secure and the majority (88.3%) were food insecure as can be seen from Table 4.15 below.

Table 4.15: Cross-Tabulation of Food Security Categories by Respondents' Occupation

			Household livelihood basis/occupation			
			pastoralist	agro-pastoralist	farmer	Total
food security categories	.Food secure	Count	16	144	12	172
		% within household livelihood basis/occupation	11.7%	66.4%	60.0%	46.0%
	Food insecure	Count	121	73	8	202
		% within household livelihood basis/occupation	88.3%	33.6%	40.0%	54.0%
Total		Count	137	217	20	374
		% within household livelihood basis/occupation	100.0%	100.0%	100.0%	100.0%

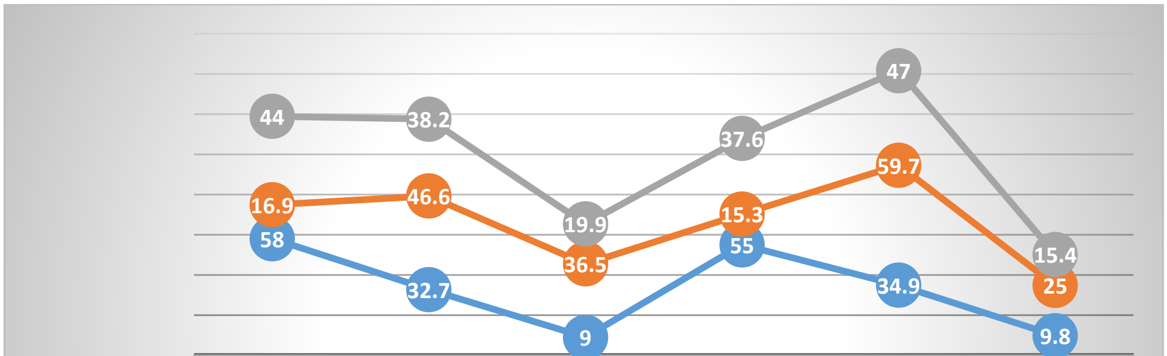
Source: Field Survey between Nov. 2021 and May 2022

It can be depicted from Table 4.15 above that food insecurity was found severe among the pastoral households as compared to the agro-pastoral and farmer households in the study area. The finding of previous study in Southern Ethiopia by Adane, Degefa and Berhanu (2020) that shows a relatively better food security of agro-pastoral livelihood groups concurs with the finding of this study. This finding is also supported by food security theories. For instance, Sen (1981) and Chambers (1989) indicate that vulnerability to famine and food insecurity as a function of factors such as poor livelihood resources and poor adaptation strategies. Others also have the view that communities' production system and level of development decide their vulnerability to food insecurity. For Jesse (1995), communities' geographic location, socio-economic basis and income determine their vulnerability to hunger and food insecurity. For pastoral household who mainly depend on livestock production for food provision for instance, drought that cause shortage of animal food and water results in animal death, asset loss, poverty and food shortage.

4.4.6. Individual Level Food Security Situation

The food security situation at individual level for the study population from the same data was calculated using the sampling weights in order to estimate the progress to SDG 2.1 achievement *(end hunger and ensure access by all people… to safe nutritious and sufficient food all year round*). FIES affirmative response row score of 4 was set as minimum threshold for food insecure category ($FI_{mod. + Sev}$) and the minimum row score 7 for severe food insecurity ($FI_{sev.}$) for this study.

As can be seen from Figure 4.9 on page 172, the descriptive analysis result shows 37.6% food secure, nearly half of the individuals in the general study population (47%) were in food insecure category ($FI_{mod. + Sev.}$) and 15.4 % were severely food insecure ($FI_{sev.}$). At household level, 46% and 15% were food insecure ($FI_{mod +sev}$) and severe food insecure (FI_{sev}.) respectively in the study area.



	percentage of household level severity			Percentage of individual level severity		
	Food secure	Food insecure(moderate+severe)	Severe food insecure	Food Secure	Food insecure(moderate+severe)	Severe food insecure
Both	44	38.2	19.9	37.6	47	15.4
Fantale	16.9	46.6	36.5	15.3	59.7	25
Boset	58	32.7	9	55	34.9	9.8

Figure 4.9: Estimated Household and Individual-Level Food Insecurity Severity in the Study Area.

Source: Field Survey between November 2021 and May 2022

Figure 4.9 above shows that food insecurity was higher among individuals in the arid district of Fantale where only 15.3% food secure, 59.7% moderately food insecure and one in four persons (25%) experience hunger at individual level in the district. The prevalence of food insecurity severity among the study population in the semiarid land area of Boset showed relatively lower as 34.9% food insecure ($FI_{mod.+sev.}$) and 10% severe food insecure ($FI_{sev.}$). There was slight increased prevalence of food insecurity severity at individual levels. The possible explanation for this difference could be the sampling method employed for the study. The wide variation of food insecurity severity between the two districts is mainly due to their geographic location as supported by many previous studies.

4.5. Regression Analysis

As discussed in the methodology part in detail, the regression analysis focuses on understanding the key determinants influencing household food situation and dynamics influencing household sustainable food security in the ASALs of the East Shewa zone in the Oromia National Regional State of Ethiopia. Prior to conducting the analysis, assumptions of logistic regression were tested for all the socioeconomic, environmental, and institutional variables to ensure that the estimated relationships between the dependent and independent variables, as well as the moderating effects of institutional variables, were not biased by issues such as outliers, multicollinearity, or non-independent observations. The results of these assumption tests are discussed in Sections 4.5.1.1. to 4.5.1.3 for binary logistic regression and Sections 4.5.2.1 to 4.5.2.4 for the ordinal logistic regression.

4.5.1. Binary Logistic Regression Analysis

4.5.1.1. No Strongly Influential Outliers

The analysis to identify influential outliers in the binary logistic regression model involved calculating Cook's Distance (Harris, 2021) for each observation. The threshold for Cook's Distance was set at 0.013, determined by the formula 4\N, where N represents the total number of observations (N=374). The results indicated that only 1.0% of the observations exceeded this threshold, suggesting that the proportion of highly influential outliers was minimal. Consequently, it was concluded that these outliers have a negligible impact on the model's quality, and the assumption of no significant influence from outliers is satisfactorily met.

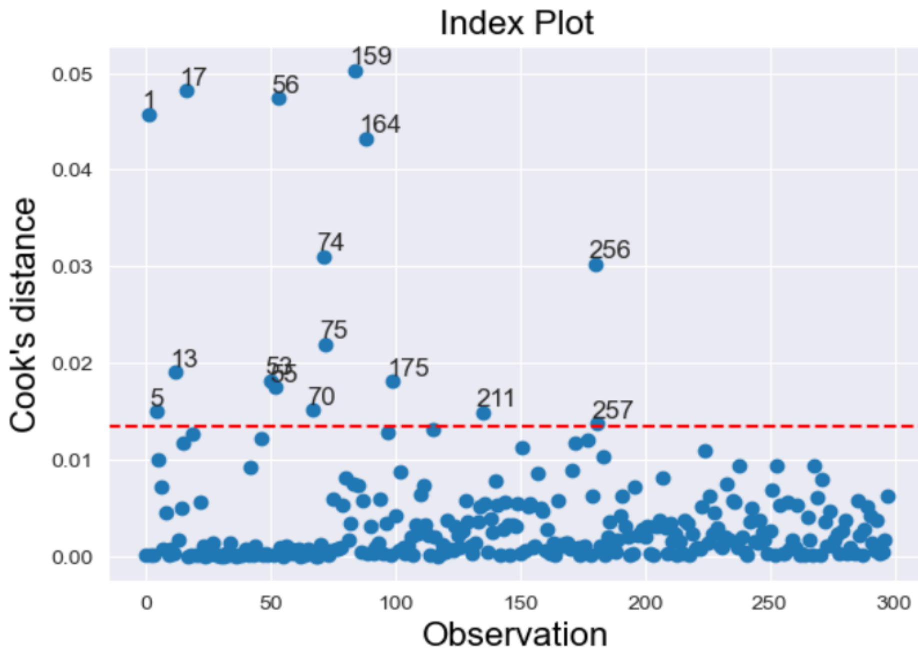


Figure 4.10: Cook's Distance Analysis for Influential Outliers in Socioeconomic Variables (Binary Logistic Regression)

Source: Field Survey between Nov. 2021 and May 2022

4.5.1.2. Absence of Multicollinearity

Multicollinearity was assessed in this study to ensure the reliability of the regression coefficients in the binary logistic regression model. The Variance Inflation Factor (VIF) was calculated for each independent variable; with a VIF value exceeding 5 typically indicating problematic multicollinearity. The analysis revealed that all variables exhibited VIF values below this threshold, with the highest VIF recorded at 3.519 for the "District" variable as shown in Table 4.16 on page 175. These results suggest that multicollinearity is not a concern in this dataset, allowing for confident interpretation of the regression model's coefficients.

Table 4.16: Variance Inflation Factor (VIF) Results for Multicollinearity Assessment of Socioeconomic Variables

Variables	VIF
District	3.518812
Sex	1.155110
Occupation	2.109668
Age cat	1.468666
Education	1.244275
Family size cat	1.295584
Privately owned farm land 2021 cat	1.641427
Non Farm income Cat	1.082162
Crop/Irrigation farm	1.040188
Support from kin community	1.094509
Government Aid	1.263567
Tropical Livestock Unit Per Capita (TLU)	1.382623

Source: Field Survey between Nov. 2021 and May 2022

4.5.1.3. Independence of Observations

The assumption of independence of observations was evaluated in this study to ensure the validity of the binary logistic regression model. This assumption requires that the error terms associated with the observations be independent, without any dependency that might arise from matched pairs or repeated measures. This assumption was assessed by examining the Deviance residuals versus index number plot (Hosmer, Lemeshow & Sturdivant, 2013). The pattern observed in the plot in Figure 4.11 on page 176 shows that the residuals were randomly distributed and do not exhibit any systematic pattern, indicating that the error terms are independent. Thus, the assumption of independence of observations is upheld in this analysis.

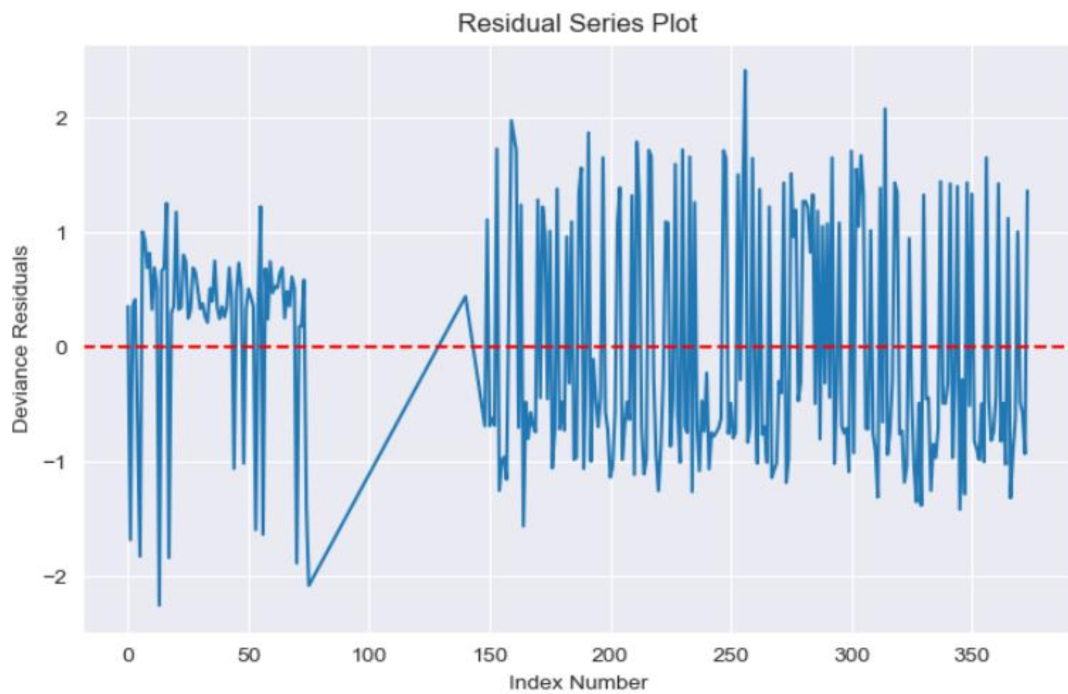


Figure 4.11: Deviance Residuals Plot for Testing Independence of Observations in Binary Logistic Regression

Source: Field Survey between Nov. 2021 and May 2022

The results of the assumption checks indicate that the binary logistic regression model used in this study meets all the necessary assumptions, including the absence of influential outliers, lack of multicollinearity, and independence of observations. These findings support the validity of the model and allow for confident interpretation of the results in assessing the factors influencing household food security in the study area.

4.5.1.4. Binary Logistic Regression Model Output for Socioeconomic Variables Association with Household Food Security Situation

Having checked that all the assumptions of binary logistic regression were satisfied, the study conducted regression analysis to establish the association of the socioeconomic variables with household food security. The standard P-vales <0.05 was utilized as indicator for existence of association between the dependent and independent variables. The result of binary logistic regression analysis showed strong association between six independent variables of household characteristics and their food security as shown in Table 4.17 on page 178. As can be seen from the Table, the regression analysis result showed that out of the eleven explanatory variables the respondents’ district (P-value= .000), family size (P-value= .029), non-farm income (P-value= .006), crop farm/irrigation (P-value= .021), government aid (P-value= .008) and TLUs (P-value= .045) were found significant in explaining the variations in food security situation of the study area households at P value < 0.05.

The finding also showed that households’ location in arid district, family size and livestock per capita owned were associated negatively with household food security. However, the model showed that respondent’s gender (P-value= .640), educational status (P-value .479), support from kin and community members (P-value=.086), and land size owned in hectare (P-value =.403) showed no association with household food security in this study.

Table 4.17: Regression Results on the Influence of Socioeconomic Variables on Household Food Security

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Respondent's District (Fantale)	-2.935	.590	24.733	1	.000	0.151
Household head's gender	.158	.337	.218	1	.640	1.171
Age cat	.079	.271	.086	1	.769	.924
Educational status	-.210	.297	.501	1	.479	.811
Household family size cat	-.369	.169	.332	1	.029	1.583
Privately owned land in hectare cat.	-.149	.178	.700	1	.403	.862
Estimated annual Non-farm income	.421	.153	7.593	1	.006	1.524
crop farm/irrigation	.481	.524	.845	1	.021	4.914
Support, gifts from family, relatives, community	-1.099	.640	2.953	1	.086	.333
Government, nongovernment support/aid	.228	.290	.617	1	.008	1.256
Livestock owned calculated in per capita Cat. (TLU)	-.2897	.144	12.088	1	.045	.748
Constant	-.921	1.263	.532	1	.466	.398
*P<0.05						

Source: Field Survey between Nov. 2021 and May 2022

From the regression output in Table 4.17 above, the geographic location of the respondents (arid land of Fantale) showed strong negative association with households' food security. In their responses to the open-ended questions, the majority of the respondents mentioned that the increase in intensity of risk factors such as drought, rainfall variability and flood had challenged their food production system during the last decades.

In a similar way, a key informant at Oromia Irrigation and Pastoral Development Office mentioned that drought cycle was very frequent almost happening every year particularly in the arid area of Fantale district (OIPDBKI 2). Another key informant, team leader from Oromia Agricultural Development Bureau Food Security indicated that major climatic changes such as El Niño and La Niño climate change events had threatened communities in the ASAL parts of Ethiopia during the last years. The informant said El Niño resulted in recurrent drought causing 50-90% crop failure and livestock food shortage in the arid areas of Eastern Ethiopia in 2015/16. He also indicated that the incidence was followed by the 2017/18 La Nino a period of heavy rain and flooding that caused human and livestock death and food insecurity in the area (ANRBKI 2).

A key informant from Fantale District Agriculture Office indicated that land use policy change and privatization of communal land has negatively affected more Fantale pastoral households' food production system due to diminished grazing land area and restricted pastoral mobility (FDAOKI 1). Another informant from Oromia agricultural development bureau also supported this explanation to the food insecurity situation in Fantale (OANRBKI 1).

Studies indicate that drought affects ASAL parts in East Africa perpetually (Zeremariam & Bereket, 2013), and climatic change such as rainfall variability is causing a serious challenge in this area (Rettberg *et al*., 2017; Tagesse *et al*., 2021). Nevertheless many previous studies claim that Ethiopian government land use policy change in the ASAL parts has affected pastoral food production system negatively (Easdale & Domptail, 2013; Mulugeta & Habtemariam, 2011; Adugna *et al*., 2022; Misselhorn *et al*., 2012; Feed the Future, 2018; WFP, 2019). For instance, Adugna *et al*. (2022) who studied 'Large scale land investment and land use conflict in agro-pastoral areas of Ethiopia' including Fantale district area, indicated that the 1974 "*land to the tiller*" worsened the situation of pastoralists due to privatization of the pastoral communal land areas. Expansion of large farms into the previous communal grazing land areas and the use of riverbanks for irrigation farm restricted pastoral mobility. He concluded that this situation of loss of livelihood resources weakened their adaptation capacity to the harsh environment and increased their vulnerability to food insecurity.

Previous studies confirm that pastoralists retained their livestock production as solo livelihood activity despite the dynamisms in the dry land parts. Farming is considered as inferior among pastoral communities and it is related to loss of livestock assets, which is the expression of economic position in that community. Thus, they have respect for pastoral way of life and strive to maintain their traditional occupations and livestock rearing is still the major livelihood basis in the ASAL parts of Ethiopia (Abera & Aklilu, 2012).

Sandford and Habtamu (2000) indicated Ethiopian pastoralists have less involvement in non-pastoral activities such as petty trade and they gain low level of income. However, Abera and Aklilu indicate that Karayyu pastoralists started crop farming and other additional income raising activities such as selling firewood, charcoal, wage labor and petty trade in the late 1970s due to climatic changes that resulted in recurrent drought, disease and livestock loss. They further indicated that women also had started selling of butter and milk to exchange for household utilities, but they claimed that no Karayyu pastoralist had business center in the town of the district or elsewhere. The same source indicates that the cultivated area was only 2,021 hectares rain fed agriculture and 202.25 hectares under irrigation agriculture, which was less than 2% of the total area of the cultivable land of Fantale District. Thus, the study area has high potential for irrigation farming which is not exploited yet by the native people of the study areas for one reason or another.

The Key informants of this study also indicated that very few well-to-do pastoralists have started small business in the town of the district such as hotel construction as additional income source recently (ESZPDIOKI 1). Thus, the land use policy change and the dynamics that followed in the study area affected more Fantale pastoral households whose livelihood depends on access to communal land. From personal observation, the researcher also realized non-farm/off-farm economic activities are mainly traditional ones based on exploiting natural resources such as selling firewood and charcoal. Thus, the study shows that local opportunities were less exploited and development impetus that could stimulate the ASALs communities' economic diversification have not developed yet in these rural areas as some researchers noted (Mulongo, Erute & Kerre, 2010) and the traditional livelihood activities remained solo economic activities of the people.

Household size was negatively associated with household food security in this study. The finding is consistent with findings of studies by Ismail (2017) and Indris and Adam (2013). The finding by Ismail showed household size was negatively associated with household food security while factors such as livestock holding, non-livestock income and social support were positively associated with household food security. In a similar way, the finding of the study conducted by Indris and Adam (2013) in a similar ASAL part of Ethiopia in Afar region shows negative association of household size with food security. Rettberg *et al*. (2017) claim that livestock production depends on mobile way of life which requires less labor in the case of pastoral and agro-pastoral communities, and it means more mouth to feed and is a disadvantageous. Findings of other studies (Mequanent, Birara & Tesfalem, 2014; Million *et al*., 2019) show consistency with this finding on the negative association of family size and household food security, that there are more household members who consume more than their contributions to food production.

Contrary to this, a study by Tagesse *et al.* (2021) reported that increased in household sizes help to increase food security because of better labor supply for food production for household consumption. They claim large family size is a benefit to farm household food security due to its labor contribution. The researchers noted that household labor availability reduces the cost for pastoral production activities such as herding and dairy production. Some other studies also said that large household size increase food security when their contribution of household members to household income is less than their consumption (Million *et al*, 2019; Amwata, Nyariki & Musimba., 2015).

The findings of many other food security studies on determinants of food security affirm that households' non-farm/off-farm incomes associate with food security positively as they buffer food supply shortage (Fekadu & Mequnanent, 2010; Degefa, 2005; Adugna *et al*., 2021; Getachew, Degefa & Negussie, 2018; Bekele *et al*., 2021). Others also claim that it improves households' access to food and farm inputs income, and diversification through non-farm/off-farm income sources is proved to be an effective poverty reduction and income generating strategy for the rural poor, particularly in fragile environmental areas (Amwata, Nyariki & Musimba, 2015; Barrett, Readon & Webb, 2001; Ellis, 2000).

However, the majority of the households in the study area reported that they have minimal or no non-farm/off-farm income. More specifically, 63.3% and 53.3% households in Boset and

Fantale districts respectively had minimal- or did not have- non-farm/off-farm income (see Figure 4.6 on page 153).

Lack of non-farm/off-farm income sources (absence of off-farms like industries for employment opportunity) was also one of the major factors raised during the group discussions. A group discussion participant explained the complex problems farmers were facing due to lack of non-farm/off-farm income sources in their area. He said:

> …*Rakkoon qotee bulaa ammayyu furmaata hin argannee. Akkuma agartan kan magalaa kana keessaa warshaan wayi nama qacaru tokoo hin jiru. Yeroon qilleensi jijjirame. Qotee bulaaf garuu wanti fooyya'e tokoo hin jiru ittuu hamate. Namni gara itti galagalu dhabe. Qillensis, yeroonis babbadeera. Qotee bulaaf waan itti waayyaa'ee hin jiru. Kubata sila lafa xaa'oo taasisuu nyaata maatiif bituuf gurgura. Lafti biyyeen gabbina hinqabu xaafii basuu didee midhaan kan biraatti geeddaruun dirqamneera* (FGDB 1).

> This means in English, *farmers' problems did not get solutions. As you can see there is no any industry or other firm that can provide employment opportunity in this district. The weather and time has changed, but for farmer nothing has changed for the better, things are at worse. Farmers have no place to turn to, and are looking for ways of survival. Now to buy food for our household we sell animals' manure, which was supposed to fertilize our farmland. Soil fertility has declined and our land no more produce "teff" grain [*which is the most common cereal crop used to make enjera/bread], *we were forced to shift to cultivate other crops.*

The above epigraph reflects the problem faced by farmers to adapt to the dynamic environment due to absence of non-farm/off-farm income sources in their districts. It also indicates the challenges they were facing as the result of land use policy change, which not only failed to solve their problem due to climatic shock but also worsened their situation and the maladaptive outcomes that resulted in soil fertility decline.

The findings of many other food security studies on determinants of food security affirm that households' non-farm incomes associate with food security positively as they buffer food supply shortages (Fekadu & Mequnanent, 2010; Degefa, 2005; Adugna *et al.*, 2021; Getachew, Degefa & Negussie, 2018; Bekele *et al.*, 2021).

Having crop farm/irrigation showed a positive association with food security in this study, and this indicates producing crop improves food availability at household level. The binary analysis showed a unit increase in farm production improves household food security by four. In their responses to the open-ended questions, some respondents indicated that owning farm for a farmer means opportunity for food crop cultivation, producing forage for livestock food, and income generating sources through selling crop residue. However, they claim crop loss due to drought, rainfall variability, poor soil fertility and financial constraints to access farm inputs as group discussion members also affirmed (FGDF6). This finding is consistent with findings from other previous studies (Million *et al.*, 2019; Ogundari, 2017; Tilksew & Fekadu, 2013) who indicated the direct contribution of farm to food security through food production.

