Exploring the Role of Early Warning Systems in Enhancing Early Response to Climate Disasters in Lowlands Ethiopia: The Case of Borana Pastoralist Area.

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Disclaimer:

This document represents part of the author's study programme while at the International Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

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DRMC	Disaster Risk Management Commission
DRMO	Disaster Risk Management Office
EDRMC	Ethiopian Disaster Risk Management Commission
EEWS	Ethiopian Early Warning System
EMA	Ethiopian Metrology Agency
EWS	Early Warning System
FAO	Food and Agriculture Organization
ODRMC	Oromia Disaster Risk Management Commission
UNDP	United Nations Development Programme
UNISDR	United Nations Office for Disaster Risk Reduction
WMA	World Metrology Agency

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Abstract

The study explores the role of early warning systems (EWS) in enhancing early response to climate-induced disasters, focusing on the Borana pastoralist community in Ethiopia. The primary purpose of the research is to understand how Early warning system can be improve disaster preparedness and brought early response. the study employs a qualitative research approach, utilizing in-depth interviews, focus group discussions to gather diverse perspectives from local communities and stakeholders and secondary data review. The study focused on the by four key elements early warning system of Risk knowledge, monitoring and warning system, communication and dissemination system, and response capacity to mitigate the adverse impacts of climate-related risks, particularly droughts under formal and informal EWS. Based on the research question the finding of research shows that integrating traditional and scientific EWS creates framework for disaster risk reduction. The study also found that early warning provides early and on time alerts regarding upcoming hazards, community and individual effectiveness of warning message influenced by community's risk knowledge, understandable and accessibly warning messages, mean of communication and existing response capacities. The study contributes to the issues of climate change induced disasters as main area in the development studies program by emphasizing on the role of EWS to enhance the resilience of vulnerable communities. The study finding also shows that the response to drought Borana pastoralist area is delayed at early stages and starts as the drought become more severe levels. It also highlights the need for technology in risk assessment, monitoring, and communication to follow-up indicators early, identify drought sooner and communicate effectively to mitigate the severity and intensity of drought events.

Relevance to Development Studies

Climate change is a global challenge to humanity in every corner of life and it was one of the challenges and areas of research in the field of development studies. Therefore, considering the significance of early warning systems, this research has relevance for development studies because the study aims to explore the role of early warning systems (EWS) in enhancing early response to climate-induced disasters, focusing on the Borana pastoralist community. Addressing climate disasters by early warning systems is crucial for human survival and sustainable developments.

Keywords

Early Warning Systems, climate disasters, Borana pastoralists, drought, disaster risk reduction, indigenous knowledge, Ethiopia.

Chapter One

1.1. Introduction

Early warning system was defined as an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities takes timely action to reduce the risk hazards in advance before hazardous events (WMO, 2016). Early warning systems are critical in disaster risk management, providing timely information that can mitigate the adverse effects of climate-related risks (Basher, 2006). On Day 23 March 2022 World Meteorological agency day, UN Secretary-General António Guterres stated that

"Today, one third of the world's people, mainly in least developed countries and small island developing states, are still not covered by early warning systems... This is unacceptable, particularly with climate impacts sure to get even worse. Early warnings and action save lives".

By adding to this WMO (2020; p-5) report shows that, "in the 73 countries considered, one-third of people are not covered by early warnings, and just 40% have multi-hazard EWS". The world conference on disaster reduction at Yokohama 1994 IDNDR, (1994), Hyogo Framework for Action 2005–2015 UNDRR, (2005); WMO (2015), and Sendai Framework for Disaster Risk Reduction 2015-2030 (UNDRR, 2015) stated the significant role of EWS for disaster prevention and preparedness tools for disaster prevention as opposed to focusing on emergency and disaster response. Effective early warning system is characterized by four key elements: Risk knowledge, monitoring and warning system, communication and dissemination system, and response capacity on one side UNISDR (2006) and UNEP (2012) and four overarching components, involvement of local community, multi hazard approach, effective governance and institutional arrangement, and consideration of gender and cultural diversity on other side as one unit to prevent disaster effectively (UNISDR 2006; WMO 2018; Brown et al. 2019), and this what Basher (2006) described as people-Centered Warning Systems'. In the Borena zone major climate related hazards such as drought, and flood have been affecting the life and livelihoods of the community (Bekele and Amsalu, 2012; UNHCR, 2023). As pastoralist and farmer of east Africa depend on traditional weather forecasting system (Radeny et al., 2019a), Borana pastoralist have much indigenous knowledge of climate and weather forecasting system (Iticha & Husen, 2019a). Drought by itself is not a disaster but a natural phenomenon that can be managed through human action of EWS. However, the Ethiopian EWS has often failed to respond effectively to crises and other natural hazards, particularly meteorological and climatic hazards, and has

