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Assessing Livelihood Vulnerability of Pastoral Community to Climate Change and Adaptation Strategy: The Case of *Ginnir Woreda*, East Bale Zone, South East Ethiopia

By:

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Lists of Abbreviation/Acronyms

FGD	Focus Group Discussion
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
LVI	Livelihood vulnerability index
PCA	Principal Component Analysis

Abstract

Vulnerability to climate change is considered high in developing countries due to social, economic, and environmental conditions that amplify propensity to negative impacts and contribute to low capacity to cope with and adapt to climate hazards. The general objective of this study is to assess livelihood vulnerability of pastoral community to climate change and adaptation strategy in Ginnir woreda. To meet the objective the study used cross-sectional survey research designs with mixed research approach. The study applied a multi-stage sampling technique with simple random sampling method to select 363 sampled households and employed both quantitative and qualitative data. The study used data from both primary and secondary sources. Both descriptive statistical tools and qualitative narration were employed for analysis. Quantitative data was analyzed by using statistical techniques (range, frequency, and percentage). Whereas qualitative data was collected from note taking and recording activities, key informant interview and focused group discussion. Moreover, livelihood vulnerability was analyzed using several indexes. The result shows that the positive trend in rainfall implies that the study area is experiencing increasing amounts of precipitation over time, which could be linked to climate change. Whereas, the decreasing trends of temperature results to a cooling trend in the study area which contrasts with the broader global pattern of warming due to climate change. Regarding to sensitivity issues Keteti kebele's livelihoods are less sensitive to climate variability, but still vulnerable. Whereas, Gamo Duksi kebele's livelihoods are moderately sensitive and Dhobus kebele's livelihoods are highly sensitive to climate change, and with the highest sensitivity score, Dhobu's residents are at significant risk of livelihood disruption from climate-related events. The livelihood status of the three kebeles in relation to climate change is most vulnerable in Dhobu and least vulnerable in Keteti based on their sensitivity scores, with Gamo Duksi falling in between. Therefore, by improving resource management, diversifying livelihoods, and increasing access to climate information and social safety nets, pastoralists can build adaptation to the challenges posed by climate change. The study recommends designing supportive policies and investments that target areas with lower adaptive capacities to level the playing field and enhance overall resilience.

Keywords: Climate change, IPCC, Livelihood, Vulnerability

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

A report from the Intergovernmental Panel on Climate Change (IPCC, 2023) emphasized that the global average temperature is already around 1.1°C above pre-industrial levels, warning that without rapid mitigation measures, global warming could exceed the critical threshold of 1.5°C within the next two decades. According to NASA's Global Climate Change report (2023), there has been a marked increase in extreme weather events, particularly heat waves, heavy rainfall, and prolonged droughts, which have been exacerbated by human-induced climate change. Therefore, Climate variability has been and will always be a challenge to human livelihoods. Human-induced climate change has lent a complex new dimension to this challenge. Evidence shows that natural climatic variability, compounded with climate change, will adversely affect millions of livelihoods around the world (IPCC, 2007).

Ethiopia is frequently cited as a country that is highly vulnerable to climate variability and change (World Bank, 2010; Conway and Schipper, 2011; Tesfaye et al., 2015). In the last 50 years, the average annual minimum temperature has shown an increasing trend of 0.2 °C per decade (Tesfaye et al., 2015). The annual rainfall variability in most part of the country remains above 30% (Kindie et al., 2016).

Over the past 55 years, there has been a warming trend also in Ethiopia. According to Tadege (2007), the temperature has been increasing by about 0.37 °C every 10 years. This increase in temperature consequently gives several impacts and effects such as heat stress to livestock, and high evapotranspiration

Climate change is an occurring phenomenon that is constantly affecting livelihoods, especially in developing countries where the livelihood of smallholder farmers depends on subsistence agriculture (Gebremichael, 2020). Though livelihood is a highly complex and comprehensive concept it is a means of living for individuals and households. The most cited understanding of livelihood includes the skills, resources (including both social and material resources), and activities that generate the means of household survival (Ndlela & Worth, 2021).

Vulnerability to climate change is considered high in developing countries due to social, economic, and environmental conditions that amplify propensity to negative impacts and contribute to low capacity to cope with and adapt to climate hazards (Cutter, Boruff, and Shirley 2009; Nelson et al., 2010). Extreme events such as droughts and floods have increased vulnerability among farmers who depend on climate conditions. Since these occur regularly, they have been reducing long term growth and affecting millions of people.

Vulnerability is a state of sensitivity to disaster as a result of exposure to stresses associated with environmental and societal change, as well as a lack of adaptive capacity. According to IPCC vulnerability of households were derived as a function of the three elements—namely, adaptive capacity, sensitivity, and exposure (IPCC, 2014). Exposure can be referred to as climate change shock and describes the pressure drought shocks put on rural households (Gessler et al., 2020) and this can be explained by the intensity, frequency, and duration of drought. Sensitivity is understood as the extent of environmental factors' impact on households (Sharafi et al., 2020) and expressed by various subcomponents, such as the prevalence of crop failure, environment-related diseases, and different crises.

In addition, the main sources of vulnerability include: degradation of arable land, high population pressures on arable land, excessive drought, water scarcity, instability, erratic rainfall, and unavailability of livestock resources. For this reason, the poor and the rich members of society had to adopt different coping strategies depending on their wealth and level of vulnerability (Mengistu, 2017).

Pastoralists' livelihood strategies are based on livestock husbandry (Goldman and Riosmena, 2013) rearing livestock sectors in Ethiopia are among the worst hit by climate variability via repeated droughts. Households design different coping strategies for precipitation variability, such as adaptive selection of crop varieties, arrangement of planting timing based on rainfall intensity, mixed crop species, annual rotation of crop fields, and use of water harvesting technologies. In addition, lending and borrowing food, selling livestock, engaging in non-agricultural activities and remittances are considered important strategies to address livelihood challenges (Sime, 2019). Therefore, the aim of this study is to assess livelihood vulnerability of pastoral community to climate change and adaptation strategy in Ginnir *woreda*.

1.2. Statement of the Problem

Climate change is one of the major challenges facing the global community, which raises a great deal of concern (Bogaerts et al., 2017; Carolan, 2019; Ojo et al., 2021). It has been observed that although climate change is a world-wide phenomenon, its influence and extent differ across multiple levels and scales. Its impacts are not the same at district, regional, national and global levels.

Climate change affects environmental ecosystems, such as natural rangeland ecosystems, reduces forage production, changes rangeland quality, erodes soils, and causes the extinction of animal and plant species (Wüst-Galley et al., 2020) In addition, the revenue from traditional livelihood based on agriculture and pastoralism activities has recently declined due to climate change and degraded environmental ecosystem (McMillen et al., 2017).

Multitude of pastoralists have suffered great damage due to endangering their pastoral livelihood against the natural phenomena, such as drought, untimely floods, and the degradation of natural rangelands (Chatrchyan et al., 2017; Neibergs et al., 2018). Low-income pastoralists are more vulnerable to climate change according to Intergovernmental Panel on Climate Change (IPCC) (Kogo et al., 2020).

Vulnerability of pastoralism in this study is explained through natural stressors of drought (Ojima, Togtokh & Altanbagana, 2014), and human factors of pasture use and vegetation cover change as a set of linked impacts on social and economic conditions and coping strategies of herder communities in responding to these stresses.

Due to the dependence of traditional pastoral livelihood on climatic situation and rangeland ecosystems, in recent years the sensitivity of pastoralists to climate change has increased. In such a way that natural phenomena have reduced pastoralists' livelihood sources. Adaptive capacity refers to the ability of a household or community to cope with and recover from the effects of climate change (Amos et al., 2014; Hahn et al., 2009; Ojo and Baiyegunhi, 2020; Thathsarani and Gunaratne, 2018). In contrast to livelihood vulnerability concept, adaptation strategy aims to raise community resilience to climate change. It is a framework to manage future climate risks, and to prioritize measures (Setten and Lein, 2019).

Accordingly, pastoralists' adaptation strategies for climate variability comprise primarily livestock and rangeland management interventions, such as "purchasing fodder", "reducing livestock", "part-time grazing", and "renting rangelands" (Zhang et al., 2019). Furthermore, they identified the main adaptation strategies adopted by the herders of this region. Some adaptation strategies including forage purchase, grazing rotation, herd composition, and post-harvest grazing have been adopted by a large number of herders.

Few studies have been undertaken in the country on vulnerability of smallholder farmers to climate change and variability using eight biophysical and socioeconomic profiles related to vulnerability by Asrat and Simane (2017); Amare and Simane (2017); Chala et al. (2017); Simane et al. (2014). However, none of these studies have used a vulnerability index calculated from assets owned to measure vulnerability levels among agro-pastoralists

Therefore, vulnerability assessment is used to identify the risk posed by climate change and the opportunities for adaptation among pastoral. So, the aim of this study is to assess livelihood vulnerability of pastoral community to climate change and adaptation strategy among *Ginnir woreda* pastoralist community.

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of this study is to assess livelihood vulnerability of pastoral community to climate change and adaptation strategy in *Ginnir woreda.*

1.3.2. Specific Objectives

The specific objectives of this study are:

1. To describe trends of climate change (precipitation & temperature) in Ginnir *woreda*.
2. To assess livelihood vulnerability status of pastoral community to climate change.
3. To assess the cause of livelihood vulnerability to climate change
4. To assess adaptation strategy of the pastoral community to climate change.

1.4. Research Questions

1. What are the trends of climate change (precipitation & temperature) in *Ginnir Woreda*?
2. To what extent do the livelihoods of pastoral communities are vulnerable to climate change?
3. Why the livelihood of pastoral communities is vulnerable to climate change?
4. Which type of livelihoods is highly vulnerable to climate change?
5. What type of adaptation strategy dose the pastoral community utilizes for climate change?

1.5. Significance of the Study

The study may provide information for the pastoral development stakeholders and policy makers on the current status of adaptation strategies in the pastoral communities of the study area. The study results will thus guide the policy options, interventions and essential support necessary for sustainability of the nomadic pastoralists. Development actors like the Ministry of Agriculture (MOA), Pastoralists and irrigation development Office, *Bussa Gonefa* Office, and other governmental and non-governmental organizations (NGO's) will get access to information from the findings and recommendation of the study to improve their interventions.

Moreover, it might be important to collect an evidence-based data on contemporary challenges and impacts of changing climate on pastoral women and children. The research will also analyze and document vulnerabilities and coping strategies of these vulnerable populations including recommendations to stay climate smart and have climate resilient community and institutions.

Finally, the information that will be obtained through the study is believed to help researchers who may have interest to be engaged in similar study while serving as a source of data. Above all, the study results and recommendations will have a paramount significance for policy makers, policy advocates, development planners and practitioners who may be in need of such information for reconsideration, evaluation and inclusion into their respective development and humanitarian programming and operational strategies.

1.6. Scope of the Study

Geographically the study is delimited to East bale zone of Oromia regional state *Ginnir woreda*. Thematically, the scope of this study was delimited thematically to assess trends of climate change, livelihood vulnerability status of pastoral community to climate change and adaptation

strategy. The study used descriptive research design with qualitative and quantitative research approach. Temporally, the study was delimited to one year (2023).

