



COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

**Assessment of Farmers' Access to Flood Forecast
Information and its Impact on Household Food Security in
Ilu Woreda, Upper Awash Basin, Ethiopia**

BY

Mengistu Dargie

September 2024

Addis Ababa,
Ethiopia

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Thesis submitted to Center for Food Security Studies, College of Development Studies, Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in Food Security and Development

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Addis Ababa,
Ethiopia

DECLARATION

I, the undersigned, hereby declare that the MSc thesis on “**Assessment of Farmers' Access to Flood Forecast Information and its Impact on Household Food Security in Ilu Woreda, Upper Awash Basin, Ethiopia**” is my original work and that neither the whole nor part of it has been or is to be submitted for another grant, nor materials used have been fully acknowledged.

Declared by: Mengistu Dargie _____
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Place: Addis Ababa University College of Development Studies, Center for Food Security Studies. This is to certify that the above declaration made by the candidate is correct to the best of my knowledge as an advisor.

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Approval

As examiners of MSc thesis, we certify that we have read and evaluated the thesis by Mengistu Dargie entitled “Assessment of Farmers' Access to Flood Forecast Information and its Impact on Household Food Security in Ilu Woreda, Upper Awash Basin, Ethiopia” submitted in partial fulfillment of the requirement for the MSc degree in food security and development complies with the regulations of Addis Ababa University and meets the accepted standards with respect to originality and quality.

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Acronyms

BGO	Bonsa Gonofa Oromia
CSA	Central Statistical Agency
ECA	Economic Commission for Africa
EAS	Ethiopian Academy of Sciences
EDRMC	Ethiopian Disaster Risk Management Commission
EMI	Ethiopian Meteorological Institute
EPCC	Ethiopian Panel on Climate Change
HFIAS	Household Food Insecurity Access Scale
HHs	Households
HRP	Humanitarian Response Plan
EPRP	Emergency Preparedness and Response Plan
FAO	Food and Agriculture Organization
FSIN	Food Security Information Network
GRFC	Global Report on Food Crisis
OCHA	Office for the Coordination of Humanitarian Affairs
RRC	Relief and Rehabilitation Commission
WB	World Bank
WHO	World Health Organization

Abstract

Flooding is a significant natural hazard in Ethiopia, particularly affecting rural agricultural communities. Floods damage crops and infrastructure and worsen food insecurity by disrupting livelihoods. The absence of timely flood forecast information further heightens vulnerability. This study assesses farmers' access to flood forecast information and its impact on household food security in the flood-prone Ilu Woreda. A mixed-method descriptive research design was employed, integrating both quantitative and qualitative approaches. The quantitative data were collected from 309 households selected randomly from the Wererso Kelina and Mulo Satay kebeles using structured questionnaires. The sample size was determined using Yamane's modified formula, yielding a proportional representation of households. Qualitative data were gathered through focus group discussions to gain deeper insights into community perceptions and responses to flood forecast information. Data were analyzed using statistical methods, including descriptive analysis, logistic regression for quantitative data, and thematic analysis for qualitative data. Logistic regression was used to identify factors influencing access to flood forecast information and its impact on food security, with variables such as education, gender, access to media devices, and farm size. The study found that 75.7% of households did not receive any flood forecast information ahead of flooding events, and access to such information was influenced by the level of education, gender, and ownership of media devices. Households led by male heads and those with higher education levels were more likely to have access to forecast information. Despite 42.4% of households possessing at least one media device, only a small proportion utilized these devices to receive flood forecast information. Among households with access to forecast information, 68% reported that it helped them to take flood preparedness measures. Households with access to flood forecast information were found to be 90% less likely to experience food insecurity. The study also revealed high levels of food insecurity, with 78% of households categorized as moderately food insecure. The impact of floods on agricultural output, coupled with limited access to flood forecasts, contributed significantly to the food insecurity levels in the region. Constrained access to flood forecast information recommends that stakeholders involved in disseminating forecast information assess their communication approaches in a manner that messages reach and have an impact on end users in vulnerable areas.

Chapter One: Introduction

1.1. Background and justification

The provision of people and organizations with accurate, timely, tailored weather and climate-related knowledge and information is crucial to reduce climate-related misfortunes and to protect lives, livelihoods, and property (ECA, 2021). Access to such information enables at-risk communities to mitigate the diversified effects of climate change-induced floods on the physical and economic system, mainly on agricultural livelihood and livestock (Umer Khayyam (2020).

Ethiopia put in place disaster management policy since 1974 with the establishment of RRC and early warning systems in 1976 (Petros Wako and Neng Shen, 2021). However, the endorsement of the 2013 national policy and strategy on disaster risk management was a significant milestone. The policy aims to reduce disaster risks and potential damage caused by a disaster through a comprehensive and coordinated Disaster Risk Management System and focuses on ten directives, which include the Disaster Risk Management System, Early Warning System, Information and communication (National Policy and Strategy on Disaster Risk Management, 2013).

The newly endorsed Roadmap for Multi-Hazard, Impact-Based Early Warning, and Early Action System (2023-2030) brings components of the Ethiopian EWS into four major pathways. These are: Risk knowledge, Detecting, monitoring, and forecasting, Early warning dissemination and communication, and Preparedness and response. The Early Warning System aims to enable risk-prone communities to take timely action to reduce disaster risks in advance of hazardous events (EDRMC, 2022).

Food insecurity remains a global challenge with more than a quarter of a billion people facing acute levels of hunger, and some are on the brink of starvation. (GRFC, 2023). FAO report indicates moderate to severe food insecurity rose by 22 percent to 30 percent, between 2014 and 2020. The report highlighted that sub-Saharan Africa registered the highest rise and Ethiopia is in the top ten largest food crises in magnitude with 23.6 million (FAO, 2023).

While food insecurity arises from a complex interplay of factors, climate-related hazards including floods are increasingly becoming significant contributors. Africa is particularly vulnerable to the impacts of climate change, including droughts, floods, and unpredictable weather patterns, which can lead to crop failures, livestock losses, and reduced agricultural productivity.

Among all types of natural disasters, floods are the risk phenomenon that causes the greatest economic loss and death. In the years 1995–2015 they affected 2.3 billion people globally, that is, over half of the total population affected by all weather-related hazards in the same period. (Alfieri et.al., 2020).

Ethiopia is a highly flood-prone country due to its geography and climate, with floods having wide-ranging impacts on agriculture, infrastructure, health, and livelihoods, significantly affecting the already food insecurity situation triggered by other shocks such as droughts and conflict (WB, 2021). The country has witnessed the negative consequences of floods that have impacted food security over the past decades. Riverine and flash floods have caused damage to crop and public infrastructure, livestock losses, displacement and loss of homes, and waterborne diseases. Ilu Woreda in the Southwest Shewa Zone of the Oromia Region is frequently affected by Riverine floods due to its alignment with the Awash River.

The Government of Ethiopia and its partners have put in place institutional arrangements to implement the DRM policies including providing access to forecast information to flood-prone communities so that they could prevent or mitigate the adverse impacts of natural hazards including floods. There are dozens of institutions at federal, regional, and local levels mandated for early warning and early action in the country. These include the Ethiopian Disaster Risk Management Commission (EDRMC), the Ethiopian Meteorological Institute (EMI), the Ministry of Water and Energy, and the Ministry of Agriculture among others.

This study aimed to assess farmer households' access to flood forecast information and its impact on food security in light of risk perception and communication.

1.2. Statement of the problem

Floods are among disasters that cause widespread destruction to human lives, properties and the environment every year and occur at different places with varied scales across the globe (Glago 2021). Disastrous floods have caused millions of fatalities in the twentieth century, tens of billions of dollars of direct economic loss each year, and serious disruption to global trade (Merz, et.al., 2021). With the changing climate conditions, the number of flood events has increased in the past few decades and the damage caused by floods is expected to increase substantially in the next few years (Alfieri et al., 2020).

In Ethiopia, riverine flood events have drastically increased over the past years affecting the food security situation of farming households. Between November and December 2023 alone, riverine floods affected more than 1.5 million people across the country, of whom more than 600,000 were displaced (UNOCHA, 2023). The recent floods have caused significant damage to crop and infrastructure, livestock losses, displacement and loss of homes, and waterborne diseases, including cholera outbreaks.

Oromia is one of the regions frequently impacted by floods in Ethiopia. The overflow of big rivers caused by heavy rains from highland areas during the major rainy seasons cause significant damage to human lives, harvest, livestock, and infrastructure.

Flooding due to the overflow of Awash River during the 2023 *meher* season (October to December) for example, has affected 1,311 households (5,277 individuals) in Wererso Kelina, Mulo Satay, Jigdu Mida, and Tulu Mangura kebeles of Ilu woreda of whom 487 individuals were displaced. The same flooding incident has damaged 1,896 hectares of crops and 206 hectares of grazing land in four kebeles according to the 2023 Oromia Region Seasonal Flood Impact Assessment (BGO, 2023).

Cognizant of the fact that early warning systems are considered a pivotal disaster risk management instrument to mitigate the situation and build resilience in communities prone to flood hazards, Ethiopia has had DRM policies and strategies and institutionalized early warning systems for decades. One of the pillars of the EWS is forecast information dissemination and communication.

While communication is considered the process through which people arrive at shared meanings through the interchange of messages (Robin, et. al., 2000), little is known about how flood-prone farmer households access flood forecast information to mitigate the adverse impacts of flood events. This study attempted to assess how farmers prone to riverine floods in Ilu Woreda, Upper Awash Basin access flood forecast information, and its impact on their household food security situations.

1.3. Objective of the study

1.3.1. General objective

The General objective of this study is to assess farmers' access to flood forecast information and its impact on household food security.

1.3.2. Specific objectives

Specific objectives of the study include:

1. examine farmer households' access to flood forecast information.
2. identify farmer households' utilization of flood forecast information.
3. assess farmer households' perception of flood risks.
4. determine the household food security status of farmers.

1.4. Research questions

1. What is the status of farmer households' access to flood forecast information?
2. How do farmer households utilize flood forecast information?
3. What is the perception of farmer households to flood risks?
4. What is the food security status of flood-affected farmer households?

1.5. Significance of the study

The finding of this research would help institutions mandated to disseminate forecast information to populations affected by climate-induced hazards including floods and to improve their communication strategies, channels, and tools in accordance with the needs and context of targeted audiences. It will also help local authorities to prioritize communication platforms that is suitable for the community. It also triggers further study why farmer households are not receiving flood forecast information despite media devices on their hands.

1.6. Scope of the study

The study assessed farmers' access to flood forecast information and its impact on household food security by surveying a total of 309 farmer households in Mulo Satay and Wererso Kelina Kebeles along the upper Awash Valley in Ilu Woreda in the Southwest Shewa zone of Oromia region, Ethiopia.