However, many of the previous studies argue that the introduction of crop farming did not improve food security situation in the ASAL parts of Ethiopia, instead aggravated land degradation and conflict in the region. The explanation given by those who argue the unprofitability of crop farming was rainfall variability and the recurrent drought in these

ASAL parts that result in crop loss (Yohannes & Mahmmud, 2015; Asebe, Yetebarek & Korf, 2018).

The findings of a study conducted by Fekadu *et al.* (2016) in 37 pastoral districts in Oromia indicated that crop farming where there was access to irrigation had improved household food security situation. They pointed out that their respondents supported to supplement crop farming with pastoral activities, but they argued that a shift from pastoral livelihood base to crop farming practically ended in poverty and food insecurity for those who shifted to crop farming.

This study, however, revealed the existence of problems that caused crop farming and irrigation farms unproductive other than the climatic factors in the ASAL parts. The Focus group participants and the Key informants of this study also identified technical weaknesses for poor productivity of crop, vegetable and fruit farming as well as other diversification strategies introduced to this area (FGDF6 & ESZPDIOKI 1). The FGD participants at Boset district mentioned issues of farm inputs such as selected seeds and fertilizers due to problems related to unaffordability, farmers' inadequate knowledge of technology use and inaccessibility as additional factors for failure to cultivate their irrigated lands and poor farm productivity (FGDB7). In a similar way, the FGD participants at Fantale said that they were forced to give their irrigated land for sharecropping due to similar situation in which case, they said that they benefited a little while the shareholders took larger profit from the farm (FGDB8).

The finding of this study is supported by previous studies conducted in similar areas. The Awash River based Fantale Irrigation-Based Integrated Development Project, launched in

2006 by Oromia Regional State in collaboration with other stakeholders and based along the Awash River, aimed to enhance pastoral development through sedentary farming in the study area. However, studies indicate that the project ended up leading to the commodification of pastoral lands due to various unforeseen constraints (Tefera & Ayalew, 2023). Although government provided ownership rights over the irrigated lands, local communities lacked access to necessary farm inputs, knowledge, experience, and market network forcing them to connect with multiple actors through sharecropping. Many sharecropped their irrigated land to other actors who cultivate large areas of vegetables, fruits and crops on the land like in Figures 4:12, 4.13 and 4.14 below.

Figure 4.12: Irrigation Based Fruit Farm in Fantale District

Source: Taken during field survey in May, 2022

Figure 4.13: A Field Farmer Preparing Irrigation Based Farm in Fantale District

Source: Taken during field survey in May, 2022

Figure 4.14: Irrigation Based Maize Farm in Fantale District

Source: Taken during field survey in May, 2022

The sharecropping system was primarily controlled by external investors, involving more than five individuals who used to undertake all production activities, including marketing. Studies indicated that the primary beneficiary was the investor, followed by field farmer, assistant farmer and brokers, while the landowner gained only marginal benefits. Thus, the pastoralists and agro-pastoralists lost the profit from their land, and were exploited by the investors who accumulated wealth (Tefera & Ayalew, 2023; Regassa, 2021).

The finding of this study showed livestock per capita has a negative association with household food security as previously shown by the regression model in Table 4.17 on page 178. However, ownership of large number of livestock is an indicator for food security with 4.5 tropical livestock unit (TLU) per capita and above for pastoral household and greater than or equals to 2.5 TLU per capita for agro-pastoralists in food secure category (de Haan, 2016). This finding is supported by the view of one of the key informants, a team leader of pastoral development in Oromia Irrigation and Pastoralist Development Bureau. He narrated the condition and manifold challenges that pastoral households were facing as follows:

> Pastoralists are still starving people. They depend on their livestock for food; mostly milk and milk products and few crops for porridge. They may have resources but could lack the awareness on food security. The pastoral training centers constructed at each *kebeles* give training on balanced diet for one or two days. But the training is not effective because its method has no integration with the community's culture and also lack practical demonstrations. It has not changed their way of nutrition because even if they may have access to food items, they lack the knowledge how to prepare nutritious food for healthy life (the training does not include actual preparation skill). The Pastoralists also love to increase the number of their livestock; they like counting their livestock than using them for food. Besides, the work of the union is not a grounded thing that can solve the practical market problem of pastoralists and it is not functional at all. …The price of food is very expensive. But pastoral households are still selling their livestock at unfair price. An ox that could cost 30.000 at normal time, they sell at less than 5000 birr during hardships (OIPDBKI 1).

The narration on page 188 indicates that besides their feeding culture, many factors such as market network problem, high food price and livestock price fluctuation negatively affected ASAL parts' pastoral and agro-pastoral food security.

Previous studies also support the finding of this study. A case study conducted by Amwata, Nyariki & Musimba (2015) in two counties; Kajiado and Makueni in the dry lands of Kenya showed similar findings on the issue of household socioeconomic characteristics and their food security status. Their analysis result showed owning large number of livestock has a negative influence on household food security in both Makueni and Kajiado counties. The explanation they gave was the decline of grazing area due to expansion of farmland that caused livestock loss. There are studies that explain the reason for negative association of TLU with food security in that pastoral household's high dependence on livestock products such as milk and milk products while FIES tool is set to measure food security in view of the right nutritious food could be a possible explanation for this deviation.

However, a possible explanation for the negative association between livestock holdings and household food security in this study could be that females have less access to physical assets, such as livestock, which are controlled by male household heads. The male household heads tend to prioritize other expenditures over household food. Studies show that women are more likely to prioritize their income for family food than their men counterparts (Carter, 1997; Amwata, Nyariki & Musimba, 2015). Thus, the traditional violation of women's right to access physical assets can be possible explanation particularly in the case of pastoralists and agro-pastoral households where livestock remains the major source for food through exchange for food commodities. The change in pastoral mobility situation could be the second explanation for negative association of large number of livestock with household food security. The recent years' increase in mobility distance and duration have made it difficult for pastoral households that remain behind to access food and the economic benefits of livestock, such as milk and milk products, which women use for family food and exchange to access other food commodities. Nevertheless, the extent to which livestock ownership per capita indicates food security needs further investigation.

There are other studies that reported the reverse to the finding of this study. They claim that ownership of larger livestock per capita lead to better household food security (Shishay, Gebrehaweria & Alem, 2020). They argue that livestock buffer food security during crop failure. De Haan (2016) claims that livestock ownership has improved household food security particularly among the wealthy pastoralists in East Africa who exchange livestock and livestock products for grains. Abera and Aklilu (2012) also indicated that the quality of food had declined in pastoral and agro-pastoral areas due to shortage of livestock products such as milk.

The regression model revealed government and non-government aids have positive association with household food security. The finding is consistent with finding of other studies that support that the PSNP in Ethiopia has improved household food security. A study conducted by Guush *et al.* (2013) showed PSNP improved beneficiary households' food security through the cash transfers that improved calorie intake. Similarly, a study by Gashaw and Seid (2018) also showed similar positive impact of PSNP on household food security through increased crop yield and income.

There are also contradictory views of researchers on the impact of Ethiopian social security programme on household food security. They claim that government and non-government aid programmes in Ethiopia have not improved household food security because the programmes were not tailored to nutrition. Bezawit *et al*. (2020) who studied the impact of PSNP on household food security in four countries including Ethiopia found that it had no impact on household food security, child dietary diversity and child anthropometry. Similarly, a survey study conducted by Tagel and Castilla (2018) claim no expected impact of PSNP was found on the beneficiary households' food security such as improving household dietary diversity and child nutrition.

In areas with uncertainties like in ASAL parts where households have limited opportunities to turn to as an alternative means of survival, government support buffers the food shortage in times of hardship. However, this does not mean it is a solution for sustainable food security as Devereux (2001) claims that the Ethiopian government's PSNP has failed to ensure food security because of its poor implementation and sustainability issues although he accepted the programmes' advantages to provide coping strategies for consumption smoothing.

The respondents of this particular study for instance, identified implementation problems that hindered the effectiveness of PSNP in the study areas. An informant, who is a public work and transfer expert of food security department in Oromia Agriculture and Natural Resource Development Bureau, accepted that the Government's support program for food security had weaknesses. He mentioned that the challenges in selecting the beneficiaries as there were cases where households hide their assets to remain in the program. He added, beneficiary households developed dependency syndrome and they never wanted to leave the program even after building their asset and reached graduation level when asset built by the household was believed could support the household for a minimum of 12 months surviving modest shocks that might happen (OANRBKI 2).

The same informant also shared his experiences about the management problems in the PSNP that made the programme's low contribution to beneficiary households' food security and households included in the programme remained food insecure due to untimely supply of the support or total loss at times the food items disappear. He said that cash and food distributions were very hard because of difficulty to coordinate the different independent organizations who ran PSNP and it was only through negotiation to get things done and no rule to force. The informant further explained the problems related to the case of food in kind particularly as the procurement, storing and distribution was done at national level which took very long time before the food items reach the beneficiaries. Besides, the distribution, which was done by different institutions through federal government (Ethiopian Disaster Risks Management Commission), follows early warning, giving priority to other urgent tasks. As the informant further indicated, Oromia had no central warehouse to store such large amount of grain. He mentioned the problems created during transportation and recalled times when food items sent to a place disappeared before reaching destinations.

Considerable numbers of food security studies indicate the recent shift of attention and interventions in developing countries of Latin America and Asia to the areas of socioeconomic dimensions of food security such as income growth and government intervention systems improve household food security (Devereux, 2000; Sen, 2001; Devereux, 2009; Ericksen, 2008b; Devereux & Edwards, 2004). In the case of Sub-Saharan Africa, lack of such interventions together with factors such as drought, conflict, and instability remained the fundamental causes for households vulnerability and persisted hunger (Devereux, 2007). However, the finding of this study revels that none of the government interventions made in the areas of household socioeconomic were in line to enhance their adaptation strategies; rather in reverse such as sedentary farming and irrigation farming implemented in the study area have negatively affected their food production system making the food insecurity situation worse.

The regression model output of this study helped to determine those household socioeconomic factors that modelled household food security situation and contributes to understand the dynamics of food security. This helps to identify key areas where policy intervention could be most effective.

4.5.2. Ordinal Logistic Regression Analysis

As mentioned in Section 4.5, before conducting the major analysis, several critical aspects such as outliers, multicollinearity, non-independent observations and proportional odds assumptions were tested to validate the model fit for the ordinal logistic regression analysis, and the results of the assumption tests are discussed hereunder.

4.5.2.1. No Strongly Influential Outliers

The analysis for outliers in the ordinal logistic regression models for environmental and institutional variables was conducted using Cook's Distance to identify potentially influential data points (Harris, 2021; Belsley, Kuh, and Welsch, 2004). A predefined threshold of 4/N (where N = 374) was used, resulting in a threshold of 0.010 for environmental variables and 0.0106 for institutional variables. The findings indicate that the proportion of highly influential outliers was only 1.0% (4 out of 374) for environmental variables and 0.8% (3 out of 374) for institutional variables. These small proportions suggest that there are no significant influential outliers, meaning the model's results are not unduly affected by any particular data points. Thus, the assumption of no strongly influential outliers is satisfied for both models, confirming that the data is robust and the regression results can be interpreted with confidence.

4.5.2.2. Absence of Multicollinearity

The multicollinearity assessment was conducted using the Variance Inflation Factor (VIF) for both Institutional and Environmental Variables in the study. The results indicate that all VIF values were below the commonly accepted threshold < 5 (Tables 4.18 and 4.19), with the highest VIF observed being 1.587 for the variable "Temperature variability". This suggests that multicollinearity is not a significant issue in this dataset, and the predictor variables are sufficiently independent of each other to be included in the ordinal regression model without concern for inflated standard errors or distorted coefficient estimates.

Table 4.18: Variance Inflation Factor (VIF) Results for Multicollinearity Assessment of Environmental Variables in Ordinal Logistic Regression

Environmental Variables	VIF
Rainfall variability	1.350958
Temperature variability	1.587001
Soil fertility decline	1.562775
Land degradation	1.328406
Biodiversity loss on private land	1.160861
Biodiversity loss on communal land	1.311523
Water shortage	1.141690
Livestock disease	1.213716
Human disease	1.286434
Natural disaster	1.100868

Source: Field Survey between Nov. 2021 and May 2022

Table 4.19: Variance Inflation Factor (VIF) Results for Multicollinearity Assessment of Institutional Variables in Ordinal Logistic Regression

Institutional Variables	VIF
Land use policy change	1.274420
Urbanization	1.247181
Restricted mobility	1.236115
Lack of access to credit	1.304168
Trade restrictions	1.509331
Livestock price fluctuation	1.419595
Food price volatility	1.325885
Market related problem	1.474233
Inadequate extension service	1.401124
Lack of technology use	1.486384
Cooperative involvement in market	1.563830
Conflict	1.107336

Source: Field Survey between Nov. 2021 and May 2022

4.5.2.3. Independence of Observations

The independence of observations was assessed through the above Deviance Residuals versus Index Number plot (Hosmer, Lemeshow & Sturdivant, 2013). The plots in Figure 4.15 below for environmental variables and 4.16 for institutional variables indicate that the residuals associated with the observations are not correlated, satisfying the assumption of independence of errors. This confirms that the errors in the model are independently distributed, which is a key requirement for the validity of the ordinal regression analysis conducted in this study.

Figure 4.15: Deviance Residuals Plot for Testing Independence of Observations in Ordinal Regression Model (Environmental Variables)

Source: Field Survey between Nov. 2021 and May 2022

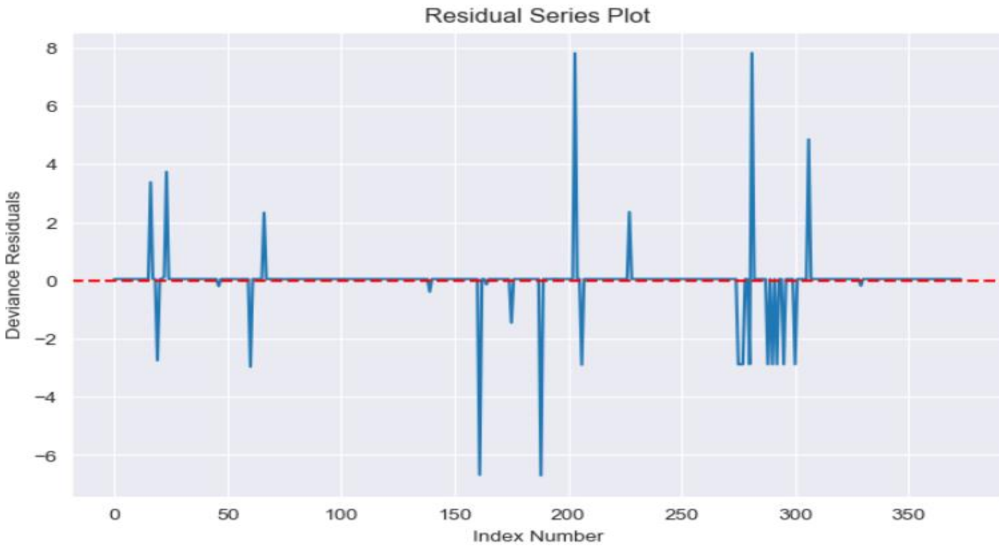


Figure 4.16: Deviance Residuals Plot for Testing Independence of Observations in Ordinal Regression Model (Institutional Variables)

Source: Field Survey between Nov. 2021 and May 2022

4.5.2.4. Testing the Proportional Odds Assumption

To assess whether the proportional odds assumption holds for the ordinal regression model used in this study, the Brant-Wald test (Hosmer, Lemeshow & Sturdivant, 2013; Brant, 1990) was employed. This test evaluates whether the coefficients for each predictor variable are consistent across the different thresholds of the ordinal outcome variable. The null hypothesis for this test showed that the proportional odds assumption holds, meaning that the effect of each predictor is the same across all categories of the dependent variable. The results of the Brant test are presented in Tables 4.20 and 4.21.

Table 4.20: Brant Test Results for Assessing the Proportional Odds Assumption of Environmental Variables in Ordinal Logistic Regression

Test for Environmental Variables	X^2	df	Probability
Omnibus	103.57	10	0.18
Rainfall variability	26.01	1	0.96
Temperature	23.59	1	0.16
Soil fertility decline	88.11	1	0.28
Land degradation	42.48	1	0.78
Biodiversity loss on private land	-531.24	1	0.32
Biodiversity loss on communal land	37.76	1	0.42
Water shortage	43.81	1	0.5
Livestock disease	47.38	1	0.15
Natural disaster	30.27	1	0.98
Human disease	72.58	1	0.45

H0: Parallel Regression Assumption holds

Source: Field Survey between Nov. 2021 and May 2022

Table 4.21: Brant Test Results for Assessing the Proportional Odds Assumption of Institutional Variables in Ordinal Logistic Regression

Test for Data on Institutional variables	X^2	df	Probability
Omnibus	225.71	12	0.65
Land use policy change	20.07	2	0.40
Urbanization	59.57	2	0.87
Restricted mobility	62.96	2	0.56
Lack of access to credit	44.81	2	0.78
Trade restrictions	22.46	2	0.59
Livestock price fluctuation	77.83	2	0.98
Food price volatility	67.58	2	0.76
Market facilities problem	49.60	2	0.63
Inadequate extension service	40.90	2	0.67
Lack of technology use	48.01	2	0.75
Cooperative involvement in market	36.83	2	0.62
Conflict	73.85	2	0.23

H0: Parallel Regression Assumption holds

Source: Field Survey between Nov. 2021 and May 2022

As can be seen from Tables 4.20 and 4.21 the p-values for all variables in both the institutional and environmental models are greater than the alpha level of 0.05. Additionally, the p-value for the Omnibus test is also greater than 0.05. These results indicate that the proportional odds assumption is not violated for any of the variables tested. Thus, the Brant Test confirms that the proportional odds assumption holds for the dataset under study.

All the test results for influential outliers, multicollinearity, independence of observations and proportional odds assumption hold and ordinal logistic regression model is appropriate to model the data. This validates the use of an ordinal regression model to analyze the dynamics towards sustainable food security in the ASAL parts of Fantale and Boset districts in Oromia Regional State of Ethiopia, as the effects of the predictor variables are consistent across the different levels of the ordinal outcome variable.

4.5.2.5. Ordinal Logistic Regression Model Outputs for Environmental Factors Association with Household Food Security Sustainability

All the assumptions for ordinal logistic regression model were satisfied, and the study conducted ordinal logistic regression analysis to establish the association of the environmental and institutional variables with household food security sustainability.

The regression analysis result for the 10 independent environmental variables showed soil fertility decline (P-value=0.000), land degradation (P-value=0.031), biodiversity loss on privately owned land (P-value=0.001), water shortage (P-value=0.027) and spreading human disease such as HIV/AIDs, COVID-19 (P-value=0.000) have significance at P-value < 0.05 have significant influence on household food security sustainability in the study area as can be seen in Table 4.22 on page 199. TheTable shows that all the significant variables have a negative influence on household food security sustainability in the study area. However, the variables, rainfall variability, temperature variability, biodiversity loss on communal land, livestock disease and natural disaster have no significant influence on household food security sustainability in the model.

Table 4.22: Ordinal Logistic Regression Model Output for Environmental Variables

Variables	Value	Std. Error	t value	p-value
Rainfall	0.114508025	0.09042095	1.26638820	0.205
Temperature	0.153835251	0.09202863	1.67160214	0.095
Soil fertility decline	-0.403924519	0.09869970	-4.09245948	0.000
Land degradation	-0.167581435	0.07783373	-2.15306951	0.031
Biodiversity loss on private land	-0.324554381	0.09361296	-3.46698133	0.001
Biodiversity loss on communal land	-0.009379214	0.09420222	-0.09956468	0.921
Water shortage	-0.194006236	0.08760975	-2.21443648	0.027
Livestock disease	-0.172500446	0.10100805	-1.70778903	0.088
Natural disaster	-0.133202508	0.09963221	-1.33694219	0.181
Human disease	-0.432515713	0.11180489	-3.86848668	0.000

Intercepts:

	Value	Std. Error	t value
High damage|Low Damage	-5.6767	0.7424	-7.6461
Low Damage|Not at all	-4.5515	0.7153	-6.3629
Not at all|Very low damage	2.0381	1.2055	1.6907

Residual Deviance: 661.6448
AIC: 687.6448

Source: Field Survey between Nov. 2021 and May 2022

The data obtained from the focus group participants, from key informant interviews, and previous studies concur with the dynamics identified by the regression analysis. In one of the group discussions at Boset District, a participant indicated a shift occurring in types of food crops they used to produce due to soil fertility decline and its failure to produce certain food grains, which he said negatively, affected their food access and income. The FGD participant said that farmers were forced to shift the types of food grains they used to cultivate from grains such as "*teff*" (named *Eragrostis teff*) which used to be the major farm product in the district and the staple food in the country as a whole due to soil fertility decline (FGDB3).

Another group member, (a 75-year-old man) supported the narration about the causes for the dynamics of land degradation and soil fertility decline as the major factor for food insecurity. He stated:

> Yeroo roobu guddaa sodaanna, yeroo caamus miidhama qabna. Lafti mukti irra hin jiru. Bokkeenyi yoo roobu biyyee haxaa'ee sokka. Mukti guddaan jiru sababa rakkina qoonqoof rakkina beelan kasalatti gubnee kasala gurgurree midhaan bitachuun of gargaarra ture. Innuu dhumee amma immo yoo mootummaan gargaarsa nuus kenne gargaarsa arganne ni gammanna gaafa dhabne immoo cinaan agabuu bulaa argannu nyaataa akkanatti jirra. (FGDB 5).

Meaning (English Translation)

> We have worries when it heavily rains, and also when there is no rain it is disadvantageous for us. The land is barren, no trees or plants covered. When it rains, it wipes the soil away. Because of food shortage and hunger, we cut trees to make charcoal and exchange for food. Now even that is finished, we do not have any trees to cut for firewood or charcoal to exchange for food. The time we get government support we are happy, the time we do not get the support most of us go the whole day without food, and eat the time we get something to eat. That is how we are living.

The group members admitted their actions have contributed to the problem of land degradation indicating that former forest areas in their village have become barren land and they said although they knew the importance of trees: to rest under its shade and to cover the land but remorselessly cutting it as a means of survival. Another focus group discussion participant explained: "Look! Now we are holding this meeting under it's [the tree] shade but people cut trees as an income source when there is no alternative means for survival. And because of declining forest; camels could not get leaves, which they depend on" (FGDB 8).

Another key informant also had the view that income sources were absent in the district and households failed to purchase food and animal feed during stresses and were exposed to food insecurity supported this narration. He added that because people exploited the natural environment for survival, the land had been degraded due to over dependence on natural resources for survival (BDADOKI 1). During a focus group discussion in Boset district, the researcher observed groups of women, one after another, heading to the town with firewood and charcoal for sale, carried on their backs or on donkeys, even though it was not a market day. As can be seen Figure 4.17 below, a woman was chasing donkeys' carrying firewood, charcoal and other goods on their Back to Olanchiti Town in Boset District.

Figure 4.17: A Woman Carrying Firewood, Charcoal and other Goods on Donkeys Back to Olanchiti Town in Boset District

Source: Taken during field survey in December, 2021

Figure 4.18 below, also shows that two women carrying firewood to the Olanchiti town in Boset District for sale.

Figure 4.18: Women Carrying Firewood to the Town for Sale

Source: Taken during field survey in December, 2021

Another key informant from Fantale District claimed that activities of poor community members such as sand extraction from farmland areas caused soil erosion and the coverage of forest was diminishing due to cutting of trees for charcoal making in the study areas (FDADOKI 1). This is supported by previous studies that claim the adaptive strategies of poor people were fragile and damaging their livelihood (Devereux, 2001).

The Key informants also claimed expansion of dry land farming was the major cause for restricted livestock grazing areas that resulted in land degradation. Large areas of the pastoral wetland on which they used to depend during dry season grazing had been expropriated by the ever-expanding projects such as Wanji sugar factory, Awash National Park, and other various privately owned projects (ESZPDIOKI 1).