1.7. Limitation of the Study

The process of conducting this research has not been without limitations. The researcher faced multiple and complicated situations.

Due to the current political instability the study faced the data collection process was interrupted due to violent conflicts. This extends the time of data collection for certain time. To solve this problem the study used field assistants who have better access to the community.

Moreover, during the time of data collection, getting the consent of respondents to have their responses for the interview schedule and focus group discussions was another challenge for this research. To overcome this problem the researcher was identified the best times and safe locations for data collection where participants feel most comfortable.

1.8. Definition of Key Terms

Vulnerability is the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2007).

Vulnerability Index is a metric characterizing the vulnerability of a system. A climate vulnerability index is typically derived by combining, with or without weighting, several indicators assumed to represent vulnerability (IPCC, 2012).

Exposure is the nature and degree to which a system is exposed to significant climatic variations (Mapplecroft, 2014).

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli (Mapplecroft, 2014).

Livelihood refers to the capabilities, assets (stores, resources, claims and access) and activities required for a means of living (Mike, 2002).

Adaptation: Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects. (IPCC, 2007).

Adaptive capacity- The resources available to the community that could help them cope with the effects of climatic factors and diseases (IPCC, 2007).

Climate Change is commonly used to describe any systematic alteration or statistically significant variation in either the average state of the climate elements such as precipitation, temperature, winds, or pressure; or in its variability, sustained over a finite time period (decades or longer). It can be referred to as the long-term change in global weather patterns, associated especially with increases in temperature, precipitation, and storm activity (IPCC, 2013).

Climate variability is the way climate fluctuates yearly as above or below of a long-term average value (NOAA, 2009).

***Kebele*:** The lowest administrative unit in to which a district is sub-divided (CSA, 2004).

Pastoralism: Pastoralism is the livelihood activity of rearing livestock often moving with the herds in search of fresh pasture and water (nomadism). Pastoralist: According to Krätli and Swift (2014), the term pastoralist can be used to indicate a cultural identity and a production/ livelihood system. This means that it can refer to people who practice Pastoralism, those who share a pastoralist background or those involved in activities related to Pastoralism.

1.9. Organization of the Study

The proposal section is divided into three chapters. The first chapter provides a discussion on the background and statement of the research problem. It also presents the research objectives, basic research questions, significance, scope of the study; limitation and definition of basic term are involved. The second chapter presents a review of the related literature. The overall purpose of this section is to review and analyze the conceptual, theoretical, empirical literature under pinning's of livelihood vulnerability status of pastoral community to climate change and adaptation strategy. This review involves the development of a conceptual framework established towards the end of this section, which is used as a guide in the development of instruments of data collection and methods of data analysis.

The third chapter of the research presents the methodology of the study. In this chapter, a discussion is made on the methodological claims of the study. In addition, the methodology part discusses the research approaches, design, data source and types, instruments of data collection, methods of data analysis, and mechanisms of checking the validity and reliability of data collection instruments.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1. Conceptual Literature

2.1.1. Climate Change

Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind, etc.) lasting for an extended period of > 3decades or longer. Climate change is resulted from: natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun; natural processes within the climate system (e.g. changes in ocean circulation); and, human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, reforestation, urbanization, desertification, etc. (ODI, 2011; IPCC 2007a).

In contemporary thinking the term climate change has become a core issue in various developmental, environmental, social and political forums at the grass roots, national, regional and international level (Akililu and Alebachew, 2009).

The Intergovernmental Panel on Climate Change (IPCC) in 2007 concluded that warming of the climate system was unequivocal and very likely (more than a 90% chance) caused by humans (Ares et al., 2009). The IPCC also concluded that global emissions would have to peak by 2015 and be reduced by 25-40% by 2020 and by 50-85% by 2050 to have a 50% change of limiting global temperature increase to 20 c.

2.1.2. Concepts of Vulnerability

Vulnerability is the degree to which individuals, households, communities or geographical areas are likely to be affected by disaster when hazardous events occur. The magnitude of each disaster - measured in number of deaths, amount of damage or cost - increases with increasing level of vulnerability (UN/ISDR, 2004). Vulnerability can encompass a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (Fussel, 2007b). Vulnerability can also mean susceptibility to harm or damage from exposure to direct or

indirect stresses associated with environmental and social changes in the absence of the capacity required to adapt (Adger, 2006; Soares et al., 2012).

The Intergovernmental Panel on Climate Change - IPCC (2012) defines vulnerability to climate change as "the degree, to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes. Vulnerability is therefore a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and adaptive capacity.

Vulnerability contexts are not the same it varies because of differences in the households' sensitivity, adaptive capacity, exposure to natural disasters, and coping strategies. Different assets played a key role in coping with the vulnerability that the households experience. Households apply Coping strategies which may be used as an ex-ante risk management strategy or accumulation of assets rather than as an ex-post coping strategy to deal with stress or shocks confronting households (Madhuri et al., 2018; Osawe, 2013).

Vulnerability may be related to particular livelihood systems, to wealth status, or people's social or political status. Vulnerability is often seen as the other face of resilience: a group of people is vulnerable when it lacks the resilience to resist to an external shock. If people can be made less vulnerable or non-vulnerable, then a hazard may still occur but need not produce a disaster. From this approach, it is apparent that reducing disaster is possible not only by modifying the hazard but also by reducing vulnerability (Gallopín, 2006).

Due to its complexity, achieving temporally and spatially comparable robust metrics to measure vulnerability however remains a major challenge in vulnerability research (Adger, 2006; Kelly and Eriksen, 2007; Cannon and Müller-Mahn, 2010). The metrics must reflect biophysical and social processes that are often in a continuous state of flux and often difficult to capture (O'Brien et al., 2007).

The vulnerability framework lays emphasis for understanding the adaptive capacity of households and communities to respond to disturbances such as drought, floods, disease outbreaks and conflicts, and how such disturbances affect households" exposure to risk, which results either in increased vulnerability or increased resilience over time (Tschakert and Dietrich 2010). Vulnerability assessment also helps to inform decision makers to facilitate decision-

making process of specific stakeholders of a sector about their options for adapting to the effects of climate change within the scope of their resources (Nkem et al., 2007).

2.1.3 Climate change adaptation strategy

Adaptation is defined as the process of adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities (IPCC, 2014). It can be categorized into spontaneous (autonomous) or planned. It can be anticipatory (proactive), concurrent (during) or responsive (reactive) in terms of timing with reference to the climatic stimuli (Pelling, 2011; IPCC, 2014).

Adaptation options can take a variety of forms (technical, policy or institutional), occur at a variety of spatial scales (global, regional and local), temporal scales (short, medium and long-terms) and be linked to climate drivers in different ways (reactive, concurrent or anticipatory) (Smit et al., 2000; Pelling, 2011). Some options might have mixed results and can lead to insufficient adaptation or maladaptation which may increase vulnerability across spatial and temporal variants (Barnett and O'Neill, 2010; Eriksen et al., 2011).

Successful adaptation requires appropriately defining and assessing climate change both as a problem and context. Climate risk assessment for adaptation planning can take two different but complementary approaches - the top-down (scenario-led) and the bottom-up (vulnerability-led) methods (Wilby and Dessai, 2010; Noble et al., 2014). The top-down approach of risk assessment takes into account the impact of climate change under a range of greenhouse gas emission scenarios and employs predictive climate and impact models. Often called the "standard approach", the top-down approach involves downscaling large scale climate change projections to local level, and impact modelling to estimate the likely impact of those projected future climate scenarios (Noble et al., 2014).

The bottom-up approach starts with an analysis of vulnerability elements including underlying factors that enable or constrain successful adaptation to past, current or future climate change. It begins at a local scale and is location-specific in its approach to climate risk assessment (Noble et al., 2014). The vulnerability-led approach recognizes that there are important climatic attributes that systems are sensitive to, and these attributes can be used to analyse implications of changing climatic conditions to specific systems and livelihoods with specific adaptive capacity

(Smit and Skinner, 2002; Wilby and Dessai, 2010). The bottom-up approach presents a practical framework to address the local vulnerability of systems and livelihoods through pragmatic risk management approaches. The strength of this approach is that it focuses on the root causes of vulnerability and enables well targeted adaptation.

Pastoralist communities living in dry land regions characterized by more climate variability have been making more efforts to cope with impacts and adapt to changing climatic conditions (Dong et al., 2011). In general, most of the adaptation to climate variability and change in Africa is reactive in response to short-term motivation, is autonomous occurring at the individual or household level, and often lacks government and policy support (Ziervogel et al., 2008; Berrang-Ford et al., 2011; IPCC, 2014). Despite ongoing efforts, whether those adaptations were effective or not are questionable.

Adaptation options are defined as the array of strategies and measures that are available and appropriate for addressing adaptation needs, and include wide range of actions that can be categorized as structural, institutional, or social (IPCC, 2014). The aim of adaptation is to reduce vulnerability or to increase resilience and involve changing processes or practices in social and ecological systems through reducing potential damages or engaging in new opportunities (Adger et al., 2007).

Key adaptation strategies are diversification of livelihood activities, adjustment in farming operations, income-generating projects, selling of labour and the move towards off-farm or non-farm livelihood incomes (Boko et al., 2007).

To analyze adaptation strategies adopted by pastoralists, the distribution of pastoralists was performed based on their adaptation strategies (Karimi et al., 2018; Zorom et al., 2013). Comparing the score of the LVI-IPCC in each livelihood vulnerability pattern with the LVI-IPCC of each county, it was specified to what extent the adoption of those adaptation strategies was appropriate.

2.2 Empirical Literature

2.2.1. Vulnerability to Climate Change Assessment

Measuring vulnerability involves a complex task of building qualitative and quantitative assessments using a significant range of explanatory parameters (Adger, 2006; Harley et al., 20 2008).

Climate change-related vulnerability has been studied in terms of climate change exposure, sensitivity, and adaptive capacity. Exposure refers to the degree of magnitude, nature and frequency of climate change in a given environmental area. Sensitivity is the extent to which a group of people is negatively influenced by climate-change related problems. For the purposes of this study, sensitivity mainly relies on the major livelihood activities accomplished in a pastoral community including the natural, human, economic, physical and social resource required to accomplish these activities, as well as the impacts of climate change on these major livelihood resource (IPCC, 2001; Adger, 2006; Fussel, 2007).

According to IPCC (2007), to determine the vulnerability of a household or community, vulnerability is calculated as a function of exposure, sensitivity, and adaptive capacity. The exposure includes the climate variability or change profile including the extreme events. The sensitivity includes the ecosystem and agricultural profiles. The adaptive capacity includes the wealth, technology, infrastructure, community, and social network profiles.

In indicator method, vulnerability is quantified based on selecting indicators from the potential set of indicators and then combining them analytically to identify the levels of vulnerability (Hahn et al., 2009). In this study, all indicators of vulnerability are assumed to have equal importance and thus giving them equal weights (Cutter et al., 2000). The LVI calculation utilized the approach by Hahn et al. (2009). Different scholars (Simane et al., 2014; Panthi et al., 2015; Aryal et al., 2014; Mohan and Sinha, 2010) also used a similar approach in various contexts.