1.7. Limitation of the study

While the impact of floods is evident in pastoralist and agropastoral households as well as households who run businesses mainly in towns across the country, the focus of this study was to assess only farmer households' access to flood forecast information and see its implication to their food security status.

Chapter Two: Review of related literature

This chapter reviews conceptual, theoretical, and empirical underpinnings regarding the relationship between farmer households' access to flood forecast information and its implications for food security. It conceptualizes the relationship considering information communication models, risk perception, and communication theories, and explore how access to information could impact the food security situation.

2.1. Conceptual understanding of communication

Communication is an interdisciplinary subject that can be defined as the process of generating meaning by sending and receiving verbal and nonverbal symbols and signs that are influenced by multiple contexts (Dance & Larson, 1976). One way how communication has been defined is to see it as a process through which meaning and social realities are created. When communication researchers examine how meanings are managed, they examine how people structure and interpret messages and use language and other symbol systems in several contexts. Communication is how people arrive at shared meanings through the interchange of messages.

While the forms of communication can be broadly classified as intrapersonal, interpersonal, group, public, and mass communication, communication researchers have developed various models of communication over the years. The most used models are transmission, interaction, and transaction models (LibreTexts, 2024).

The search for who is doing what in a communication process and with what effects raised by Lasswell is a basic question of every communication theory, although it might be studied from different angles. Some of the questions relate to people's access to communication equipment, thereby accessing decisive information they need in their lives. Of course, contemporary communication seeks the transaction of meaning where the sender and receiver of information interact in a two-way mode to reach a shared understanding of messages. Because Communication takes place between people, between institutions, and between data systems (Brian, 2022), the study assesses farmers' access to flood forecast information with a particular focus on the receiver end of the model.

2.2. Theoretical related literature

2.2.1. Risk perception and communication

Communication researchers study the processes through which meaning and social reality are created, and they examine the flow of information and the interchange of messages between individuals in several contexts including disasters due to climatic shocks such as flood hazards. Communication research, like all research, must be systematic to be effective (Rubin, 2000).

While a disaster is a serious disruption to the functioning of a community that exceeds its capacity to cope within its resources, early warning information and risk communication in disasters aim to prevent and mitigate harm from disasters, prepare the population before a disaster, disseminate information during disasters and aid subsequent recovery (Bradley et.al., 2014)

The communication of risk descriptions is a key issue for the success of disaster risk management activities. Among various challenges of disaster risk management and climate change impacts, it is noted that most residents are poorly informed about their risk exposure or apposite response (Shabana and Jyoti 2022).

Disaster risk management requires the collaboration of a variety of stakeholders working in different sectors. The actors depend on each other to share risk information, and effective collaboration and coordination is required for efficient communication.

Whereas communication is a potentially valuable way of avoiding and reducing harm caused by disasters, risk communication in particular aims to provide the public with information about the effects of an event, and how actions may affect the outcome of the event. Crisis and Emergency Risk Communication (CERC) is the use of risk communication in emergencies to inform the public about an event or issue and to empower members of a community to protect themselves.

Risk communication in disasters has historically been a one-way transfer of information from authorities to the public, rather than an interactive flow of information. Disaster risk communication may take place through many different channels, including some that have been recently developed or expanded (Bradley, et.al., 2014).

Potential communication channels include face-to-face conversations, telephone calls, group meetings, mass media such as television, and interactive social media such as Twitter (Bradley

et.al., 2014). This theory explains the communication processes, strategies, and models employed by flood information forecasters.

2.3. Empirical related literature

2.3.1. Forecast information and dissemination in risk mitigation

The United Nations International Strategy for Disaster Reduction (UNISDR) defines forecast information as ‘the set of capacities needed to generate and disseminate timely and meaningful forecast information to enable individuals, communities, and organizations threatened by a hazard to prepare and act appropriately and in sufficient time to reduce the possibility of harm or losses. (UNISDR, 2009)

One of the solutions UNISDR (2009) recommends for mitigating the adverse effects of natural hazards such as floods is to set up a people-centered early warning system that attempts to raise knowledge of the risks, capacity for monitoring, analysis, and forecasting of the hazards, communication or dissemination of alerts and warnings; and local capabilities to respond to the warnings received (UNISDR, 2009).

Warning systems are processes that attempt to translate hazard and risk information, such as the strength of an approaching tropical cyclone or the dangers of living on the bank of a ravine prone to excessive flooding, into timely decisions and actions among populations receiving the warnings. The intention is to prompt behavior that safeguards lives and livelihoods as much as possible, accounting for all potential needs and capabilities in a society. Scientific data and information must be recorded, analyzed, and translated into a meaningful message before being broadcast to its intended audience (World Bank, 2022).

Early warning systems and climate outlooks can help communities predict and prepare for impending disasters and prepare for related risks. In the longer term, robust, evidence-based climate information can guide governments on how to invest in infrastructure that is located, designed, and built in light of the current and changing climate. Using climate information to avoid immediate shocks and stresses, or to climate-proof longer-term investment can help countries lift themselves out of the vicious cycles of damage and recovery. The responsibility of media towards society is to fill knowledge gaps, set agendas, and cultivate perceptions of audiences. In the context of flood management, the media occupy an intermediate position between decision-makers and the

population, a position that confers upon them the essential but delicate responsibility of bridging between the two parties (WMO, 2015).

2.3.2. Climate change and food security

The impact of climate change on food security has increased globally. Between 691 and 783 million people in the world faced hunger in 2022 with global hunger affecting around 9.2 percent of the world population compared with 7.9 percent in 2019. The number of people facing hunger in Africa has increased by 11 million people since 2021 and by more than 57 million people since the outbreak of the pandemic (UNDRR, 2023).

Food security is influenced by a complex interplay of factors, including conflict and political instability, climate change and environmental degradation, poverty and inequality, lack of infrastructure, population growth, and urbanization, limited access to inputs and technology, health challenges, and trade barriers and economic shocks (FAO 2023). The magnitude of the effect of these factors on food security varies from continent to continent and from country to country depending on the geographic conditions.

Africa is particularly vulnerable to the impacts of climate change, including droughts, floods, and unpredictable weather patterns, which can lead to crop failures, livestock losses, and reduced agricultural productivity. Addressing food insecurity in Africa requires a multifaceted approach that considers these interconnected factors, including investments in agricultural development, infrastructure, social safety nets, and policies to promote resilience to climate change and conflict.

Natural and man-induced alterations to the natural environment have significantly contributed to global climate change and local weather variability. This has been marked by frequent occurrence of extreme weather events such as floods and drought in many parts of the world. The societal implications of such weather variability are diverse and particularly jeopardize the livelihoods of the rural community in developing countries (ECA, 2012).

The agrarian community in developing nations is categorically equipped with the least adaptive measures to cope with such adverse effects. In many cases, the magnitude of resulting damage and coping strategies exercised by the local community are not well documented in an informative manner. The indigenous coping mechanisms that have a significant impact on recovering from flood and drought shock, in many cases, are overlooked (ECA, 2012).

Annual humanitarian response plans (HRP) prepared by the United Nations and its partners including the Government of Ethiopia indicate that the country continues to depend on large-scale humanitarian aid due to cycles of multiple, often overlapping crises driven by climate crises (flood and drought), armed conflicts, diseases, and economic shocks.

The convergence of these shocks pushes millions of people into displacement, food insecurity, malnutrition, disease outbreaks, and increased protection concerns amid economic challenges. In 2024, some 21 million people need assistance, and humanitarians target 14 million of the most vulnerable populations who require about three billion US dollars to meet their urgent life-saving needs (HRP, 2024).

Every year, many parts of the world are affected by natural disasters related to excess water resources. Among all types of natural disasters, floods are the risk phenomenon that causes the greatest economic loss and death. It can be noted that on a global scale, these hazards affect about 200 million people every year (Ali et al., 2020). Due to global climate change, the number of such disasters recorded in the past few decades has increased (Alfieri et al., 2018) and the amount of damage caused by floods is expected to increase substantially in the next few years (Arabameri et al., 2019).

2.3.3. Flooding and Flood Hazards in Ethiopia

Flooding in Ethiopia is typically caused by heavy or prolonged rainfall that exceeds the soil's capacity to absorb water and the rivers' capacity to handle the flow. The floods are mainly due to flash floods and riverine floods caused by above-normal rains in the upper streams and the overflow of main rivers (EPRP, 2023).

In recent decades, flooding has become a growing concern in Ethiopia, leading to damage to people, property, and the natural environment. Reports indicate that more than 1.5 million people were affected by riverine and flash floods between November and December 2023, with over 600,000 people displaced and several deaths reported. The floods also caused significant damage to crops, infrastructure, and livestock, as well as outbreaks of waterborne diseases such as cholera. Reports by humanitarian organizations such as the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) indicate that more than 1.5 million people were affected by riverine and flash floods across the country between November and December 2023. At the peak this disaster, more than 600,000 were displaced and dozens were reported dead due to floods.

(UNOCHA, 2023). Apart from displacement and loss of human lives, floods had caused significant damage to crop and infrastructure, livestock losses, loss of homes, and resulted in waterborne diseases including cholera outbreaks.

The impact of flooding due to seasonal rains (October-December) in the Somali, Afar, Oromia, Amhara, and SNNP Regions grew as reported by the Regional Disaster Risk Management Bureau (DRMB). A total of 56 woredas/districts and 206 sites in 23 zones have been affected by flash, and river floods hence caused landslides, in parts of the Oromia region. Since October 2023, heavy rainfall has been reported in Ethiopia, affecting thousands of people across the regions of Somali, SNNP, Afar, and Oromia mainly (Relief Web, 2023).

Regional reports indicate that flood hazards in the Oromia region result in severe humanitarian consequences including displacement of communities, loss of life and properties, water-borne disease outbreaks for both humans and livestock, erosion of fertile soil, hindering economic use of lands, depletion of natural resources, shortage of food, and increased level of malnutrition, sexual violence, interruption in schooling and increased dropout rates, separation of families, damage of infrastructures and basic services, lack of safe water and basic sanitation are the main humanitarian consequences (BGO, 2023).

Many of the disasters in Oromia are related to rivers that overflow and burst their banks due to heavy rains and inundated lowland plains. The highlands are extensively deforested and thus land degradation is higher; rains are sometimes heavy and torrential; water converges in river basins and causes swelling of rivers. In Oromia, flooding usually takes place at the peak of *kiremt* rainy season (July and August) in most flood-prone areas (Season Flood Impact, 2023).