been unable to save lives and reduce the intensity of hazards like drought, which have long lead times. Many studies indicate that the main challenge of the Ethiopian EWS is the lack of a proper early warning policy, which results in inadequate management of disaster risk.

1.2. Problematization

As Kelman and Glantz (2014), stated in his study, there is not a common universal definition of Early Warning System (EWS). However As defined by United Nations General Assembly resolution 69/284, 1 December 2016, EWS was defined as an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities takes timely action to reduce the risk hazards in advance before hazardous events (WMO 2016). The world conference on disaster reduction at Yokohama 1994 IDNDR, (1994) stated the role EWS for disaster prevention and preparedness, followed by the Hyogo Framework for Action 2005–2015 UNDRR, (2005); WMO (2015), and Sendai Framework for Disaster Risk Reduction 2015-2030 (UNDRR, 2015) emphasized the significance of early warning systems as main tools for disaster prevention as opposed to focusing on emergency and disaster response.

The effectiveness of EWS is contingent upon the generation of "early" early warning information, which is depends upon the specific disaster and lead time UNEP, (2012) with warning messages be communicated in an understandable manner to prevent loss of life and minimize damage during a given disaster with significant social participation (Kelman and Glantz, 2014) from those who are vulnerable to the disaster, as well as those involved in the administrative system prior to, during, and after the disaster, is essential (Šakić Trogrlić et al., 2022). By adding to this, The United Nations International Strategy for Disaster Reduction (UNISDR, 2012) stated that the objective of EWS is to provide the information worth enough to reduce potential losses of lives or property damage.

As described by UNISDR (2006) and UNEP (2012) effective early warning system is characterized by four key elements: Risk knowledge, monitoring and warning system, communication and dissemination system, and response capacity on one side and four overarching components, involvement of local community, multi hazard approach, effective governance and institutional arrangement, and consideration of gender and cultural diversity on other side as one unit to prevent disaster effectively (UNISDR 2006; WMO 2018; Brown et al. 2019), and this what Basher (2006) described as people-Centered Warning Systems'.

Even though different convention, framework, United Nation initiatives, and world conference encouraging use of early warning system for early disaster prevention, still disaster

risk reduction and management action skewed toward disaster response, emergency, and relief after disaster happened and affect the lives and assets (Šakić Trogrlić *et al.*, 2022). The WMO (2022) report reveal the gap of EWS usage and coverage and stating that one third of the world population especially those in less developed countries are not covered by early warning system.

In most of developing countries, early warning information generated by the existing early warning system is failed to reduce loss of life and damage to property and the EWS remains ineffective to early disaster risk response (UNDRR, 2023). The literature on early warning shows that, existing EWS was unable to early respond to disaster hazard due to the technical and institutional challenges of creating on time risk knowledge, generating warning alert, disseminating and communicating warning message in understandable manner, weak on time response to warning, lack of coordination and stakeholder involvement, lack of risk mapping and strong monitoring and evaluation bounded by legal ground responsibility (Kelman and Glantz, 2014; Šakić Trogrlić *et al.*, 2022; Prudhomme *et al.*, 2024; Agbehadji et al. 2023; ibid).

In Ethiopia, climate related disasters such as flood and drought are two natural hazardous events that frequently affects country's economic potential including loss of life and destruction to means of livelihood every year by varying its coverage and intensity (Mekonnen and Mengesha 2015; UNHCR, 2023; (Mera, 2018). Ethiopia has a long history of suffering from droughts and famines including devastating famine of 1973–1974, which killed approximately 200,000 people, and the famine of 1983–1985, which killed two to five times as many people and these catastrophic events prompted the United States government to establish a famine early warning system in Ethiopia (Metcalf et al., 1989; (Adgeh, 2017) and even today humanitarian action analysis and need reports reveal that 21.4 million people need emergency response (see humanitarian action report [1]).