There are contradictory views among researchers on the causes of natural resources decline such as land degradation and subsequent poor productivity and food insecurity. Some attribute the causes of land degradation that led to food insecurity in Ethiopia and other African countries to the production practices of farmers (Hurni, 2010; Alemneh 1990; Markos 1997).

Those in the political ecology school of thought, however, claim land degradation as the outcome of interacting multi-disciplinary issues such as inappropriate development policies, land use practices, and spatial factors (Little, 2002; Scoones, 2007; Wisner *et al*., 2003; Adugna *et al*., 2022; Ali, 2008; Daniel & Gerber, 2017; Degefa, 2005; Yohannes & Mahmmud, 2015). These sources attribute the reasons to the government's ineffective land use policy changes such as sedentary farming introduced to Ethiopia ASAL parts that restricted pastoralist's mobility and caused land degradation due to overgrazing.

This group of researchers claim that farmers and pastoralists were aware of natural resource management importance and evidences show they have been utilizing various soil fertility conservation and land management techniques even before soil conservation sciences had developed (Wisner *et al.,* 2003; Scoones, 2020; Degefa, 2005). Yohannes and Mahmmud (2015) claim that government sedentary policy and the expansion of crop farming and plantation projects in the ASAL parts of Ethiopia resulted in many externalities such as land degradation, soil erosion, biodiversity decline, shortage of livestock food, limited access to water sources and food insecurity in this part of the country. This indicates that the macro-level policies' failure to recognize the specific social and environmental characteristics weakened the local communities' adaptation strategies and triggered complicated problems that led to natural resource degradation, poor land productivity and food insecurity. Moreover, failures to recognize the local communities' knowledge and inability to use the opportunities have led to drawbacks in the designed adaptive strategies. Degefa argues:

> …degradation of land resources has been highly generalized, without making the distinction between degradation taking place due to natural processes and that induced by real intervention as a result of human activities; second, with good policy interventions and improving the livelihoods of the poor, it is possible to prevent resource degradation. There is an extensive knowledge of resource management at the local level. What lacks is good governance that designs policies creating viable sources of livelihoods by overcoming the overexploiting of land resources, as well as putting in place a participatory resource management at local level (Degefa, 2005, pp. 334-335).

Blaikie (2016) adds another dimension to the political ecology explanation of land degradation as the result of appropriation of farmlands and pastoral rangelands by the government and investors. He claims that besides causing food insecurity and income loss of pastoralists due to spatial displacement of food crops by cash crops, the rich class backed by government policies cause soil erosion and land degradation directly through the expansion of dry land cultivation and indirectly pushing the pastoralist to more dry areas.

The regression model also identified biodiversity loss on privately owned land as one of the dynamics that has challenged the study area households' food production. In their response to open-ended questions, many of the respondents indicated that the introduction of a sedentary farming system into the ASAL parts limited mobility and keeping livestock on small private farms caused overgrazing and biodiversity loss. They also mentioned that they were using mountain areas and forests for livestock grazing due to diminished communal grazing land areas, which caused land degradation and biodiversity loss. In a similar way, Yohannes and Mahmmud (2015) claim that sedentarization underestimated the multifunctional nature of pastoral mobility such as conservation of biodiversity by minimizing overgrazing. Studies claim that mobility is a solution for biodiversity conservation as it gives the rangeland areas to rest so that seeds get time to disperse (Davies *et al*., 2010 page 16 citing Savory, 1999). Thus, biodiversity loss of ASAL parts not only affected pastoral and agro-pastoral communities' food production due to shortage of livestock food but also caused extinction of bio cultural heritage such as the wide range traditional plant medicines used for treatment of human and to livestock illness and variety of wild food (Yohannes & Mahmmud, 2015).

A focus group discussion member at Fantale district indicated that a very fast multiplying thorny plant locally called *wayane* tree (named as *prosophis juliflora)* that devoured the rangeland was destroying grazing land areas. The respondent indicated that this plant invaded the rangeland and had caused biodiversity decline adversely affecting pastoral production in the area. He said that livestock did not eat the plant leaves, and other types of plants or grasses cannot grow under its shade (FGDF 1). The respondent claims that the *wayane* trees were introduced into Fantale district by the government in the 1980s through an unproductive project for the afforestation program which was supported by Yohannes and Mahmmud (2015). Zeremariam and Bereket (2013) indicated that 30% of the respondents in their study said they lost much of their grazing land areas to prosophis and this weed invaded 1.2 million hectares of land in Afar region of Ethiopia. Adugna *et al*. (2022) also indicated that 30% of the study households reported that they suffered from the invasive plant that caused shortage of grazing land area.

The regression model also identified shortage of water as one of the major challenges to food production in the study area. Rainfall variability and drought caused shortage of water for crop production, human consumption and livestock food. However, studies claim that the expansion of sedentary and mega plantation farming projects that shifted the river basins into irrigation farm areas in the ASAL parts of Ethiopia limited pastoralists access to water resources (Adugna *et al*., 2022). Mobility and access to water sources was mentioned as the major relief for livestock survival during drought seasons enabling the pastoral and agro-pastoral communities to remain productive as mentioned by Little *et al*. (2011).

In the same vein, Amartya Sen (1981) claims that pastoralists were affected not only due to natural phenomena such as drought but by structural changes and expropriation of pastoral land for commercial farms. He noted that this deprived pastoral communities in rift valley areas of Ethiopia from the wetlands areas for the long dry seasons grazing which in turn led households to severe economic problems and famine. Sen expressed how the change affected Ethiopian pastoral communities in the Rift Valley in his book “Poverty and Famines: An Essay on Entitlement and Deprivation” as follows:

> About 50,000 hectares of good land in the Awash Valley were 'developed' during 1970-1 for growing commercial crops, particularly cotton and sugar, … The land thus developed had been among the best of the grazing land available … during the long dry season lasting from September to May, and this land alienation led to severe economic problems. …pastoralists must have access to adequate dry season grazing near the river', and 'when a small area close to the river is made unavailable for dry season grazing, a much larger area away from the river is rendered useless (P.104).

Blaikie, (2016 page 151, citing Williams, 1976) argues that governments need to revise strategies that threaten peasants and pastoralists' rights to access land resources by empowering them and encouraging initiatives that enhance their food production activities. Similarly, Scoones (2021) argues that political choices that cause commodification of natural resources change patterns of resource ownership and control resulting in gains for some and losses for others influence ecology. He further contends that development actions introducing changes to diversify livelihoods, such as crop farming or animal fattening, as adaptive strategies in ASAL parts, but undermining strategies of the rural people themselves, fail to recognize the dynamics that cause livelihood vulnerability (Scoones, 2020).

The regression model identified the spread of human diseases such as HIV/AIDs and COVID-19 was significantly associated with food insecurity in the study area. A study by Degninet and Anteneh (2020) claims that COVID-19 particularly affected all the four pillars of food security as it affected the production, transport and market structure and also caused economic destabilization. Degefa (2005) also claims that communities in the ASAL parts are exposed to diseases such as malaria due to the nature of the natural environment and inadequate health services.

There are various explanations on how disease affects food security. Wisner *et al*. (2003) mentioned that there are more than 30 deadly diseases including HIV, Ebola and about 20 infectious diseases such as cholera and about 74% of people who live with HIV were in Sub-Saharan Africa. They claim that disease is one of the dynamic pressures that people face besides environmental changes, war, conflict and structural changes, which affect food security.

They further argue that disasters such as disease are not discrete events particularly in developing countries but linked to living conditions and multiple factors such as economic and political systems and social processes such as unequal access to opportunities that determine their exposure. Thus, Wisner *et al* claim that the environment provides opportunities and hazards to all, but access to land resources are determined by social, economic and political factors, and it is inequality in access to opportunities that expose some to hazards (such as disease).

Some scholars used the ‘health crises model’ to explain African famines such as the 1985/86 Darfur (Sudan) famine, which was caused by the spread of disease and people’s vulnerability to disease (De Waal, 1989 cited in Scoones, 2020 page 96). Scoones (2020) agrees that health crises and food crises have strong interrelation particularly in the case of modern African famines although he mentioned poor nutrition as a proxy for the crisis and poor people the most vulnerable to disease. Other studies admit that nutrition and disease have a strong association as resistance to disease is highly affected by nutritional status and poor health affects family labor contribution for food production. They further indicated that the problem of stability in food availability, access and utilization as well as sanitation problems expose people to disease (Tilksew & Fekadu, 2013; Meskerem &Degefa, 2015). However, their causal-effect relationship may demand further study.

4.5.2.6. Ordinal Logistic Regression Model Outputs for Institutional Factors Association with Household Food Security Sustainability

The regression analysis for institutional variables showed that restricted pastoral mobility (P-value=0.000), market facilities and infrastructure problems (P-value=0.022), and conflict (P-value=0.000) have significant correlation with household food security sustainability at P-value 0.05 as shown in Table 4.23 below.

Table 4.23: Ordinal Logistic Regression Model Outputs for Institutional Variables

Variables	Value	Std. Error	t value	p-value
Land use policy change	0.0835456138	0.09698740	0.86140692	0.389
Urbanization	-0.0619821527	0.11402155	-0.54360036	0.587
Restricted mobility	-0.3440307588	0.08638401	-3.98257433	0.000
Lack of access to credit	-0.1685394661	0.09557972	-1.76333913	0.078
Trade restrictions	0.1096446855	0.09977714	1.09889584	0.272
Livestock price fluctuation	-0.1248275999	0.09449606	-1.32098203	0.187
Food price volatility	-0.0881030267	0.09819671	-0.89720958	0.370
Market facilities problem	-0.2213803871	0.09673896	-2.28843046	0.022
Inadequate extension service	-0.1353051906	0.09544922	-1.41756197	0.156
Lack of technology use	-0.1144897358	0.09075538	-1.26152003	0.207
Cooperative involvement in market	0.0273008222	0.10542143	0.25896842	0.796
Conflict theft and robbery	-0.5571107100	0.09177863	-6.07015726	0.000

Intercepts:

	Value	Std. Error	t value
High damage|Low Damage	-5.8023	0.7952	-7.2966
Low Damage|Not at all	-4.8484	0.7664	-6.3260
Not at all|Very low damage	-0.1559	0.8500	-0.1834

Residual Deviance: 676.9011
AIC: 710.9011

Source: Field Survey between Nov. 2021 and May 2022

Table 4.23 above also shows that all the variables that have significant correlation were negatively associated with household food security sustainability in the study area whereas the remaining nine variables did not show significant correlation with household food production in this study.

Table 4.23 further shows restricted mobility has a strong negative correlation (P-value=.000) with household food security sustainability in the study areas. In their response to the open-ended questions, many of the respondents indicated that the communal grazing land area has diminished following land use policy change that restricted pastoral mobility. They listed the negative effects of restricted mobility such as they were exposed to extra expenses to purchase animal food, livestock death due to drought as mobility was restricted, demand for child labor for herding, conflict over resources, low livestock product, asset loss and food shortage. The respondents also indicated that they were exposed to long distance mobility to search for livestock food.

Many of the respondents indicated that the situation had affected their food production system in several ways, including exposure to insecurity and conflicts over resources with farmers and bordering people as they moved in search of livestock food. In their response to the open-ended questions of the questionnaire, 70% of the respondent households indicated that livestock productivity had declined during the last 15 years and they were exposed to decline of income from livestock as they were forced to keep a minimum number of livestock that their privately owned land area can support due to restricted mobility.

A synthesis of the responses of the respondents to the open-ended questions has shown that the culture of gift and support from relatives, community members and families had declined gradually. This was due to the declining asset base and resources such as grazing areas and plant residue became the means of income. Culture of gift and support from kin and community had been the major coping strategy for poor community members and absence of such support means vulnerability to destitution and food insecurity for this segment of the community.

A key informant indicated that most former grazing areas of the district's land had been expropriated by the ever-expanding sugar factory and pastoral mobility distance had become longer than before. He indicated that Fantale pastoralists for instance were forced to move up to a distance more than 250 km as far as Ziway in south Shewa, Shashemene in Arsi Zone and Waliso in south west Shewa zone in search of livestock food (OIPDBKI 1).

Studies on food security support pastoral mobility as an effective adaptation strategy that enabled the ASAL parts communities' productivity in the uncertain dry land environment (Müller-Mahn, Rettberg and Girum, 2010; Swift, 2020; Shomo & Arab, 2001 in Scoones, 2020; FAO, *et al.*, 2018). They claim that as a resource management system, mobility enabled pastoralists to remain productive in this harsh environment with many uncertainties and variable rainfall patterns. Pastoralists use mobility during different seasons in different locations as a way of production system to manage the natural resources available in this dry land in a sustainable way (MoA, June 2014; HLPE, 2017).

In the same vein, studies indicate that mobility distance, frequency and length of time the mobile people stay away from their residential areas and families have increased up to over a year, which created many problems such as lack of access to market (De Haan, 2016; Rettberg, 2017; Adugna *et al.,* 2022; Little *et a.l,* 2011). Easdale and Domptail (2013), Twigg (2015), and FAO (2018) indicate that the decline of mobility as traditional adaptation strategies is the major cause for pastoral food production decline and vulnerability of the ASAL parts pastoral and agro-pastoral communities to food insecurity.

It was also indicated that such structural changes have accounted for the current problems of overgrazing, encroachment into marginal lands, environmental degradation, limited coping capacity, increased conflict over resources and instability which caused productivity decline and intensified the food insecurity situation of pastoral communities in the area (Little *et al*., 2011; FAO *et al*., 2018).

In their political ecology explanation to ASAL parts' food insecurity, Little (2002) and Little *et al* (2011) argue that restricted mobility is the effect of political marginalization and stereotyping of pastoralist blaming pastoral system as less productive and destructive to the environment while the true motives have been commercial farms and other economic interests.

The regression analysis also has shown that conflict was negatively correlated (at P-value=.000) with household food security sustainability in the study area as can be seen from Table 4.23 on page 209. In their response to open-ended questions, 17% of the respondents reported that conflict and security problems as the major challenge to their food production activities in the study areas. About 46% of the respondents affirmed that their property was looted by theft and robbery during the last 15 years. They mentioned lack of good governance, declining power of the traditional communal administration, and conflict over limited land resources and political instability as the major causes of security problems in the study area. The respondents indicated that bordering people from Amhara National Regional State (Region 3) grabbed previous grazing areas used by Fantale district pastoral communities, and intensified security problems due to political instability in the area. The respondents also mentioned the problem of cattle raids by people from bordering regions.

Many studies conducted on ASAL parts' food security claim that access and control over resources (mainly land and water sources) is the major cause of conflict in the area. The study conducted by Adugna *et al*. (2022) revealed that tenure insecurity of the communal land was the major cause for conflict in pastoral and agro pastoral parts of Ethiopia. The study also revealed the intensity of the conflict was increasing as 18.2% of the study households reported they had faced conflict over land in the past 12 months before the study (the study was conducted in 2021) while 16% of households reported they had faced the problem in 2018. FAO (2021) also reports conflict has been the leading cause of global food crises during the last ten years, pushing several countries to the verge of famine. In a similar way, Alemmaya and Hagmann (2008) indicate that allocating the previous Karayyu's pastoralists grazing land area into Argoba sedentary farmers territory following the ethnic based decentralization resulted in violent conflict and cattle raids between the two tribes. Conflicts also interrupted the market in some areas (MoA, June 2014; Esayas, Solomon & Girma, 2019).

Cousins (1996) argues that the source of conflict in pastoral areas is more than resource issues but deep rooted in the question of identity. He suggested that the resolution of such conflicts requires in-depth understanding of the human ecology to give solutions that satisfy the conflicting parties. Van der Merwe *et al.* (1990, cited in Scoones, 2020: 184) *suggest:*

> … where gross injustices occur, conflict cannot be accommodated constructively without fundamental social change, and that even violence, while destructive, should be seen as part of the communication process between adversaries. Furthermore, in situations of great asymmetries of power between adversaries, a process of empowerment of the weaker party is essential if negotiations or other procedures are to be effective in resolving (or accommodating) the conflict.

The regression model also showed that the market situation in the study area was associated negatively with household food security sustainability (at P-value=.022) as can be seen from

Table 4.23 on page 209. In their responses to open-ended questions, many of the respondents indicated that there were market related problems such as poor market facilities; road problems and place to keep livestock during night when they travel to far distance markets in big towns in search of better price for their livestock. They also mentioned the difficulties they faced when they were forced to sell their farm products at unfair prices while buying food items and other farm inputs at higher price due to uncontrolled act of brokers/traders, the problem of lack of market information, market price fluctuation, limited market days and taxation and wrong function of cooperatives. The respondents said that sometimes they used to sell their livestock at unfair prices so as to avoid taking them back home the long distance and because of the taxes, which they were paying each time they took the livestock to market. They also mentioned government policy such as restriction on cross border livestock market as causing low income from livestock limiting household access to food.

An informant, who was a market development agency team leader, from Oromia Bureau of Agriculture and Natural Resource Development Bureau (OANRBKI 3), mentioned weak government control of market and lack of uniform market policy to control the activities of traders and intermediaries such as the cooperatives who continued to maximize their profit as the major problem. He noted that *teff* is the stable food grain for all Ethiopians and demand for grains like *teff* is inelastic. People do not change behavior easily and they hardly substitute it for cheaper grains but continue to buy even if it is expensive. Thus, under such free market policy (in practice it is a mixed policy) intermediaries and merchants profit maximization act is not controlled. The act of price fixing activities done at grain shops is not strong enough to control price because it is done based on general observation of price but does not decide the selling price by calculations based on the real price at which traders buy grain from farmers and profit they make. Thus, lack of government attention was found to be a serious market problem in the study area.

In their responses to the open ended questions, quite sizable respondents indicated that those who kept improved dairy cattle breed for milk and improved their production were challenged due to lack of market chain and were being exploited by intermediary traders and brokers. They mentioned that to travel to look for a market for their products at other towns exposed them for extra expenses and time.

A key informant who was a team leader at East Shewa Zone Irrigation and Pastoral Development Office (ESZPDIOKI 1) also added that the market was the major problem in Fantale district as the market needs of the pastoral community and the available market did not do much. For example, pastoralists' major livestock was camel but the market was not available for camel milk, as the community did not consume camel milk and no butchery process for camels except the market to sell livestock. He further explained that brokers who used to buy livestock to make high profit selling at other nearby markets at Adama and Addis Ababa dominated the livestock market. He added, even the cooperatives were profit makers. They used to buy milk from pastoralists and sell at higher prices at the Karayyu milk selling shop at Adama University, and at Addis Ababa markets without any value adding process. The cooperatives did not work on processing such products. He further explained that brokers who buy livestock to make high profit selling at other nearby markets at Adama and Addis Ababa have dominated the livestock market. He narrated:

> Pastoralists in this area have a weak market chain. [Their] major livestock is camel but the community does not consume camel milk and the market is not available for camel milk. Brokers who dominate the market for livestock, improved seed, and other items keep livestock and livestock products at low price making excessive high profit exploited pastoralists. However, the price of food and farm inputs remained high. The unions are only profit makers buying from farmers and sell without any value adding at higher prices in other markets in Adama or Addis Ababa *(*ESZPDIOKI 1).

Figure 4.19: Livestock Market at Matahara Town in Fantale District Saturated by Brokers and Traders

Sources: Taken during field survey in January, 2022

Figure 4.19 above shows the multitude of traders and brokers acting in the livestock market at Matahara town in Fantale district. An informant, who was a market development team leader from Oromia Bureau of Agriculture and Natural Resource, further explained that the farmers' cooperatives were organized to create market linkage for farmers with the primary objective to solve farmers' market problems. He further explained that there were supply side cooperatives that were buying grains from farmers and storing. There were also demand side cooperatives that were buying from suppliers and selling to consumers. The Oromia cooperative promotion agency used to organize this linkage to move food grains and other farm products from high accumulation to shortage areas. However, the horde of cooperatives worked to maximize their profit according to their own interest and this became one of the major problems in the study area (OANRBKI 3).

Similarly, two informants, who were marketing experts in Oromia Agricultural Cooperative Promotion Agency, said that the cooperatives had no value adding activities but they were buying from producers and selling for consumers or other processors. One of the informants added:

> There are various types of farmers' cooperatives on vegetable and fruits and livestock, marketing, grain and seed production and grain banking, etc. The cooperatives do not do value adding activities. They collect primary farm products from producers and sell them at other locations. For example, they supply primary products (livestock) to Qera, Bishoftu and Sululta beef production centers (Butcheries). However, there were brokers who control large portion of the market (about 80%) and were making high profit in the area since there is no market control mechanism *(*OCDAKI 1 &).

Esayas, Solomon and Girma (2019) have the view that Ethiopian ASAL parts were less market integrated and communication services for rural-urban linkage were poor. Besides, communities in the ASAL parts of Ethiopia lacked effective market development policy attention by governments. They said that due to the fragile nature of Ethiopia's ASAL parts, factors like poor infrastructure for rural-urban linkage, weak market system, poor communication services and lack of information were hindrances to trade in the area. Policies and programmes in the area failed to target the local communities effectively (Mulugeta & Habtemariam, 2011; MoA, 2014).

In relation to ASAL areas communities' low benefit from trade, studies claim that government policies' failure to appreciate local constraints that hinder pastoralists' market supply have limited their income from the livestock trade in the area. Little, Dejene and Waktole (2014) identified factors such as low price, pastoralists' low engagement with market and production system limited ASAL parts households to exploit market benefits. Their study showed that although livestock market prices have been on rise, pastoralists were not benefiting from the opportunity due to various constraints. The researchers indicated that pastoralists move to remote areas far away from markets to search for livestock food and only 55% of the households sold their livestock at market place and very few sold to local butchers while the rest sold to traders who travel to remote rural areas. The study further showed that pastoralists received only 45-50 percent of the sale price of their livestock in the national market. The study further indicated that only 50% of pastoralists had mobile phones and their low negotiation skill due to lack of market information and low literacy rate were also identified as additional factors for low price.

ASAL areas communities' low participation in export trade was also identified by Little, Dejene and Waktole as one of the factors for low benefit from the growing livestock market in Ethiopia. It was indicated that livestock export trade in Ethiopia has been growing and the 2015 country's Growth and Transformation plan targeted 90% of the 2 million livestock export to be from pastoral areas. However, only 5% of households sold directly to exporters while traders who made huge profit controlled more than 94% of the trade.

Groups of consumers associations (Cooperatives) for diversifying food supply and providing substitution possibilities of less expensive food items with the same nutritional values for food oil, cereals and other food commodity supply is functioning as an adaptive strategy in the study area. The objective of the cooperatives was to support small-scale producer farmers during market failure to increase farmers bargaining power in selling their farm products. However, a study by Bezabih claims their contribution to stabilize the market for farmers remained questionable as the union ended up making profit without value adding although those farmers who joined the union might have benefited (Bezabih, 2009). Therefore, besides their being located in the marginal ASAL parts with poor market situation, farmers and pastoralists were exploited by both market actors- the cooperatives and traders.

In conclusion, the regression analysis has confirmed that socioeconomic constraints and a combination of multiple environmental and institutional dynamics significantly influenced sustainable food security in the ASAL parts of Fantale and Boset districts. Key variables such as soil fertility decline, land degradation, biodiversity loss, shortages of water, spread of diseases, restricted pastoral mobility, market infrastructure problems, and conflict negatively affected households' food production system influencing households' food security sustainability. The respondents' views highlight the tangible impact these factors had on their food production systems, reinforcing the analysis results. These findings align with previous studies that have emphasized the critical role of environmental degradation and institutional barriers in exacerbating food insecurity in arid and semi-arid regions. The convergence of the respondents' views, empirical evidence, and existing literature underscores the necessity for comprehensive strategies that address socioeconomic factors as well as both environmental and institutional dynamics.

Addressing these issues is crucial for enhancing food security in these areas. The findings emphasize the importance of targeted interventions to promote sustainable food security, ensuring that efforts are informed by both local experiences and broader research insights. By doing so, policymakers and development practitioners can more effectively support sustainable food security in the ASAL areas.