The overflow of the Awash, Gibe, and Gelana Rivers, and the outflow of Abaya Lake have been causing flood-induced disasters in the region (BGO). Southwest Shewa Zone of the Oromia Region faces frequent flooding events due to its alignment with the Awash River.

Ilu Woreda in the Southwest Shewa zone is one of the flood-prone areas with repeated and high-scale occurrences with greater vulnerability to flood-induced disasters. It is one of the most frequently affected areas where evacuating affected communities including using military helicopters has been practiced due to flooding, environmental degradation from successive

deforestation, fertile soil erosion and poor agricultural practices have been triggering flood hazards in the region.

According to the Oromia Region Disaster Risk Management Office, flooding due to the overflow of Awash River during the 2023 meher season (October to December) for example, had affected 1,311 households (5,277 individuals) in Wererso Kelina, Mulo Satay, Jigdu Mida, and Tulu Mangura kebeles of Ilu woreda of whom 487 individuals were displaced. The incident has caused damage to 1,896 hectares of crops and 206 hectares of grazing land in four kebeles (BGO, 2023).

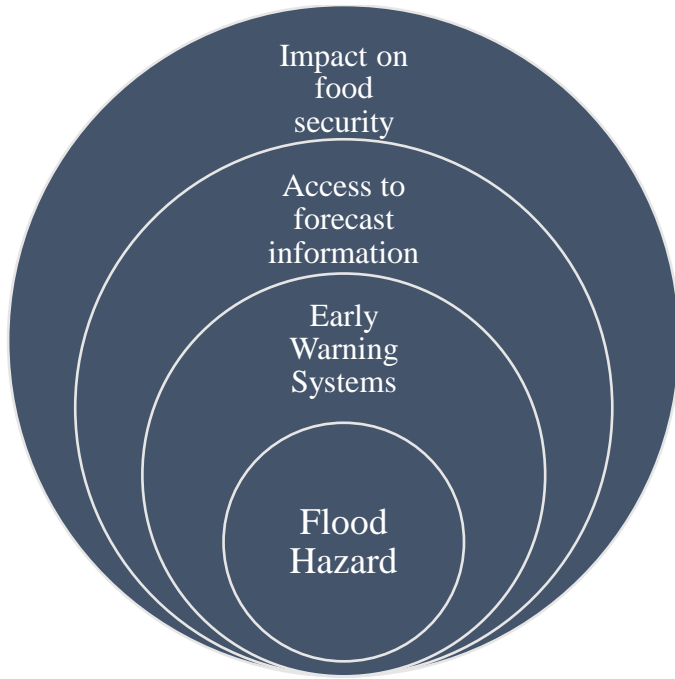
2.4. Conceptual framework

Climate change from a global perspective has increased the occurrence of natural disasters, which subsequently decreased agricultural production and intensified the issue of food security. Flood disasters ruin valuable land, cause agricultural production losses, and interrupt livelihood routines as expected household livelihood becomes more vulnerable (Dilshad et.al., 2022).

Hydro-meteorological hazards, such as floods, strike communities around the globe each year with detrimental impacts on roads, real estate, power distribution, and mobility. The adverse impacts of climate-induced hazards include food insecurity and epidemics, mainly cholera, meningitis, and malaria (ECA, 2021).

Timely and accurate weather and climate information is vital for day-to-day decision-making. Weather and climate services are therefore needed to provide people and organizations with accurate, timely, tailored climate-related knowledge and information that people can use to reduce climate-related misfortunes and to protect lives, livelihoods, and property (Vaughan and Dessai, 2014). If African nations are to avoid losses from climate shocks and stresses or reap the potential benefits from changing climatic patterns, governments need accurate, timely, and accessible climate information services (WISER, 2018).

This study explores how access to flood forecast information for farmer households in Ilu Woreda, Upper Awash Valley, can be crucial for preventing and mitigating the negative effects of riverine floods on their lives, livelihoods, and overall food security. The study approaches the proposed research questions in light of Risk Perception and Communication theory.



Chapter Three: Research Design and Methodology

3.1. Description of the study area

The study was undertaken in the Oromia Regional State, particularly in Mulo Satay and Wererso Kelina kebeles of Ilu woreda. Ilu woreda is found in the Southwest Shewa zone of the region. The Astronomical location of Ilu woreda ranges between $8^{\circ} 33' 36''$ to $8^{\circ} 56' 24''$ N latitude and $38^{\circ} 06' 18''$ to $38^{\circ} 34' 12''$ E longitude. Ilu Woreda is bordered by Becho, Dawa, Ejere, Sebeta Hawas, and Tole woredas.

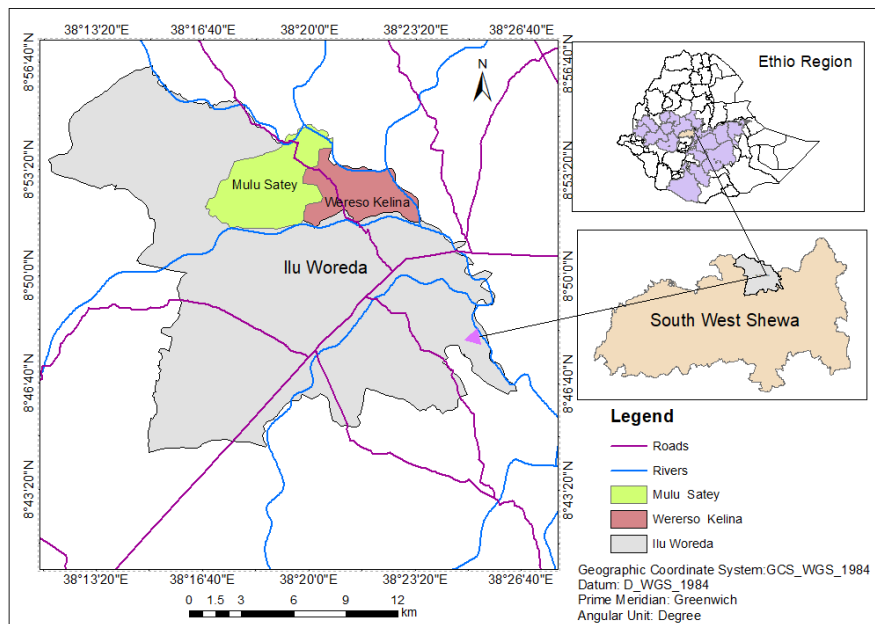


Figure 1 locational map of the study area

Southwest Shewa zone is one of the recipients of normal to above normal rainfall in the main rainy season (June to September) and the *belg* seasonal rains (February to May). It is found in the lower stream of the Awash River, the overflow of which causes recurrent inundation resulting in loss of lives and damage to infrastructure in flood-prone communities.

Ilu is one of the 12 woredas in Southwest Shewa of the Oromia Region. Based on figures published by the Central Statistical Agency in 2005, the Woreda has an estimated total population of 66,758, of whom 33,273 were males and 33,485 were females; 8,596 or 12.88% of its population are urban dwellers, which is about the same as the Zone average of 12.3%. With an estimated area of 312.5 square kilometers, Ilu has an estimated population density of 213.6 people per square kilometer, which is greater than the Zone average of 152.8. (CSA, 2005). Based on figures from the woreda

administration, Ilu woreda has an estimated total population of 75,244, a total cultivated land of 25,997 hectares, and a total yield of 70,239MT of cereals such as Teff, wheat, chickpeas, and lentils in 2016.

Ilu Woreda is one of the most severely affected areas by riverine floods in the Southwest Shewa zone mainly due to its alignment with the Awash River that separates the woreda from Alem Gena woredas as witnessed in previous years. In October 2023, the overflow of the Awash River in Sabata Hawas and Ilu woredas of Southwest Showa zone induced displacement affected cropland, grazing land, and damaged infrastructure according to the 2023 Seasonal Flood Impact Report released by Bonsa Gonofa Oromia (disaster risk management office) of Oromia region.

In Ilu woreda, 6,588 people across four kebeles were severely affected by the latest floods between October and December 2023. According to the Ilu Woreda Disaster Risk Management Office, Mulo Satay, Wererso Kelina, Jigdu Mida kebeles, and Tejjii town have been among the recurrently flood-affected areas in the recent past. (BGO, 2023).

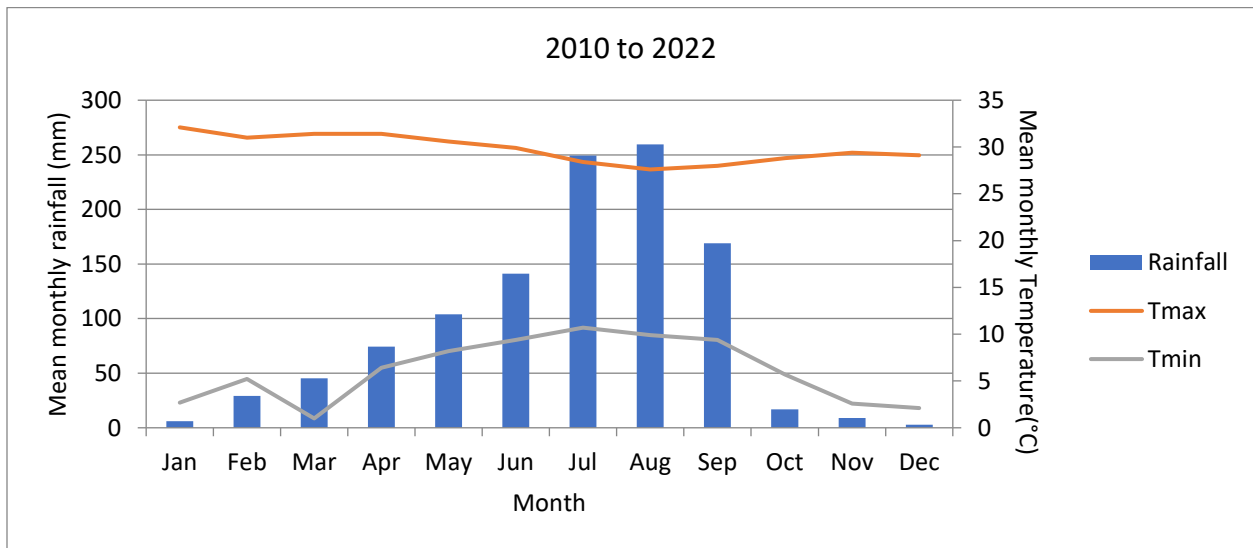


Figure 2 2010-2022 Mean Monthly Rainfall and Mean Monthly Temperature of Ilu Woreda. Source: Ethiopian Meteorological Institute.