The lowlands of Ethiopia, including the Borana, Guji, Bale, and Hararghe zones of the Oromia region, as well as other regions such as Afar, Somali, parts of the Southern Nations, Nationalities, and Peoples' Region (SNNPR), Amhara, and Tigray, are frequently affected by severe climate-related hazards, mostly drought (Alemayehu and Workeneh, 2023). In the Borena zone major climate related hazards such as drought, and flood have been affecting

[1] humanitarian action analysis and need report 2024 https://humanitarianaction.info/plan/1195

the life and livelihoods of the community (Bekele and Amsalu, 2012; UNHCR, 2023). Most often below normal rainfall and drought period like that of 1980s, 1990s, 2008, 2009, 2011, 2015, 2017, 2021, 2022 and 2023 OCHA, (2024) that negatively affected ecosystem, community's livelihood and social aspects were occurring in Borena zone (Bekele and Amsalu, 2012). Due to the drought Borana pastoralists lost their tangible and intangible assets during every drought cycle. For example, in 2021-2023 there was more than 1.7 million livestock death economic loss of more than 12 billion Ethiopian birr (23,076,923 USD), (OLLA 2023), and displaced 867,000 people displaced according to Helvetas, (2023) in Borana zone alone and death 4.5 million livestock death in Ethiopia as whole (IOM 2023); Alemayehu and Workeneh, 2023; FAO (2023; EU, 2022).

Drought by itself is not a disaster but a natural phenomenon that can be managed through human action of EWS. However, the Ethiopian EWS has often failed to respond effectively to crises and other natural hazards, particularly meteorological and climatic hazards, and has been unable to save lives and reduce the intensity of hazards like drought, which have long lead times. Studies by Beyi, 2011, Lautze et al., 2005) indicate that the main challenge of the Ethiopian EWS is the lack of a proper early warning policy, which results in inadequate management of disaster risk. Although Ethiopia implemented its own national policy and strategy on disaster risk management[2] in 2013, which includes early warning as a one component, the country does not have a specific early warning policy and strategy with hazard-specific implementation plans as recommended by both the Hyogo Framework and the Sendai Framework.

Therefore, the Ethiopian Early Warning System (EEWS) often fails to effectively respond to crises and natural hazards, particularly meteorological and climatic ones (Lautze et al., 2005). According to Kelman and Glantz (2014), EWS failure is due to deficiencies in key EWS principles, including continuity, transparency, integration, human capacity, flexibility, catalyst/patterns, and timeliness. Moreover, the Ethiopian EWS lacks the capability to accurately predict, issue timely warnings or alerts, and respond swiftly to the onset of disaster emergencies (Lautze et al., 2005).

[2] The Federal Democratic Republic of Ethiopia, National Policy and Strategy on Disaster Risk Management 2013: https://disasterlaw.ifrc.org/sites/default/files/media/disaster_law/2022-03/National%20Policy%20and%20Strategy%20on%20Disaster%20Risk%20Management.pdf accessed 15/5/2024

The biggest weakness of Ethiopian early warning system is its inability of warning alert generation on time Damtie and Asmare, (2020) and poor timeliness of hazard information flow (Getachew, 2003). Instead of early response action, Ethiopian early warning and disaster risk reduction and management action skewed toward disaster response, emergency, and relief after disaster happened and affect the lives and assets (Beyi, 2011). Additionally, as Borana pastoralist whose livelihood is depending on livestock production which have their own indigenous (Iticha & Husen, 2019a) and traditional community based EWS, Ethiopian EWS lack of coordination with community based early warning system Holly and Tekle, (2011) as disaster risk reduction needs involvement of community and individuals Mena and Hilhorst, (2022) from grassroot level. For an early warning system to be effective, Rogers and Tsirkunov (2019) argue that, it must be transparent, authentic, and accepted by stakeholders.