Farmers in both *Dega* and *Kolla* agro-ecological zones were more vulnerable than those in the midland agro-ecological zone (Simane et al., 2016). Teshome (2016) indicated that households are increasingly vulnerable to climate change risks in Dembia *woreda*, Northwest Ethiopia.

Fenta et al. (2019) reported that pastoral households were highly vulnerable than agro-pastoral households in their studies on vulnerability of southern Afar pastoralists to climate variability and change, Ethiopia. Pastoral households are still less likely to diversify their livelihoods (Tsegaye et al., 2013).

Many scholars assess vulnerability to climate change using different approaches, Deressa et al. (2009) used vulnerability as expected poverty' (VEP) approach which is developed by the World Bank to measure the vulnerability of households to climate extremes in the Nile Basin of Ethiopia employed one of the econometric models to vulnerability. Whereas Jha and Dang (2009) used Vulnerability as Expected Utility (VEU). Furthermore, Hoddinott and Quisumbing (2008) used Vulnerability as Uninsured Exposure to Risk (VER) measures all models to assess vulnerability to poverty as used by.

O'Brien et al., 2009 used a Southern Africa Vulnerability Initiative (SAVI) Framework that emphasizes interconnections of multiple stressors, including HIV/AIDS that was developed by group of scientists in 2004. The Household Economy Approach which is livelihoods-based analytical framework developed by Save the Children UK in the early 90s designed to obtain information on how people access food and cash based on multi-level analysis (Lawrence et al., 2008).

Moreover, Holzmann et al., (2008) employed Individual Household Model (IHM) which is designed to provide more detailed vulnerability analysis at the household level. The Local Vulnerability Index was designed by Naude et al. (2008) to address a gap in vulnerability assessment methodologies, which tended to either focus on the household or country levels, but not in between. Nelson et al. (2010) came up with a more inclusive framework with both biophysical (exposure and sensitivity) and socioeconomic (adaptive capacity) components.

Likewise, Gebrehieot and van der Veen (2013) studies based on principal component analysis following the Intergovernmental Panel on Climate Change (IPCC) (2001) definition of vulnerability. Simane et al. (2016) used IPCC's Livelihood Vulnerability Index (LVI-IPCC) in 12 their study of agro-ecosystem specific climate vulnerability analysis to measure community vulnerability. Zelalem and Belay (2019) used both Livelihood Vulnerability Index (LVI) and

Livelihood Vulnerability Index-Intergovernmental Panel on Climate Change (LVI-IPCC) in their in their study of livelihood vulnerability to climate variability and change in different agro-ecological zone of Gurage administrative zone, Ethiopia.

2.2.1.1. Adaptive Capacity

Dechassa et al. (2016) stated that adaptive capacity of a household is taken to be an emergent property of the five types of livelihood assets namely human, natural, social, financial, and physical assets. Human asset visualizes entitlement to indicators such as knowledge, level of dependency, labor force, and information access. Education level which provides basic information on individuals' ability to understand technical aspects of climate information, improve their decision-making and also to embrace a diverse range of technological and economic opportunities to enhance their livelihoods can increase adaptive capacity (Coulibaly et al., 2015).

Solomon et al. (2016) used social and demographic profile (dependency ratio, percent of female headed, Average age of female head of household, percent of households haven't attended school and percent of households with orphans), livelihood strategies (percent of households working in a different community, percent of households dependent solely on agriculture and average agricultural livelihood diversification index) and social networks (average receive/give a ratio, average borrows/lend money ratio and percent of households who has not gone to their local government for assistance) as adaptive capacity indicators.

2.2.1.2. Sensitivity

Sensitivity was specified by the degree to which a system is modified or affected by an internal or external disturbance or set of disturbances (Gallopin 2006). Bobadoye et al. (2017) used household size, number of dependent, marital status, gender of household head, age of household head and level of education as sensitivity indicators. Zelalem and Belay (2019) used health (average time to nearest health center, percent of households reported at least one chronically ill and Percentage of households without sanitary), food (average food insufficient months, percent of households faced with food shortage and average crop diversity index) and water (percent of households who haven't consistent water supply, percent of households utilizing natural water and average time to water source).

2.2.1.3. Exposure

Exposure is an important component to describe a systems' vulnerability. In the context of climate, exposure is defined as "the nature and degree to which a system is exposed to significant climate variations" (IPCC, 2001). It includes all the background climate features and any variation a certain analysis unit is subjected to and the magnitude and frequency of these variables (Adger, 2006; Monterroso and Conde, 2015). Sewando et al. (2016) reported that they used the rate of change in average annual maximum temperature, average annual minimum temperature, and average annual precipitation as exposures to climate change which represents the historical climate changes.

Furthermore, Solomon et al., (2016) was used as exposure indicators of natural disaster and climate change (average number of climate hazards, percent of households that did not get a warning, percent of households with an injury/death, mean monthly maximum temperature, mean monthly minimum temperature and mean monthly rainfall.

2.3. Conceptual Framework

The study adopts an integrated vulnerability approach to explore the vulnerability and adaptation of pastoralists to climatic and non-climatic stressors. According to the framework, pastoralists work in a multi-dimensional risk environment characterized by the interaction between climatic and non-climatic stressors to influence vulnerability and adaptation decisions. The framework takes as its starting point the definition of vulnerability as a function of exposure, sensitivity and adaptive capacity. That is, vulnerability is the manner and degree to which a pastoralist is exposed to climatic and non-climatic stressors to which is it sensitive, and the capacity to adapt to these stressors. The components of exposure and sensitivity create potential impacts and increase the vulnerability of pastoralist households, while adaptive capacity decreases it. Ceteris paribus, a high degree of exposure or sensitivity and low adaptive capacity would suggest the pastoralists is more vulnerable; and a low degree of exposure or sensitivity and high adaptive capacity would mean the pastoralists is less vulnerable.

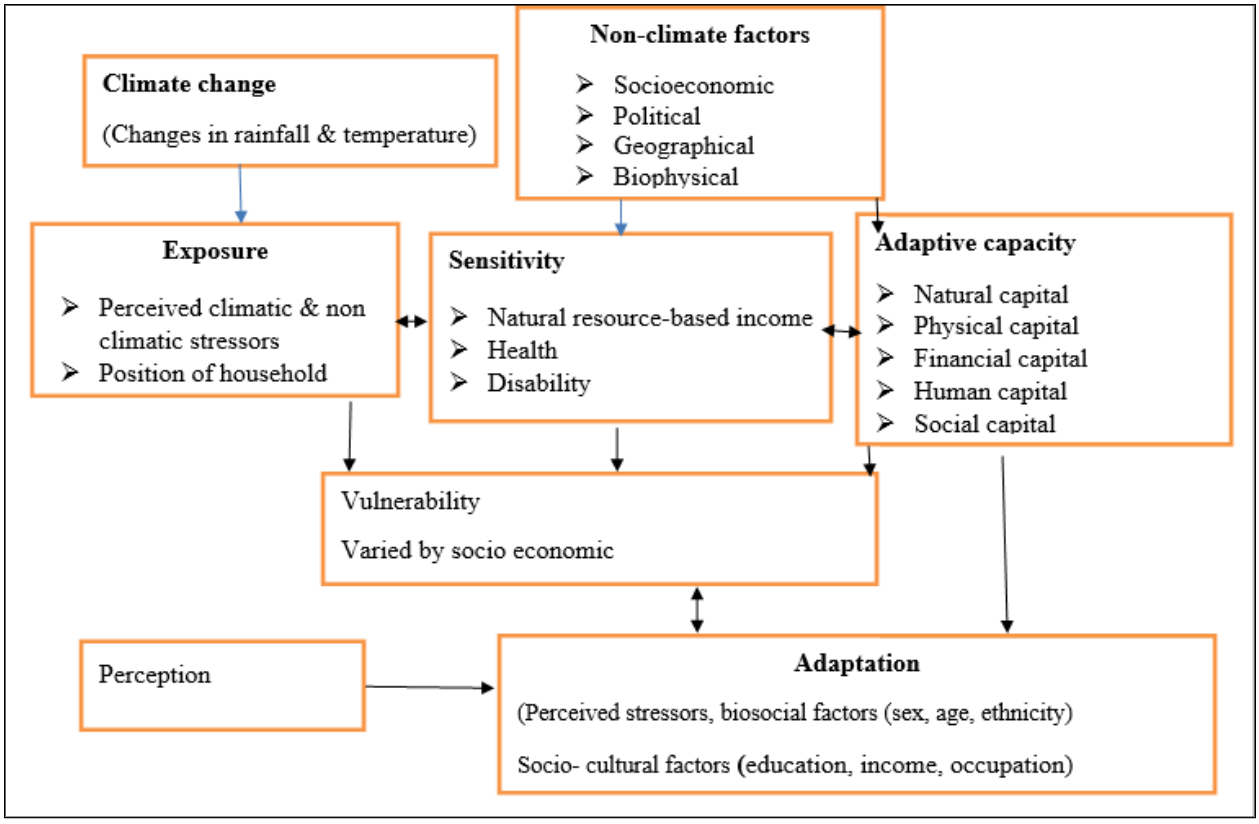


Figure: 1 Conceptual framework: Household vulnerability to multiple stressors

Source: Author's construct based on literature readings, 2023).

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

3.1.1. Geographic Location

Ginnir woreda is located in the Eastern part of East *Bale zone*. It is located to the Western of *Sinana* and *Goro*, North of *Gololcha*, Eastern of *Sewena*, South Eastern of *Dawe Kachen* and *Rayitu*. The total area of the *woreda* is about 2,384 km^2 which ranked as the 1st largest woreda in the zone and its area account for about 7.05 % of the total area of the zone (34,016km^2). The administrative center of the district is *Ginnir* town and has 28 peasant associations' *kebeles* with 24,449 member of peasant association. The woreda is located at a latitude of 6°40'23''N to 7°25'32''N & longitude of 40°15'24''E to 41° 6 '39''E.