4.6. Challenges to Sustainable Food Security in the Study Areas

The respondents were asked to indicate the challenges to their food security sustainability, and adaptive strategies they employed to climatic change, land use policy change, sedentary farming, restricted mobility and market dynamics. Their responses have been summarized in Tables 4.25 and 4.26.

Regarding their adaptation strategies to the land use policy change, about 26% of the respondents who responded to the open-ended questions indicated that they used crop residue and water from irrigation or river for livestock feeding. About 24% replied they were purchasing crop residue or forage, 15% ranching lands and preparing ponds for their livestock, and 14.4% said that they started settling crop farming and irrigation farms as indicated in Table 4.24 on page 221. Others mentioned that they reduced the number of livestock and kept to a manageable size; and retained a few selected types of livestock such as dairy cattle and ruminants such as goat and chicken on privately owned land around home. Others said that they joined cooperatives, used mountain areas and border area-grazing, forest grazing, long distance mobility, or sent their livestock to "*daraba*" to keep their livestock with relatives at distant places where livestock forage was available.

Table 4.24: Adaptation Strategies to the Changing Environment

Adaptation strategies	Responses
Use crop residue and irrigation or river water for livestock food	26.5%
Purchase crop residue/oil factory residue or forage for livestock food	24%
Ranched grazing area and pond preparation	15%
Shifted to settled crop irrigation farming	14%
Reduced number of livestock kept	5%
Joined cooperatives for animal fattening/shifted to animal fattening	5%
Hired herder	5%
Mountain area grazing and border grazing	3%
Tree growing for livestock food	2%
Migration to relatives area (*Darabaa*)	1%
Total Response Category Count	100%

Source: Field Survey between November 2021 and May 2022

Requested to indicate any challenges they might face as the result of the strategies they had adapted in the study areas, the respondents identified 10 challenges as can be seen from in Table 4.25 on page 222.

Out of 274 respondents who responded to the question, 20%, 15%, 14.2%, 14%, 10.6%, and 10.2% respectively indicated that shortage of livestock food and water, crop failure, market related problems, shortage of farm inputs, conflict and insecurity, and asset loss and food shortage as the major challenges to sustainable food security in the study areas.

Table 4.25: Challenges that Negatively Affected Households' Food Security Sustainability

Challenges Identified by Respondents	Responses	Percent
Livestock food and water shortage	55	20
crop failure and food shortage	40	14.6
Market related problems	39	14.2
Problems related to farm inputs/ financial difficulty to purchase farm inputs, low awareness on technology use/	38	14
Increased conflict and insecurity	29	10.6
Asset loss and food shortage	28	10.2
Land degradation due to livestock overgrazing	18	6.6
Soil fertility decline	10	3.7
Disease and health problem	9	3.3
Climate change	8	3
Total Response Category Count	274	100.2

Source: Field Survey between November 2021 and May 2022

Shortage of livestock food was identified as the major challenge to sustainable food security in the study areas. There are previous studies conducted in ASAL parts that support the findings of this particular study. The study conducted among Southern Ethiopia and Northern Kenya pastoral communities by Little, Dejene and Waktole (2014), for instance, shows that livestock food shortage was ranked the major challenge to pastoral food production next to food insecurity and poor human health. The researchers claim recurrent drought in the area caused livestock food shortage. However, as discussed in the literature review Chapter (Yohannes and Mahmmud, 2015), and repeatedly claimed by the respondents of this study, supporting the view that government policy that limited pastoral mobility causing lack of seasonal grazing area, was the major cause for livestock food shortage in the study areas although climate change had its share.

Considerable number of the respondents also indicated that they had joined animal fattening cooperatives on fenced former communal land while a few respondents mentioned that they kept on improving dairy breed cattle. However, they mentioned that they were challenged by shortage of water and animal feed in this dry land area and poor market connection for live-stock products. Others mentioned they were forced to purchase forage from those who had ranch and plant residue or oil residue. Thus, poor handling due to poor feed resulted in poor prices, which made paying back their credit difficult. Thus, their new survival strategies were challenged by lack of inputs such as animal feed, water, improved breeds; and intensive re-quired care, and market access causing poor farm productivity which was supported by similar previous studies (Ericksen, 2008a).

This study identified crop failure as the second major challenge faced by households in the study areas. The respondents of this study claimed sedentary farming introduced by the gov-ernment to ASALs as adaptation strategy was less favorable to the ASALs agro-ecology and exposed them to recurrent drought, and rainfall variability that resulted in crop failure and shortage of food although they affirmed owning farm improves food access. Thus, grain price volatility, shortage of food, and food insecurity occurred. They further indicated that crop farming was also used for livestock forage production from crop residue as an adaptive strat-egy to the declining livestock grazing land areas. Thus, crop failure exposed households not only to households' food shortage but also to shortage of livestock feed, livestock death and asset loss (see Table 4.25 on page 222).

The respondents also indicated that collecting all crop residues from farms to feed livestock had a negative impact causing soil erosion and when livestock were kept at a fixed place, overgrazing caused land degradation. In addition, the informants claimed that most of the projects introduced to the study areas, particularly in the pastoral area of Fantale district were not well placed to improve the livelihood of the community. They said that the irrigation introduced to pastoral areas to produce vegetables and fruits had not been considered pastoralists' way of life. Because pastoralists were mobile people and they had less interest in farming, and consequently they rented their irrigation land to others living in the town (FGDF 4).

Focus group participants and Key informants of this study identified similar constraints related to shifting to sedentary life and crop farming indicating poor productivity of crop farming as well as other diversification strategies introduced to the study areas. The Key informants indicated that drought, rainfall variability, poor soil fertility and financial constraints to access farm inputs were the major causes for crop failure; this was also affirmed by one of the discussants (FGDF6).

Previous studies support the respondents' arguments regarding the disadvantages of settled crop farming. Considerable number of studies evidenced that a shift from pastoral way of life to sedentary farming in ASALs pastoral areas of Ethiopia resulted in poverty and food insecurity for those pastoral households who started crop farming. Even those who joined the diversification activities indicated that they were not productive. Various constraints such as the agroecology of ASALs, lack of access to technologies, lack of access to market, and shortage of livestock food limited their productivity. Soboka (2018) claims that promoting crop farming in these peripheral areas was related to Ethiopian governments' border policy objectives to control the ASAL parts communal land areas since the 19th century. Many previous studies argue that the introduction of crop farming did not improve the food security situation in the ASAL parts of Ethiopia, instead aggravated land degradation and conflict in the region. The explanation given by some of those who argued the unprofitability of crop farming was rainfall variability and the recurrent drought in these ASAL parts that resulted in crop loss (Yohannes & Mahmmud, 2015; Asebe, Yetebarek & Korf, 2018).

Studies indicate that owning a crop farm where there is access to irrigation has improved household food security in ASAL parts (Fekadu *et al.*, 2016; Fekadu, Gadissa and Jabessa, 2020). A study by Fekadu, Gadissa and Jabessa (2020) shows that the study respondents supported to supplement crop farming with pastoral activity, but they argued that a shift from pastoral livelihood to sedentary farming as an adaptation strategy in ASALs ended in poverty for those who shifted to crop farming in order to be considered for the government led safety net programme. The same study reported that the respondents believed crop farming as unproductive undertaking due to drought, rainfall variability, high input cost and poor harvest. Instead, they favored livestock production because of its fit to the ASAL parts agro ecology, high price of livestock as compared to crop and its relatively low labor demand. The respondents of the study also claimed the return for livestock per unit of land was always higher as compared to crop but the return from investment in crop was lower.

In a similar way, previous studies indicated that pastoralists claimed a livelihood shift to sedentary farming as an adaptation strategy for food security in ASALs had caused poverty (Fekadu, Gadissa & Jebessa, 2020).

Scholars criticized governments' development programs introduced into ASAL parts based on linear evolutionary change that promoted a shift from pastoralism to settled crop farming and the preference of private land holding as more effective than communal ownership. They claimed that the governments failed to recognize the specific ASAL parts spatial, temporal and socioeconomic aspects; its agroecology, which are decisive for agricultural production (Scoones and Wolmer, 2000). The necessary social and institutional constraints and opportunities that helped to improve livelihoods' resilience in the dry land areas were not given attention as the basis to identify development options. Opportunities and constraints for different farming systems such as crop farming or pastoralism depend on farmers' social differences and power relations such as wealth, age, gender, ethnicity, ecology (Gass & Sumberg, 1993 cited in Scoones & Wolmer, 2000 page 23). The scholars believed, for promoting food security in the area, exploring the alternative potentials that can be adapted to the agro-ecology and socioeconomic conditions of the specific areas and identifying the institutional opportunities could resolve the challenges faced. They suggest the need to give attention to available livelihood resources and capacities in adapting livelihood strategies in a given context. Access to resources such as land, information, technologies and physical infrastructure determine livelihood outcomes. Thus, poor pastoral households had less capacity to benefit from development projects such as mega plantation farms promoted in ASAL parts (Scoone and Wolmer, 2000).

The same scholars claim that adaptation strategies commonly used by poor households such as vegetable farms on irrigation, animal fattening and dairy farms require access to market and animal food (which the respondents of this study also indicated as the major challenges).

In a similar way, the households lacked the capacity to access adaptive technologies to be productive in mixed crop-livestock farming. Thus, a shift from livestock farming to mixed farming may function well for some, but not uniformly for all. Thus, the government's development programs pushed by donors, and lacking local people's participation to capture diversity of social context, failed to improve sustainability of livelihoods. They suggested promoting diversity in adaptive technologies to address poverty among marginalized groups such as poor pastoral households than mixed farming in the areas.

Farm inputs were also identified by the respondents of this particular study as the major challenges to the crop farm productivity (see Table 4.25 on page 222). This finding is consistent with a study conducted by Mequanent, Birara and Tesfalem (2014) which reported that farm inputs such as improved seeds and technologies chemical fertilizer showed negative association with food security. The researchers claim that due to the high cost of farm inputs, farmers sell their assets and spend their money to purchase farm inputs, which decreases food security. Fekadu, Gadissa and Jebessa (2020) also claim that pastoralists in the ASAL parts sell their livestock to purchase farm inputs while the return from crop farms do not cover investment costs due to low productivity in the area.

A respondent in one of the FGDs at Boset district explained desperately how lack of access to technology was putting the poor farmers in a poverty track. The respondent said;

> The price for fertilizer rose too much and the have-not farmers cannot afford to buy. We are forced to make our farmland [includes irrigated land] share-cropping with people who can buy fertilizer since we cannot afford to buy. Then we share the yield with the shareholder. Next year we will continue to work on a shared basis. Because the previous year yield was shared and small for our family, we cannot afford to buy fertilizer this year again. We are not

> using our farmland fully for our household in this way. How can we have enough food then? We cannot have. Even the so-called government support there was no visible impact that we see….she continued asking “How does poverty end then?” …the respondent expressed her worries saying …farmers are now facing a serious problem emanating from this situation (FGDB8).

Other group members also shared the feeling regarding the problem caused due to lack of access to farm inputs. One respondent added, “Nowadays the land is not yielding without using fertilizer. But most farmers could not afford to buy a full sack of fertilizer and they were forced to buy from retailers who were making huge profit”. Therefore, farmers cannot add the right amount of fertilizer to their farms and this reduced the yield from farm (FGDB2).

Some of the respondents indicated that they started business but were unsuccessful due to limited trade activities in their localities. Others indicated that they used to sell firewood and charcoal but trees for firewood and charcoal were diminishing, and they were forced to work on share base with those who had trees, which caused inadequate income to support their households. Those who mentioned that their survival means government aid also complained it was not dependable. Others said they had no survival means as such, as non-farm income sources were rare in the area.

A key informant who was a seed analysis expert at the Oromia Agricultural Development Office explained the manifold technical problems related to improved seed such as inadequate seed breeding, seed marketing information and infrastructure and farmers’ lack of knowledge hindered productivity of crop farming in ASALs. The informant said that seeds adapt only to specific agroecosystems but farmers may not have adequate knowledge and lack such information while buying seeds. As a result, most of their maize farm remained unproductive as the short period rain in arid areas went while the crop was still growing. He added that lack of effective large-scale seed enterprise was also a major problem in Ethiopia as the large seed breeder companies, such as Comet, were not working in the country. In addition, he claimed, the pre-basic and basic seed suppliers that existed in the country were inadequate and lacked skills. The only large importer company was Pioneer Hi Bred Seeds Ethiopia PLC and there was shortage of seeds such as maize breeds. Other small seed producers also lacked clear awareness and knowledge about seed production and faced problems to isolate when seeds produced. Seeds may get hybrid due to pollination when produced where there are other breeds of seeds nearby and they can be exposed to diseases and pests due to quarantine problem and crop disease such as rust, which easily spreads (OANRBKI 4).

Another major challenge in technology use, indicated by the informant, was that fertilizers were susceptible to moisture in the dry land of arid or semi-arid parts due to shortage of rain. Besides, affordability was another problem for farmers; for instance, 12.5kg, which is for ½-hectare used to cost around 1200 Ethiopian birr.

In regard to the improved breed adaptation problem with pastoralists, one of the key informants argued that modern breed system demands settled life and supply of balanced diet, healthcare, care taking and follow-up system for the livestock. High inputs such as animal food, and intensive care is required to increase productivity of the livestock. Therefore, they are not convenient due to environmental factors and the pastoral lifestyle as they move from place to place in search of livestock food and water. He underlined that convincing pastoralists and bringing behavioral change and providing the necessary technical support was required to help them adapt to modern ways of livestock production (OIPDBKI 1).

Asset loss was also identified by this particular study among the major challenges to households' sustainable food security as shown in Table 4.23 on page 209. In a similar way, COMESA CAADP (2009) claims that ASAL pastoralists are highly vulnerable to food insecurity due to asset loss. COMESA CAADP indicates that natural hazards, conflict, poor governance, market problems, environmental change, displacement and limited access to grazing areas were the causes for asset loss. A study by Amwata, Nyariki and Musimba (2015) indicates that livestock losses was the major cause for food insecurity in ASAL parts because of expansion of farmlands and pastoral and agro-pastoral households lack of access to-and control-over land resources and diminishing animal food (Amwata, Nyariki & Musimba 2015).

Many of the respondents of this particular study indicated that they faced decline of livestock productivity and livestock death during drought seasons due to loss of seasonal grazing area, overgrazing and shortage of livestock food. Some also revealed that they had ranch lands and they used mountain grazing, former forest areas or border areas' grazing. The respondents mentioned that they were forced to reduce the number and kinds of their livestock to a few types such as dairy cattle and ruminants such as goat and poultry to a manageable size to keep on crop farm/irrigation around home as a survival strategy in the changing environments. Others complained that they were exposed to extra labor demands for preparing livestock feed, herding livestock around home on crop farm/irrigation lands, increased expenses for purchasing forage from those who had ranch land. Lack of money to purchase forage for livestock food, lack of animal herders and low school participation of children were listed as additional challenges. They also mentioned that livestock that were kept around homes used to destroy crops of others, usually causing conflicts with neighbors, increased conflict over resources, animal raid and theft, and adults' labor time was consumed to herd at border and mountain areas grazing due to security problems.

The respondents further complained that they were forced to send their livestock to relatives at distant places (*darabaa*) due to diminished communal land areas and shortage of livestock food. They mentioned that these acts had disadvantaged the households as they lost some benefits from livestock products and incomes, animal dung for soil fertility, and being a burden on relatives, and sustained food insecurity. They also indicated flooding, introduction of new weeds coming with improved seeds, and a declining culture of sharing as forage and plant residue became sources of income.

The challenges related to market identified by the respondents of this study such as traders dominance of market and lack of market information are in agreement with findings of previous studies (Little, Dejene and Waktole, 2015; Teklehaimanot, Ingenbleek van Trijp, 2019) that claim the role of market dominating traders, farmers limited market knowledge and taxation problems limited farmers income.

As established from the field study, both those who shifted their livelihood basis to sedentary farming and those who pursued to continue their traditional pastoral lives were struggling to survive without any sustainable pathway.

The responses of the respondents to the open-ended questions on changes in their localities, their adaptation strategies, benefits and challenges they faced were summarized in Table 4.26.

Table 4.26: Major Changes, Adaptation Strategies, Benefits and Challenges to Sustainable Food Security in the Study Areas

Areas of change	Adaptation practices (survival strategies)	Benefit	Major Challenges
Climate change(frequent drought, rainfall variability)	Irrigation farm,	crop available for household food, use plant residue for livestock feed, income from selling plant residue	Limited access to improved seed supply and limited knowledge, poor irrigation schemes, low productivity, shortage of food and food insecurity, Loss of seasonal grazing area during drought seasons, livestock death during long drought occurrences due to shortage of food, asset loss,
Land use policy change, privatization of land and expansion of mega projects and farmlands	Shift to settled farming (mixed farming) and irrigation farm, own land privately,	food crop available for household food, use plant residue to feed livestock kept on farm, business in plant residue, forage and animal dung, oil residue available to purchase for animal food	crop failure due to frequent drought, rainfall variability, food shortage; Loss of seasonal grazing area, Lack of access farm inputs; improved seed supply and limited knowledge, fertilizers are expensive to afford, low productivity, shortage of food and food insecurity; Collection of animal dung and plant residue used to fertilize soil caused land degradation and soil fertility decline, poor crop productivity, the spirit of gift for supporting each other has declined, financial limitation to buy animal food, Expropriation of communal grazing lands, privatization of previously communal grazing land areas for crop farming, restricted pastoral mobility, poor productivity, income decline,
	ranching, fencing previous communal grazing land areas by private owners	access to animal food for those who own ranch lands,	Limited access to land resources for those who do not have ranchland and crop farm, limited pastoral mobility,

Restricted mobility	Longer diameter of mobility distance (more than 250km) as far as Shashi Mane in South Arsi zone and Waliso in South West Shewa	access to livestock food,	exposed to conflict with bordering people, insecurity, livestock raid Limited pastoral mobility in the study area, shortage of livestock food, Land degradation, soil fertility decline, biodiversity loss, poor food production, food shortage
	Reducing number of livestock and keeping few dairy animals and small livestock around home on crop farm/irrigation, ranching *(kalo)*, mountain and border areas grazing, use plant residue for livestock food	keep livestock on crop farm/irrigation	asset loss, overgrazing, land degradation when livestock kept on the small privately owned land areas, shortage of animal food during drought seasons when crop farm fails, poor production, income decline, livestock death, child labor for herding livestock around home, adult labor for herding for security reasons, Insecurity, increased conflict with bordering people over resources, animal raid, theft
	send livestock to keep with relatives at distant, migrate to live with relatives at other areas~~,~~ (*Darabaa*)	access to livestock food and water	burden on relatives, household losses benefits from livestock products when livestock sent to (*darabaa*) soil fertility loss, , income decline and food insecurity,
	Keep improved dairy breed animals	Easy to handle	lack of market for dairy product at near by and exposed to expenses to travel to look for market, limited knowledge on how to handle improved breeds, poor productivity, low income, less productive in arid area, paying back the credit is difficult, livestock breed declined
Market Situation	Exchange livestock	Income to access food and other commodities	Lack of market network, lack of market information (not all have mobile phone), poor infrastructure,

			limited market days, selling livestock during holydays exposed farmers to over expending the money, shortage of livestock food, poor quality, low price; brokers and traders control price and dominate the market and keep the price of farmers products at lower prices, livestock price fluctuates, sell livestock at low price when price falls due to difficulty to carry back home long distance, or when money is in need to buy food and other commodities
	Joined cooperative for animal fattening, farm products supply, animal fattening on private basis,	Get access to grazing areas fenced by cooperatives on previous communal lands, supply farm input and grain, get income	Cooperatives buy from individual farmers and sell at profit at other markets without value adding, profit makers
	Started small business, non-farm activities	Income diversification	limited trade activities in the area, absence of employment opportunities
	Trade livestock	Income diversification	Absence of conducive environment for trade, high taxes on market days, limited market days, road security problems (crossing big rivers like Galan),
	sell firewood, charcoal, sand	Get income	trees for firewood and charcoal are diminishing, soil erosion, poor productivity of land, forced to work on share base with those who have trees, income decline,

	pastoral dropout	Depend on government aid, no action	Government aid is not dependable, unemployment, migration, poverty, food insecurity

Source: Field Survey between Nov. 2021 and May 2022

The respondents' responses to the open-ended questions show that the government's interventions through sedentary farming resulted in complex dynamic changes in the study areas. The local communities' access to land resources has been limited due to land privatization and expansion of mega projects and farmland areas. Ranching and fencing previously communal land areas by private owners resulted in diminishing of grazing land areas and shortage of livestock food that caused asset loss. Conflict over access to land resources increased hostility and insecurity in the ASAL parts. Thus, besides climatic change, respondents identified dynamics such as shortage of livestock food, crop failure, problems related to farm input, poor market situations, conflict, asset loss and food insecurity, land degradation, soil fertility decline, and production decline as major challenges to sustainable food security in the study area. This condition in the ASAL parts affected both household food availability and access. Thus, the political ecology explanation applies to this situation as the land tenure change that affected households' right to access to their livelihood resources and the unsustainable adaptation strategies of the people that degraded the fragile ASAL parts environments have negatively affected the sustainability of households' food security in the study areas.

4.7. The Hypothesis and Hypothesis Testing Results

4.7.1. Hypotheses for the Households' Socioeconomic Factors

Food security: a binary dependent variable with values 1 for food secure and 0 for food insecure individual

Household head gender: a dummy independent variable referring to male or female gender of the household head with value of 1 if the household head is male 0 otherwise. Men have decisive role in pastoral and agro-pastoral production context. Besides, the gender of household head is a determinant factor for access to resources due to gender stereotyping. Male household heads have more access to productive resources such as land and farm inputs and hence male gender was hypothesized to have positive association with food security.

District: is a context variable referring to respondent's location with values 1 if the respondent was in Fantale district and 0 if in Boset district. The arid Fantale district was expected to negatively affect food security as it is known that the ecosystem is affected by desertification (Zeremariam & Bereket, 2013).

Age (age_cat): respondent age measured in number of years is a continuous variable. In pastoral production system the accumulated knowledge and experience is an asset for production and hence age was assumed to have positive association with household food security.

Education: a dummy independent variable with value of 1 if the respondent can read and write 0 otherwise. Besides its value for knowledge of nutrition and access to information, education has contribution to food security in various ways including increased access to non-farm income. It was expected that having the reading and writing skills will have a positive association with household food security.

Family size (Family_size_cat): refers to number of total family members of the respondent a continuous independent variable. A large family size is more mouths to feed and was expected to have negative association with food security.

Privately owned land (privately owned land_2021): a continuous variable referring to the total area of land owned by the household in hectares. Land is a capital resource and access to land was assumed to have a positive association with food security.

Owning crop farm/irrigation is dummy variables taking the value 1 if the household crop farm/irrigation for crop cultivation 0 otherwise. Crop farm/irrigation in irrigation or dry land is source of food crop supply and was expected to be positively associated with household food security.

Non-farm/off-farm income (Non_Farm_income_Cat): a dummy independent variable taking the value of 1 if the household has or participates in non-farm/off-farm income sources 0 otherwise. Non-farm/off-farm income helps households to access farm inputs and food and was hypothesized to be positively associated with food security.

Government support/aid and kin/family support: dummy independent variables. Access to government support such as being beneficiary of productive safety net program is social security and support from kin and community in cash or in kind is social capital that enable households to cope with food shortages and were hypothesized to have positive association with household food security.

Livestock owned per capita (TLU): a continuous independent variable referring to the per capita Tropical Livestock Units a household owns. It is livestock numbers converted to a common unit based on the standard set for conversion. Larger livestock per capita owned is an indication of food security. Livestock per capita owned is physical asset that affect household's livelihood. It improves food availability and access and hence was expected to be positively associated with food security.

The significance coefficients (P) were calculated at $P < 0.05$. That means P-value ≥ 0.05 signifies that $\mathbf{H_{01}}$ could be accepted meaning there is no significant association. Whereas P-value < 0.05 indicates there is significant association, and the hypothesis (H_{O1}) will be rejected.