3.2. Research Design and Approach

In this research, a mixed descriptive research design was employed to analyze the impact of flood forecast systems on household food security and the factors that determine this relationship. Utilizing a mixed-methods approach allows for the collection of data from a variety of sources through the application of different data collection tools. This comprehensive strategy enabled the researcher to capture the perspectives and insights of various segments of the community, ensuring a more holistic understanding of how access to flood forecast information affects food security. By integrating both qualitative and quantitative data, the study provided a nuanced analysis that illuminated the complex interactions between communication, flood forecast information, and household food security.

3.3. Methods

3.3.1. Sampling techniques and sample size determination

The sample size for quantitative data in this study was determined using Yamane's modified formula: $n = \frac{N}{1+Ne^2}$ Where: n= sample population, N= Total population, e= margin of error.

The sample population was determined based on the total number of households (N) in the purposively selected kebeles of Wererso Kelina and Mulo Satay. The Ilu Woreda Disaster Risk Management office provided us with a list containing 2067 households - 1210 households from Mulo Satay and 857 households from Wererso Kelina Kebele.

$$\text{Hence, } n = \frac{2067}{1+(2067)(0.0025)} = 334$$

The identified total sample size of 334 respondents was then proportionally divided into Wererso Kelina (138) and Mulo Satay (196) kebeles.

A simple random sampling technique was utilized from the list of all households in both Wererso Kelina and Mulo Satay kebeles obtained from the Woreda administrative office through Woreda disaster risk management office. The sample size of each kebele was proportionate to their corresponding population sizes. A total of 309 respondents completed the survey from Mulo Stay (187) and Wererso Kelina (122) kebeles.

Samples were selected using a lottery method where the first n was assigned to a random number six and the subsequent respondents were determined using n+5 counts signaling every sixth person had participated in the household survey unless the randomly selected households failed to fulfill

the inclusion criteria. In such cases, the data enumerators were told to include the household before or after the randomly selected household in the list.

While access to flood forecast information and food security status were the dependent variables, socio-demographic characteristics such as sex, age, educational status, and family size of the household were the independent variables. Access to forecast information, farm size, and access to agricultural extension services were identified as determinants of the food security status of farmer households.

3.3.2. Data sources and collection tools

While the source population was all farmer households living in Ilu woreda, the study population was randomly selected farmer households drawn from purposively selected flood-affected kebeles of Wererso Kelina and Mulo Satay fulfilling the inclusion criteria living in the kebeles.

Households included in this study were farmers living in the identified kebeles which are frequently affected by floods. An attempt was also made to ensure that the respondents sampled farmer households lived in the woreda for at least one full year so that the respondents had all seasonal climatic variations. Finally, inclusion was made based on the willingness of households to participate in the study.

Farmers households who refused to participate in the study or provide information about their experiences with flood forecast information access and response were excluded. Households who were unable to provide informed consent due to cognitive or communication barriers did not take part in this survey. Farming households who were absent during the data collection period were also excluded from participating in the survey.

3.3.3. Techniques of data analysis

A structured questionnaire, administered by an interviewer and based on previously published studies, was used to assess farmer households' access to flood forecasting information, their promptness in responding to floods, and their perceptions of flood hazards.

Additionally, the Household Food Insecurity Access Scale (HFIAS) indicator guide and the Household Food Balance Model were employed as validated tools to evaluate the food security status of the households.

Before the data analysis, variables were checked for Statistical normality test using Shapiro-Wilk Test, and parametric statistical tests were considered based on the **p-value > 0.05**: Fail to reject the null hypothesis. There was no significant evidence to suggest that the data is not normally distributed.

To determine the Household Food Insecurity Access Scale (HFIA) category for each household, categories were assigned based on the following criteria:

- Food Secure (Category 1): A household falls into this category if either Q1a is 0 or 1, and all other questions (Q2 to Q9) are 0.
- Mildly Food Insecure (Category 2): A household falls into this category if Q1a is 2 or 3, or if Q2a, Q3a, or Q4a are 1, 2, or 3, provided that all subsequent questions (Q5 to Q9) are 0.
- Moderately Food Insecure (Category 3): A household falls into this category if Q3a or Q4a are 2 or 3, or if Q5a or Q6a are 1 or 2, provided that all subsequent questions (Q7 to Q9) are 0.
- Severely Food Insecure (Category 4): A household falls into this category if Q5a or Q6a is 3, or if Q7a, Q8a, or Q9a are 1, 2, or 3.

By applying these criteria, each household was classified into one of the four HFIA categories, enabling a clearer understanding of the food insecurity status across different households. Furthermore, Categories 2 – 4 were merged as “Food Insecure” to compute the logistic regression by considering food insecurity status as a dichotomous dependent variable.

The Household Food Balance Model (HFBM) was quantified by the following mathematical expression adopted from a previous study (Meskerem and Degefa, 2015).

$$N_{ij} = (C_{ij} + P_{ij} + B_{ij} + F_{ij} + R_{ij}) - (H_{ij} + S_{ij} + M_{ij})$$

Where,

- N_{ij} - is the net food available for household i in year j
- C_{ij} - is the total crop produced by household i in year j
- P_{ij} - is total grain purchased from market by household i in year j
- B_{ij} - is the total food household i borrowed in the year j
- F_{ij} - is the total grain obtain through FFW by household i in year j
- R_{ij} - is the total relief food received by household i in year j

- H_{ij} - is post-harvest losses out of total output produced by household i in year j
- S_{ij} - is the amount of grains utilized for seed by household i in year j
- M_{ij} - is total grain marketed (sold out) by household i in year j

The reliability test for access to flood forecast information and the HIFAS tool also showed a Cronbach's Alpha value of 0.84 (84%) hence decided to be reliable. All questionnaires were gathered using Kobo Collect software, followed by exporting the data to SPSS version 25 for subsequent cleaning and validation checks to ensure completeness. The data underwent descriptive analysis and was visually presented through tables, bar charts, frequencies, and textual summaries. Subsequently, a binary logistic regression model has been applied, initially conducting bivariable logistic regression analysis to examine the association of each independent variable with the outcome variable, yielding crude odds ratios (COR) with 95% confidence intervals (CI). Independent variables that demonstrated a significance level of $p < 0.25$ were included in multivariable logistic regression models to ascertain the effect on the outcome variable.

Variables exhibiting a p-value of less than 0.05 in the multivariable logistic regression model were deemed statistically significant. Adjusted Odds Ratios (AOR) with 95% CI was then computed to delineate the association. Qualitative data was analyzed thematically after verbatim transcription and coding of emerging themes. Furthermore, qualitative was triangulated with quantitative data for comprehensive analysis.

3.3.4. Validity and reliability of data and techniques

The questionnaire underwent rigorous evaluation by experienced researchers and advisors. Data collectors received comprehensive training for two days to ensure data quality, including clarification of questions for simplicity and clarity. The questionnaire was prepared in English but was administered in Afan Oromo, the native language. Before the actual data collection, a pilot was conducted using 5% of the total sample size in Awash Balo kebele from Sebeta Hawas woreda to assess language clarity, consistency, and estimated completion time, allowing for appropriate modifications. The principal investigator meticulously oversaw the data collection process, and filled questionnaires were reviewed daily to ensure completeness and consistency of the data.

3.4. Ethical consideration

Ethical clearance was obtained from the Addis Ababa University College of Developmental Studies institutional review board. A letter of support was also obtained from the Center for Food Security Studies to the Southwest Shewa Zone DRM Office and Ilu Woreda Administration Office.

The study participants received comprehensive and transparent information regarding the study's purpose and procedures. They were then allowed to decide whether to participate or not. Those who agreed to participate provided verbal consent. The identity of participants was kept anonymous, and any information collected from them was handled with utmost confidentiality. The data collected was stored securely and anonymously, with no identifying information attached. Only authorized individuals had access to the raw data, ensuring privacy and confidentiality throughout the study process.

Chapter Four: Results and discussion

4.1. Results

4.1.1. Socio-demographic characteristics

A total of 309 respondents/household heads who agreed to participate in this survey were included in the data collection giving a 92.5% response rate. Of the total households surveyed, 187 (60.5%) were in Mulo Satay, while the remaining 122 (39.5%) were in Wererso Kelina kebele.

The demographic analysis of the current population indicates a male majority, constituting 84.1% of the total respondents, with 260 individuals being male. In Mulo Satay, 59.2% of households were led by males, while in Wererso Kelina, this proportion slightly increased to 67.3%. Female household heads were notably fewer, totaling 49 individuals, representing 15.9% of the sample. The distribution of female-headed households is 40.8% in Mulo Satay and 32.7% in Wererso Kelina

Regarding educational attainment, a significant proportion of household heads lack formal education, as 175 individuals (56.6%) were unable to read or write. Additionally, 63 household heads (20.4%) could read and write, while 58 household heads (18.8%) had completed primary education. A minor proportion of 13 individuals (4.2%) have attained secondary education or higher. This trend is consistent across both areas, with 68.0% of household heads in Mulo Satay and 32% in Wererso Kelin lacking basic literacy skills. Literate individuals constitute the second

largest group, followed by those with primary education and those with secondary education or higher.

The average age of the household heads was 45.85 years, with a standard deviation of 10.89 years, indicating a moderately wide age range. The family size within these households averages 6.45 members, with a standard deviation of 3.71 members, while the mean (\pm SD) of farm size owned by the household is 3.71 ± 1.52 hectares.

Table 1 Socio-demographic characteristics of survey participants. Source: HH survey, 2024.

Categorical variables		Kebele of the respondent/household		Total
		Mulo Satay	Wererso Kelina	
Sex	Male	154 (59.2%)	106 (40.8%)	260 (100.0%)
	Female	33 (67.3%)	16 (32.7%)	49 (100.0%)
Level of education	Unable to read and write	119 (68.0%)	56 (32.0%)	175 (100.0%)
	Able to read and write	39 (61.9%)	24 (38.1%)	63 (100.0%)
	Primary education	25 (43.1%)	33 (56.9%)	58 (100.0%)
	Secondary and above	4 (30.8%)	9 (69.2%)	13 (100.0%)
Continuous variables			Mean	Standard Deviation
Age of the head of households			45.85	10.89
Family size of the households			6.45	3.71
Farm size of the household in hectares			3.71	1.52

4.1.1.2. Perceived access adequacy of agricultural inputs

Table 2 below shows the findings of farmer households' perceived access to agricultural inputs and services to increase productivity in the flood-affected kebeles. Using four indicators—access to fertilizer, seeds, irrigation services, and financing/loans—to classify the perceived level of adequacy, the result showed that only 3.9% of the farmers replied they had adequate access to fertilizer seeds, compared to 93.9% who had inadequate access to such inputs. Similarly, 64.1% of farmers believed they had insufficient access to irrigation services. Access to finance or loans was also perceived as insufficient with a 49.8% rating.