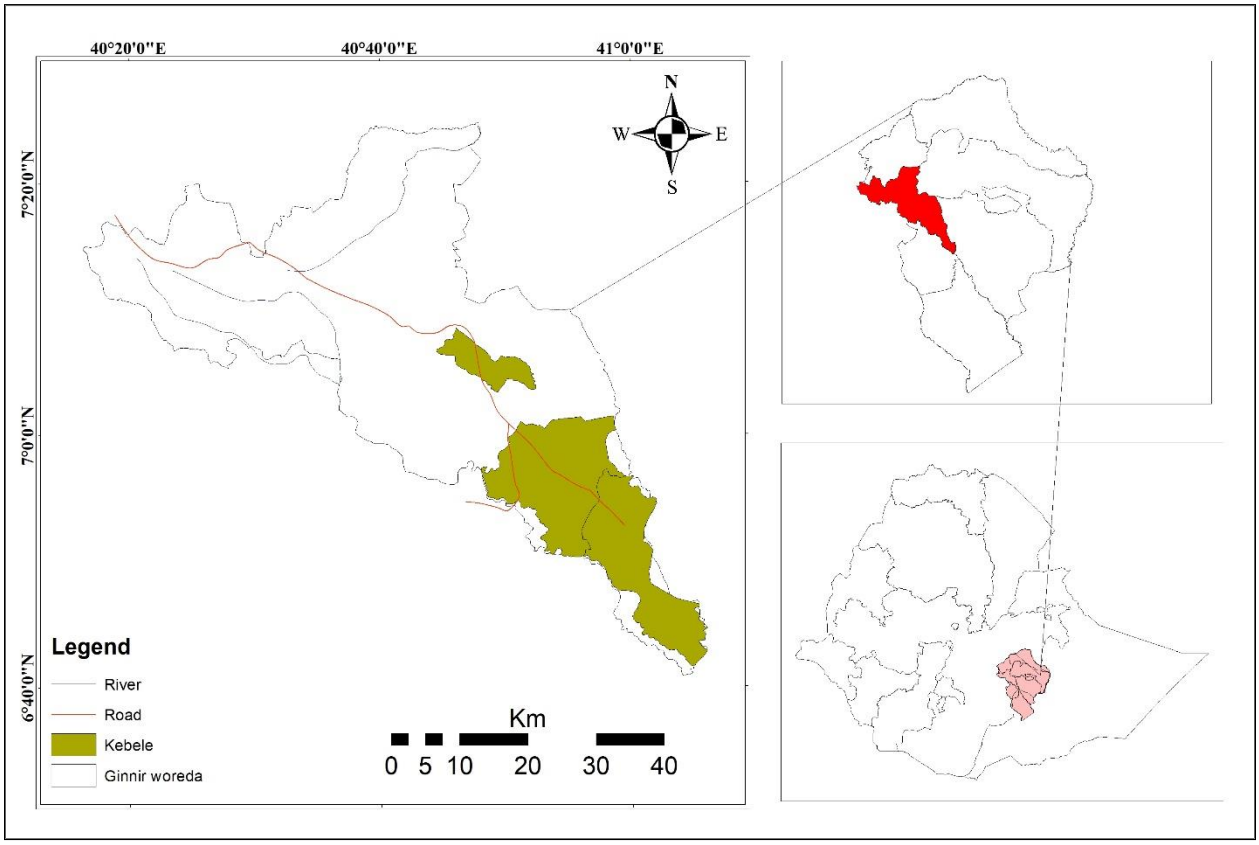


Figure: 2 Study Area Map

3.1.2. Topography

The lowest and highest altitude of the *woreda* is extended from 1200m below sea level which is located at the southern extreme corner of the district to 2406m above sea level which is found along the northern margin of the district respectively. From the total area of the *woreda* about 85% is plain land, 3% is mountains, and 12 % is rugged and gorge (*Ginnir woreda* socio economic profile, 2012)

3.1.3. Climate

Ginnir woreda have two types of rainfall regime. These are long rainy season and the two rainy seasons (Bimodal rainfall). The long rainy season extends from March to April. The two rainy seasons of rain fall regime influenced by equatorial westerly and easterly winds with rainfall during spring and autumn. The mean annual rainfall varies from 600mm from extreme lowland up to greater than 1250mm on highlands. The rain fall increases from southern lowlands toward the northern highlands (*Ginnir woreda* socio economic profile, 2012).

Even though some variation is observed in season with in the *woreda* there has been the following seasonal distribution**.** The annual average temperature is 25.45°c whereas the minimum and maximum temperature is 23.2^{o}c and 27.7^{o}c, respectively. The minimum and maximum rainfall is 600 and 1250mm respectively.

Generally, spring and autumn are among the seasons which are known in most parts of *woreda* for their rainy season and the *Ginnir woreda* farmers harvest highly during this season.

3.1.4. Soil and Vegetation

According to Atlas of Bale zone, July 2008, Ginnir *woreda* have been identified three types of soils. The major one is Chromic and Pellic Vertisols: These are clay Black Basaltic soil which mostly develop from tertiary volcanic rocks this soil is very fertile they fairly good Agricultural potential (*Ginnir woreda* socio economic profile, 2012). However, they have a limited agricultural use. The Soil shrink, develop deep cracks and become very hard in dry season. They swell and become sticky during the wet (rainy) Seasons. Besides, because of their low permeability, they are more prone to water logging during the rainy season. Dystric, Chromic, Eutric, Calcic and Vertic Cambisols: They develop from recent lava and linked with sedimentary

rocks. Their agricultural value is limited as they are mostly found on rugged and Stepp terrain. For this reason, this type of soil left under natural plant cover. And Dystric and Eutric Nitosols (deep with high clay continent): Soils have good Agricultural potential (good physical and chemical properties, stable structure and high moisture storage capacity).

3.2. Research Approach and Design

To meet the objective of the study were use cross-sectional survey research designs with qualitative and quantitative research approach along with empirical analysis.

3.3. Target Population, Sampling Method and Sample Size Selection

The study applied a multi-stage sampling technique. Firstly, *Ginnir woreda* was selected by using purposive sampling because of the presence of livelihood vulnerability to climate change situations. Secondly, three representative kebele of *katatii*, *G/duksii* and *Dhoobbuu* were selected purposively from 28 rural kebeles. Thirdly, sampled households were randomly selected by lottery method. Lastly, sample size was allocated proportional to household size of each sampled *kebeles*.

The total population of the sampled *kebeles* is 3875 households as shown by the following table (1). The study employed purposive and simple random sampling methods. For the qualitative data, purposive sampling techniques were employed to select respondents. However, simple random sampling methods were applied to identify respondents for the questionnaire survey. The total sample size is calculated using Yemane's sampling formula:

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

$$n = \frac{3875}{1 + 3875(0.05^2)}$$

$$n = \frac{3875}{10.6875}$$

$$n = 362.57 = 363$$

The proportions of sample from each *kebeles* for data collection were allocated as follows

Table: 1 Proportional Allocation of Sample for Each *Kebeles*

Kebeles Name	Households head	Sample size
Katati	1610	151
G/Duksi	1110	104
Dhoobbu	1155	108
Total	3875	363

Source: Population projection for 2017 (CSA, 2013) and own calculation

3.4. Data Sources and Types

The study employed both quantitative and qualitative data to achieve its objectives. The study used data from both primary and secondary sources. Quantitative data from survey questioner and qualitative data include: personal observation, key informant interview, and focused group discussion. The study used both socio-economic data of Primary and secondary data in the study area. Primary data was obtained from respondents through interviews, FGD and questionnaires whereas; historical climate data was collected from Ethiopian metrological agency.

3.4.1. Primary Sources

The researcher used data collection instruments like key informants' interview, personal observation, focus group discussion and survey questionnaire.

i. Survey Questionnaires

The detail close ended questionnaires pertain to adaptation strategies of climate change after reviewing related review literature in line with the objectives of the study. It was the main data collecting instruments and administer to the sample representatives. To check their standardization, consistency and whether there are unclear concepts and questions or not, a pilot survey in a randomly selected households were done and some adjustments were made before an actual field survey. The questionnaires were translated in to Afan Oromo and Amharic languages.

Finally data was collected by the enumerators from sampled households. The collected data was checked for completeness, accuracy, and consistence. Such a data helped to gather quantitative information.

ii. Key Informants Interview (KII)

Key informants' interview was under taken to collect relevant data. Hence; unstructured questions were used to allow respondents to express their views in their own words without restriction. So that it was made with the head *kebele* administrators of the municipality offices, the sample household heads and officials. Key informants' interview was held with three individuals per *kebele* and a total of nine participants were involved.

iii. Focus Group Discussion (FGD)

In addition to survey questionnaire and key informants' interview, Focus Group Discussion (FGD) was used as a part of the data collection method to increase the reliability of data collected by other methods. So that participants were selected from pastoralists. Open ended questions were forwarded. Focus group discussion was enabled to extract sufficient information on vulnerability of pastoralist's livelihood to climate change and adaptation options used by the pastoralists of study area. FGD with a participant of seven members per *kebele* three elders, two natural resource experts and two *kebele* leaders a total of twenty-one participants were conducted for FGD. The entire discussion was held in the language of choice of participants. Hence, three FGDs with members of seven were made at the three sampled *kebeles* (one FGD at each *kebele*).

iv. Observation

Personal observation of the study area was made by the researcher to gather further accurate and first-hand information. It also enhances the validity and reliability of the collected data.

3.4.2. Secondary sources

Secondary data was collected from both published and unpublished materials such as: - relevant books, working papers, previous researches, articles. It was also collected from the published and un published documents to support the reliability of the information that was obtained from local community

3.5. Methods of Data Analysis

Both descriptive statistical tools and qualitative narration were employed for analysis. Quantitative data were analyzed by using statistical tools (range, frequency, and percentage). Whereas qualitative data was collected from note taking and recording activities, key informant interview and focused group discussion.

Moreover, livelihood vulnerability was analyzed using the IPCC third Assessment Report (2007) mentions that climate change vulnerability is a function of exposure, sensitivity, and adaptive capacity (Macchi, 2011). The vulnerability is a positive function of the system's exposure and sensitivity, and a negative function of the system's adaptive capacity.

Sensitivity is specified by the degree to which a system is modified or affected by an internal or external disturbance or set of disturbances (Gallopin, 2006). Livelihood impacts of climate-related disasters in pastoral systems were taken into account as sensitivity indicators. These were livestock deaths and shortage of food at the household level and the income structure also determines the household sensitivity (Piya, Maharjan and Joshi, 2015), whereby the study considered Food insecurity, social structure& role of women in livelihood activities, HH income diversity and Frequency of livestock disease as the measure of sensitivity in the study area.

Exposure contributes positively to vulnerability of a household to climate change and variability. Exposure indicators were analyzed by drought occurrence, flashflood, extreme heat events, rain fall pattern changes and temperature change.

Table: 2 Indicators or Proxy Variables for Sensitivity and Exposure Component

Indicator Variables	Unit
Exposure	
Drought occurrence	Dummy:1 = yes and 0 = no
Flash flood	Dummy:1 = yes and 0 = no
Extreme heat events	Dummy:1 = yes and 0 = no
Rainfall pattern change	Dummy:1 = yes and 0 = no
Temperature change	Dummy:1 = yes and 0 = no
Sensitivity	
Food insecurity	Dummy:1 = yes and 0 = no
Social structure& role of women in livelihood activities	Dummy:1 = yes and 0 = no
HH income diversity	Dummy:1 = yes and 0 = no
Frequency of livestock disease	Number

At the community level, the mean values were computed and used in the analysis. HH (household); HHH (household head); HHM (household members). Adaptive capacity of a household is taken to be an emergent property of the five types of livelihood assets namely human, natural, social, financial, and physical assets (Piya, Maharjan, and Joshi 2015; Dechassa

et al. 2016). These indicators are not necessarily specific to climate shocks only, but are related in addressing other shocks like food shortages.