4.7.2. Hypotheses Testing Results

H_{o1}: There is no significance relationship between household food security and their socioeconomic factors in the ASAL parts of East Shewa zone.

Table 4.27: Results of Hypothesis Test for Household Socioeconomic Variables Association with their Food Security

Variables	P-Value	Ho
Respondent's District	.000	rejected
Household head's Sex	.640	accepted
Age cat	.769	accepted
educational status	.479	accepted
Household family size cat	.029	rejected
Privately owned land in hectare cat.	.403	accepted
estimated annual Non-farm income	.006	rejected
Crop farm/irrigation	.021	rejected
support, gifts from family, relatives, community	.086	accepted
government, nongovernment support/aid	.008	rejected
Livestock owned calculated in per capita Cat.	.045	rejected

Source: Taken during field survey in December, 2021

As pronounced from the regression analysis, positive association existed between household food security, and having crop farming/irrigation, non-farm income and government support in the study area.

The study demonstrates that socioeconomic factors such as crop farming/irrigation, non-farm income, and government support have a positive association with improving food security in these districts. These elements are crucial in enhancing the resilience of households against food insecurity, especially in arid and semi-arid environments. The hypothesis test helped to determine those household socioeconomic factors that modeled household food security situations and contributed to understanding the dynamics of food security. This implies that efforts to improve diversification activities through crop farm/irrigation, non-farm income and social support systems may be effective at supporting household food security. But large family size and large TLU may not be effective at enhancing household food security. This helps to identify key areas where policy intervention could be most effective.

Ho_2: There is no significant relationship between household food security sustainability and environmental factors in the ASAL parts of East Shewa zone.

Table 4.28: Model Test Results for the Association of Environmental Factors with Sustainable Household Food Security

Variable	P-Value	Ho Results
Rainfall variability	.205	accepted
Temperature variability (Heat stress)	.095	accepted
Soil fertility decline	0.000	rejected
Land degradation	0.031	rejected
Biodiversity loss (poor quality and quantity of forage,) on private land	.001	rejected
Biodiversity loss (poor quality and quantity of forage) on communal land	.921	accepted
Water shortage	.0.027	rejected
Spreading livestock disease	.088	accepted
Spread of human disease (HIV/AIDs, COVID-19…)	.000	rejected
Wild life and natural disaster	.181	accepted

Source: Taken during field survey in December, 2021

Ho$_3$: There is no significant relationship between household food security sustainability and institutional factors in the ASAL parts of East Shewa zone.

Table 4.29: Model Test Results for the Association of Institutional Factors with Sustainable Household Food Security

Variable	P-Value	Ho Results
Changes in land use policy	.103	accepted
restricted pastoral mobility	.007	rejected
Trade restrictions & lack of access to cross border livestock market	.453	accepted
Inadequate extension service provision	.204	accepted
Expanding urban areas	.211	accepted
conflict	.000	rejected
market facilities and infrastructure problem	.022	rejected
Food price volatility	.062	accepted
Livestock price fluctuation	.106	accepted
Cooperatives involvement in market	.070	accepted
Lack of access to credit	.078	accepted
Lack of technology use	.207	accepted

Source: Taken during field survey in December, 2021

It can be depicted from the ordinal regression model outputs shown in Table 4.28 and Table 4.29 above that the relationship existed between household food security sustainability and environmental and institutional factors such as soil fertility decline, water shortage, land degradation, biodiversity loss on privately owned land, human disease, restricted mobility, market facilities and infrastructure problem and conflict. This implies these multiple environmental and institutional dynamics in the study area may not be effective to ensure sustainable food security. They hindered household food production activities influencing household food security sustainability in the study area. However, most of these negative drivers are undoable. Proper mechanisms to improve household socioeconomic, environmental and institutional drivers can help to solve the problem of food security in the study population.

The hypotheses test results helped to identify those variables that significantly influenced food security sustainability, and provided insights into the socioeconomic, environmental and institutional dynamics that enhanced or undermined sustainable food security in the study areas. This approach not only helped to fulfill the study's objective but also helped to suggest practical guidance for improving food security through informed policy-making and interventions. It informs policymakers and stakeholders about which areas need attention to improve food security sustainability in the ASAL regions. Understanding the impact of these factors allows for targeted actions that address the root causes of food insecurity.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary of the Findings

This study was informed by the desire to investigate the dynamics towards sustainable food security in Boset and Fantale districts, located in the arid and semi-arid lands (ASALs) of East Shewa zone in Oromia Regional State of Ethiopia. The study was guided by the livelihood vulnerability and political ecology theories. A conceptual framework was developed and the association of independent and moderating variables with household food security in the study area was tested empirically utilizing three models developed from the conceptual framework. Descriptive statistics was used for giving a detailed account of the households' demographic and socioeconomic characteristics. Logistic regression analysis and hypotheses testing procedures were utilized to achieve the following specific objectives of the study: the food security situations in Boset and Fantale districts, assessing the dynamics contributing to sustainable food (in) security in Boset and Fantale districts, and analyzing the challenges that hinder food security sustainability in Boset and Fantale districts.

5.1.1. Household Food Security Situation in Fantale and Boset Districts

The findings of the study have shown that the majority (78.4%) of the respondents were males. The average age of the respondents was 48 years, and 70% of them were illiterate. The average number of children per household was 6.2, and the households in the arid Fantale district had larger household sizes. The findings established that crop farm/irrigation, livestock production and exchange of livestock and livestock products were the main sources of household food provisions. The study has further shown that household assets, such as the number of livestock owned, and access to communal grazing land had experienced a declining trend over the past fifteen years. Specifically, the average size of communal grazing land accessed by households had decreased drastically from 4,048.5 hectares in 2004/5 to 1,947.7 hectares in 2020/21. Similarly, the average number of livestock owned per household has declined for all types except poultry and equine animals. Moreover, livestock production for cattle, sheep, and goats has shown a downward trend. While camels and equine animals exhibited slight fluctuations, poultry production increased consistently throughout the period. Additionally, while crop production has steadily increased in Boset district over the span of fifteen years, the trend in Fantale district has shown a decline.

The findings of the study have shown that just 21.4% of the respondent households were food secure, while the majorities (78.6%) were food insecure in the study areas. Food insecurity was found to be more prevalent among households in the arid district of Fantale where 90% of the respondents were experiencing food insecurity as compared to 71% in Boset district (semi-arid). Looking at the severity level, 35% of the respondents were severely food insecure in Fantale district as compared to only 8% in Boset district. The finding corresponds with many other previous studies conducted in dry land parts of Ethiopia although it shows slight increase in severity of food insecurity which is assumed to be the effect of COVID-19.

It has also been found out that at the individual level, 37.6% of the study areas' population was food secure, while 47% were food insecure ($FI_{mod+sev}$), with 15.4% experiencing severe food insecurity (FIsev). Food insecurity was higher among individuals in the arid areas of Fantale district where only 15.3% were food secure, while one in four households in the district experienced physiological hunger, where people used to go days without food, compared to one in ten in the semi-arid areas of Boset district implies that food insecurity was severe in Fantale district. This implies that it is unlikely to ascertain the global SDG 2.1 plan to ensure access by all people to safe, nutritious, and sufficient food all year round by 2030 in the study areas.

Binary regression analysis of qualitative data collected on household socioeconomic characteristics was utilized to test the first model of the study. For the first hypothesis $H_{o1,}$ postulated that 'There is no significant relationship between household's food security and their socioeconomic characteristics in the study areas' the result of binary regression analysis has shown that socioeconomic dynamics including household non-farm/off-farm income, crop farm/irrigation and government support have positive association with household food security in the study areas of Fantale and Boset districts. This helped to determine those household socioeconomic factors that modeled household food security situation in the study area.

5.1.2. Dynamics Influencing Sustainable Food Security in Fantale and Boset Districts

Ordinal logistic regression was utilized to model the second and third hypotheses on the impact of environmental and institutional variables on household food security sustainability. The hypothesis '**Ho_2:** postulates that 'There is no significant relationship between household's food security sustainability and Environmental factors in the study areas' and hypothesis '**Ho_3:** postulates that 'There is no significant relationship between household's food security sustainability and institutional factors in the study areas'. The model test result for the environmental variables indicated that critical environmental dynamics such as soil fertility decline, shortage of water, land degradation, biodiversity loss on privately owned land and human disease have significantly undermined food production and food security sustainability at the study areas of Fantale and Boset districts. Additionally, the model test result for the institutional variables indicated that dynamics including restricted mobility, inadequate market facilities and infrastructure problems, and conflicts exacerbated food insecurity in the study areas. The models test results helped to identify those environmental and institutional dynamics that significantly influence food security sustainability in the study area.

The dynamics towards sustainable food security identified by the regression models concur with what the key informants, FGD participants and other studies indicated. Different studies claim that government sedentary policy and the resulting expansion of farmland and mega projects that undermined indigenous communities access to land resources and people's unsustainable adaptation strategies had negatively affected food production system with eventual effect on household food security in the ASAL parts (Adugna *et al.,* 2022; Blaikie & Brookfield, 2015; & Scoones, 2021)

5.1.3. Challenges to Sustainable Food Security in Fantale and Boset Districts

The study has identified that shortage of livestock food and water, crop failure and increased conflict and insecurity induced by land use policy change were the major challenges to household sustainable food security at the study areas of Fantale and Boset districts. The study established that some of those challenges such as financial difficulties in accessing farm inputs were internally induced due to lack of capacity and others such as conflict and market related challenges were externally induced due to institutional weaknesses. These challenges have led to a decline in productivity, income, and overall food security, implying that the available policies and practices are insufficient to support sustainable food security in the study areas.

5.2. Conclusions

With the purpose to investigate the factors influencing food security in the ASAL parts of East Shewa Zone in the Oromia Regional State of Ethiopia by using mixed method research approach, the study analyzed the food security situations in the districts, assessed the dynamics contributing to sustainable food security, and examined the challenges that hindered food sustainability in the study areas.

Regarding food situation, the findings have revealed worrying statistics that 78% of the respondent households were food insecure. The situation was severe in the arid areas of Fantale district. The findings have revealed that the dynamics that influenced household food security have elements of heterogeneity limited to the specific study area such as indigenous people's weak socioeconomic capacity, land use policy change, poor market integration and conflict, and homogeneity such as location in fragile land areas and poverty common to the ASAL parts. This finding signals a critical need for targeted interventions to address both the internally induced and externally exacerbating dynamics affecting the communities' livelihoods.

It has also been learnt from the study that socioeconomic factors such as non-farm/off-farm incomes, crop/irrigation farming and government support have positive associations with improving food security in the study area. These elements are crucial in enhancing the resilience of households against food insecurity, especially in arid and semi-arid environments. However, the fact that 52% of the study population owned less than one hectare of privately owned land, 50% of households in Fantale district owned less than 0.25 hectares in 2021, low crop production in the district, and a decline in household access to communal grazing land by 62% over the last fifteen years show the worsening of the case in point. In the same vein, the majority (53.4%) of the households were earning an average annual non-farm/off-farm income of less than 2 USD, which was minimal to supplement the poor production in the harsh environments. The Government's interventions to improve the indigenous communities' access to land resources, to promote agricultural productivity through indigenous people's increased benefit from crop/irrigation farming schemes, to diversify income, and to reduce poverty along with strengthening social support systems would enhance the households' adaptation strategies to shocks and stresses, and guarantee their sustainable food security. However, these efforts were not coupled with systemic strategies that enhance sustainable agriculture and irrigation to ensure long-term food sustainability.

The study pronounced significant environmental dynamics including soil fertility decline, shortage of water, land degradation, biodiversity loss on privately owned land, and human diseases as the major threats to food security. These issues are particularly acute in the ASAL parts, where the environment is already fragile; and environmental degradation as the result of social-nature interactions in the food production process is an ongoing issue that threatens long-term food security. Additionally, institutional dynamics such as restricted mobility, market related problems and conflict have exacerbated food insecurity in the study areas.

In regard to the challenges to sustainable food security in the ASAL parts of East Shewa zone, the study concluded that the shift to a sedentary lifestyle and restricted pastoral mobility coupled with the existing land use policies has resulted in significant challenges, including crop failure, livestock food and water shortages, financial difficulties in accessing farm inputs, and lack of market integration. These issues exacerbated poverty and food insecurity in these

ASAL parts. The available policies were not fully aligned with the unique needs and realities of the communities, and consequently instigated socioeconomic and environmental barriers, which further complicated the efforts to achieve sustainable food security.

This study, therefore, conveys a critical insight that achieving sustainable food security in the arid and semi-arid areas of East Shewa zone requires a comprehensive and integrated approach. It emphasizes that food security is not merely a matter of agricultural output but is deeply intertwined with socioeconomic development, environmental stewardship, and effective institutional frameworks. By analyzing the unique dynamics of the study areas, the study has demonstrated the importance of addressing both internally and externally induced challenges through inclusive policies that respect indigenous practices and promote their resilience. This underscores the potential of the areas to achieve food security, despite their harsh conditions, offering valuable lessons for similar contexts locally, regionally, nationally, and globally. The fact that this study has demonstrated that food security is a multidimensional issue calls for an integrated approach to realize food security in the arid and semi-arid areas of East Shewa Zone. This also implies the need to simultaneously address socioeconomic development, environmental degradation, and institutional barriers. Achieving sustainable food security in these areas necessitates leveraging the positive contributions of identified socioeconomic factors while mitigating the adverse impacts of environmental and institutional challenges.

It can, therefore, be concluded that putting in place: a) sustainable agricultural practices to improve land resilience and its productivity for better food security outcomes; b) clear legal and inclusive institutional framework for ASAL areas to enhance peace and security in ASAL parts; and c) effective conflict resolution mechanisms and clear land and resource rights so as to mitigate conflict incidences contributing to greater stability and security to create a more stable environment conducive to agricultural productivity and food security in the ASAL parts enhance to unlock the potential of the area for food security. The results also imply that strengthening local institutions and inclusive land use planning enhance the resilience of ASAL communities. Enabling them to manage their resources sustainably and equitably in the face of environmental and economic challenges; and effectively managing both internally and externally induced challenges through the integration of comprehensive legal policies and inclusive institutional frameworks incorporating the voices of indigenous communities enhance sustainability and fulfilment of welfare of the people.

The findings and the recommendations from this study offer valuable insights for policymakers, development practitioners, and stakeholders working to improve food security in the ASAL parts of East Shewa Zone on Oromia Regional State of Ethiopia and in other similar contexts. The dynamics observed in these parts demonstrate that even in challenging environments, a multifaceted approach integrating socioeconomic development, environmental conservation, and institutional reform can unlock significant potential for food security in the study area.

The study has addressed several key policy matters related to sustainable food security in arid and semi-arid parts of East Shewa zone including land use, environmental conservation, market integration, conflict resolution, and the creation of inclusive institutional frameworks to ensure sustainable food security in the study area and beyond.

Other regions can learn from this approach by recognizing the importance of addressing both internal and external challenges through inclusive policy-making and robust legal frameworks that incorporate the perspectives of indigenous communities. Additionally, understanding the balance between the homogeneity and heterogeneity of local conditions is crucial. While certain strategies may be broadly applicable, tailoring interventions to the specific environmental, cultural, and institutional contexts of each region is essential for achieving long-term sustainability and resilience in food security efforts. Ethiopia can replicate the recommendations of this study to other similar areas by tailoring and customizing them to specific issues and contexts of each area as required.

In conclusion, this study has provided a nuanced understanding of the dynamics shaping food security in the ASAL parts of East Shewa zone guided by vulnerable livelihood and political ecology theoretical perspectives and pragmatic world view. Integrating these frameworks have enabled the researcher to offer insights that bridge theory and practice, contributing to both scholarly discourse and practical interventions. Through the lens of pragmatic view, the researcher has emphasized the importance of context specific and adaptable strategies in addressing the challenges of food security unsustainability in ASAL parts. Based on this perspective, a flexible research method (mixed method) was employed by engaging local communities and incorporating indigenous knowledge that responds to the dynamic nature of these environments.

Furthermore, the study has applied the vulnerable livelihood theoretical framework to assess the multidimensional aspects of vulnerabilities among households in the ASAL parts. By combining quantitative and qualitative methods, the study identified the socioeconomic, environmental and institutional factors contributing to food insecurity laying the ground for targeted intervention aimed at enhancing livelihood resilience.

In addition, informed by political economy theory, the analyses uncovered the underlying power dynamics, resource governance structures, and policy frameworks that shape food security outcomes in the ASAL parts. By situating the research within these theoretical frameworks, the study also highlighted the importance of addressing structural inequalities and fostering inclusive decision-making processes to promote sustainable food systems.

The findings of this study underscore the need for holistic and context-specific approaches to food security that integrates theoretical insights with practical interventions. By collaborating with local stakeholders, policy makers, and researchers strategies that address the root causes of food insecurity while enhancing the resilience of vulnerable people in ASAL parts can be developed.

This study contributes to the literature on sustainable food security by demonstrating the value of interdisciplinary approaches that rely on various diverse theoretical perspectives. By synthesizing theory and methodology, the study advanced understanding of the complex dynamics at work in ASAL parts and paved the way for evidence-based intervention that prioritizes the well-being and livelihoods of local communities.

5.3. Recommendations

Based on the findings and the conclusions drawn, the following Recommendations have been forwarded.

1. The fact that 78% of the households were food insecure calls for urgent and concerted interventions. The Ethiopian Government, the Regional State of Oromia, and non-governmental organizations operating in Fantale and Boset districts need to design a policy

framework for regular monitoring and data collection to identify food insecurity early warnings for timely responses, and to put in place sustainable social protection programs and emergency food aids particularly for the most vulnerable households.

2. Oromia Natural Resources and Agriculture Development Bureau (ONRADB) in collaboration with its zonal and district level offices as well as with NGOs acting in the area need to develop institutional framework and conduct awareness raising training for the indigenous people. Particularly, Fantale district should be targeted to foster attitudinal changes that encourage them to benefit from irrigation projects rather than leaving them to outsiders who gain significant incomes from the projects.
3. ONRADB and Oromia Irrigation and Pastoralists Development Bureau (OIPDB), mobilizing their zonal and district level offices as well as NGOs acting in the areas, need to develop and implement institutional framework for integrating indigenous communities, diversifying income sources, promoting agricultural productivity, and protecting environmental resources simultaneously. This includes strategies that encourage sustainable crop farming/irrigation initiatives, non-farm/off-farm income opportunities through vocational training and microcredit schemes and providing consistent government support for a sustainable food production system that enhances food security of the households.
4. The Regional State of Oromia needs to put in place a policy framework to promote sustainable land management, soil conservation, climate-resilient agriculture, water management infrastructure, and biodiversity protection. On these bases, ONRADB and OIPDB in collaboration with pertinent district offices and the local communities have to develop

institutional framework and implement practices of sustainable land and water management, and rotational grazing techniques to mitigate the impacts of environmental challenges on food security.

5. The Ethiopian government needs to develop and/or strengthen a local conflict resolution and prevention policy framework for the study area by actively engaging local communities to ensure that resource allocation is fair and equitable. This framework should include the establishment of community-based peace committees and conflict mediation bodies empowered to address disputes over land use, water rights, and grazing areas before they escalate into larger conflicts. Additionally, traditional conflict resolution practices should be legally recognized and integrated into the formal legal framework by codifying customary laws that: a) govern resource use and dispute resolution among pastoralist communities; and b) clearly define land tenure and resource rights, providing a transparent and enforceable system for resource allocation and use, particularly in the ASAL areas where competition for resources like water and grazing land is intense. Given that many conflicts in ASAL parts may involve cross-regional or cross-border issues, the Ethiopian government should foster cooperation with neighboring countries and/or regions by establishing cross-border agreements and institutions to manage shared resources and to prevent conflicts across those boundaries.
6. The Ethiopian government needs to undertake a comprehensive revision of its ASAL parts' development policies to better align them with the needs and realities of the communities in areas, to address financial barriers, and to improve market integration for sustainable agriculture and livestock management in ASAL parts. The revised and aligned development

policies need: a) to support both traditional livelihoods, such as pastoralism, and any shifts towards sedentary agriculture; b) to facilitate the creation of microfinance institutions and credit facilities accessible to smallholder farmers and pastoralists, offering low-interest loans and flexible repayment terms to support the purchase of farm inputs and investment in sustainable agricultural practices; and c) to ensure sustainability and prevent exacerbating the existing vulnerabilities.

7. The government should also revise land use and agricultural policies: a) to include provisions for ASAL communities' need-based subsidies or financial support to programs that reduce the cost of essential farm inputs, such as seeds, fertilizers, and livestock feed; and b) to recognize and protect the rights of indigenous communities to maintain their traditional pastoralist practices, ensuring access to grazing lands, water resources, and the mobility necessary for effective livestock management.

Overall, the revised development, land use and agricultural policies should: a) promote better integration of the ASAL parts into national, regional, and local markets by way of putting in place infrastructure such as roads and transport networks to facilitate the movement of goods, to reduce transaction costs, and to regulate market practices; b) establish market information systems that provide farmers and pastoralists with real-time data on prices, and demand and supply trends that enhance better decision-making and profitability of agricultural activities; c) regulate market practices so as to prevent exploitation by traders and brokers; and d) support the formation of agricultural cooperatives or producer groups so as to allow them to collectively market their products, negotiate better prices, and reduce risks associated with market volatility.

5.4. Recommendation for Further Studies

Further study is needed to:

1. assess the Effectiveness of Crop farming/irrigation in enhancing food security in Specific ASAL Parts;
2. analyze the impact of market dynamics/dynamism on food security in ASAL Parts; and
3. evaluate the economic and environmental benefits of shifting to keeping small ruminant livestock in ASAL parts.

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APPENDICES

Appendix 1a: Household Survey Questionnaire to be completed by household heads (English version)

Dear Respondent,

The objective of this questionnaire is to gathert data for a research entitled “Dynamics towards sustainable food security in Arid and Semi-arid Lands (ASALs) areas of East Shewa Zone. The information you give is solely for academic purpose and your response is highly valuable and will be held in confidentiality. You will not be identified by name in any case and the data collection will be held based on your full consent.

Thank you in advance for your cooperation.
Almaz Taffesse Mossissa, PhD Student at Moi University, Eldoret, Kenya

General Direction: Please give your answer for the following questions by writing your answer or putting “✓” sign on the space provided as required

Section I: Households’ demographic characteristics

1. Your 1.1 District: __________ 1.2. kebele: ________ 1.3. Religion: ______1.5. occupation___________
2. The questionnaire is filled by 1. Female household head_____ 2. Male household head___
3. Your age______
4. Ability to read and write: 1. Can read and write____ 2. cannot read and write____
5. Number of children: male_____ female________ Total family size______ Family members contributing labor to food production activities: 1. Male____2.female__ Total____

Section 2: Questions on household's socioeconomic characteristics to identify determinant factors of household food security

Direction II: Please indicate the quantity of your household asset/wealth trends for the years indicated

Year No	Household asset	Quantity (annual estimate in number)					
		1984	2017	2018	2019	2020	2021
6	Land size you own privately in hectare						
7	estimated communal grazing areas you can access in hectares						
8	Number of cattle						
	Number of camels						
	Number of donkeys						
	Number of sheep						
	Number of goats						
	Number of poultry						
	Other animals, specify if any						
9	Your estimated annual crop production in quintals/ kilogram						

10. Please indicate your estimated average annual Non-farm/off-farm income in birr________

Direction IIII**:** From items listed in the left side of table below, please show your household's livelihood activities to obtain food by putting "✓" mark under your 'yes' or 'no' response and indicate the percentage from each source to your house food supply.