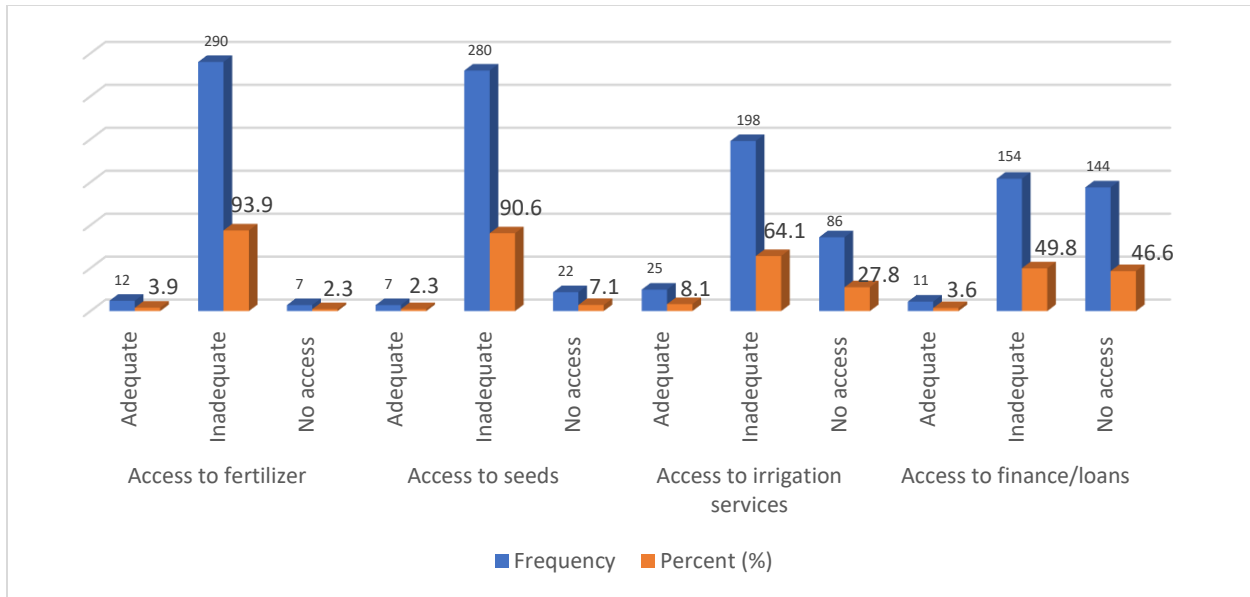


Figure 3 Farmers' perceived access and adequacy of agricultural inputs

4.1.1.3. Households' source of income and possession of information reception devices

The finding of this study illustrated that 92.6% of farmer households in the study kebeles rely on on-farm activities as their primary income source. Off-farm activities account for 5.8%, non-farm income for 0.3%, and regular salaries for 1.3% of households. This shows a significant dependence on agricultural activities for income in the region (Figure 4).

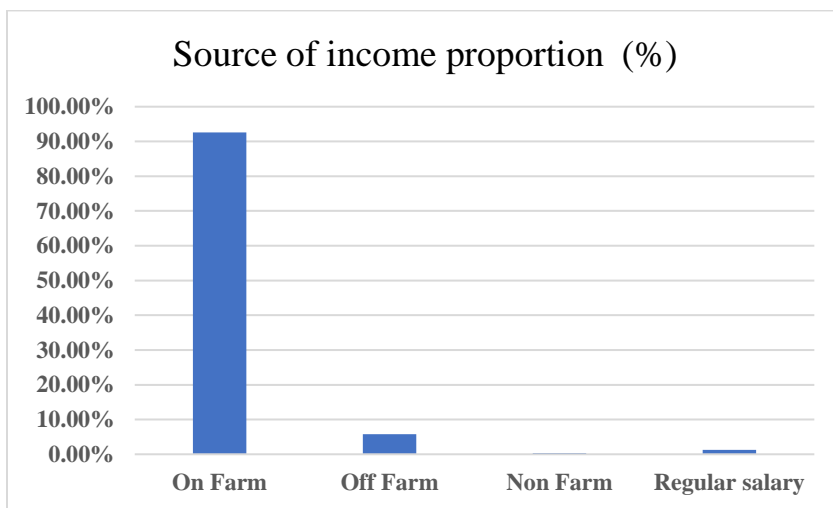


Figure 4 Main Source of income for households

NB: on-farm activities (sale of grains, vegetables, fruit, bedding plants, milk, calves, raised market livestock, eggs, and hay), Off-farm activities (Petty trade activities, fattening, credits, sale of grass/ charcoal/manure), non-farm income (remittance, agro-processing, manufacturing, etc).

4.1.1.4. Possession of information reception/media devices

The current study on the presence and type of information reception devices such as television, radio, and mobile phones among farmer households shows that 42.4% of households own at least one media device, while 57.6% of them do not have any media devices. Among households with media devices, 37.9% have only one type of media device. Specifically, 0.96% of households have a combination of television, radio, and smartphone; 0.64% have both television and mobile phones; and 2.92% have both radio and mobile phones. This distribution indicates that while a significant portion of households lack access to media devices, those that do generally possess only a single type of device, with few having multiple types of media access (table 2).

Table 2 Households' access to information reception/media devices

	Presence /ownership/	Number of media devices	Type of media devices	Number	(%)	
Presence of media device	Yes	One means	Radio	114	36.96	
			Television	1	0.3	
			Mobile phone	2	0.64	
			Total	117	37.9	
		More than one means	Television + Radio + mobile phone	3	0.96	
			Television + mobile phone	2	0.64	
			Radio + mobile phone	9	2.92	
			Total	14	4.52	
		Total			131	42.4
		NO			178	57.6
Total			309	100		

4.1.1.5. Association of sociodemographic characteristics with access to media devices

The logistic regression analysis examined the association between sociodemographic variables and media device utilization. The study found that male-headed households were significantly more likely (10.130 times) to use media devices than households with female heads. Additionally, individuals with higher levels of education (primary and secondary level education) showed a higher likelihood of possessing information reception/media devices than those with the lowest level of education (unable to read and write) although this difference was not statistically significant for category 1.

Furthermore, for each year an increase in the age of the head of the household, the odds of media device ownership and utilization decreased by a factor of 0.981. Family size did not have a significant effect on media device utilization, with the odds changing minimally for each unit

change in family size. Conversely, for each hectare an increase in farm size, the odds of media device utilization increased by a factor of 1.119.

These findings suggest that factors such as the sex and education level of the household head, as well as the age and farm size of the household play important roles in determining media device utilization.

Table 3 Logistic regression analysis of HH head characteristics on access to media devices

	Coef (B)	S.E.	p-value	AOR	95% C.I.
Sex				1	
Male	2.315	0.628	≤ 0.001*	10.13	[2.957, 34.703]
Educational status				1	
Able to read and write	0.542	0.346	0.118	1.719	[0.872, 3.389]
Primary education	1.319	0.386	0.001*	3.739	[1.756, 7.963]
Secondary	2.55	0.460	≤ 0.001*	6.221	[3.48, 29.49]
Kebele				1	
	0.181	0.235	0.44	1.19	[0.756, 1.901]
Age of the head of the household in years	-0.019	0.015	0.202	0.981	[0.954, 1.010]
Family size of the household	-0.004	0.035	0.910	0.996	[0.931, 1.066]
Farm size of the household in hectares	0.113	0.094	0.229	1.119	[0.932, 1.345]

Coef (B): The regression coefficient, S.E: The standard error of the Coefficient. AOR: The Adjusted Odds Ratio CI: Confidence Interval for the AOR, **NB: *Statistically significant at $p \leq 0.05$**

4.1.2. Access and utilization of forecast information

Of all the households surveyed, 75.73% (or 234 households) said they did not receive flood-related forecast information; only 24.3% (or 75 households) said they had access to flood forecast information. 68% (51 households) of those having access to forecast information found the material useful for preparedness and response, whereas 32% (24 households) did not. These results demonstrate that although a sizable fraction of households lack access to flood forecast information, most of those who had access found the forecast information beneficial to mitigate the diverse impacts of floods (Table 4). This suggests a gap in access to critical information that could aid in flood preparedness and response among households.

Data disaggregated at the kebele level indicates that 152 (81%) households in Mulo Satay and 82 (67%) households in Wererso Kelina had no access to information.

Table 4 HH Accessibility and Perceived Usefulness of Flood Forecast Information

	Response N (%)	Perceived Usefulness	
Accessibility of Flood Forecast Information	Yes = 75 (24.3%)	Useful	51 (68%)
		Not useful	24 (32%)
	NO = 234 (75.7%)		

4.1.2.1. Disparities in the accessibility of flood forecast information by Sex and Education Level

Table 5 highlights significant disparities in the accessibility of flood forecast information based on respondents' sex and educational status. Among males, 27.7% reported having access, whereas only 6.1% of females reported the same. This gender gap indicates a substantial difference in access, with males being more likely to have access to flood forecast information. Respondents with higher education levels were more likely to have access compared to those with lower levels. For instance, while only 13.1% of those unable to read and write had access, this number increased to 44.8% for those with primary education, and even further to 53.8% for those with secondary education and above. This trend suggests that education might be a significant factor influencing access to flood forecast information, with higher education levels associated with increased access to forecast information. These findings were further analyzed by logistic regression and the objective findings are illustrated below.

Table 5: Disparities in accessibility of flood forecast information by Sex and Education Level

Variables		Accessibility of Flood Forecast Information		
		Yes	No	Total
Sex	Male	72 (27.7%)	188 (72.3%)	260 (100%)
	Female	3 (6.1%)	46 (93.9%)	49 (100%)
Educational status	Unable to read and write	23 (13.1%)	152 (86.9%)	175(100%)
	Able to read and write	19 (30.2%)	44 (69.8%)	63 (100%)
	Primary education	26 (44.8%)	32 (55.2%)	58 (100%)
	Secondary and above	7 (53.8%)	6 (46.2%)	13 (100%)

4.1.2.2. Association of Household Access to Flood Forecast Information

The results of the logistic regression analysis indicated that households with male heads were more likely to have access, with an odds ratio of 2.080, although this effect is not statistically significant. The effect of age of the household, family size, and farm size was not statistically significant. However, lack of access to media devices significantly negatively affected access to flood forecast information, with an odds ratio of 0.376 and a highly significant p-value of 0.002.