Generally, in Ethiopia as a general and Borana particularly there was failurity of EWS in terms of its basic elements of risk knowledge (lack of risk information, data gap both manual and digital), monitoring and warning (time of warning, clarity of warning message, content of warning message, unclear indicator and warning message validity question), communication and dissemination (top-down approach, lack of feedback, language barrier, lack of communication technology and coverage), and response capacity (weak public response, lack of post event review) as this is also supported by the study of (Basher, 2006; Grasso, 2014; Zommers and Singh, 2014; and UNDP, 2018). With this problem the study was conducted to answer the following questions research questions.

1.3. Research Question

The main question of the paper is "How early is early warning system and its role in Borana pastoralist community enhancing early response to drought disasters?" this question followed by the following sub-questions.

1.3.1. Research Sub-Questions

- What are the factors that affect EWS in early response of drought disasters in Ethiopia?
- How are the four elements of early warning system (risk knowledge; monitoring and warning system, communication and dissemination and response capacity) functioning towards drought in Borana pastoralist area?
- What is the role of indigenous knowledge in the four components of EWS in Borana pastoralist area?

Chapter Two: Theoretical Framework

2.1. Theoretical Approach

This part review focused on reviewing about climate related risk, climate related disaster risk management, the role of early warning system in disaster risk management and the Ethiopian early warning system (Šakić Trogrlić *et al.*, 2022). The review attempted to indicate climate related risks and how they were managed to reduce the adverse effects they imposed on social, environmental, and economic aspects. Early warning information system of Ethiopia was analyzed based on the framework of early warning system consisting of four major elements, climate related risk knowledge, monitoring and forecasting of climate related risk and effectiveness of response to climate related early warning information.

2.2. Climate Related Disaster Risk

The definition of risk varies based on depending on the field of studies and context. It is the probability of something will occurs due to a hazard event occurring in a given area over a specific time period (Twigg, 2015; UNDRR, 2016; Šakić Trogrlić *et al.*, 2022). Climate related disaster results from the atmospheric processes which result to an event that possess damaging potential in case an event makes interaction with exposed elements of lower capacity to withstand the power of the threat (IPCC, 2021). Hence, climate related risk depends on climate hazard, vulnerability, and capacity of the exposed elements (Mena and Hilhorst, 2022). When the community, environment and resources are exposed to hazard and are likely to be adversely affected by its impact, they are said to be at risk. Climate related disaster risks the likelihood of loss of life, injury or destruction and damage from climatic disaster in each period (UNDRR, 2016).

A hazard is an event that has the potential to threaten or causing injury to life or damage to property or the environment (UNDRR, 2020 p-7). It can be biological, chemical, mechanical, environmental, or physical agent that is reasonably likely to cause harm or damage to humans, other organisms, or the environment in the absence of its control. Major climate related hazards include heat waves, intense storms and heavy precipitation events, drought, rising in sea level, floods, vector-borne diseases, water-borne diseases, climate change favored pests, weeds, and invasive species etc. (Abebe et al., 2016).

Vulnerability is the extent to which the exposed elements are likely to be damaged or disrupted by the impact of hazard (UNDRR, 2016). Exposed elements include people, infrastructure, housing, production capacities and other tangible human assets located in hazard-

prone areas. The level of vulnerability can vary based on physical condition, proximity to the hazard, location, nature of the hazard and capacity of the exposed elements to resist the power of devastating events. Capacity includes means and strengths which exist in households and communities, and which enable them to cope with, withstand, prepare for, prevent, mitigate, or quickly recover from a disaster (Kelman and Glantz, 2014). Accordingly, communities with high economic capacity will likely be affected less by hazards while poor communities will likely be affected more.

2.3. Early Warning and Disaster Risk Reduction

Early warning is a major element of disaster risk reduction (USISDR, 2006). Early warning system includes three significant elements (Kelman and Glantz, 2014) such as 'early' which focus on time, 'warning' which concern about impeding danger and 'system' which more or less describes the different chains of institutional concerns. 'Early warning system' is the matter provision of reliable information for early action to be taken (Basher, 2006). It has been traditionally focused on collecting and analyzing hazard data to produce warning messages that help inform stakeholders of impending disasters via existing governmental institutional structure by focusing on when, where, and how to initiate response activities (Akerkar et al, 2020). Early warning systems (EWS) are based on the premise that hazard-related information can be gathered, analyzed, processed into a warning message(s), and disseminated with sufficient lead time to warn exposed and vulnerable populations of the impending disaster. Ideally, these warnings prompt preparation and/or early action that prevent or mitigate the impact of the disaster (Akerkar et al, 2020).