Table: 3 Descriptions of Adaptive Capacity and Vulnerability Indices for Study Communities

Indicator Variables	Unit
Human capital	
Health facilities	Dummy:1 = yes and 0 = no
HH Size	Number
Education	Dummy:1 = yes and 0 = no
HH head	Dummy:1 = yes and 0 = no
Natural Capital	
Grazing Land	Hectare (Ha)
Water Accessibility	Dummy:1 = yes and 0 = no
NTFP	Dummy:1 = yes and 0 = no
Financial capital	
Ownership of LVK (Number of Cattle, sheep, Goat, Camel, and chicken)	TLU
Saving	Dummy:1 = yes and 0 = no
Credit	Dummy:1 = yes and 0 = no
Remittance	Dummy:1 = yes and 0 = no
Jewelry	Dummy:1 = yes and 0 = no
Social Capital	
Good Network & Communication	Dummy:1 = yes and 0 = no
Access to weather information	Dummy:1 = yes and 0 = no
Infrastructure Insurance	Dummy:1 = yes and 0 = no
Member ship in social group	Dummy:1 = yes and 0 = no
Physical Capital	
Road	Dummy:1 = yes and 0 = no
Safe house	Dummy:1 = yes and 0 = no
Water	Dummy:1 = yes and 0 = no
Electric	Dummy:1 = yes and 0 = no
Tools & Equipment	Dummy:1 = yes and 0 = no

HH (household); HHH (household head); HHM (household members); TLU (Tropical Livestock Unit): cow = 0.70; sheep/goat = 0.10; pigs = 0.20, fowl = 0.01.

The values of the selected indicators have different units of measurement, and therefore, they are not compatible. To ensure compatibility in the construction of the vulnerability index, the values of indicators were normalized to nullify the effect of their units of measurement and also to have

a relative position within the range of 0 to 1. Values were normalized using the max-min approach described by Iyengar & Sudarshan (1982) and adopted by OECD (2008). If the indicator Xi had a positive relationship with the resulting component index, the normalized values were computed using equation 1.

$$\boldsymbol{Normalized\ Xi = \frac{Xi + min(x)}{Max(X) - min(x)}}$$

Aggregate the indicators to calculate scores for each sub-component (Exposure, Sensitivity, and Adaptive Capacity). This can be done by averaging the normalized indicators for each component:

$$\textbf{Component Score} = \frac{\sum \boldsymbol{Inorm}}{\boldsymbol{n}}$$

Where *I norm* = normalized indicator values

n = number of indicators in that component

Livelihood Vulnerability Index- LVI-based livelihood vulnerability to climate change in the study areas was assessed by an integrated vulnerability assessment approach. The integrated vulnerability approach is superior over other approaches and is particularly useful for policy decision-making (Deressa, Hassan, and Ringler 2010). Integrated vulnerability approach comprises socioeconomic and biophysical indicators of vulnerability and classified these indicators into adaptive capacity, sensitivity, and exposure. Once exposure, sensitivity, and adaptive capacity are calculated, the three contributing factors were combined using the following equation:

$$\boldsymbol{LVI = \frac{E + S - AC}{3}}$$

Where:

E = Exposure S = Sensitivity AC= Adaptive Capacity

3.6. Data Quality Assurance: Reliability and Validity of Collection Instruments

Validity is a necessary criterion for assessing the quality and acceptability of research (Zohrabi, 2013). It refers to the appropriateness of the instrument to measure what it intends to measure (Amin, 2005). To ensure validity, interview was used to do a pretest of the instruments. To ensure greater chances of data validity, the questionnaire was reviewed with the research

supervisor for expert input. Approval from the supervisor was conducted field-test with the interviewer.

Reliability is one of the main requirements of any research process it deals with the consistency, dependability, and reliability of the results obtained from a part of the research (Zohrabi, 2013).

The first step in ensuring reliability is by providing clear operational definitions of the variables under study. Thereafter, internal consistency was measured through internal consistency reliability (Sekeran, 2009) as well as split-half reliability using Cronbach's alpha. If α (cronbach alpha) value is computed to be 0.7 and above, then the instrument is considered satisfactory (Cronbach, 1951 as cited by Sekeran & Bougie, 2010), using results from the pretested questionnaire. According to Zaiontz (2015), Cronbach's alpha, α can be computed by running Excel's Anova: Two Factor without Replication data analysis tool and computing

$$\alpha = 1 - \frac{\text{MSE}}{\text{MSB}}$$

Where MSε, is Mean square/MS Error while MS в is Mean square/ MS Rows

CHAPTER FOUR

4. DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter presents the main results obtained from household survey, key informant interviews and secondary data sources. It presented and summarized the information about respondents' characteristics and detailed analysis on the livelihood vulnerability of pastoral community to climate change and adaptation strategy in *Ginnir woreda*. The researcher applied the introductory of each specific part, analysis of the data obtained from questionnaires, triangulating the result of questionnaires with the information obtained via interview, FGD and observation.

In the study 363 respondents were participated. The first section briefly introduces the chapter, the second section provides socio demographic characteristics of respondents, the third section presented trends of climate change (precipitation & temperature), the fourth section deals with livelihood vulnerability of pastoral community to climate change and adaptation strategy in *Ginnir woreda*, the fifth section presented adaptation strategy of the pastoral community to climate change and the last section concludes the chapter.

4.2. Demographic Characteristics of the Respondents

4.2.1. Sex and Age Composition of Respondents

Results in the following Table (4) showed that the sex and age characteristics of the respondents in the study area. Sex is one of the variables used to discuss the demographic characteristics of the respondents. The activity rate of young males has been much higher than that of young females participating. These might be due to the different opportunities society provided to males than females.

Table: 4 Sex and Age Composition of Respondents

Categories		Frequency	Percent
Sex of household heads	Male	296	81
	Female	69	19
	Total	**363**	**100.0**
	18-23	15	4.13
Age of household heads	24-29	21	5.78
	30-34	90	24.8
	35-39	82	22.58
	40-44	67	18.46
	45- 49	52	14.32
	>50	36	9.92
	Total	**363**	**100.0**

Source: Field Survey, 2024

With regarding to sex composition, the survey results revealed that majority of the respondents were male which account for 81% and 19% were female. In terms of age composition majority were with age group of 30-34 (24.8%) the remaining 22.58%, 18.46% , 14.32%, 9.92%, 5.78% and 4.13% were with age group of 35- 39, 40 -44, 45-49, >50, 24-29, and 18-23respectively. This purely indicated that majority of the household heads are males. This means majority of the households held the property by the name of male than female head households.

4.2.2. Education and Marital Status of the Respondents

Educational level of peoples determines the skills and knowledge they have which is also a means to bearing an occupation. Education is one of the factors that affect livelihood of the community. As a result, those household heads with higher educational status have higher probability to be more resilient and to get better income than its counter parts. It is also an important tool to bring an all-rounded development in a country. This condition may lessen degree of vulnerability.

Table: 5 Educational and Marital Statuses of the Respondents

	Categories	Frequency	Percent
Educational level of respondents	Unable read and write	138	38
	Informal Education	103	28.4
	Primary (Grade 1-8)	67	18.4
	Secondary General (Grades 9-12)	38	10.5
	Technical/Vocational Certificate/ Diploma	17	4.7
	Degree	-	-
	Above first Degree	-	-
	Total	**363**	**100**
Marital status	Single	14	3.9
	Married	302	83.2
	Divorced	31	8.5
	Widowed/Widower	16	4.4
	Total	**363**	100.0

Source: Field Survey, 2024

With regarding to educational status, the survey result revealed that majority of the respondents were unable to read and write which accounts for 38% and the remaining 28.4%, 18.4%, 10.5% and 4.7% of the respondents were followed informal education, Primary (Grade 1-8) , Secondary education (9-12) and technical/vocational respectively. Whereas, the marital status of the respondents revealed that about 83.2% of the total respondents were married and the remaining 3.9%, 8.5% and 4.4% were single, divorced and widowed/widower respectively.

Generally, the result showed that the study area was dominated by household heads that are un educated and followed informal education. From the result we can conclude that many individuals living in the study area were married. It is often the case that marriage contributes to the desire to have a permanent settlement.

4.2.3 Family Size of the Respondents

Household size has a significant influence on the rate of livelihood choice of the pastoralist. This is due to the prevalence of economies of scale at household level. Economies of scale indicate that as family size increases, household tends to diversify their livelihood sources. Data on the family size and persons per household can be used as a proxy measure of vulnerability of a population. to climate change hazards. Furthermore, household size has its own implication on livelihood vulnerability to climate change and adaptation strategy.

Table: 6 Household Family Size

No	Family size	Frequency	Percent
1	1-3	22	6
2	4-6	83	22.9
3	7-9	94	25.9
4	10 and above	164	45.2
	Total	**363**	**100**

Source: Field Survey, 2024

The result of the study depicted that the household size ranges from 1 to 10 and the house hold sizes include family members, relatives or other people living with in the household for an extended period of time. The result of the study indicated that majority of the respondents about 45.2% had 10 and above family size and 25.9%, 22.9% and 6% had 7-9, 4-6 and 1-3 family size respectively (see Table 6).

4.3. Trends of Climate Change (precipitation & temperature) in *Ginnir woreda*

4.3.1. Trends of Precipitation

Meteorological data show that there have been some changes in rainfall in the study areas. The graph shows the mean annual rainfall (in mm) over a time period from 1991 to 2023. Several trends can be observed:

From the late 1991s to around the year 2000, there is a clear downward trend in annual rainfall. The graph shows significant year-to-year variability, with occasional peaks, but overall, the trend line is decreasing sharply. This suggests a period of reduced rainfall or increasing drought

frequency during this time. The finding also agreed with the finding of Gebrechorkos et al. (2019), many parts of Ethiopia, especially in the lowlands, experienced reduced rainfall during the latter part of the 20th century, which is strongly linked to recurrent drought events and the El Niño Southern Oscillation (ENSO) phenomenon.

Whereas, after 2000, there is a notable period where rainfall remains relatively low and stable compared to earlier decades. The data points during this time hover around 200-600 mm, which is a substantial reduction compared to the earlier years. This period may indicate a drought or prolonged dry spell. The result also confirmed by Funk et al. (2014) highlights that East Africa, including Ethiopia's lowlands, faced declining rainfall during this period due to changes in atmospheric circulation patterns.

Finally, after 2010, the rainfall appears to increase again, with several peaks visible, especially in the last decade. The rainfall fluctuates between 800 mm and 1400 mm, suggesting a recovery but with higher variability. This finding also similar with Niang et al. (2014) indicate that East Africa's lowland areas are expected to see increased variability in rainfall due to rising global temperatures, leading to both floods and droughts.

Generally, the equation ($y = 2.3825x - 4473$) for the trend line in the graph suggests that, overall, there is a slight increasing trend in rainfall. The positive slope (2.3825) indicates that mean annual rainfall is expected to increase over time in the long run, although this contrasts with the observed decline up to 2000. While the long-term trend seems to suggest an increase, the data reveals considerable variability, with periods of both drought and excess rainfall, illustrating climate variability and changes over time.

Overall, the graph suggests a shift in rainfall patterns with periods of decline followed by recovery. This could be indicative of climate variability or changes in regional weather patterns.