No	Sources of household food provision	Yes	No	Percentage
11	Livestock production (milk/meat)			
12	exchange/livestock sale (purchase of staple grains)			
13	Own crop production/irrigation farm			
14	wage work, haired salary			
15	trade, small business			
16	Fire wood and charcoal sell			
17	Support and gifts from family/clan members, community			

18	Government/non-government support/aid provision				
19	Other activities specify if any___________				

20. In your perception, is your household's current food provision better compared to two decades ago? 1. Yes 2. No
21. If your answer to question 20 above is "No", why? 1. Income decline 2. Increasing food price 3. Declining pastoral productivity 4. others specify _________, _________

Section 3. Food Insecurity Experience Scale module to measure study area food security situation

Direction IV: For questions 1-8 below, depending on your household food consumption situation during the last 12 months, please encircle "1"if your answer is "Yes", and "0" if "No"

No	**Questions**	**Yes**	**No**
1	You were worried you or your family member would run out of food because of a lack of money or other resources?	1	0
2	You or your family member were unable to eat healthy and nutritious food because of a lack of money or other resources?	1	0
3	You or your family member ate only a few kinds of foods because of a lack of money or other resources?	1	0
4	You or your family member had to skip a meal because there was not enough money or other resources to get food?	1	0
5	You or your family member ate less than you thought you should because of a lack of money or other resources?	1	0
6	Your or your family member household ran out of food because of a lack of money or other resources?	1	0
7	You or your family member were hungry but did not eat because there was not enough money or other resources for food?	1	0
8	You or your family member went without eating for a whole day because of a lack of money or other resources?	1	0

Section 4: Questions to determine the dynamics that have negatively affected household food production activities influencing sustainability of food security in the study area

Direction V: Please give your answer for the following questions by writing your answer or putting "✓" sign on the space provided or encircle the letter of your choice as required

22. Have you perceived any change in the soil fertility of your kebele over the last two decades? 1. soil fertility declined 2. it is improving 3. I can't determine
23. In your view, how is the condition of natural vegetation for animal forage in your district over the last twenty years? 1. improved 2. Diminished 3. no change
24. How is availability of water sources for your livestock in your district? 1. Diminishing 2. Improving 3. No change 4. Others if any______________________________
25. In your perception, how is the productivity of your livestock during the last two decades? 1. improving 2. declining 3.no change 4. others, specify if any_______
26. Please indicate any change that occurred in your village that has affected your food production activities causing your household food insecurity during the last 15 years
    ____
27. Do you face problem in exchanging and retailing your crop or pastoral products to access food? 1. Yes 2. No
28. If your answer to question 27 above is "Yes" what factors limit your food exchanging and retailing activities? 1. Market price fluctuation 2. government policy such as restriction to cross border market and taxation 3. lack of market facilities 4. others specify if any _____
29. Is there security problem in your district in the past 15 years? 1. Yes 2. No
30. If your answer to question 29 above is "Yes"; what is the main cause? 1. Lack of good governance 2. declining power of traditional communal administration 3. Others, specify if any____

Questions on perception of Environmental and institutional changes influence household's sustainable food security

Direction VI: From among the Biophysical elements listed in table A and B below, please give your perception regarding the level of damage to your food production activities and its influence to your household's food security during the last two decades by assigning:
"1" for very low damage, "2" for a low damage "3" for not at all, "4" for high damage and "5" for very high.

No	A. Environmental dynamics that damaged household food production activities influencing household food security	Level of damage/influence				
31	rainfall variability	1	2	3	4	5
32	Temperature variability (Heat stress)	1	2	3	4	5
33	Soil fertility decline	1	2	3	4	5
34	Land degradation	1	2	3	4	5
35	Biodiversity loss (poor quality and quantity of forage,) on privately owned land	1	2	3	4	5
36	Biodiversity loss (poor quality and quantity of forage) on communal land	1	2	3	4	5
37	Water shortage	1	2	3	4	5
38	Spreading livestock disease	1	2	3	4	5
39	Spread of human disease (HIV/AIDs, COVID-19…)	1	2	3	4	5
40	Wild life and natural disaster	1	2	3	4	5
	Others if any______________					

41. How effectively has your household been able to adapt to changes in environmental factors like rainfall variability, temperature variability, or soil fertility decline to maintain food security? 1. very ineffective, 2 ineffective, 3 neutral, 4 effective, 5 very effective.

42. How sustainable do you believe your household's food security is under the current environmental conditions? 1. very unsustainable, 2 unsustainable, 3 neutral, 4 sustainable, 5 very sustainable.

43. How confident are you in your household's ability to maintain food security in the future given the current environmental trends? 1 not confident at all, 2 slightly confident, 3 moderately confident, 4 confident, 5 very confident.

44. To what extent have government or NGO interventions helped improve your household's food security in response to environmental challenges like land degradation or water shortages? 1. no impact, 2 low impact, 3 moderate impact, 4 high impact, 5 very high impact.

	B. Institutional dynamics that damaged household food production activities	**Level of influence**				
45	Changes in land use policy	1	2	3	4	5
46	Expanding urban areas	1	2	3	4	5
47	Restricted pastoral mobility	1	2	3	4	5
48	Trade restrictions	1	2	3	4	5
49	livestock price fluctuation	1	2	3	4	5
50	Food price volatility	1	2	3	4	5
51	market facilities and infrastructure problem	1	2	3	4	5
52	Cooperatives involvement in market	1	2	3	4	5
53	Lack of access to credit	1	2	3	4	5
54	Inadequate extension service provision	1	2	3	4	5
55	Lack of access to modern technology such as improved breed	1	2	3	4	5
56	Conflict and insecurity problem	1	2	3	4	5
	Others please specify if any	1	2	3	4	5

57. How effectively has your household been able to adapt to changes in institutional factors like changes in land use policy, expanding urban areas, or restricted pastoral mobility to maintain food security?

    1. very ineffective, 2 ineffective, 3 neutral, 4 effective, 5 very effective.

58. How sustainable do you believe your household's food security is under the current institutional conditions? 1. very unsustainable, 2 unsustainable, 3 neutral, 4 sustainable, 5 very sustainable.

59. How confident are you in your household's ability to maintain food security in the future given the current institutional trends? 1 not confident at all, 2 slightly confident, 3 moderately confident, 4 confident, 5 very confident.

50. To what extent have government or NGO interventions helped improve your household's food security in response to institutional challenges like market infrastructure problems or lack of access to credit?1 no impact, 2 low impact, 3 moderate impact, 4 high impact, 5 very high impact.

Section 5: Questions to identify the challenges due to changes in ASAL parts.

Direction VII**:** If any of the changes listed in the left hand side of the table below has happened in your locality, please mention the adaptive strategies you employed or introduced by the government, benefits of the strategies employed and any challenge it have to your food security sustainability

No	**Areas of changes**	**Adaotation practicies**	**Benefits of adaptation strategies**	**Challenges you faced in adapting to the changes**
61	Climate change (frequent drought, rainfall variability)			
62	Land use policy change			
63	Sedentary farming			
64	Restricted mobility			
65	Market dynamics			
	Others if any__________			

Appendix 1b: Key Informant Interview Guide

B. Key Informant Interview Guide

Dear informant,

The objective of this interview is to gather data for a research entitled "Dynamics towards sustainable food security in Arid and Semi-arid Lands (ASALs) areas of East Shewa Zone. Your participation is fully based on your willingness. The information you give is solely for academic purpose and your response is highly valuable and will be held in confidentiality. You will not be identified by name in any case and the interview will be held based on your full consent.

Thank you in advance for your cooperation.

Almaz Taffesse Mossissa, PhD Student at Moi University, Eldoret, Kenya

Basic Information
INformant's village/Office: ___________________________________ Sex ____ age ____ responsibility ________________________Date of interview: ___________ Place interview conducted______________________ Name of interviewer: ____________________________

1. Over the past 15 years, have there been any socioeconomic, environmental, or land use changes in the Fantale and Boset districts that you believe have influenced household food security? If so, could you describe how these changes have manifested?
2. How do you think these socioeconomic, environmental, or land use changes have influenced household access to food in the Fantale and Boset districts?
3. What measures have been taken to improve the food security of households in the districts, and what were the recorded outcomes or consequences of these actions, if any?
4. What are the major challenges to achieving sustainable food security for households in the Fantale and Boset districts? How do you think these challenges can be addressed?
5. Do you have any additional point to add please?

Appendix 1c: Focus Group Discussion Guide

III. FGD guide for district and sub-district representatives

Dear participants,
The objective of this discussion is to gather data for a research entitled "Dynamics towards sustainable food security in Arid and Semi-arid Lands (ASAL) parts of East Shewa Zone. Your participation is fully based on your willingness. The information you give is solely for academic purpose and your response is highly valuable and will be held in confidentiality.
Thank you in advance for your cooperation.

Almaz Taffesse Mossissa, PhD Student at Moi University, Eldoret, Kenya

Village: ______________place FGD is conducted ___________number of participants: Male_____ Female________ name of data collector _______________________________

Focus group composition: representatives of male headed households, female headed households, youth group, clan leaders, Gada leaders district and kebele leaders, district food security expert, irrigation and pastoral expert, extension expert, food security task force.

1. What is your perception about household food security sustainability in your district?
2. Have you observed any environmental changes in factors like weather (temperature, rainfall), availability of livestock food, soil fertility, land degradation, disease prevalence and the like that damaged household food security of your district during the last two decades? If your answer is "yes" what are they?
3. Have you observed changes in the areas of land use policy, mobility, labor supply, use of modern technology, market, aid and support provision that damaged household food security situation? If your answer is "yes" what are they?
4. Which household food production activities from among food producing (mobility, forage production, irrigation farm, off-farm work, etc), exchanging farm products for food, purchasing food using income from other sources (small business, wage, etc.), food acquisition through support and aid provision do you think the changes you observed affected? How?
5. What are the adaptation mechanisms employed by households and government to overcome problems causing household food insecurity in your district during the last two decades? Are there success stories? What is the output of the strategies on livelihood and environment?
6. What are the major challenges to sustain household's food security you observed in the district during the last two decades? Any measures you suggest to be taken by the government and households to improve household food security sustainability in your district please?

Appendix 2a: Household Survey Questionnaire Afan Oromo Version

A. Gaaffilee abbaa/haadha warraa maatiin guutamu

Kabajama Hirmataa/ttu,

Kaayyoon gaaffannoo kanaa qorannoo mata duree **“Dynamics towards sustainable food security in Arid and Semi-arid Lands of East Shewa Zone Fantalle District”** jedhuuf odeeffannoo sassaabuu dha. Odeeffannoon ati kennitu dhimma qorannoo kana qofaaf kan ooluuf iccitiin deebii keetii eegamaa ta’uus siif nan mirkaneessa. Hirmaachuunis fedha kee irrattii hundaa’aa. Deebiin kee galma qoraannoo kanaaf murteessa dha.

Galatoomii!

Almaz Taffassaa Mossissa, baratuu digrii 3ffaa

Kutaa 1. Odeeffannoo bu’uuraa kan maatii hirmaattotaa:

Qajeelfama I: Gaaffilee gadiif bakka duwwaaratti deebii kee barreessuun ykn mallattoo “✓” kaa’uun ykn qubee filannoo keetitti maruun deebisi

1. Ati: 1) Ganda: __________ 2) Amantaa: _______3) Qomoo: ________ 4. Dalagaa_______
2. Kan gaaffii kana guute: 1) Abbaa warraa 2) haadha warraa
3. Umurii____
4. Barreessuu fi dubbisuu: 4.1 Nan danda’a___ 4.2. hin danda’u_____
5. Baay’ina Miseensota maatii: 1) Dhiira_____, 2) dubara______miseensota maatii humna hojii oomishuu irratti gumaachan: 3. dhiira___, 4. dubartii___

Kuta 2. Odeeffannoo bu'uura hawasi-dinagdee matii hirmaattotaa

Qajeelfama II: **G**abatee gadii keessatti baayi'na qabeenya maatii keetii waggichaa barreessi

Lak	Akaakuu qabeenya maatii	Baay'ina Qabeenya kee kan wag-gichaa/ALH/				
		1997	2010	2011	2012	2013
6	Lafa qonnaa dhuunfaa kee hektaaraan					
7	Lafa dheedumsa waliin tikifachuu dandeesu /communal grazing area/ hekitaara					
6	Saawwan					
	Gaala					
	Harree					
	Hoolaa					
	Re'ee					
	Handaaqqoo/lukkuu					
	Garbiroo ______________________					
9	Omisha midhaan callaa/nyaataa kuntaala/kg					

10. Hojii horsiisa beelledaa ykn qonnaan alaarra galiin qabdu tilmaamaan waggaatti qarshii___

Qajeelfama III: Gabatee armaan gadii keessatti kanneen tarreeffaman keessaa "Eeyyee" ykn "Lakki" jalatte mallattoo "✓" kaa'uun madda dhiheessii midhaan nyaataa maatii keetii adda baasuun kanneen "Eyyee" jetteef nyaata maatii keetiif harka meeqa akka gumachu dhibbentaan muli'isi.

No	Madda dhiheessii midhaan nyaata maatii kan ta'e kami?	Eyyee	Lakki	Dhibbentaa (%)
11	Beelladaa fi oomisha beelladaa (aannan, fooon, kkf)			
12	Waljijjiirraa; gurgurtaa beelladaa fi bittaa midhaanii			
13	Oomisha qonna fi jali'sii midhaan nyaataa			
14	Kaffaltii hojii humnaa/mindaan midhaan nyaataa bituu			
15	Galii daldala irraa argamuun midhan bituu			
16	Gurgurtaa waantota biroo (qoran, kasala, Ashawa, kkf)			
17	deegersa maatii, fira, hawaasa irraa argadhu			
18	Gargaarsa mootummaa/mit-mootummaa			
19	Garbiroo ________________________________			

20. Yeroo ammaa haalli midhaan nyaataa qabaachuu/argachuu maatii keetii kan waggoota 15 darbanii waiin yoo madalte wayya'aa dhufee jettaa? 1. Eyyee 2. Lakki
21. Yoo deebiin kee gaaffii 20ffaa oliif "Lakki" ta'e, rakkoo cimaan maalii jettee yaaddaa? 1) galiin maatii xiqqachaa deemuu 2) gatiin midhaan nyaataa dabalaa dhufe 3) omishitumman beelledaa xiqqachaa dhufee 4. Garbi-roo_______________________________

Kutaa 3: Madaala muuxannoo hanqina wabii midhaan nyaataa/Food Insecurity Experience Scale/

Qajeelfama IV: Akkaataa fayyadama nyaata maatii keetii ji'oota 3n darban irratti hundaa'uun gaaffilee gabatee gadii keessa jiraniif yoo deebiin kee "eyyee" ta'e "1" yoo "lakki" ta'e immoo "0"tti maruun deebisi.

No	Gaaffilee	filannoo	
1	Qarshii ykn qabeenya dhabuun ati ykn maatiin kee midhaan nyaataan dhaba jettee yaadofteetaa?	1	0
2	Qarshii ykn qabeenya dhabuun ati ykn maatiin kee nyaata gabbataa/gaarii argachuu dhabdeeta?	1	0
3	Qarshii ykn qabeenya dhabuun ati ykn maatiin kee nyaata akaakuu muraa-saa nyaatteeta?	1	0
4	Qarshii ykn qabeenya dhabuun ati ykn maatiin kee ciree ykn laaqana ykn ir-ribata dhiifiteetta?	1	0
5	Qarshii ykn qabeenya dhabuun ati ykn maatiin kee amma yaadduu gadi nyaatteettaa?	1	0
6	Qarshii ykn qabeenya dhabuun ati ykn maatiin kee nyaata dhabee beekaa?	1	0
7	Qarshii ykn qabeenya ga'aa waan dhabdeef ati ykn maatiin kee beeloftee hin nyaatin hafteettaa?	1	0
8	Qarshii ykn qabeenya dhabuun ati ykn maatiin kee guyyaa guutuu hin nyaatin oolteettaa?	1	0

Kutaa 4: Jijjiirama naannoo, hawasi-dinagdeef bulchiinsaa bara 1997 as hojii omishaa danquun wabii midhaan nyaataa maatii irraan hubaatii geesise adda baasuuf gaaffilee dhihaatan

22. Misooma biyyee kebele keetii irratti jijjiiramni hubattee jiraa? 1) Lafti caalaatti qoddii ta'e 2) wayyaa'aadha 3) murteessuu hin danda'u

23. Haalli biqiltuuwwan uumamaa nyaata beelladaa kebele keetii hoo? 1) Fooyya'aa dhufe 2) haphachaa dhufe 3) jijjiirama hin argine 4) garbiroo______________________________
24. Qebele kee keessatti beelleda keetiif argamni madda bishaanii attam jetta? 1) hanqachaa dhufe, 2) wayyaa'eera 3) jijiirama hin qabu 4) Garbiroo____________________________
25. Haalli omishitummaa hojii horsiisee bulaa keetii waggoota 15nii as maal fakkaata? 1) Fooyya'aa dhufe 2) Hanqachaa dhufee 3) Jijjiirama hin qabuu 4) Garbiroo____________
26. Waggoota 15 as jijjiiramni naannoo omishitumman hojii horsiisee bula kee irraan midhaa geesisee biroo yoo jiraate maal fa'a? __________________________________
27. Waggoota 15nii as omisha kee gurgurachuu fi midhaan nyaataan waljijjiiruuf haalli gabaa mijataa dhufeera? 1. Eyyee 2. Lakki 3. Jijjiiramni hinjiru
28. Yoo deebiin keessan gaaffii 27ffaa oliif "Lakkii" ta'e, rakkoo maaltu uumame? 1. Gatiin beelledaa bu'e ba'uu 2. Seeraa mootumma kan akka daangeffama gabaa addunyaatti gurgurachuu 3. Rakkoo geejjibaa, daandii fi bakka tursuu 4. garbiroo________, __________,
29. Qabeenyi kee hannaa, saamichaaf saaxilamee beekaa? 1. Eyyee 2. Lakkii
30. Yoo deebiin kee gaaffii 29ffaa oliif "Eyyee" ta'e sababni isaa maal? 1. Bulchiinsa gaariin dhibuu 2. Caasaan bulchiins aadaa laafaa dhufee 3. Garbiroo _________________________

Qajeelfama V: Aanaa kee keessatti qabatoota gabatee A fi B gadii keessatti tarreefaman irratti wagoota 15nii as jijjiiramni mul'ate kan midhaan nyaataan of danda'uu maatii keetii irraan hubaatii geesise yoo jiraate;

baayyee xiqqoo hubeera kan jettuuf "1", hamma xiqqoo hubeera kan jettuuf "2", hoomaayyu hin hubne/hinjijjiiramne kan jettuuf "3", hamma tokkoo hubeera yoo ta'e "4", yoo hubaatii guddaa ol'aanaa hubeera ta'e "5" itti maruudhaan deebii kee muli'isi

Gabatee A:

Lak	Qabattoota jijjiirama naannoo omishitumma naannoo, dhiheessii sorrata maatii irran dhiibaa geessise	Hangaataa dhiibbaa/hubaatii				
31	Jijijjirama roobaa	1	2	3	4	5
32	Haala o’aa	1	2	3	4	5
33	Haala gabbina biyyee	1	2	3	4	5
34	Manca’insa lafaa	1	2	3	4	5
35	Haala nyaata beelledaa lafa dheedumsa qabiyee dhuunfa	1	2	3	4	5
36	Haala nyaata beelleda lafa dhedumsa waliinii irratti	1	2	3	4	5
37	Hanqina bishaanii	1	2	3	4	5
38	Babal’ina dhibee beelledaa/du’aa beelledaa	1	2	3	4	5
39	Babali’ina dhibee namaa (busaa, COVID-19, HIV/AID)	1	2	3	4	5
40	Miidhaa bineensa bosonaa fi balaa uumamaa	1	2	3	4	5
	Kan biraa yoo jiraate ibsi___________	1	2	3	4	5

41. Maatiin kee wabii midhaan nyaataa eeguuf jijjiirama dhimmoota naannoo kanneen akka jijjiirama rooba, jijjiirama ho’aa, ykn haphina biyyee wajjin haala bu’a qabeessa ta’een madaquu danda’eera?
    1. baay'ee bu'a qabeessa kan hin taane, 2 bu'a qabeessa hin taane, 3 giddu galeessa, 4 bu'a qabeessa, 5 baay'ee bu'a qabeessa.

42. Haala naannoo amma jiruun wabii midhaan nyaataa maatii keetii hangam itti fufiinsa qaba jettee amanta?
    1. baayyee itti fufiinsa kan hin qabne, 2 itti fufiinsa kan hin qabne, 3 giddu galeessa, 4 itti fufiinsa kan qabu, 5 baayyee kan itti fufiinsa qabu.

43. Haala naannoo yeroo ammaa jiru ilaalcha keessa galchuun dandeettii maatiin kee gara fuulduraatti wabii midhaan nyaataa qabaachuu irratti hangam ofitti amanamummaa qabdu?
    1 tasuma ofitti amanamummaa hinqabu, 2 xiqqoo ofitti amanamummaa qaba, 3 ofitti amanamummaa giddu galeessaan qaba, 4 ofitti amanamummaa qaba, 5 ofitti amanamummaa guddaan qaba.
44. Mootummaan ykn dhaabbilee miti mootummaa qormaata naannoo akka manca’iinsa lafaa ykn hanqina bishaaniif deebii kennuudhaan wabii nyaataa maatii keessanii fooyyessuuf hangam gargaareera?
    1. dhiibbaa hin qabne, 2 dhiibbaa xiqqaa, 3 dhiibbaa giddu galeessaa, 4 dhiibbaa guddaa, 5 dhiibbaa baayyee ol'aanaa.

Gabatee B

Lak	Qabattoota jijjiirama naannoo omishitumma naannoo, dhiheessii sorrata maatii irran dhiibaa geessise	Hangaataa dhiibbaa/hubaatii				
45	Jijjiirama imaammata itti fayyadama lafaa	1	2	3	4	5
46	Babal'ina magaalaa	1	2	3	4	5
47	Dangefamuu sosochii beelledaa/restricted pastoral mobility	1	2	3	4	5
48	Daldalli daangeffamuu, gabaa addunya argachuu dhabuu	1	2	3	4	5
49	Gatiin gabaa beelledaa kan takka bu'ee takka ka'u ta'uu	1	2	3	4	5
50	Gatiin midhaan nyaataa garmalee olka'uu	1	2	3	4	5
51	Haala gabaa kan akka, fageenya, geejibaa, rakkoo daandii fi bakka beelleda tursuu faa baasii dabaluu	1	2	3	4	5
52	Hanqina ga'umsa tajaajila Eksiteenshinii	1	2	3	4	5
53	Carraa liqii, qusannoo fi investimentiii dhabuu	1	2	3	4	5
54	Hanqina tekinolojii ammayya kan akka sanyii filatama faa	1	2	3	4	5
55	Waldaaleen gabaa seenuu (cooperatives involvement in	1	2	3	4	5
56	Rakkoo walitti bu'insa fi nageenyaa	1	2	3	4	5
	Kan biraa yoo jiraate ibsi____________	1	2	3	4	5

57. Maatiin kee jijjiirama kan akka jijjiirama imaammata itti fayyadama lafaa ykn daangeffama sosochii tikfatee wabii midhaan nyaataa eeguuf hammam haalaa bu'a qabeessa ta'een madaquu danda'eera?
   1. baay'ee bu'a qabeessa, 2 bu'a qabeessa hin taane, 3 giddu galeessa, 4 bu'a qabeessa, 5 baay'ee bu'a qabeessa.

58. Haala dhaabbilee amma jiruun wabiin midhaan nyaataa maatii keetii hangam itti fufiinsa qaba jettee amanta?
   1. baayyee itti fufiinsa kan hin qabne, 2 itti fufiinsa kan hin qabne, 3 giddu galeessa, 4 itti fufiinsa kan qabu, 5 baayyee kan itti fufiinsa qabu.