Early warning system is effective if early warning massage reaches the last and most vulnerable person of the community; helps to reduce disaster risks; contribute to saving life, reducing injury; damage of property and if the system is well managed and if the resources are used in the most appropriate way. When the four major elements and their inter connection are properly achieved the early warning system will be effective in achieving climate related risk reduction. As indicated by different literatures (UNISDR, 2006; UNEP, 2012 and IFRCRCS, 2012) the four major early warning systems elements and four overarching components

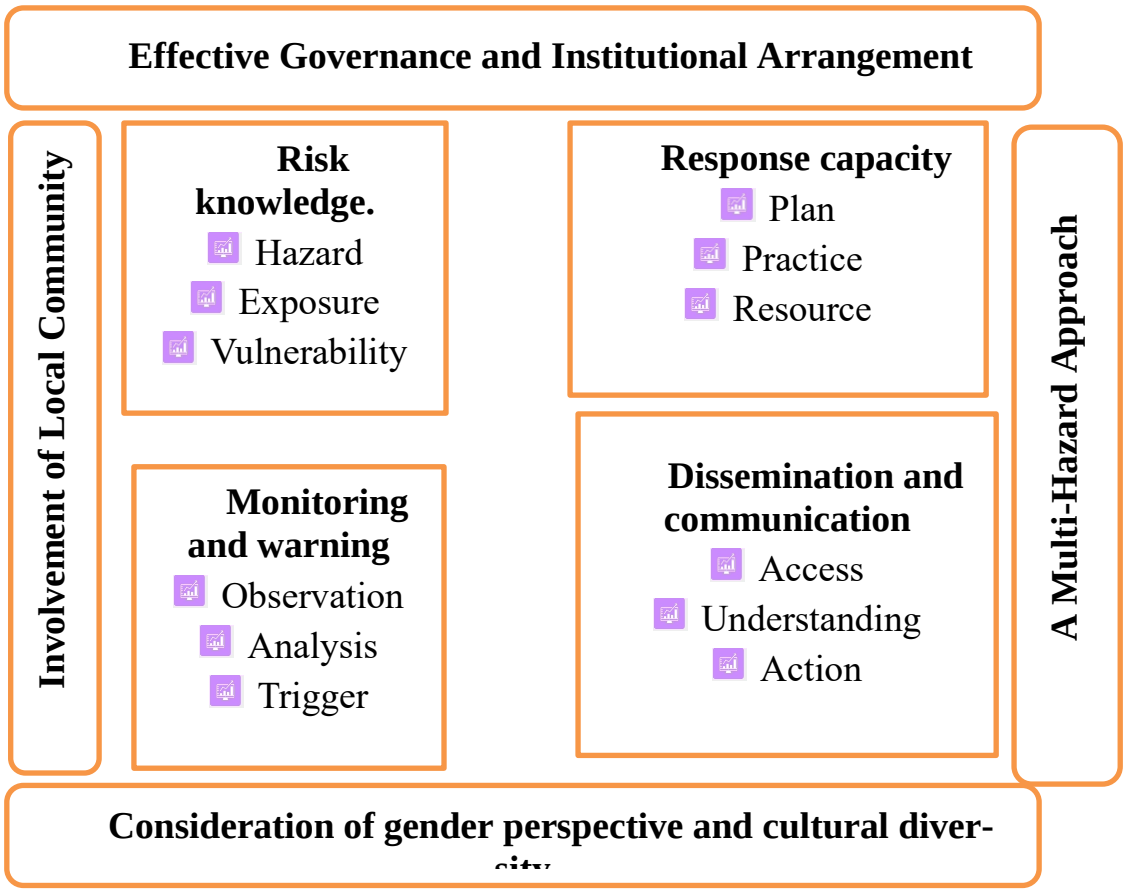

Figure 1: Components of an early warning system. (from Brown et al. 2019)

2.3.1. Analysis of EWS

Early warning systems (EWS's) are based on the premise that hazard-related information can be gathered, analyzed, processed into a warning message(s), and disseminated with sufficient lead time to warn exposed and vulnerable populations of the impending disaster. Ideally, these warnings prompt preparation and/or early action that prevent or mitigate the impact of the disaster (Akerkar et al, 2020).