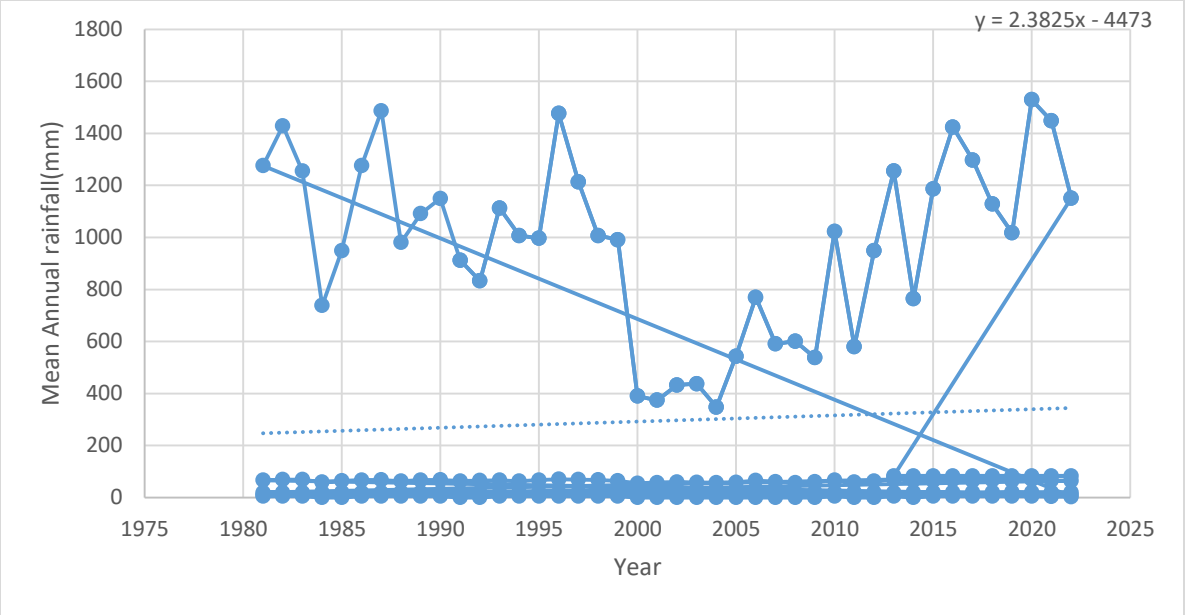


Figure: 3 Mean Annual Rainfall Trends

4.3.2. Trends of Temperature

The graph displays mean annual temperature (in unspecified units) from 1991 to 2023. Several important trends can be observed:

From the late 1991s to about the year 2000, the graph shows a general downward trend in mean annual temperatures, similar to what was observed in the rainfall graph. Although there are occasional peaks, the general trend points to a decline in temperatures during this period. The initial decline in temperature may be due to natural climate variability or localized cooling effects such as cloud cover, increased vegetation, or changes in land use.

Whereas, from 2000 to around 2010, temperatures remain relatively low and stable this could indicate a cooler period in the region, possibly tied to a prolonged cooler climate phase. During the last phase after 2010, the temperatures rise again, with a marked increase in variability. Some of the highest temperatures in the graph occur in this period, suggesting a warming phase. The fluctuations between high and low temperatures indicate increased variability in recent years. The recent increase (2010-present) could be tied to global climate change, with temperatures rising due to increased greenhouse gas emissions and land degradation in the region, which can reduce the cooling effect of vegetation and increase heat absorption.

The trend line equation (y = -0.7919x + 1713.2) indicates a slight long-term increase in temperature, with a negative slope (-0.7919), even though the observed data points show considerable variability. The trend line suggests a general increase in temperature, the data itself shows substantial fluctuation and variability, indicating climatic changes or variability in the region's temperature patterns.

The study result is similar with the research from the Ethiopian Meteorological Agency (EMA, 2020) shows that the lowlands of Ethiopia have been experiencing a rise in temperature in recent decades. The EMA reported that temperatures increased by an average of 0.37°C per decade since the 1980s in the lowland regions. According to a study by Taye et al. (2018), Ethiopia's lowlands, especially regions like the Afar and Somali regions, are experiencing rising temperatures due to global climate change. The study found that mean annual temperatures in these regions increased by 1.3°C between 1980 and 2017, a trend that aligns with the warming phase in your data after 2010.

Intergovernmental Panel on Climate Change (IPCC, 2021) reports indicate that East Africa in general, including Ethiopia's lowlands, is projected to experience a significant rise in temperatures of up to 2.5°C by 2050 if global greenhouse gas emissions are not reduced. This matches the increasing variability and recent warming trend seen in the graph.

In general, while the long-term trend line on the graph suggests a slight increase, the recent warming trend observed after 2010 is consistent with broader regional and global climate data for Ethiopia's lowlands, where increasing temperatures are expected due to climate change.

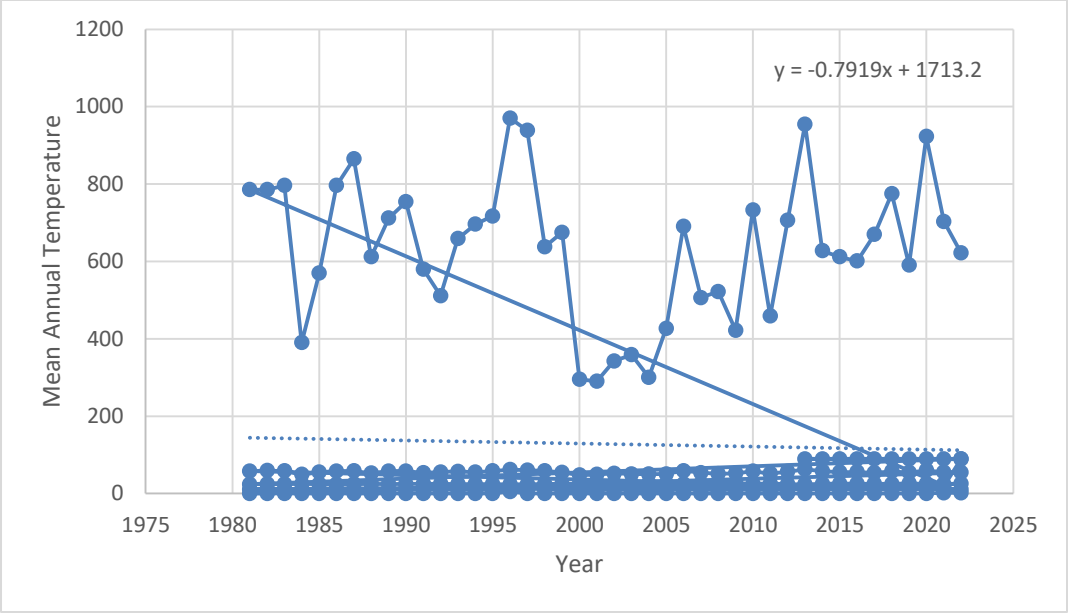


Figure: 4 Mean Annual Temperature Trends

4.4. Livelihood Vulnerability Status of Pastoral Community to Climate Change

Table: 7 Exposure and Sensitivity Indices of Study Communities

Variables	Kebeles		
Exposure	Katati	G/Duksi	Dhoobbu
Drought occurrence	76.82	76.92	85.19
Flash flood	36.42	39.42	0.5
Extreme heat events	76.16	66.35	68.52
Rainfall pattern change	72.85	76.92	77.78
Temperature change	70.19	67.31	66.67
	66.49	65.38	69.63
Sensitivity			
Food insecurity	54.30	0.5	55.56
Social structure& role of women in livelihood activities	50.99	49.04	45.37
HH income diversity	57.62	58.65	58.33
Frequency of livestock disease	46.03	50.72	38.70
	49.49	52.10	52.24

Source: Field Survey, 2024

Exposure measures how much a community is exposed to climate change risks such as droughts, flash floods, changes in rainfall and temperature patterns, and extreme heat events. Table (7) depicted that *Dhobu* has the highest exposure at 69.63%, suggesting it is the most affected by climate-related hazards whereas, *Keteti* and *Gamo Duksi* have slightly lower exposure scores at

66.49% and 65.38%, respectively, indicating that these *kebelles* are also highly exposed to climate-related risks, though *Dhobu* faces slightly higher risks.

Hence, *Dhobu,* with the highest exposure and facing more frequent and intense climate events, its relatively higher adaptive capacity could help mitigate some of these risks. However, *Gamo Duksi* and *Keteti b*oth have lower exposure but also slightly lower adaptive capacities, which may increase their vulnerability since they might struggle to cope with even moderate climate shocks.

The study result shows that all three *kebelles* face high exposure to climate risks, but *Dhobu's* slightly higher adaptive capacity might give it a slight edge in resilience compared to *Keteti* and *Gamo Duksi.*

Sensitivity refers to how much the community's livelihoods rely on these resources, which can be affected by climate change. These sensitivity scores indicate how susceptible the communities' livelihoods are to climate change impacts, with higher scores indicating a stronger dependency on climate-sensitive resources.

Keteti *kebele* has the lowest sensitivity score of the three *kebeles* which in account 49.49%, the *kebele* livelihoods are slightly less dependent on climate-sensitive resources compared to *Gamo Duksi* and *Dhobu*. This suggests that the people in *Keteti* may have more diverse livelihood sources, or may be slightly less reliant on agriculture or natural resources that are vulnerable to climate variability. While still vulnerable, *Keteti's* livelihoods are potentially more resilient to climate shocks than the other *kebelles,* as they are not as tightly linked to sensitive resources.

However, *Gamo Duksi's* livelihoods are moderately sensitive to climate change which in account 52.10%, meaning that the community is more reliant on climate-sensitive resources like rain-fed agriculture, livestock, or natural water sources. This higher sensitivity implies that any changes in climate patterns (such as droughts or floods) could significantly affect the community's livelihood status. Crop failures, livestock losses, or reduced water availability could severely impact their well-being. The livelihood status here is more fragile, as they have greater exposure to climate risks due to their dependence on natural resources.

Finally, *Dhobu* has scored 52.24% which implies that the kebele are found at Highest sensitivity of the three *kebeles* indicates that *Dhobu's* livelihoods are the most dependent on climate-sensitive activities. *Dhobu's* high sensitivity suggests that even minor changes in rainfall, temperature, or extreme events can have severe impacts on livelihood status, potentially leading to reduced food security, income, and overall well-being.

The livelihood vulnerability to climate change of the study *kebeles* shows in Table 7, based on their human capital for adaptive capacity scores are described as the human capital score of *Keteti* is 43.03% this suggests that *Keteti* has a relatively low to moderate adaptive capacity to climate change. This means the community likely faces significant challenges in coping with climate-related shocks such as droughts, floods, or erratic weather patterns.

The low human capital score indicates limited access to education and technical training, reducing the community's ability to adopt innovative strategies (e.g., climate-smart agriculture, alternative income sources). Therefore, with limited education, health services, and livelihood diversification options, they may struggle to adapt to changing climate conditions.

Gamo Duksi has slightly higher score of 45.03%, which means a moderate adaptive capacity compared to *Keteti*. This means the community may have marginally better access to education, healthcare, and social networks, but still faces significant vulnerabilities.