Additionally, the level of education of the household head was a significant predictor overall; heads of households with the ability to read and write were 2.541 times more likely to have access (p-value = 0.023), and those with primary education were 4.251 times more likely (p-value = 0.001). Those with secondary education and above are 4.285 times more likely (p-value = 0.030).

Furthermore, the analysis reveals a statistically significant association between the Kebele location and access to flood forecast information. Specifically, households in Mulo Satay Kebeles were more likely to have access to flood forecast information compared to those in Wererso Kelina (AOR = 2.118, p = 0.005). The positive coefficient of 0.751 further supports this, indicating a higher likelihood of access to forecast information for households in Mulo Satay Kebeles. This can be explained by relatively more access to media devices in Mulo Satay than in wererso Kelina.

Table 6: Logistic Regression Analysis Results for HH Access to Flood Forecast Information

Independent Variables	Coef (B)	S.E.	p-value	AOR	95% C.I. for Exp(B)
Sex				1	
Male	0.732	0.654	0.263	2.080	[0.578, 7.491]
Age					
Age	0.021	0.017	0.232	1.021	[0.987, 1.056]
Family size					
Family size	-0.019	0.073	0.790	0.981	[0.850, 1.131]
Farm size					
Farm size	0.139	0.098	0.157	1.150	[0.948, 1.394]
Media utilization				1	
Yes	-0.978	0.321	0.002*	0.376	[0.200, 0.706]
Educational status				1	
Able to read and write	0.933	0.409	0.023*	2.541	[1.141, 5.661]
Primary education	1.447	0.432	0.001*	4.251	[1.823, 9.911]
Secondary education and above	1.455	0.672	0.030*	4.285	[1.147, 16.006]
Kebele				1	
Mulo Satay	0.751	0.269	0.005*	2.118	[1.25, 3.589]

Coef (B): The regression coefficient, S.E: The standard error of the Coefficient. AOR: The Adjusted Odds Ratio CI: Confidence Interval for the AOR, NB: *Statistically significant at $p \leq 0.05$

4.1.2.3. Channels or means households employed to access flood forecast information

Among the total responses, the most common channels or sources of forecast information were local authorities (32%), meaning kebele administration, DRM office and Bureau of Water and Energy, as well as social gatherings (36%) such as marketplaces, religious gatherings, formal meetings and weddings, and radio (8%).

Other less frequently mentioned channels included television and radio combined with other sources like indigenous forecast systems, SMS, and family and friends. These results indicate a reliance on both mediated and public communication platforms for accessing flood forecast information.

Indigenous flood forecast systems used in Ilu Woreda include relying on the previous year's rainfall, observing excessive rain or high heat temperatures, informal observations, depending on climate changes, and consulting local religious figures like Qaallu or Raajii. Other methods involve highland rains, seasonal forecasts between June and August, wind patterns during rain, general weather conditions, and river levels exceeding known amounts.

4.1.2.4. Comprehensibility of language and state of Indigenous forecast systems

Regarding the comprehensibility of the language used in disseminating flood forecast information, 60 respondents (80%) found it understandable, while 15 respondents (20%) did not. In terms of the timing of receiving flood forecast information in comparison to flood events, 9 respondents (12%) received it 1-6 hours before a flood, 27 respondents (36%) received it 1 day before, 17 respondents (22.7%) received it 1 week before, and 22 respondents (29.3%) received it 1 month before.

Table 7 Channels, Language Clarity, and Time of Delivery of Forecast Information

		Frequency	Percent
Channel of communication	Radio	6	8%
	Local authorities	24	32%
	Social gatherings	27	36%
	Television + Radio + Social gatherings + Family and friends + Local authorities	1	1.3%
	Radio + Television + Indigenous forecast systems + Local authorities	1	1.3%
	Radio + SMS (text message) + Indigenous forecast systems	1	1.3%
	Indigenous forecast systems	5	6.7%
	Family and friends	11	14.7%
Language clarity	Yes	60	80
	No	15	20
Delivery time before flooding events	1-6 hours before	9	12
	1 day before	27	36
	1 week before	17	22.7
	1 month before	22	29.3

4.1.2.5. Availability of community-level preparedness and rescue support initiatives

A mere 6.1% of respondents, representing 19 individuals, reported the presence of community-led flood rescue groups. In stark contrast, 93.9% (290 respondents) indicated that such groups were unavailable. Similarly, only 6.8% (21 respondents) acknowledged the existence of mechanisms to raise awareness about flood risks and evacuation procedures, while a significant 93.2% (288 respondents) reported the absence of these mechanisms. Additionally, 14.6% of respondents, totaling 45 individuals, stated that they were informed about what to do during an evacuation. However, a substantial majority of 85.4% (264 respondents) were not informed.

Table 8. Availability of community-level preparedness and rescue initiatives

	Response	Number	Proportion (%)
Availability of community-led flood rescue group	Yes	19	6.1
	No	290	93.9
Availability of mechanisms to make people aware of flood risk and evacuation procedures	Yes	21	6.8
	No	288	93.2
informed status on what to do during an evacuation	Yes	45	14.6
	No	264	85.4

4.1.3. Perception, response, and vulnerability to flood risks and associated impacts

Table 9 outlines key insights into the current study findings about the community's awareness, perception, and response to flood risks and impacts. It reveals that a vast majority (93.5%) of respondents know of the timing of floods in their area, contrasting with a small minority (6.5%) who were not. Most respondents (94.8%) said they experienced flooding once a year, with fewer experiencing it twice (4.9%) or three times annually (0.3%).

Children were identified as the most affected group (66%), followed by the elderly (15.9%), persons with disabilities (11.3%), and women (6.8%). Perceptions of flood risks were notably high, with 53.7% considering them very high risks and 46.3% rating them as high risks.

As far as the impact of floods on agricultural produce is concerned, a significant portion reports substantial damage, with 54.7% experiencing 76-100% damage to their produce. Interestingly, 52.4% of respondents implement small-scale flood preventive measures, while 47.6% do not. Additionally, 70.6% practice terrace farming and contour plowing to mitigate water runoff, and 40.1% plant new trees to prevent soil erosion. These findings collectively reflect a community having a high perception of flood risks, with a varied response regarding adopting preventive measures. Almost all households surveyed indicated they know the main causes of flooding. They pointed out that a combination of factors such as excessive rainfall, overflow of rivers, and flash floods from highland areas contributed to flooding.

Experts who participated in the FGDs indicated that Ilu woreda is affected by river flooding when the Awash River overflows its natural banks and inundates dry land. One of the causes of floods in this woreda is the location at which different rivers join and flow through a single river channel. The discharge collected from the upper mountainous or highlands and neighboring districts is also beyond the accommodation capacity of the existing channel. Moreover, the previously started flood protection dike construction was stopped before it was completed.

Table 9: Perception and response to flood risks

Variables	Responses	Number (%)
Knowledge of flood occurrence time.	Yes	289 (93.5)
	No	20 (6.5)
Frequency of flooding experience	Once a year	293 (94.8)
	Twice a year	15 (4.9)
	Three times a year	1 (0.3)
Most vulnerable groups to floods	Women	21 (6.8)
	Children	204 (66)
	Persons with disability	35 (11.3)
	The elderly	49 (15.9)
Perception of flood risks	Very high	166 (53.7)
	High	143 (46.3)
	Low	0
	Very low	0
Percentage of crop loss due to the last/previous floods	76 - 100%	169 (54.7)
	51 - 75%	124 (40.1)
	26 - 50%	13 (4.2)
	0 - 25%	3 (1)
HH-level flood preventive measures such as building dikes	Yes	162 (52.4)
	No	147 (47.6)
HH-level flood preventive measures such as terrace/ contour bunds	Yes	218 (70.6)
	No	91 (29.4)
Planting new trees to protect soil erosion	Yes	124 (40.1)
	No	185 (59.9)

4.1.4. Household Food Insecurity Access Scale

The result of household food insecurity using the Household Food Insecurity Access Scale (HFIAS) indicators indicated that nearly 70% of households were worried about food insufficiency with a rare frequency of (15.5%), sometimes (44.8%), and often (9.4%) experience the anxiety of food. Additionally, 94.8% of households were unable to eat their preferred foods, of these, 7.7% experienced the issue rarely, 75.5% sometimes, and 11.3% often.

Similarly, 95.8% of households have a limited variety of foods, with 5.8% rarely, 73.5% sometimes, and 16.1% often experiencing this limitation. Moreover, 87.4% of households ate foods they did not want to eat, with 3.2% rarely, 73.9% sometimes, and 10% often facing this situation. Moreover, 87.1% of households ate smaller meals, 5.5% rarely, 71.6% sometimes, and 9.4% often had smaller meals.

Furthermore, 77.7% of households ate fewer meals per day, with 6.8% rarely, 64.5% sometimes, and 6.1% often experiencing this. About 11.3% of households have no food at all, with 1% rarely, 8.7% sometimes, and 1.6% often having no food. Additionally, 5.8% of households go to sleep hungry, with 0% rarely, 4.8% sometimes, and 1% often experiencing this. Finally, 3.2% of households go a whole day and night without eating, with 0% rarely, 2.3% sometimes, and 1% often face this extreme situation.

Summary of the HFIAS category showed that the household food insecurity experiences of the households were classified as “Anxiety and uncertainty”, “reduced quality of food”, “reduced quantity of food” and “hunger”. In view of this, the study found that 69.9%, 92.7%, 82.4% and 6.8% of the households experienced the insecurity scenarios respectively. Among the households surveyed, only 2.6% are classified as food secure.

Table 10: HFIAS analysis of households surveyed

HFIAS indicators	Responses	N (%)	Frequency	N (%)
Worrying about food	Yes	216 (69.9)	Rarely	48 (15.5)
			Sometimes	139 (44.8)
			Often	29 (9.4)
	NO	93 (30.1)		
Unable to eat preferred foods	Yes	293 (94.8)	Rarely	24 (7.7)
			Sometimes	234 (75.5)
			Often	35 (11.3)
	NO	16 (5.2)		
Eat just a limited variety of foods	Yes	296 (95.8)	Rarely	18 (5.8)
			Sometimes	228 (73.5)
			Often	50 (16.1)
	NO	13 (4.2)		
Eat foods they really do not want eat	Yes	270 (87.4)	Rarely	10 (3.2)
			Sometimes	229 (73.9)
			Often	31 (10)
	NO	39 (12.6)		
Eat a smaller meal	Yes	269 (87.1)	Rarely	17 (5.5)
			Sometimes	222 (71.6)
			Often	29 (9.4)
	NO	40 (12.9)		
Eat fewer meals in a day	Yes	240 (77.7)	Rarely	21 (6.8)
			Sometimes	200 (64.5)
			Often	19 (6.1)
	NO	69 (22.3)		
No food of any kind in the household	Yes	35 (11.3)	Rarely	3 (1)
			Sometimes	27 (8.7)
			Often	5 (1.6)
	NO	274 (88.7)		
Go to sleep hungry	Yes	18 (5.8)	Rarely	0
			Sometimes	15 (4.8)
			Often	3 (1)
	NO	291 (94.2)		
Go a whole day and night without eating	Yes	10 (3.2)	Rarely	0
			Sometimes	7 (2.3)
			Often	3 (1)
	NO	299 (96.8)		

A slightly larger group, 7.4%, falls into the mildly food insecure access category, suggesting occasional concerns about food adequacy. The majority of households, 78.0%, are categorized as moderately food insecure. Lastly, 12.0% (37 households) are severely food insecure, indicating they frequently experience severe disruptions in their food intake.