59. Haalaa aanaa keetii yeroo ammaa jiru ilaalcha keessa galchuun dandeettii maatiin kee gara fuulduraatti wabii midhaan nyaataa qabaachuu irratti hangam ofitti amanamummaa qabda? 1 tasuma ofitti amanamummaa hin qabu, 2 xiqqoo ofitti amanamummaa qaba, 3 ofitti amanamummaa giddu galeessaan qaba, 4 ofitti amanamummaa qaba, 5 ofitti amanamummaa guddaan qaba

60. Mootummaa ykn dhaabbileen miti mootummaa qormaata kanneen akka rakkoo bu'uuraalee gabaa ykn walitti bu'insaa dhabuudhaaf deebii kennuudhaan wabii midhaan nyaataa maatii keetii fooyyessuuf hangam gargaareera?
   1. tasumaa hin gargaarree, 2 xiqqoo gargaareera, 3 giddu galeessaa, 4 olaanaa, 5 baay'ee ol'aanaa

Kutaa 5: Jijjiiramoota midhaan nyaataan of-danda'uu maatiitti danqaa ta'anii fi tooftaalee madaqsii maatii akkasumas bu'aa argame addan baasuuf gaaffilee dhi'hatan

Qajeelfama VII: Gabatee armaan gadii gara bitaa irratti kan tarreeffaman keessaa jijjiirama soorata argachuu maatiin kee danqan jettuuf tooftaalee madaqisii keetii ykn mit/mootummaa fi bu'aa ykn miidhan tooftaalee kunniin hawaasaa fi naannoo irratti qaban barreessi.

No	Jijjiirama	Tooftaalee madaqisii	Bu'aa argamsiise	Gufuu jijjiramichi fide	Qormaata/Danqaa Isin mudate
61	Jijjiirama qilleensaa				
62	Jijjiirama imammata itti fayyadama lafaa fi qonni challaa baballachuu				
63	Jiruu tikifattee beeyladaa irraa gara qonnaatti jijjiiruu				
64	Sosochiin beyiledaa daangefamuu				
65	Haala gabaa				
	Kan biro yoo qabaattan_____				

Appendix 2b: Key Informant Interview Guide Afan Oromo Version

B. Gaaffilee Af-gaafii hojjettoota waajiraalee Mit/mootummaa (Interveiw guide)

Kabajamaa hirmaataa marii garee kanaa,

Kaayyoon gaaffannoo kanaa qorannoo mata duree “Dynamics towards sustainable food security in Arid and Semi-arid Land areas of East Shewa Zone Fantalle district” jedhuuf odeeffannoo sassaabuudha. Odeeffannoon ati kennitu dhimma qorannoo kana qofaaf kan ooluuf iccitiin deebii keetiis eegamaa ta’uus siif nan mirkaneessa. Hirmaachuunis fedha kee irrattii hundaa’aa. Deebiin kee galma qoraannoo kanaaf murteessadha.
Galatooma!
Almaz Taffassaa Mossissa, baratuu digrii 3ffaa
Odeeffannoo bu’uuraa

kebele/Waajjira gaafatamaa/tuu: ________________________ga’ee hojii ______________ saala: ___umurii____Guyyaa af-gaaffiin itti geggeefame ________ maqaa gaafataa ______________

Hirnaattota: 1. Aannaa irraa: I/g waajira aannaa, I/g waajira misooma horsiisee bulaa, eksiperttoota wabii midhaan nyaataa; dhaabbilee mit-mootummaa horsiisaa bulaa irratti hojjetan 2. Godiina irraa: I/g waajira misooma horsiisee bulaa, eksipertoota wabii midhaan nyaataa, ogeessa/tti extensionii; I/Gaafatamaa qorannoo qonnaa horsiisee bulaa, Ogeessa gabaa beelledaa, I/g waldaalee horsiisee bulaa 3. Naannoo irraa: I/g misooma horsiisee bulaa, eksipertii wabii midhaan nyaataa, ogeessaa qorannoo beeledaa.

1. Waggoota 15 darbe keessa jijjiiramni haala naannoo, gama itti fayyadama lafaa, bulchiinsaa kan gabaa wabii midhaan nyaataa maatii aanaa keessan irraan miidhaa geessise jettu jiraa? Yoo jitaatee mul’istoonni jijjiirama kanaa maal fa’i jetta?
2. Jijjiiramni kunniin wabii midhaan nyaataa maatiin aanaa keessanii haala kamiin miidhe jetta?
3. Wabii midhaan nyaataa maatii aanichaa fooyyeessuuf tarkaanfiiwwan fudhataman maal fa’i? Tarkaanfii fudhatameen bu’an galmeefame ykn miidhaan naannoo fi hawaasa irratti qaqqabe yoo jiraatee maal fa’i?
4. Maatii aanaa Keessan midhaan nyaataan dhaabbataan akka of danda’uu taasisuu irratti danqaa cimaan waajjira kee mudatee yoo jira jette maali? Danqaa kana dhabamsiisuun akkamin danda’ama jetta?
5. Qabxii dabalata yoo kan qabdan ta’e ibsaa?

Appendix 2c: Focus Group Discussion Guide Afan Oromo Version

C. Gaaffilee marii garee bakka buutota hawasa aanichaa (FGD guide)

Kabajamoo hirmaattoota marii garee kanaa (Dear participants),
Kaayyoon gaaffannoo kanaa qorannoo mata duree "Dynamics towards sustainable food security in Arid and Semi-arid Land areas of East Shewa Zone Fantalle district" jedhuuf odeeffannoo sassaabuudha. Odeeffannoon isin kennitan dhimma qorannoo kana qofaaf kan ooluuf iccitiin deebii keessanii eegamaa ta'uus isiniif nan mirkaneessa. Hirmaachuunis fedha keessan irrattii hundaa'aa. Deebiin keessan galma qoraannoo kanaaf murteessadha.

Galatooma!

Almaz Taffassaa Mossissa, baratuu digrii 3ffaa

Odeeffannoo bu'uuraa:
Ganda: _______Bakka mariin itti geggeefame______ guyyaa____ baay'ina hirmaattota garee: dhiira___ dubartii ___maqaa raga sassaabaa/duu: ______________
Hirmaattota: Bakka buutota abba/haadha warraa, geggeesitoota aanaa, Gandaa, dargaggoota, dubartoota, Ekispertii wabii midhaan nyaataa "task force" wabii midhaan nyaataa gandichaa.

1. Yeroo ammaa haalli midhaan nyaataan ofdanda'uu hawasa ganda keessaanii akkamiin ibstu?
2. Aanaa keessan keessatti waggaa 15 darban haala qilleensaa (roobaa, o'aa), argama nyaata beelladaa, misooma biyyee, dhibee beelledaa fi namaafaa ilaalchisee jijjiiramni midhaan nyaataan of-danda'uu maatii irraan hubaatii geesisee hubattan jiraa? Yoo jiraate maal fa'i?
3. Gama imaammata qabiyyee lafaa, dangeffamuu sosochii horsiisee bulaa, humna omishuu, itti fayyadama tekinolojii ammayyaa, haala gabaa, gargaarsaa fi deeggersa adda addaa fi bulchiinsa aanichaa ilaalchisee hoo? Jijjiiramni midhaan nyaataan of danda'uu maatii irran hubaatii geesise jettan yoo jirate maal fa'i?
4. Jijjiiramni hubatan yoo jiraate mala maatiin nyaata ittiin argatuu kan akka nyaata omishuu, omisha gurguruun naataan wal-jijjiirraa, galii biroo irraa argamuun nyaata bituu, kennaa/gargaarsaa argachuu ykn filannoo nyaataa maatii irraan akkamiin hubatti geesisa jettu?
5. Dhiibbaa jijjiirama kunniinii dandamachuun midhaan nyaataan of danda'uf maatiin aanaa keessanii ykn mootummaan tarsiimoo maal faa fayyadamu? Tarsiimoowwan kunniin hagam gargaarera jettu? Maatiin ciminaa galmeesise jiraa? Tarsiimoon maatiin fayyadaman kunniin naannoo fi hawasicha irratti bu'aa fi miidhaan geesise yoo jirate maal fa'i?
6. Waggoota 15 darban keessaa maatii horsiisee bulaa ganda keessanii midhaan nyaataan of danda'uf danqan cimaan hubattan maal fa'i? Akkamiin fooyyeessuun danda'ama jettu?

Appendix 3: Observation Guide

The study will be observing:

1. Availability of government services such as schools, market, health services, financial services
2. Sociocultural practices
3. Agricultural activities (farming, irrigation, livestock)
4. Environmental condition (vegetation, rivers, land situation)
5. Policy/Institutional issues such as mega plantations, grazing areas

Appendix 4: The Sampling Weight and Adjusted Weight for this Study

	Districts		
	Fantale (Arid)	Boset (Semi-arid)	Total
Target population (HH)	15526	26841	42367
Target population (Individual)			
Sample size	150	243	393
General population (household)			
General population (Individual)			
Sampling probability	150/15526 = 0.00966	243/26841= 0.0091	
Sampling weight	103.52	109.9	
Responses	148	226	374
Sampling weight adjusted for non-response	15526/150) x (148/150) = 102.14	(26841/243) x 226/243) =102.2	
Individual sampling weight	102.13 x 6.72 (av. HH size) =686.31	102.2 x 5.71 (AV. HH size) =583.6	
HH Design weight	15526/150 = 103.52	26841/243 = 110.5	

The table depicts that 59.35% of the respondents were selected from Fantale district where 33.14% of households live. The normalized weight for Fantale is 0.56 (33%/59%) whereas the design weight for the same district is 133.05 as can be seen from the table above. In the case of Boset district, the normalized weight is 1.65 and the design weight is 391.96. Thus, the normalized weights for the data from the two districts was used for analyzing the data since both are in the acceptable range for accuracy and the sample design is efficient although in the case of Boset the normalized weight is a little bit higher but still in acceptable range. (Normalized weight have to be ranging from 0.75 to 1.5 although it is said still acceptable between 0.5 and 2 but above 2 and less than 0.5 can decrease accuracy.

Appendix 5: Respondents Demographic Characteristics

Respondent demographic characteristics

Variable	Description	Fantale frequency	%	Boset frequency	%	Both frequency	%
Number of respondents	Sample size	148	39.6	226	60.4	374	95.2
Household head	M	115	77.7	179	79.2	294	78.6
Gender	F	33	22.3	47	20.8	80	21.4
household head	Average		44.7		50.2		48
age in years	22-39	50	33.8	37	16.4	87	23.3
	40-64	90	60.8	157	69.5	247	66
	>64	8	5.4	32	14.2	40	10.7
Educational status	Can't read and write	25	17	139	61	112	30
	Can read and write	123	83	87	39	262	70
Religion	Muslim	72	47.3	37	15.9	109	29.14
	Orthodox	25	16.9	79	35	104	27.81
	Protestant	16	10.8	66	29.3	82	21.93
	Waqefata	35	23.7	44	19.5	79	21.12
Household family size	Household size	Av= 6.9		Av=5.7		Av=6.2	
	1 -4	27	18.2	76	33.6	103	27.5
	5-8	87	58.8	126	55.8	216	57.5
	more than 8	34	23	62	27.4	55	14.7
Number of family members labor contributing	Average		3.45		3.41		3.43
HH livelihood/occupation	Agro-pastoralist	5	3.38	211	93.4	217	58.1
	Farmer	7	4.73	15	6.6	20	5.4
	Pastoralist	136	91.9	-	-	137	36.6
	Total	148	39.6	226	60.4	374	95.2

Appendix 6: Respondent's Socioeconomic Characteristics

	Both			Boset			Fantale		
	No	%	AV	No	%	AV	No	%	AV
HH land size owned in hectare 2005			0.98			1.9			0.05
less than 0.25	151	40.4		11	4.9		140	94.6	
0.25-1	50	13.4		44	19.5		6	4.1	
1.1-1.74	40	1.1		39	17.3		1	0.7	
1.75 and above	133	35.6		132	58.4		1	0.7	
Communal grazing area accesses in hectares in 2005			2291			1.2			5806
HH land size in hectare 2021			1.24			2.03			0.44
less than 0.25	75	20.1		1	0.44		74	50	
0.25-1	119	31.8		51	22.6		68	46	
1.1-1.74	55	14.7		55	24.3		-	-	
1.75 and above	125	33.4		119	52.7		6	4	
Communal grazing area accesses in hectares in 2021			1104.4			0.7			2791
Livestock TLU per capita (Boset)									1.5
<=1 TLU	123			95	42		-	-	
1.01-2.49 TLU	-	-		93	41		-	-	
>=2.5 TLU	-	-		38	17		-	-	
Livestock TLU per capita (Fantale)									2.8
<=1 TLU				-	-		28	18.9	
1.01 -4.49 TLU				-	-		99	66.9	
>=4.5 TLU				-	-		21	14.4	
Estimated average annual non-farm income in USD			6288.3			7075.4			5888.3
<= 2 USD	222	59.4		143	63.3		79	53.4	
2 USD-195 USD	56	15		25	11.1		31	20.9	
>=195 USD	96	25.7		58	25.7		38	25.7	
Major food provision sources:									
livestock and livestock									
products	70	18.7		86	38.1		101	68.2	
Yes	304	81.3		140	61.9		47	31.8	
No									

livestock and livestock product exchange						
Yes	355	95	213	94.2	142	96
No	19	5	20	5.8	6	4
crop farm/irrigation						
Yes	322	86.1	220	97.3	102	68.9
No	52	13.9	6	2.7	46	31.1
income from wage work, salary						
Yes	70	18.7	59	26.1	11	7.4
No	304	81.3	167	73.9	137	92.6
trade, small business						
Yes	52	13.9	19	8.4	33	22.3
No	322	86.1	207	91.6	115	77.7
other sales such as charcoal, firewood						
Yes	136	36.4	108	47.8	28	18.9
No	238	63.6	118	52.2	120	81.1
family, community support and gifts						
Yes	20	5.3	8	3.5	12	8.1
No	354	94.7	218	96.5	136	91.9
government, nongovernment support/aid						
Yes	123	32.9	70	31	53	35.8
No	251	67.1	156	69	95	64.2

Appendix 7: Multicollinearity Test for Household Socioeconomic Variables

Correlations

		Respondent's District	occupation	Household head sex	educational status	Age cat	Household family size	estimated HH non-farm income	land owned in hectare
Respondent's District	Pearson Correlation	1	**.816****	.018	.231**	.225**	-.219**	-.125*	.741**
	Sig. (2-tailed)		.000	.730	.000	.000	.000	.016	.000
	N	374	374	374	374	374	374	374	374
Household head Sex	Pearson Correlation	.018	.000	1	.142**	.206**	-.021	.094	.030
	Sig. (2-tailed)	.730	.995		.006	.000	.687	.069	.562
	N	374	374	374	374	374	374	374	374
educational status	Pearson Correlation	.231**	.216**	.142**	1	-.204**	-.227**	.050	.088
	Sig. (2-tailed)	.000	.000	.006		.000	.000	.333	.090
	N	374	374	374	374	374	374	374	374
Age cat	Pearson Correlation	.225**	.118*	.206**	-.204**	1	.206**	-.051	.312**
	Sig. (2-tailed)	.000	.022	.000	.000		.000	.323	.000
	N	374	374	374	374	374	374	374	374
Household family size	Pearson Correlation	-.219**	-.160**	-.021	-.227**	.206**	1	-.164**	-.040
	Sig. (2-tailed)	.000	.002	.687	.000	.000		.001	.441
	N	374	374	374	374	374	374	374	374
estimated HH non-farm income	Pearson Correlation	-.125*	-.154**	.094	.050	-.051	-.164**	1	-.199**
	Sig. (2-tailed)	.016	.003	.069	.333	.323	.001		.000
	N	374	374	374	374	374	374	374	374
land owned in hectare in 2021	Pearson Correlation	.741**	.645**	.030	.088	.312**	-.040	-.199**	1
	Sig. (2-tailed)	.000	.000	.562	.090	.000	.441	.000	
	N	374	374	374	374	374	374	374	374
TLU cat	Pearson Correlation	-.394**	-.267**	.052	-.220**	.042	.046	.007	-.174**
	Sig. (2-tailed)	.000	.000	.314	.000	.419	.379	.896	.001
	N	374	374	374	374	374	374	374	374
livestock & livestock product exchange	Pearson Correlation	.038	.032	.035	.061	1	-.023	-.076	-.153**
	Sig. (2-tailed)	.466	.542	.502	.240		.663	.141	.003
	N	374	374	374	374	374	374	374	374
other sales such as charcoal, firewood, honey	Pearson Correlation	-.293**	.053	-.113*	-.356**	.124*	.207**	.293**	-.191**
	Sig. (2-tailed)	.000	.307	.030	.000	.016	.000	.000	.000
	N	374	374	374	374	374	374	374	374
Govt, and non-govt support/aid	Pearson Correlation	.050	.107*	.060	-.142**	.084	.117*	.058	-.133**
	Sig. (2-tailed)	.332	.039	.247	.006	.104	.024	.263	.010
	N	374	374	374	374	374	374	374	374

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 8: FIES Data Row Score

The responses obtained through the eight FIES questions were coded in binary (1 for "Yes" and 0 for "No") and entered into SPSS version 26 and the row data of each of the 374 households for each item was displayed as shown in table 14 below (for the full data see Annex 4.1).

Table: Household heads survey responses row data to FIES questions

Respond-ent	wor-ried	Health y	Few-Food	Ate-Less	Skippe d	RunO ut	Hun-gry	Whole-Day	su m
1	1	1	1	1	1	1	1	0	7
2	1	1	1	0	0	0	0	0	3
3	1	1	1	1	1	1	1	0	7
4	1	1	1	1	1	0	1	0	6
‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’
‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’
‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’	‘’
374	1	1	1	0	1	0	0	0	4
Ave.	0.59	0.74	0.78	0.30	0.64	0.32	0.19	0.10	

The FIES data item severity parameter test result shows the experience of the study households with some items performing different from the definition of Rasch theory (Annex 8). Item 3 (FewFood) is the least severe item experienced by most households (78%) which was also the same for Boset district when analyzed separately. However, "Healthy" is the least severe item for Fantale district respondents. Thus, based on household's response items severity order was done by switching the least severe items to the left. Hence; **3** and **1** and in a similar way **5** and 3 and 6 and 4 were switched. Items 2, 7 and 8 remained as expected in Rasch model assumption by most respondents. The order for the general sample is thus, questions **3, 2, 5, 1, 6, 4, 7 and 8.**

Appendix 9: FIES Data Inter-Item Correlation Matrix

	worried about run out of food	unable to eat healthy and nutri-tious food	ate only a few kinds of food	skip a meal	ate less than you thought you should	ran out of food	were hungry but did not eat	went with-out food the whole day
worried about run out of food	1.000	.429	.325	.148	.417	.319	.160	-.105
unable to eat healthy and nutritious food	.429	1.000	.305	.173	.263	.207	.116	-.174
ate only a few kinds of food	.325	.305	1.000	.029	.272	.202	.163	.005
skip a meal	.148	.173	.029	1.000	.152	.334	.535	.133
ate less than you thought you should	.417	.263	.272	.152	1.000	.322	.223	.098
ran out of food	.319	.207	.202	.334	.322	1.000	.536	.194
were hungry but did not eat	.160	.116	.163	.535	.223	.536	1.000	.338
went without food the whole day	-.105	-.174	.005	.133	.098	.194	.338	1.000

Appendix 10: Multicollinearity Test for Environmental Variables

Correlations

		rainfall variability	temperature variability/drought	soil fertility decline	land degradation, flooding	Biodiversity loss on private land	Bio-diversity on communal land	Water shortage	spreading livestock disease	spreading human disease	wild life and natural disaster
rainfall variability	Pearson Correlation	1	.466**	.338**	.185**	.163**	.212**	-.006	-.017	-.184**	-.073
	Sig. (2-tailed)		.000	.000	.000	.002	.000	.910	.740	.000	.160
	N	374	374	374	374	374	374	374	374	374	374
temperature variability/drought	Pearson Correlation	.466**	1	.434**	.378**	.188**	.221**	.047	-.063	-.250**	-.079
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.366	.222	.000	.130
	N	374	374	374	374	374	374	374	374	374	374
soil fertility decline	Pearson Correlation	.338**	.434**	1	.382**	.056	.252**	-.085	-.244**	-.310**	-.042
	Sig. (2-tailed)	.000	.000		.000	.276	.000	.102	.000	.000	.413
	N	374	374	374	374	374	374	374	374	374	374
land degradation, flooding	Pearson Correlation	.185**	.378**	.382**	1	.014	.140**	.040	.032	-.176**	-.040
	Sig. (2-tailed)	.000	.000	.000		.792	.007	.446	.532	.001	.445
	N	374	374	374	374	374	374	374	374	374	374
Biodiversity loss on private land	Pearson Correlation	.163**	.188**	.056	.014	1	.272**	.143**	.027	.002	-.006
	Sig. (2-tailed)	.002	.000	.276	.792		.000	.006	.601	.966	.913
	N	374	374	374	374	374	374	374	374	374	374
Biodiversity loss on communal land	Pearson Correlation	.212**	.221**	.252**	.140**	.272**	1	-.060	-.063	-.222**	-.047
	Sig. (2-tailed)	.000	.000	.000	.007	.000		.246	.225	.000	.368
	N	374	374	374	374	374	374	374	374	374	374
Water shortage	Pearson Correlation	-.006	.047	-.085	.040	.143**	-.060	1	.261**	-.031	-.079
	Sig. (2-tailed)	.910	.366	.102	.446	.006	.246		.000	.554	.128
	N	374	374	374	374	374	374	374	374	374	374
spreading livestock disease	Pearson Correlation	-.017	-.063	-.244**	.032	.027	-.063	.261**	1	.212**	.117*
	Sig. (2-tailed)	.740	.222	.000	.532	.601	.225	.000		.000	.024
	N	374	374	374	374	374	374	374	374	374	374
spreading human disease	Pearson Correlation	-.184**	-.250**	-.310**	-.176**	.002	-.222**	-.031	.212**	1	.265**
	Sig. (2-tailed)	.000	.000	.000	.001	.966	.000	.554	.000		.000
	N	374	374	374	374	374	374	374	374	374	374
wild life and natural disaster	Pearson Correlation	-.073	-.079	-.042	-.040	-.006	-.047	-.079	.117*	.265**	1
	Sig. (2-tailed)	.160	.130	.413	.445	.913	.368	.128	.024	.000	
	N	374	374	374	374	374	374	374	374	374	374

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 11: Multicollinearity Test for Institutional Variables