The community is still vulnerable to climate-induced shocks, as they likely face similar challenges in terms of livelihood dependence on climate-sensitive resources and limited health and education services. The moderate score suggests some level of knowledge and skills but not enough to fully support effective adaptation strategies. While healthcare access may be slightly better than in *Keteti,* it remains insufficient to provide full resilience to the physical impacts of climate change.

Therefore, *Gamo Duksi* has a moderately vulnerable status. Although it is slightly better positioned than *Keteti,* it still requires significant improvements in human capital (education, healthcare, and economic opportunities) to effectively reduce its vulnerability to climate change

Dhobu's human capital score of 55.96% indicates a relatively higher adaptive capacity compared to both *Keteti* and *Gamo Duksi*. This means the community in *Dhobu* has a better foundation to

cope with and adapt to climate-related challenges. With a score above 50%, it's likely that *Dhobu's* population has better access to education and skills training. This enhances their capacity to adopt adaptive measures such as improved livestock management, diversified livelihoods, and modern farming techniques.

A higher score suggests better access to healthcare, contributing to improved physical resilience. Healthier individuals can more actively participate in adaptation activities, such as migration or changing agricultural practices.

Dhobu has a moderately lower vulnerability to climate change due to its higher human capital score. The community has better resources, skills, and health services, which improve their capacity to respond to and adapt to climate challenges. However, further investments in education and economic diversification can further strengthen their resilience.

Whereas, the adaptive capacity based on natural capital of *keteti, GamoDuksi and Dhobu* are 60.64%, 59.62% and 56.17 % respectively. This figure (4) indicated that *keteti* has relatively higher adaptive capacity in terms of natural capital compared to the other *kebeles.* This suggests that *Keteti* has relatively better access to and management of grazing land, water, and non-timber forest products. *Gamo Duksi* has slightly lower than *Keteti* but still relatively high but might face some challenges compared to *Keteti*. Finally, *Dhob*u has the lowest among the three, suggesting that *Dhobu* might be facing more constraints in terms of natural capital, which could affect its adaptive capacity.

Financial capital plays a crucial role in determining the ability of pastoral communities to adapt to climate change. It is assessed by key variables like ownership of livestock (cattle, sheep, goats, camels, and chickens), savings, access to credit, jewelry ownership, and remittances received. These financial resources influence the community's ability to cope with and adapt to climate-related stressors. The financial capital of *Keteti, GamoDuksi* and *Dhobu* are 46.57%, 47.39% and 48.14% respectively.

Financial capital of *Keteti* has the lowest adaptive capacity this indicate that the community has limited financial resources, including livestock holdings, savings, or access to credit. The lack of financial security can make it more difficult for households in *Keteti* to recover from climate shocks, such as droughts or floods, leading to higher livelihood vulnerability. Whereas, *Gamo*

Duksi's financial capacity is slightly higher than *Keteti's*, but still moderate. This suggests that while the community may have some access to financial resources, it remains vulnerable to climate change impacts. There might be weaknesses in savings, access to credit, or remittances, making it challenging to respond effectively to climate shocks. Finally, *Dhobu* has the highest financial adaptive capacity among the three *kebelles*, though the margin is narrow.

This could mean that *Dhobu's* households have relatively better access to livestock, savings, or remittances, which can act as buffers against the impacts of climate change. However, given that the score is still below 50%, *Dhobu's* community is not financially resilient and may still struggle with the long-term impacts of climate variability.

Social capital is a crucial determinant of adaptive capacity, especially for pastoral communities that rely on social networks, community support, and shared knowledge for survival in changing environmental conditions. Social capital encompasses relationships, trust, norms, and networks that facilitate cooperation and collective action, which are vital for communities adapting to climate change.

While *Keteti* has scored 63.41% a relatively high social capital score, it is the lowest among the three *kebelles*. This indicates that *Keteti's* community has strong, though slightly less developed, social networks and support systems compared to the others. This could mean that the community engages in collective action, but there may be certain limitations in trust, cohesion, or the extent of collaboration that could be further enhanced to boost resilience.

Gamo *Duksi* scored 66.11% it shows a slightly higher social capital score than *Keteti*. This suggests a more robust level of social cohesion and community support. Gamo *Duksi's* pastoral community likely benefits from strong social networks, which help in sharing resources, information, and knowledge, especially in times of climate-related stress. This relatively higher social capital may contribute to a greater capacity to mobilize resources and respond collectively to climate challenges.

Dhobu has scored 67.82% the highest score in terms of social capital. This indicates that *Dhobu's* community is highly cohesive, with strong networks, trust, and collective action mechanisms. These social structures enhance the community's ability to share resources and knowledge, seek assistance, and engage in cooperative behavior that reduces their vulnerability

to climate change. *Dhobu's* strong social capital likely acts as a key buffer, helping households adapt more easily to environmental changes.

Physical capital refers to the infrastructure, equipment, and goods that pastoral communities rely on for their livelihoods. This includes access to basic services such as roads, markets, health services, water infrastructure, and energy sources. Physical capital plays a crucial role in determining a community's ability to adapt to climate change, as access to infrastructure enables better mobility, access to markets, and resources that mitigate the impacts of environmental changes.

Table 7 shows that *Keteti* has scored 71.26% which is the highest physical capital score, indicating strong infrastructure and access to services. This suggests that *Keteti's* pastoral community has better access to essential physical resources such as roads, health centers, markets, and water infrastructure. This level of physical capital significantly enhances the community's ability to adapt to climate change, as they can more easily move livestock to better grazing areas, access markets for selling livestock, and receive health and emergency services in times of need. While, Gamo *Duksi* has scored 63.46% a moderate physical capital score. While the community enjoys access to some key infrastructure and services, there may be limitations in transportation, market access, or water infrastructure that could reduce their adaptive capacity. This level of physical capital still provides a decent buffer against climate shocks, but there is room for improvement, especially in enhancing mobility and access to critical services.

Dhobu has scored 47.41%which the lowest physical capital score, indicating limited access to infrastructure and essential services. This suggests that the community may struggle with poor road networks, limited market access, insufficient water infrastructure, and a lack of essential services such as healthcare or electricity. *Dhobu's* low physical capital significantly heightens its vulnerability to climate change, as the community may be isolated and unable to quickly respond to or recover from climate shocks.

Table: 8 Adaptive Capacity and Vulnerability Indices for Study Communities

Variables	*Kebeles*		
Human capital	*Katati*	*G/Duksi*	*Dhoobbu*
Health facilities	68.2%	68.27%	74.07%
HH Size	46.95%	50.32%	43.29%
Education	41.72%	38.46%	40.74%
HH head	15.23%	23.08%	65.74%
	43.03%	45.03%	55.96%
Natural Capital			
Grazing Land	57.62%	58.65%	61.11%
Water Accessibility	63.58%	62.5%	56.48%
NTFP	58.94%	57.69%	50.93%
	60.04%	59.62%	56.17%
Financial capital			
Ownership of LVK			
Cattel	33.98%	34.38%	24.72%
Sheep	67.42%	73.37%	70.37%
Goat	50.26%	49.17%	46.33%
Camel	23.97%	20.96%	20.83%
Chicken	10.39%	10.23%	10.79%
Saving	54.97%	60.58%	57.41%
Credit	54.97%	52.88%	66.67%
Remittance	66.89%	66.35%	76.85%
Jewelry	56.29%	58.65%	59.26%
	46.57%	47.39%	48.14%
Social Capital			
Good Network & Communication	50.33%	60.58%	60.19%
Access to weather information	64.25%	59.62%	57.41%
Infrastructure Insurance	49.67%	46.15%	53.73%
Member ship in social group	89.40%	98.08%	67.82%
	63.41%	66.11%	67.82%
Physical Capital			
Road	79.47%	77.88%	19.44%
Safe House	65.56%	69.23%	59.26%
Access to Water	76.82%	74.04%	70.37%
Access to Electricity	68.21%	53.85%	71.29%
Tools & Equipment	66.23%	42.31%	16.67%
	71.26%	63.46%	47.41%

Source: Field Survey, 2024

4.5. Causes of Livelihood Vulnerability to Climate Change

In pastoral areas, livelihood vulnerability to climate change is shaped by both environmental and socio-economic factors. Here are the primary causes:

Table: 9 Cause of Livelihood Vulnerability to Climate Change

Cause of livelihood vulnerability to climate change	Response	Frequency	%
Conflict and Insecurity	Yes	276	76.03
	No	87	23.97
Water Scarcity	Yes	222	61.16
	No	141	38.84
Rangeland Degradation	Yes	211	58.13
	No	152	41.87
Climate Variability	Yes	309	85.12
	No	54	14.88
Governance and Policy Challenges	Yes	80	22.04
	No	283	77.96
Economic Marginalization	Yes	78	21.49
	No	285	78.51

Source: Field Survey, 2024

Pastoral communities depend heavily on livestock, which are highly sensitive to climatic factors such as droughts, erratic rainfall, and rising temperatures. These changes affect the availability of grazing land and water sources, leading to reduced livestock productivity and loss of herds. The result of survey showed that majority of the sample respondents agrees that climate variability have major role for the cause of livelihood vulnerability to climate change. On the other hand, climate change exacerbates rangeland degradation through desertification, overgrazing, and loss of vegetation cover. This makes it difficult for pastoralists to sustain their herds, as grazing lands become less productive.

Water scarcity also one of the causes of livelihood vulnerability to climate change when increasing drought frequency and intensity reduce the availability of water for both livestock and

human consumption, making it difficult for pastoralists to maintain their livelihoods. Water scarcity also forces communities to migrate, leading to conflicts over limited resources.

On the other hand, conflict and insecurity are also the causes of livelihood vulnerability to climate change in the study area which in account76.03%. The results from the survey, FGDs, interviews and expert opinion reported that climate change can intensify resource-based conflicts in pastoral areas, particularly over water and grazing land. These conflicts further erode the social and economic resilience of pastoralists, increasing their vulnerability.

Moreover, economic marginalization also one of the causes of livelihood vulnerability in the study area even though the respondents result is not higher than that of the result explained**.** The results from the survey, FGDs, interviews and expert opinion reported that the study area often have limited access to markets, infrastructure, and financial services. This economic marginalization reduces their ability to diversify income sources, invest in adaptive strategies, and recover from climate-induced shocks.

Consequently, governance and policy challenges are also the cause of livelihood vulnerability to climate change. The result depicted that some of the sample respondents agree that many pastoral communities lack representation in national policy processes, which often favor sedentary agriculture over pastoralism. This governance gap results in policies that do not support pastoral adaptation strategies.

4.6. Adaptation Strategy of the Pastoral Community to Climate Change

Adaptation strategies for pastoral communities to cope with climate change need to be tailored to their specific environmental, social, and economic contexts. These strategies should focus on building resilience to climate risks like droughts, erratic rainfall, and extreme temperatures, which are key challenges for pastoral livelihoods. The study investigated the following adaptation strategies for pastoral communities:

Table: 10 Adaptation Strategy of the Pastoral Community to Climate Change

Adaptation strategies	Response	Frequency	%
Livestock Management Practices	Yes	288	79.34
	No	75	20.66
Social Safety Nets and Insurance Purchasing and providing supplementary feed	Yes	321	88.43
	No	42	11.57
Herd mobility/Migration	Yes	211	58.13
	No	152	41.87
Diversification of Livelihoods	Yes	335	92.29
	No	28	7.71
Sell of livestock	Yes	186	51.24
	No	177	48.76

Source: Field Survey, 2024

The result shows that majority of the sample respondents agree that diversification of livelihood is the major adaptation strategies for pastoral communities to cope with climate change through developing alternative income sources, such as small-scale trade, handicrafts, or crop farming where feasible.