Table 11: HFIAS category of households in Flood-Prone Areas of Ilu Woreda

HFIAS category	Frequency	Percent
Food Secure	8	2.6
Mildly Food Insecure	23	7.4
Moderately Food Insecure	241	78.0
Severely Food Insecure	37	12.0
Total	309	100

4.1.4.1. Association of Food insecurity status with socio-demographic variables

The study showed that moderate food insecurity is the most common category across all socio-demographic groups, with significant figures highlighting 89.8% of female-headed households and 83.4% of households where the head cannot read and write falling into this category. Food insecurity varies slightly between sample kebeles, with Mulo Satay having a higher proportion of moderately food-insecure households (80.7%) compared to Wererso Keline (73.8%). (Table 12).

Table 12: Cross tabulation result of Food insecurity status with socio-demographic variables

Socio-demographic variables		HFIAS Category			
		Mildly Food Insecure Access	Moderately Food Insecure Access	Severely Food Insecure Access	Food Secure
Sex of head of household	Male	23 (8.8%)	197 (75.8%)	35 (13.5%)	5 (1.9%)
	Female	0	44 (89.8)	2 (4.1)	3 (6.1%)
Educational Status	Unable to read and write	8 (4.6%)	146 (83.4%)	18 (10.3)	3 (1.7%)
	Able to read and write	9 (14.3)	46 (73%)	5 (7.9%)	3 (4.8%)
	Primary education	2 (3.4%)	5 (8.6%)	42 (72.4%)	2 (3.4%)
	Secondary and above	1 (7.7%)	7 (53.8%)	5 (38.5%)	0
Residence kebele	Mulo Satay	10 (3.2%)	151 (80.7%)	20 (10.7%)	6 (3.2%)
	Wererso Kelina	13 (10.7%)	90 (73.8%)	17 (13.9%)	2 (1.6%)

As depicted in Table 13, the logistic regression analysis was conducted by merging mild, moderate and severe food insecurity as “Food insecure”. As a result, our analysis reveals that male-headed households are significantly more likely to experience food insecurity, with the odds being nearly 10 times higher when compared to female-headed households. The regression result based on the

data shows an output that is a deviation from the expected result that male-headed households generally have better food security than female-headed households. This might also explain that women are more caring and responsible than men in a family from the virtue of our cultural perspective. However, this shall be explained as a contradictory output due to variable socioeconomic discrepancies in the households, and further studies in the area should be suggested. Other variables, including the kebele of residence, level of education, age, family size, and farm size, do not affect food insecurity status.

Table 13: logistic regression analysis of Food insecurity status with socio-demographic variables

	Coef (B)	S.E.	p-value	AOR	95% C.I.	
					Lower	Upper
Sex				1		
Male	2.28	0.977	0.019*	9.82	1.447	66.653
Residence kebele				1		
Mulo Satay	0.800	0.889	0.368	2.227	0.390	12.724
Age	0.051	0.042	0.228	1.052	0.969	1.142
Family size	0.048	0.088	0.582	1.050	0.883	1.247
Farm size	-0.011	0.253	0.966	0.989	0.603	1.624
Educational Status				1		
Able to read and write	2.306	1.061	0.830	10.029	1.254	80.236
Primary education	2.406	1.241	0.453	11.089	0.974	126.305
Secondary	2.425	1.367	0.999	14.000	0.80	187.77

Coef (B): The regression coefficient, S.E: The standard error of the Coefficient. AOR: The Adjusted Odds Ratio CI: Confidence Interval for the AOR, **NB: *Statistically significant at $p \leq 0.05$**

Moreover, the result of this study suggests that households receiving flood forecast information are less likely to experience food insecurity, with the odds being about 90% lower compared to those not receiving such information. However, other variables, including being informed of evacuation procedures, knowing the time or period of floods, recent flood damages, building small-scale preventive measures, and practicing terrace farming and contour ploughing, do not show significant effects on food insecurity status.

Table 14: Logistic regression analysis of Food insecurity status with Household Access to Flood Forecast Information

Access to Flood Forecast Information variables	Coef (B)	S.E.	P-value	AOR	95% CI	
					Lower	Upper
Receiving forecast information				1		
Yes	-2.514	0.920	0.006*	0.081	0.013	0.491
Being informed of what to do during evacuation				1		
	18.496	0.87	0.997	10.841	0.47	177.31
Knowledge of when floods occur						10.608
Yes	-0.293	1.355	0.829	0.746	0.052	1.88
Percentage of agricultural harvest damaged				1		
76 - 100%	3.254	2.141	0.129	25.894	0.390	1721.110
51 - 75%	-0.766	1.468	0.602	0.465	0.026	8.249
26 - 50%	-1.103	1.391	0.428	0.332	0.022	5.072
Building flood preventive measures				1		
Yes	-1.510	1.215	0.214	0.221	0.020	2.388
Terrace farming and contour ploughing practice				1		
Yes	0.210	0.990	0.832	1.233	0.177	8.585

Coef (B): The regression coefficient, S.E: The standard error of the Coefficient. AOR: The Adjusted Odds Ratio CI: Confidence Interval for the AOR, NB: *Statistically significant at $p \leq 0.05$

4.1.5. Household Food Balance Model

The analysis of net available grain for consumption per annum in our study revealed significant contributions from various types of grains to the total dietary energy requirements of the population. Teff, with a net available grain of 160,070 kgs, provided a total dietary energy equivalent of 291,935,666 kcal, making up 19.11% of the total dietary energy requirement. Wheat, although in smaller quantities at 4,800 kgs, still contributed 0.77% to the total dietary energy equivalent of 9,408,000 kcal. Chickpeas and lentils played crucial roles as well, with chickpeas contributing 6.97% with 45,805 kgs of net available grain and a total dietary energy equivalent of 73,288,000 kcal, while lentils, with 10,420 kgs of net available grain, provided 5.4% of the total dietary energy equivalent of 19,793,000 kcal. The mean (\pm SD) household's total harvest damage/loss due to floods in the year is 17.99 ± 11.792 quintals.

Table 15: Household Food Consumption Balance Model (HFCBM)

	Net available grain for consumption (kgs) per annum	Dietary energy of 100gm edible part (kcal)	Total dietary energy equivalent (kcal) per annum	Population (sample household size x family size)	Contribution value to total dietary energy requirement (%)
Teff	160070	182.38	291935666	1993	19.11 %
Wheat	4800	196.38	9408000	814	0.77%
Chickpeas	45805	160	73288000	1371	6.97 %
Lentils	10420	165	19793000	412	5.4%
Total contribution value to total dietary energy requirement (%)					32.25

4.1.6 Reported damage due to recent floods

The most frequently reported damage was crop damage, affecting 41.7% of households. A significant number of households (19.4%) experienced damage across multiple categories: crop damage, livestock damage, house/home destruction, and public infrastructure damage. Crop damage combined with livestock damage was reported by 5.8% of households, while 6.5% experienced crop damage, livestock damage, and house/home destruction. Livestock damage alone was reported by 1.3% of households, and a combination of crop damage and livestock damage was reported by 5.2%. Less common but still significant were reports of damage spanning all four categories or various combinations of these damages.

Table 16: Damage Caused by Recent Floods in assessed kebeles

Damage Caused by Recent Floods	Frequency	Percent
Crop damage	129	41.7%
Crop + Livestock damage	18	5.8%
Crop + Livestock + House/home damage	20	6.5%
Crop + Livestock + House/home destruction + Public infrastructure damage	60	19.4%
Crop + Livestock + Public infrastructure + House/home destruction	5	1.6%
Crop + House/home destruction + Livestock damage	1	0.3%
Livestock damage	4	1.3%
Livestock + Crop damage	16	5.2%
Livestock + Crop + House/home destruction	7	2.3%
Livestock + Crop + House/home destruction + Public infrastructure damage	44	14.2%
Livestock + Crop + Public infrastructure damage	1	0.3%
Livestock + Crop + Public infrastructure + House/home destruction	3	1.0%
Livestock + House/home destruction + Public infrastructure damage + Crop damage	1	0.3%
Total	309	100.0%

4.2. Discussion of findings

This section discusses the socio-demographic characteristics, the status of households' access to forecast information, awareness of flood risk and hazards and their response, the food security status of households, and factors that determine the food security situation of farmer households in the study area.

4.2.1. Socio-demographic characteristics

The socio-demographic situation of 309 sample farmer households in the Southwest Shewa zone of the Oromia region for this survey was characterized by an average of 45.85 years, male household head dominated (84. %), and mostly uneducated, (56.6% unable to read and write). The households owned an average farm size of 3.71 hectares which is higher than the national average of less than two hectares (Kibrom and Matin, 2017). Most households had a perception of having inadequate access to agricultural inputs such as fertilizer (93.9%), seeds (90.6%), irrigation services 96.1%, and finance or loans (49.8%.) The main source of income or cash for the households surveyed was almost entirely dependent on on-farm activities (92.6%).

4.2.2. The status of access to forecast information

The study revealed that the status of flood forecast information access among households was generally poor. This can be attributed to their lack of formal education with 56.6% of the respondents unable to read and write and lack of access to information reception devices; 57.6% had no access to any of the information reception devices mentioned. The fact that 42.4% of households in Wererso Kelina and Mulo Stay kebeles, Ilu Woreda owned at least one type of media device, is a positive result if flood forecast information providers could use the available devices to communicate and disseminate flood alert messages. This distribution indicates that while a significant portion of households lack access to media devices, those that do generally possess only a single type of device, with few having multiple types of media access.

The fact that 234 households (75.73%) did not receive flood forecast information is very crucial considering the risk floods pose in the study area. Only 61 (19.74%) said they received the information mainly from local authorities (11%), social gatherings (9%), family and friends (8.5%), radio (6.5%), and indigenous forecast systems (3%).