Correlations

		conflict, theft robbery	Changes in land use policy,	Expanding urban areas	Restricted pastoral mobility	Trade restrictions	livestock price fluctuation	Food price volatility	market facilities and infrastructure problem	Inadequate extension service	Lack of use of modern technology	Cooperatives involvement in market
Increased conflict, theft and robbery	Pearson Correlation	1	.038	-.074	.135**	.121*	.205**	.029	.095	.066	.008	.166**
	Sig. (2-tailed)		.469	.155	.009	.020	.000	.579	.068	.202	.874	.001
	N	374	374	374	374	374	374	374	374	374	374	374
Changes in land use policy,	Pearson Correlation	.038	1	-.336**	.161**	.191**	.115*	.059	-.025	.084	.076	.275**
	Sig. (2-tailed)	.469		.000	.002	.000	.026	.253	.635	.106	.140	.000
	N	374	374	374	374	374	374	374	374	374	374	374
Expanding urban areas	Pearson Correlation	-.074	-.336**	1	-.131*	-.017	-.113*	.019	.102*	.019	-.021	-.071
	Sig. (2-tailed)	.155	.000		.011	.741	.028	.719	.048	.716	.681	.173
	N	374	374	374	374	374	374	374	374	374	374	374
Restricted pastoral mobility	Pearson Correlation	.135**	.161**	-.131*	1	.313**	.089	.214**	.220**	.238**	.281**	.274**
	Sig. (2-tailed)	.009	.002	.011		.000	.084	.000	.000	.000	.000	.000
	N	374	374	374	374	374	374	374	374	374	374	374
Trade restrictions	Pearson Correlation	.121*	.191**	-.017	.313**	1	.245**	.286**	.305**	.161**	.259**	.471**
	Sig. (2-tailed)	.020	.000	.741	.000		.000	.000	.000	.002	.000	.000
	N	374	374	374	374	374	374	374	374	374	374	374
livestock price fluctuation	Pearson Correlation	.205**	.115*	-.113*	.089	.245**	1	.306**	.048	.222**	.253**	.185**
	Sig. (2-tailed)	.000	.026	.028	.084	.000		.000	.352	.000	.000	.000
	N	374	374	374	374	374	374	374	374	374	374	374
Food price volatility	Pearson Correlation	.029	.059	.019	.214**	.286**	.306**	1	.240**	.097	.287**	.259**
	Sig. (2-tailed)	.579	.253	.719	.000	.000	.000		.000	.062	.000	.000
	N	374	374	374	374	374	374	374	374	374	374	374
market facilities and infrastructure problem	Pearson Correlation	.095	-.025	.102*	.220**	.305**	.048	.240**	1	.332**	.339**	.352**
	Sig. (2-tailed)	.068	.635	.048	.000	.000	.352	.000		.000	.000	.000
	N	374	374	374	374	374	374	374	374	374	374	374
Inadequate extension service	Pearson Correlation	.066	.084	.019	.238**	.161**	.222**	.097	.332**	1	.381**	.188**
	Sig. (2-tailed)	.202	.106	.716	.000	.002	.000	.062	.000		.000	.000
	N	374	374	374	374	374	374	374	374	374	374	374
Lack of use of modern technology	Pearson Correlation	.008	.076	-.021	.281**	.259**	.253**	.287**	.339**	.381**	1	.188**
	Sig. (2-tailed)	.874	.140	.681	.000	.000	.000	.000	.000	.000		.000
	N	374	374	374	374	374	374	374	374	374	374	374
Cooperatives involvement in market	Pearson Correlation	.166**	.275**	-.071	.274**	.471**	.185**	.259**	.352**	.188**	.188**	1
	Sig. (2-tailed)	.001	.000	.173	.000	.000	.000	.000	.000	.000	.000	
	N	374	374	374	374	374	374	374	374	374	374	374

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 12: List of Boset District 'Kebeles', Households and Total Population

Ragaa Baay'ina Uummaata Aanaa Boosat Bara 2008 tii

S/N	Names of Kebeles	Total No.of House hold			No. of families under the HHd		Total No.	Ida'aama maatii fi abbaa warra		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
00	01	02	03		04	05				
1	Tadecha	321	118	439	1,251	1,327	2,578	1,572	1,445	3,017
2	Rukecha Bokore	390	63	453	1,717	1,916	3,633	2,107	1,979	4,086
3	Borchota	513	271	784	1,203	1,400	2,603	1,716	1,671	3,387
4	Gari N/Dera	1,007	162	1,169	1,998	2,204	4,202	3,005	2,366	5,371
5	Digelu wanga	363	216	579	682	1,007	1,689	1,045	1,223	2,268
6	Tiri Bireti	389	109	498	1,220	816	2,036	1,609	925	2,534
7	Sara Areda	887	141	1,028	3,040	2,256	5,296	3,927	2,397	6,324
8	Ararso Bero	819	132	951	2,655	2,100	4,755	3,474	2,232	5,706
9	Dire Degaga	1,310	321	1,631	2,976	1,915	4,891	4,286	2,236	6,522
10	Kechachule Guja	886	247	1,133	3,200	3,611	6,811	4,086	3,858	7,944
11	Kombe gugsa	893	222	1,115	2,408	3,812	6,220	3,301	4,034	7,335
12	Biresa Aba Bora	396	32	428	903	1,022	1,925	1,299	1,054	2,353
13	B/wagare	198	32	230	407	492	899	605	524	1,129
14	B/D/Geda	248	39	287	552	636	1,188	800	675	1,475
15	B/Donkore	122	25	147	255	372	627	377	397	774
16	S/Chare	238	90	328	304	1,200	1,504	542	1,290	1,832
17	B/Bedaso	334	65	399	849	993	1,842	1,183	1,058	2,241
18	B/Dache	355	80	435	1,155	1,170	2,325	1,510	1,250	2,760
19	H/Hurula	581	139	720	1,654	2,146	3,800	2,235	2,285	4,520
20	N/Hase	1,397	127	1,524	5,011	7,089	12,100	6,408	7,216	13,624
21	Q/H/Mirkesa	1,503	371	1,874	4,070	3,674	7,744	5,573	4,045	9,618
22	Sifa Bale	1,045	202	1,247	2,924	3,619	6,543	3,969	3,821	7,790
23	D/Rukkeetti	393	90	483	680	904	1,584	1,073	994	2,067
24	D/Chale	694	86	780	1,601	2,345	3,946	2,295	2,431	4,726
25	Golbo Bitmiti	540	102	642	1,917	1,980	3,897	2,457	2,082	4,539
26	D/Furda	1,111	309	1,420	2,803	2,040	4,843	3,914	2,349	6,263
27	H/kurkurfa	942	169	1,111	2,366	2,080	4,446	3,308	2,249	5,557
28	D/Tiyo	1,713	459	2,172	4,483	4,526	9,009	6,196	4,985	11,181
29	S/Kasale	251	46	297	1,185	1,098	2,283	1,436	1,144	2,580
30	Chamari Jawis	432	156	588	1,322	1,172	2,494	1,754	1,328	3,082
31	M/O/Lagaa	496	75	571	1,076	1,291	2,367	1,572	1,366	2,938
32	K/G/Wasaan	585	67	652	1,530	1,205	2,735	2,115	1,272	3,387
33	B/Mome	272	64	336	553	768	1,321	825	832	1,657
34	Goda Dera	1,457	1,330	2,787	2,633	2,008	4,641	4,090	3,338	7,428
35	Bole 01	798	503	1,301	10,452	6,847	17,299	11,250	7,350	18,600
36	Olenchiti 01	2,872	583	3,455	7,075	6,745	13,820	9,947	7,328	17,275
37	Olenchiti 02	1,499	703	2,202	4,524	4,637	9,161	6,023	5,340	11,363
38	Doni	1,286	220	1,506	1,306	2,468	3,774	2,592	2,688	5,280
39	Nura Hera No-1	345	25	370	507	805	1,312	852	830	1,682
40	Nuuraa Hera No-2	208	212	420	792	888	1,680	1,000	1,100	2,100
41	Nura Hera No-3	382	18	400	363	935	1,298	745	953	1,698
42	Kone Degaga	169	145	314	434	371	805	603	516	1,119
total		30,640	8,566	39,206	88,036	89,890	177,926	118,676	98,456	217,132

Appendix 13: Research Permit from Moi University

MOI UNIVERSITY
SCHOOL OF ARTS & SOCIAL SCIENCES

Tel: (053) 43093
(053) 43620 Ext 2515
Fax: (053) 43047
E-mail: deanarts@mu.ac.ke

P.O Box 3900
ELDORET
KENYA

6th April, 2021

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: ALMAZ TEFESSE MOSSISSA - SASS/DPHIL/DS/01/19

This is to certify that the above named is a bonafide student at Moi University, School of Arts and Social Sciences. She is a Doctor of Philosophy (DPhil) student in Development Studies.

She has completed her coursework component and proposal and has now embarked on Thesis writing.

Her Thesis is entitled: **"Dynamics Towards Sustainable Food Security in Ethiopian's Arid and SemiArid Parts of East Shewa Zone, Oromia Regional State".**

Any assistance accorded to her will be appreciated.

DEAN
SCHOOL OF ARTS
AND SOCIAL SCIENCES
MOI UNIVERSITY

PROF. MARY WAHOME
AG. DEAN, SCHOOL OF ARTS AND SOCIAL SCIENCES

(ISO 9001:2015 Certified Institution)

Appendix 14: Support Letter from Addis Ababa University

አዲስ አበባ ዩኒቨርሲቲ
የምርምርና የቴክኖሎጂ ሽግግር
ምክትል ፕሬዚዳንት ጽ/ቤት
የምርምር ዳይሬክተር ቢሮ

Addis Ababa University
Vice President for Research and
Technology Transfer
Office of the Director for Research

ቀን፡ ህዳር 10/2014 ዓ.ም

ቁጥር፡ RD/LT- 026/2014 ዓ.ም

<u>ለሚመለከተው ሁሉ</u>

ወ/ሮ አልማዝ ታፈሰ ሞሲሳ የአዲስ አበባ ዩኒቨርስቲ ባልደረባ በአሁኑ ጊዜ በኬንያ ሀገር በሚገኘዉ የሞይ ዩኒቨርስቲ የፒኤቹዲ ዲግሪአቸዉን እየሰሩ ሲሆን የመመረቂያ ጽሑፋቸውን "*Dynamics Towards Sustainable Food Security in Ethiopia's Arid and Semiarid Parts of East Shewa Zone, Oromia Regional State*" በሚል ርዕስ ላይ ምርምር እየሰሩ ይገኛሉ።

ወ/ሮ አልማዝ ከምስራቅ ሸዋ ዞንና ፈንታሌ ወረዳ የአርብቶ አደር ቤተሰቦች ለጥናታቸው አስፈላጊ የሆነ መረጃ ለመሰብሰብ የድጋፍ ደብዳቤ እንድንጽፍላቸዉ ጠይቀዋል። በመሆኑም ወ/ሮ አልማዝ የዩንቨርስቲአችን ባልደረባ ሲሆኑ በአሁኑ ሰአት ለዶክትሬት ድግሪ የመመረቂያ ጽሑፋቸዉን እየሰሩ ሲሆን ለጥናታቸዉ የሚሆን አስፈላጊዉን መረጃ መሰብሰብ እንዲችሉ የሚመለከታቸዉ አካላት በሙሉ አስፈላጊዉን ትብብር እንዲያደርጉላቸዉ የተለመደ ትብብራችሁን እንጠይቃለን።

ከሰላምታ ጋር

አዲስ አበባ ዩኒቨርስቲ
የምርምር
ዳይሬክተር
ጽ/ቤት
Office of the Director for Research
ADDIS ABABA UNIVERSITY

ታደሰ ፈታሂ (ዶ/ር)
የምርምር ዳይሬክተር
አዲስ አበባ ዩኒቨርስቲ

Tel: 251 111 23 97 71, 251 111 23 9749 e-mail: vpr_dgs@aau.edu.et P.O.Box 1176, Addis Ababa, Ethiopia

Appendix 15: Support Letter from Oronia Regional State Agriculture and Natural Resource Bureau

Bulchiinsa Mootummaa Naannoo Oromiyaatti
Biiroo Qonnaa fi Qabeenya Uummama
በኦሮሚያ ብሔራዊ ክልላዊ መንግስት የእርሻና ተፈጥሮ ሀብት ቢሮ
The Regional Government of Oromia
Bureau of Agriculture and Natural Resource

Guyyaa/ቀን/Date 8/4/2014
Lakk./ቁጥር/Ref.No. 4-13/18/09

ለምሥራቅ ሸዋ ዞን ግብርና ጽ/ቤት
አዳማ

ጉዳዩ:- የጥናት መረጃ እንዲያሰባስቡ ትብብር መጠየቅ ይሆናል::

የአዲስ አበባ ዩኒቨርስቲ ባልደረባ የሆኑት ወ/ሮ አልማዝ ታደሰ ሞሲሳ በአሁኑ ጊዜ ደግሞ በኬንያ በሚገኘው በሞይ ዩኒቨርስቲ የፒኤችዲ ዲግሪያቸውን "Dynamics Towards Sustainable Food Security in Ethiopia's Arid and Semiarid Parts of East Shawa Zone, Oromia Regional State" በሚል ርዕስ ላይ የጥናት ምርምር እያደረጉ መሆናቸውን የአዲስ አበባ ዩኒቨርስቲ በቁጥር RD/LT-026/2014 በቀን 10/03/2014 ዓ.ም በተጻፈ ደብዳቤ ገልጾ መረጃ ለመሰብሰብ እንዲችሉ የድጋፍ ደብዳቤ እንድንጽፍላቸው ጠይቆናል::

በዚሁ መሠረት ወ/ሮ አልማዝ ታደሰ በምስራቅ ሸዋ ዞን እና በፈንታሌ ወረዳ አርብቶ አደር ቤተሰቦች ለጥናታቸው አስፈላጊ የሆነ መረጃ መሰብሰብ እንዲችሉ እና የዶክትሬት ድግሪ መመረቂያ ጹሁፋቸውን መስራት እንዲችሉ እና ለጥናቱ አስፈላጊውን መረጃ ለመሰብሰብ በእናንተ በኩል የሚመለከታቸው አካል አስፈላጊውን ትብብር እንዲደረግላቸው እየገለጽን ለመረጃ እዲረዳ ዩንቨርስቲው የጻፈልንን ደብዳቤ አንድ (1) ገጽ ፎቶ ኮፒ በዚህ ሸኚ ደብዳቤ አያይዘን መላካችንን እንገልጻለን::

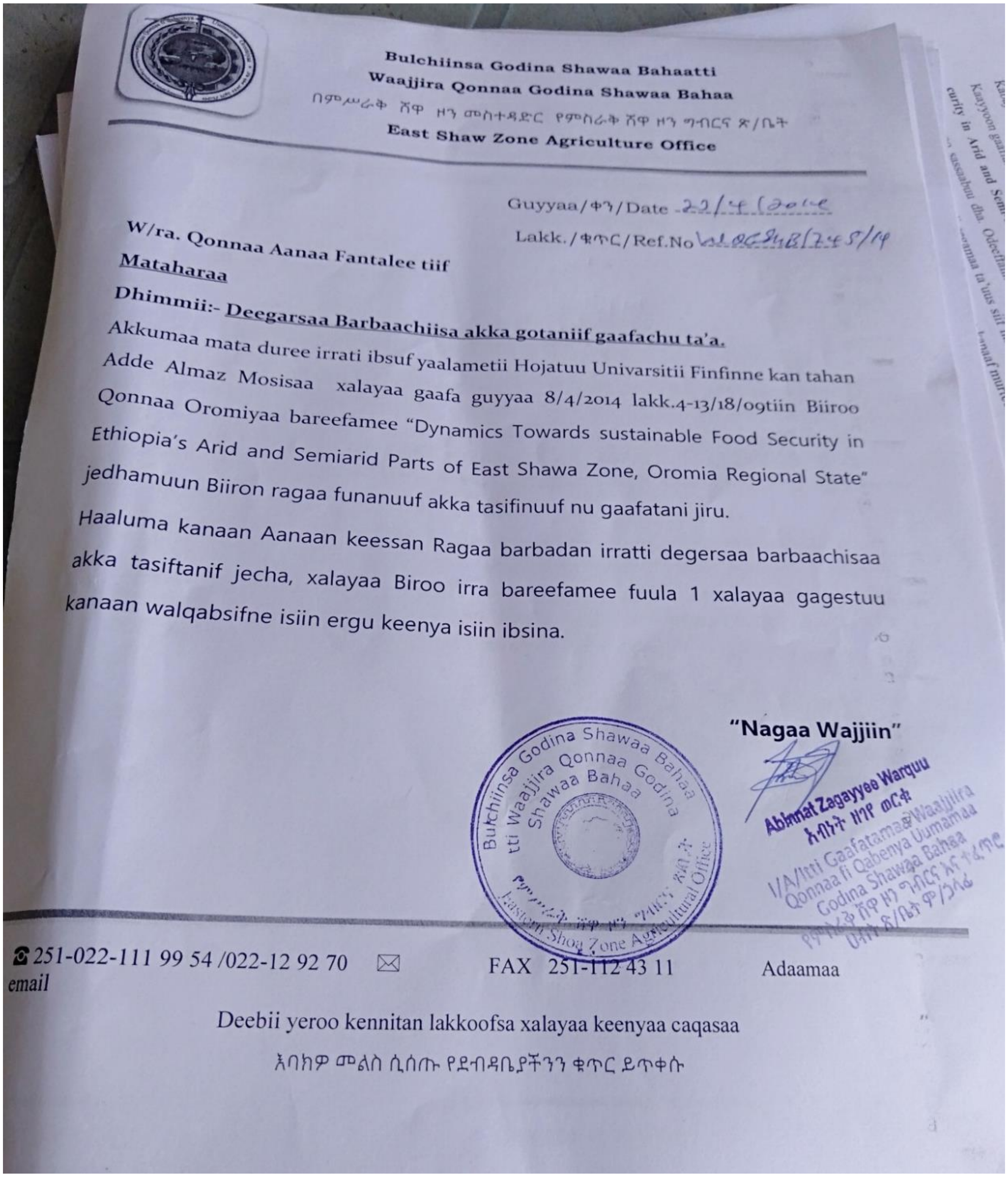
ከሠላምታ ጋር

ግልባጭ
ወ/ሮ አልማዝ ታደሰ
ባሉበት

251 11 371 7455/011 371 7506 ✉ 8770 FAX 251 11 371 7488
Finfinnee/Addis Ababa
ፊንፊኔ/አዲስ አበባ
Email: oboanr@gmail.com

Deebii Yeroo Kennitan lakkoofsa xalayaa keenyaa caqasaa!
እባክዎ መልስ ሲሰጡ የደብዳቤያችንን ቁጥር ይጥቀሱ!
Please quote our Ref. No. While replying!

Appendix 16: Support Letter from East Shewa Zone Agriculture and Natural Resources Office



Bulchiinsa Godina Shawaa Bahaatti
Waajjira Qonnaa Godina Shawaa Bahaa
በምሥራቅ ሸዋ ዞን መስተዳድር የምስራቅ ሸዋ ዞን ግብርና ጽ/ቤት
East Shaw Zone Agriculture Office

Guyyaa/ቀን/Date 22/4/2014
Lakk./ቁጥር/Ref.No [illegible]/245/14

W/ra. Qonnaa Aanaa Fantalee tiif
Mataharaa

Dhimmii:- Deegarsaa Barbaachiisa akka gotaniif gaafachu ta'a.

Akkumaa mata duree irrati ibsuf yaalametii Hojatuu Univarsitii Finfinne kan tahan Adde Almaz Mosisaa xalayaa gaafa guyyaa 8/4/2014 lakk.4-13/18/09tiin Biiroo Qonnaa Oromiyaa bareefamee "Dynamics Towards sustainable Food Security in Ethiopia's Arid and Semiarid Parts of East Shawa Zone, Oromia Regional State" jedhamuun Biiron ragaa funanuuf akka tasifinuuf nu gaafatani jiru.

Haaluma kanaan Aanaan keessan Ragaa barbadan irratti degersaa barbaachisaa akka tasiftanif jecha, xalayaa Biroo irra bareefamee fuula 1 xalayaa gagestuu kanaan walqabsifne isiin ergu keenya isiin ibsina.

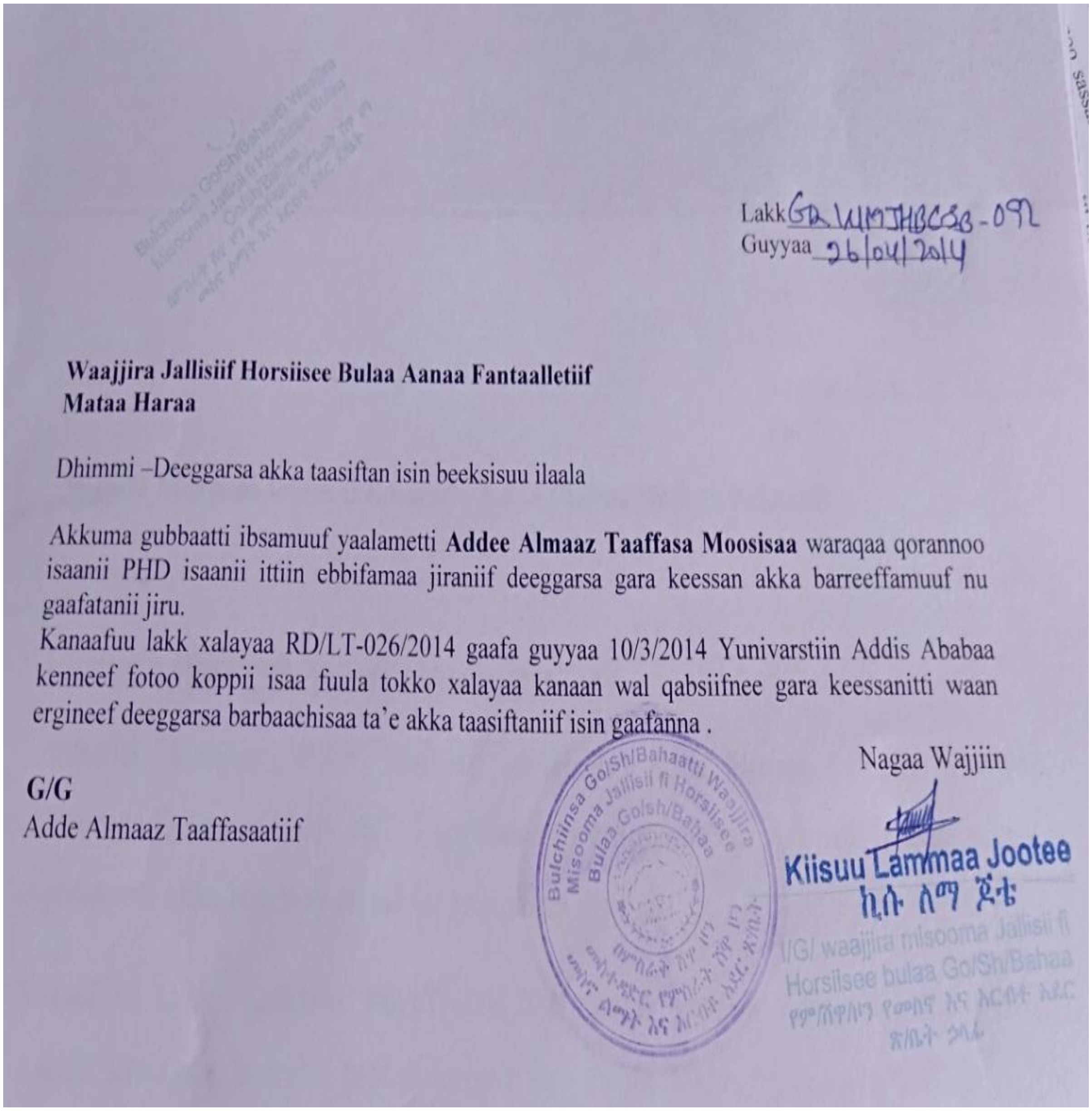
"Nagaa Wajjiin"

Abinnat Zagayyee Warquu
አብነት ዘገየ ወርቁ

☎ 251-022-111 99 54 /022-12 92 70 ✉ email FAX 251-112 43 11 Adaamaa

Deebii yeroo kennitan lakkoofsa xalayaa keenyaa caqasaa
እባክዎ መልስ ሲሰጡ የደብዳቤያችንን ቁጥር ይጥቀሱ

Appendix 17: Support Letter from East Shewa Zone Irrigation and Pastoral Development Office



Lakk GB WMJHBC&B-092
Guyyaa 26/04/2014

Waajjira Jallisiif Horsiisee Bulaa Aanaa Fantaalletiif
Mataa Haraa

Dhimmi –Deeggarsa akka taasiftan isin beeksisuu ilaala

Akkuma gubbaatti ibsamuuf yaalametti **Addee Almaaz Taaffasa Moosisaa** waraqaa qorannoo isaanii PHD isaanii ittiin ebbifamaa jiraniif deeggarsa gara keessan akka barreeffamuuf nu gaafatanii jiru.
Kanaafuu lakk xalayaa RD/LT-026/2014 gaafa guyyaa 10/3/2014 Yunivarstiin Addis Ababaa kenneef fotoo koppii isaa fuula tokko xalayaa kanaan wal qabsiifnee gara keessanitti waan ergineef deeggarsa barbaachisaa ta'e akka taasiftaniif isin gaafanna .

Nagaa Wajjiin

Kiisuu Lammaa Jootee
ኪሱ ለማ ጆቴ
I/G/ waajjira misooma Jallisii fi Horsiisee bulaa Go/Sh/Bahaa

G/G
Adde Almaaz Taaffasaatiif