The results from the survey, FGDs, interviews and expert opinion reported that integrating crop cultivation with livestock rearing can help to diversify their food and income sources and encouraging non-livestock-based income opportunities such as eco-tourism, wage labor, or small businesses can reduce reliance on vulnerable livestock systems.

Adaptation options practiced by the study *kebeles* were presented in Table 10. The results revealed that 79.34% of respondents applied livestock management practices including diversified their livestock herd. Herd diversification in favor of browsers (camel and goats) is an important strategy of pastoralist adaptive response to climate-induced shifts in rangeland ecosystems (Berhanu and Beyene, 2015). On the other hand, maintaining traditional transhumance or migration patterns, allowing pastoralists to move livestock to areas with better grazing and water availability during dry periods.

The KI also confirmed that encouraging controlled destocking before severe droughts to reduce losses and allow quicker recovery afterward. Restocking programs can help rebuild herds after a disaster.

On the other hand, different development program such as the safety net program, which is an extension of "food for work" program of Dergue régime, is practiced by Ethiopian government to help extremely affected society during crisis. And the program has two components, public work and direct support. However, with the exception of few *kebeles,* most of the *kebeles* in *Ginnir woreda* has safety net.

The KI also confirmed that Index-based livestock insurance can help pastoralists cope with livestock losses due to drought or disease, providing financial relief during times of crisis and community-based support networks also strengthening traditional social safety nets where wealthier members support poorer members during crises (e.g., livestock sharing or redistribution).

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Climate change is a key threat to the livelihoods of pastoral communities of arid and semi-arid areas. In pastoral communities of Ethiopia, climate-induced shocks and stresses, such as droughts, rising temperature and irregular rainfall reduce pasture production which causes animal deaths owing to hunger and diseases.

The overall trends of rainfall suggest a shift in rainfall patterns with periods of decline followed by recovery. This could be indicative of climate variability or changes in regional weather patterns. While the long-term trendline of temperature suggests a slight increase, the recent warming trend observed after 2010 is consistent with broader regional and global climate data for Ethiopia's lowlands, where increasing temperatures are expected due to climate change.

Regarding to sensitivity issues *Keteti kebeles* livelihoods are less sensitive to climate variability, but still vulnerable. The lower sensitivity score suggests the community may have some buffering capacity, but overall vulnerability remains due to exposure and limited ability to adapt. Whereas *Gamo Duksi kebele* livelihoods are moderately sensitive and the community is more reliant on climate-sensitive resources, making their livelihoods more vulnerable to climate change impacts. Any climate shocks will likely have a more direct and severe impact on income and food security. Although, *Dhobus kebeles* livelihoods are highly sensitive to climate change, and with the highest sensitivity score, *Dhobu's* residents are at significant risk of livelihood disruption from climate-related events. Their dependence on sensitive resources means that even small changes in climate can result in substantial challenges for food security and income stability.

However, adaptive capacity scores reflect the potential of each *kebele* to manage and adapt to climate change through natural resources. Higher scores indicate a better starting point for adaptation, while lower scores highlight areas needing more targeted support. Tailoring strategies to the specific needs and conditions of each *kebele* will help improve their overall resilience to climate change.

Financial capital plays a critical role in determining the ability of pastoral communities to adapt to climate change. While the scores for all three *kebelles* indicate moderate adaptive capacity, *Keteti* is the most vulnerable, followed by *Gamo Duksi*, with *Dhobu* showing relatively higher resilience. Adaptation strategies should focus on strengthening financial resources through access to credit, savings, and diversified income sources, which are key to reducing vulnerability and enhancing long-term resilience to climate change.

Social capital plays a significant role in shaping the adaptive capacity of pastoral communities to climate change. *Dhobu*, with the highest score, enjoys strong community networks and cooperation, making it more resilient to climate impacts. *Gamo Duksi* also has a relatively strong social capital base, but there is still room for strengthening. *Keteti*, with the lowest score, remains vulnerable in terms of social structures and may need targeted interventions to enhance trust and cooperation within the community.

Physical capital plays a crucial role in shaping the ability of pastoral communities to adapt to climate change. While *Keteti* and *Gamo Duksi* have relatively stronger infrastructure, *Dhobu* faces considerable challenges that need to be addressed to improve the community's overall adaptive capacity. The livelihood status of the three *kebelles* in relation to climate change is most vulnerable in *Dhobu* and least vulnerable in *Keteti* based on their sensitivity scores, with *Gamo Duksi* falling in between.

Finally, adaptation strategies for pastoral communities combine traditional practices with new technologies and approaches. By improving resource management, diversifying livelihoods, and increasing access to climate information and social safety nets, pastoralists can build resilience to the challenges posed by climate change. Key to these strategies is a community-based approach that empowers pastoralists, respects indigenous knowledge, and enhances their ability to adapt to an uncertain future.

5.2. Recommendations

Based on the results of the study, the following points are suggested:

- ✓ To mitigate the effects of unpredictable rainfall and extreme weather events, Ethiopia should invest in climate early warning systems. These systems can help communities prepare for both droughts and floods by providing timely data on expected rainfall and weather patterns.
- ✓ Given the observed climate variability, promoting climate-smart agriculture in the lowlands is crucial. Techniques such as rainwater harvesting, conservation agriculture and drought-resistant crop varieties can help communities cope with erratic rainfall patterns.
- ✓ Implement regular monitoring of natural capital indicators to track changes and assess the effectiveness of adaptation strategies.
- ✓ Advocate for supportive policies and investments that target areas with lower adaptive capacities to level the playing field and enhance overall resilience.
- ✓ All three *kebeles* are still vulnerable, but targeted interventions in education, health, and skills development could significantly improve the adaptive capacity of *Keteti* and *Gamo Duksi*, helping them better cope with climate change.
- ✓ Further research has to be done applying model to identify more suitable adaptation options in the study area.

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Appendix: I Survey Questionnaires to be filled by Pastoral Households

My name is Abdulkadir Ahmed. I am going to conduct research in Madda walabu University. This questionnaire is prepared for the study on "**Assessing livelihood vulnerability of pastoral community to climate change and adaptation strategy: The case of *Ginnir* woreda, East Bale Zone, South east Ethiopia**". The success of the study entirely depends on your cooperation. There is no right and wrong answer, so you are kindly requested, to give your genuine responses to the following questions. Your responses will be kept confidential and will only be used for research purposes.

Thank you in advance

Instruction: Please circle it your response

1. Sex: A. Male B. Female
2. Age: _____
3. Marital status: A Single B Married C Divorced D Widowed/Widower
4. What is your educational level?
   A. Unable to read and write
   B. Informal education
   C. Primary (1-8)
   D. Secondary (9-12)
   E. TVET/Certificate
   F. University/College Diploma
   G. If Other, Specify
5. Do you own livestock?
   A. Yes B. No
6. If yes, what are the major livestock types you reared?
   A. Cattle
   B. Shoats (sheep and goats)
   C. Camel
   D. Chickens
   E. Others, specify _____
7. For what purpose(s) do you rear livestock?
   A. Its product
   B. Income generation by selling them
   C. Transportation
8. Did you have access to the following human capital in the last year?

S/N	Human capitals	Yes,	No
1	Health facilities		
2	HH Size		
3	Education		
4	HH head		
5	Others, specify__		

9. Did you have access to use the following natural capital in the last year?

S/N	Natural capital	Yes	No
1	Grazing Land		
2	Water Accessibility		
3	NTFP		

4	Others, specify__		

10. Did you have access to the following financial resources in the last year?

S/N	Financial capital	Yes	No
1	Ownership of LVK (Number of Cattel, sheep, Goat, Camel, and chicken)		
2	Saving		
3	Credit		
4	Remittance		
5	Jewelry		
6	Others, specify__		

11. Did you have the following Social Capital with your clan/ethnic groups?

S/N	Social Capital	Yes	No
1	Good Network & Communication		
2	Access to weather information		
3	Infrastructure Insurance		
4	Member ship in social group		
5	Others, specify__		

12. Did you have access to the following physical capital in the last year?

S/N	Physical capital	Yes	No
1	Road		
2	Safe Building		
3	Water		
4	Electric		
5	Tools & Equipment		
6	Others, specify__		

13. Do you think that your means of living is vulnerable to climate change? A. Yes B. No

S/N	Livestock	No. owned	No. died	Main reason for death? 1= diseases 2= drought 3 = floods 4= conflicts 5= predation 6= slaughter
1	Cattle			
2	Camels			
3	Goats			
4	Sheep			
5	Equines			
6	Chickens			

14. What are the causes of Livelihood Vulnerability to Climate Change?

A. Conflict and Insecurity
B. Water Scarcity
C. Rangeland Degradation
D. Climate Variability
E. Governance and Policy Challenges
F. Economic Marginalization
G. If other specify _____

15. What is the most frequently used and effective adaptation strategy you used to respond to climate variability/change during the last 30 years period?

    A. Livestock Management Practices

    B. Social Safety Nets and Insurance Purchasing and providing supplementary feed

    C. Herd mobility/Migration

    D. Diversification of Livelihoods

    E. Sell of livestock

Appendix II: Interview and Focus Group Discussion

My name is Abdulkadir Ahmed. I am going to conduct research in Madda walabu University. This questionnaire is prepared for the study on "**Assessing livelihood vulnerability of pastoral community to climate change and adaptation strategy: The case of *Ginnir* woreda, East Bale Zone, South East Ethiopia**". The success of the study entirely depends on your cooperation. There is no right and wrong answer, so you are kindly requested, to give your genuine responses to the following questions. Your responses will be kept confidential and will only be used for research purposes.

Thank you in advance

Part I: Interview questions

1. How would you describe the main climatic changes in Ginnir woreda in recent years?
2. How has the pastoral community's livelihood been affected by these climatic changes? (e.g., livestock mortality, water scarcity, reduced crop yields)
3. What strategies have the pastoral communities adopted to cope with and adapt to climate change?
4. Are there any success stories or effective practices that have helped the community mitigate the effects of climate change?
5. What are the major constraints hindering pastoralists' ability to adapt to climate change? (e.g., financial, technical, policy-related)
6. Are there cultural or social factors that limit the community's response to climate challenges?

Appendix: III Focus Group Discussion Guide

1. How have you noticed the climate changing in your community over the years?
2. What specific weather patterns (e.g., rainfall, droughts) have become more frequent or intense in the past decade?
3. Have there been any changes in the availability of grazing land due to climate changes?
4. What strategies do you and your community use to cope with droughts or other climate impacts?
5. Are there any traditional practices you rely on that help in dealing with climate variability?

Thank you very much for your particpation