The overall early warning system going to be studied was summarized in the following diagram which shows the conceptual framework of the study. As discussed above and shown in the following diagram (Figure: 1), early warning information system activities performed at its different level and the proper coordination between the whole system results into effective early warnings ends with effective response. The framework used by UNDP, (2018) is found the best approach of analyzing the existing EWS in the present study area (figure 2). Hence, the review of this literature was done based on the four concepts of EWS shown in figure 2. As discussed above and shown in the following diagram (figure: 2), early warning

the whole system results in either effective or noneffective disaster risk capacity.

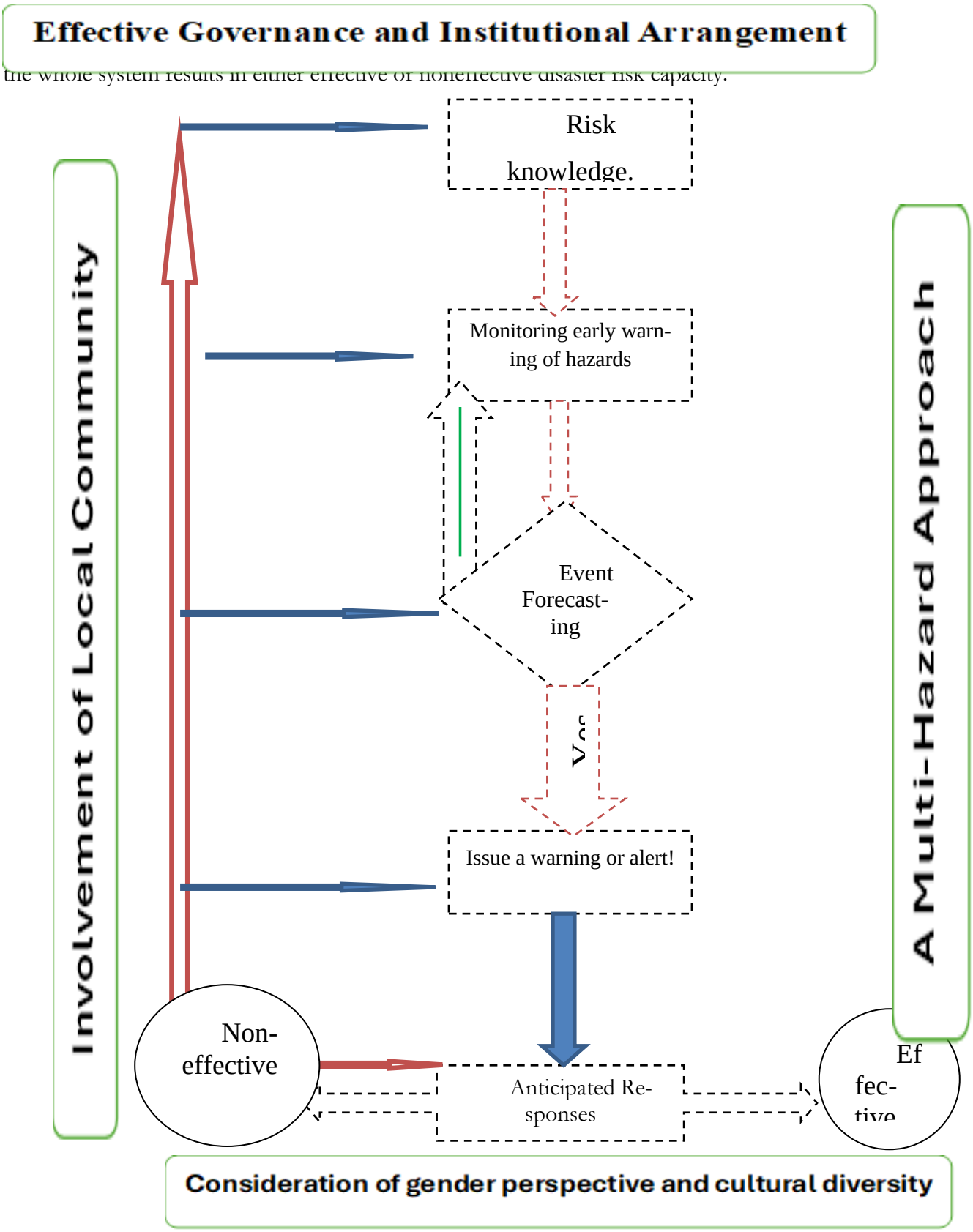

Figure 2: Conceptual framework shows the function of early warning system.