Even though 126 households (40%) were found to have owned radios, the study revealed that only three households with radio ownership said they had received flood forecast information. Whereas

the reason why the relatively large number of households with radio ownership had not received flood forecast information triggers further investigation, it was clear from this study that possession of information or media devices does not correlate with the utilization of these platforms to receive forecast messages. FGDs indicated that the forecast information mentioned above refers to general meteorological information by EMI, not specific flood-related information was provided to the communities.

Understandability of language of communication by flood information recipients indicated that the language through which the forecast was disseminated was understandable by 60 households (19.5%) while 15 households (5%) said it was not understandable. This was supported by the result of the focus group discussion that confirmed that households with access to media devices had a chance to forecast messages broadcasted by their mother tongue, Afan Oromo, and could switch to other languages of preference such as Amharic.

Regarding the timeline of forecast information with the occurrence of flooding events, it is important to note that the majority (233 households or 75%) had not received any information as discussed above. From those households who received the forecast information, 27 (36%) received the information one day before the flooding event, 22 (29.3%) said they received the information one month before the incident 17 (22.7%) and, 9 respondents (12%) said they received it 1-6 hours before the flood event. Only nine households said they received the information before one to six hours of the flooding event. It was evident from the focus group discussions that households with flood information well ahead of flood incidences managed to take early actions to avoid the adverse impacts of floods on lives and livelihoods.

This study did not identify any local or indigenous flood forecast systems that stood out as a major source of knowledge to forecast floods as 93% of the households did not know such practices. However, eight households said they had acquired such local knowledge from their past experiences. They said they usually anticipate flooding by observing the temperature, direction of the wind, excessive rainfall, rising river levels, and the obvious July-September season.

4.2.3. Households' perception of risk, awareness, and response to flood hazards

The study indicated that households had a very high (54%) and high (46%) perception of flood risks and flood-associated impacts. The result also revealed that the majority of households (94%) were aware of the season (usually between July - September, the main rainy season in the area) in which

major floods occur. Households were also well aware that floods usually occurred due to overflow of rivers (95%), excessive or torrential rainfall (91%), flash floods from highland areas (78%), and the opening of dams (69%).

When it comes to preventive or control measures households take to mitigate the impacts of floods, 162 (52%) said they build small-scale household-level flood preventive measures such as dikes to minimize flood impacts, 218 (71%) practiced terrace farming and contour bunds to reduce water or surface runoff, and 124 (40%) planted new trees to protect against soil erosion.

However, it was clear from the focus group discussions that the contribution of household-level and small endeavors was minimal and could not prevent or control the dire consequences of floods in their localities. This was because the magnitude of floods was far beyond the capacity and household-level small-scale preparedness and response endeavors. Discussants also mentioned that the large-scale government-constructed dikes are not fully functional because they have been damaged by recurrent floods and maintenance efforts have been minimal.

4.2.4. Vulnerability to flood incidences and the existence of support mechanisms

The study revealed that the most vulnerable to floods were children (66%) followed by elderly (16%), persons with disability (11%), and women (7%). The study also revealed that 90% of the respondents had not experienced any community support network or a team available to support these vulnerable groups during flood events. It was also found that 92% of households witnessed the absence of community-led flood rescue groups and a lack of training, seminars, and drills to aware people of flood risk and evacuation procedures during emergencies. 85% of households were not informed about a list of things they needed to do during an evacuation.

4.2.5. Household Food Insecurity Access Scale

The Household Food Insecurity Access Scale indicated that nearly 70% of households were worried about insufficient food. The study identified that households faced problems in obtaining enough quality and good quantity of food in their meals. More than 70% did not eat preferred foods, ate just a few kinds of foods, ate fewer meals in a day, ate foods they didn't want to eat, and ate smaller meals. The frequency of such behaviors was observed between three to ten times during the month, indicating a prevalence of moderate food insecurity in the area which requires development intervention. It was also found that less than 6% of households had no food of any kind, went to

bed hungry, and went the whole day and night without eating for some time, calling for humanitarian assistance.

Generally, the findings of the HIFIAS highlighted that households faced anxiety and uncertainty about the household food supply and were obliged to eat insufficient quality (variety and preference of the type of food three to ten times a month. And to some extent, a smaller portion of households had insufficient food intake which could have physical consequences. The result indicated challenges faced by households in accessing sufficient and nutritious food, indicating a critical need for interventions such as food aid to address food insecurity.

Categorically, the food insecurity scenarios of the households were classified as anxiety and uncertainty (69.9%) reduced quality of food (92.7%) reduced quantity of food (82.4%), and hunger (6.8%). Only 2.6% of the surveyed households were classified as food secure. A slightly larger group, 7.4%, falls into the mildly food insecure access category, suggesting occasional concerns about food adequacy. The majority of households, 78.0%, were categorized as moderately food insecure. Lastly, 12% were severely food insecure, indicating they frequently experience severe disruptions in their food intake

4.2.6. Household Food Balance Model

The analysis of net available grain for consumption per annum in this study revealed significant contributions of the four major grains to the total dietary energy requirements of the population. Teff was found to be the major contributor (19.11%) to the total dietary energy requirements followed by chickpeas (6.97%), lentils (5.4%), and wheat (0.77%).

The total contribution value to the dietary energy requirement of the four major grains in the study areas was found to stand at 32.25%. Meaning, that 67.75% of households in the study area had their dietary energy consumption below the required 2100kca/per day. The mean (\pm SD) household's total harvest damage/loss due to floods in the year is 17.99 ± 11.792 quintals could have increased the energy requirements of households if crop damage due to floods had been avoided.

Chapter Five: Summar, conclusion and recommendation

5.1. Summary of findings

The socio-demographic situation of households surveyed for this research is characterized as predominantly headed by men, mostly uneducated, entirely dependent on on-farm incomes, and having farmland relatively larger than the national average and inadequately supplied with agricultural inputs.

5.1.1. The status of forecast information

The status of flood forecast information among surveyed households was poor as more than half of the respondents indicated that they had not received the information. The study revealed that the majority (57.6%) of households did not own information reception devices.

The association of sociodemographic characteristics with households' access to media devices suggests that factors such as sex and education may play important roles in determining household access to media devices. For example, households with male heads were significantly more likely (10.130 times) to own media devices than female heads. Households with primary and secondary levels of education showed a higher likelihood of having the devices than those with the lowest level of education.

75.7% of flood-affected households did not receive flood forecast information; only 75 households (24.3%) had received forecast information from various sources. Although a sizable fraction of households lack access to forecast information, most of those who received the information (68%) found the flood forecast information beneficial. This suggests a potential gap in access to critical information that could aid in flood preparedness and response among households. Strangely, the study also found that even most of those who own the devices (42.4%) were not receiving the information.

Logistic regression analysis of food insecurity status with household access to flood forecast information suggests that households receiving flood forecast information are significantly less likely to experience food insecurity, with the odds being about 90% lower compared to those not receiving such information.

80% of households who received flood forecast information said they understood the language of communication and they pointed out that they received the information one month (29.3%), one week (22.7), one day (36%), or 1 - 6 hours (12%) before a flooding event occurred. The traditional

methods through which households anticipate imminent flooding include temperature, direction of the wind, excessive rainfall, rising river levels, and the regular rainy season.

Almost all surveyed households had a very high perception of the risks of floods in their localities and they were well aware of the times and causes of floods. Households practice significant flood protection measures, but the contribution of such household-level endeavors to prevent or control the dire consequences of floods in their localities was minimal. FGD participants called for urgent maintenance of large-scale government-constructed dikes that are not fully functional currently.

Households said there was no community support network or a team available to support population groups that are most vulnerable to flood including children (66%) followed by the elderly (16%), persons with disability (11%), and women (7%). In addition, households witnessed no community-led flood rescue groups and a lack of training, seminars, drills, and evacuation procedures during emergencies. 85% of households were not informed about a list of activities they needed to do during an evacuation.

Household Food Insecurity Access Scale (HFIAS) analysis of households indicated a prevalence of food insecurity classified as anxiety and uncertainty (69.9%) reduced quality of food (92.7%) reduced quantity of food (82.4%), and hunger (6.8%) with the majority (78%) categorized as moderately food insecure. The result informs of challenges faced by households in accessing sufficient and nutritious food, indicating a critical need for humanitarian aid interventions to address food insecurity.

Analysis of the Household Food Balance Model also revealed the significant contributions of the four major grains to attain the total dietary energy requirements of the population of households.

5.2. Conclusion

The study revealed that 75% of farmer households in the study area lacked access to flood forecast information. Limited income sources, a lack of devices to receive information, and low education levels restricted access to flood forecasts. This hindered farmers' ability to take proactive measures before floods damaged their crops, livestock, and infrastructure, which in turn impacted the food security.

The study found that male-headed households and households with primary or secondary education possessed information devices and had more access to forecast information than female-headed households and those with lower education levels. Additionally, household heads with higher educational attainment and male heads owned more media devices and had better access to flood forecasts. This suggests that gender and education levels play important roles in determining access to information and devices.

Households that received flood forecast information reported lower rates of food insecurity, with an odds ratio approximately 90% lower than those who did not receive such information. However, the study revealed that access to information reception devices did not guarantee access to flood forecast information as 97% of households that owned radios had not received any flood forecast information.

Almost all surveyed households were aware of the timing, seasons, and causes of floods affecting their livelihoods, and the survey indicated a high perception of flood risk among them. However, Minimal flood mitigation measures could not prevent or control the severe consequences of floods, as the magnitude of the floods exceeded their small-scale efforts.

The study found a lack of community support networks and community-led flood rescue groups to assist the most vulnerable groups. There were no training sessions, seminars, drills, or established evacuation procedures in place for emergencies. Additionally, no information was provided regarding the activities that flood-affected individuals needed to follow during an evacuation.

HFIAS analysis showed that 78% of households experienced moderate food insecurity. 69.9% reported feelings of anxiety and uncertainty due to insufficient food, 92.7% reduced food quality, 82.4% diminished food quantity, and 6.8% faced hunger, highlighting an urgent need for development and humanitarian interventions to tackle food insecurity. Furthermore, an analysis of

the Household Food Balance Model indicated that four major grains play a significant role in meeting the total dietary energy requirements.

5.3 Recommendation

The findings of this study recommend that government and non-government organizations involved in disaster risk management and the dissemination of forecast information should assess the effectiveness of their communication strategies.

It is important to ensure that forecast messages effectively reach and have an impact on end users in vulnerable areas.

Additionally, the study suggests that local and regional authorities should educate communities at risk of hazards on how to access forecast information using the devices they have available.

Given the low levels of access to forecast information through media devices, local authorities should consider implementing public communication models to effectively share forecast information and reduce the adverse effects of hazards, such as floods.

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