Source: author (2024).

2.3.2. **Risk Knowledge**

Risk arises from the combination of hazards and vulnerabilities at a particular location (UNDP, 2018). Risk knowledge is also generated from investigating factors related to hazards, vulnerability, and the resources of the area. UNDP (2018) defined risk knowledge as, 'the interplay between establishing organizational arrangements, identifying natural hazards, community vulnerability assessment, risk assessment, and information storing and sharing'. Mean that risk knowledge is produced through risk assessment.

Risk assessment is an involved procedure of deciding the nature, area coverage and extent of impact of hazards to the community and its family within an expected time duration (Shi, 2019). Risk assessment decides the probability of negative consequence of hazard on vulnerable life, livelihood and environment and why certain households and communities are vulnerable to specific threats and others are not? The coping strategies and the resources that the community have also identified (Shi, 2019). Risk assessment can be done through three interwoven steps. These procedures include risk identification, risk analysis and risk evaluation (UNISDR, 2017).

Risk Identification includes the hazard, vulnerability, and capacity assessments Shi, 2019). Hazard assessment includes differentiation of the nature and characteristic of the hazards the community is vulnerable to (UNISDR, 2017). Sources of danger as well as the level of probability of its happening are also investigated. Hazard investigation is also concerned with the properties of the threats.

According to UNISDR (2017), the vulnerability analysis identifies what prone elements are risks and why they are at risk (the reasons for their vulnerability). Vulnerability Assessment is the process of estimating the susceptibility of 'elements at risk' to various hazards and analyzing the causes behind their vulnerability. The assessment considers the physical, geographical, economic, social, political and psychological factors, which make some people more vulnerable to the dangers of a given hazard while others are relatively protected. In vulnerability assessment the most important factor is the level of income. Levels of poverty and education status are similarly important factors.

Hazard and vulnerability assessment capacity assessment is one the components of risk identification (UNISDR, 2017). Capacity assessment is the step to determine how people cope in times of crisis to reduce the damaging effects of hazards. Through capacity

assessment, the community's coping strategies and resources, which are available, for disaster preparedness, mitigation and prevention are identified (Akerkar et al, 2020).

The second very important step of risk assessment is risk analysis which is done after the completion of hazard, vulnerability, and capacity assessment (UNISDR, 2017). The risk analysis will enable the community and the local authorities to understand the potential impact of various hazard events. During risk analysis we identify what kind of impact a hazard will have on various elements at risk and identify the extent of the impact.

The last but very vigorous step of risk assessment is risk evaluation (UNISDR, 2017). Risk evaluation is to make decisions about what strategies should be followed for the reduction of various disaster risks. The risk evaluation can also be used to rank the most vulnerable communities. This is done upon the basis of information from risk analysis. Communities and local authorities jointly can agree on criteria to rank the risks. They can decide the acceptable risk. Likewise, they rank the higher priority to the potential damage and loss.

Finally, the risk knowledge produced through these interconnected various steps of assessments of different risk causing factors is used for early warning system as the baseline needed before undertaking further action (UNDP, 2018).

Identified risk and risk knowledge

Drought, livestock disease, desert locust swarms, crop pests, flood and landslide are hazards identified in Borena zone based on the order of their priority. The nature and effects of hazards vary in terms of its intensity, extent, time of occurrence (seasonality and time frame) and frequency of occurrences (Drechsler & Soer, 2016; Dinku, 2018; Damtie, & Asmare, 2020). The effects caused by hazards directly or indirectly depend on the nature of each hazard (Drechsler & Soer, 2016; Damtie & Asmare, 2020). Accordingly, the nature of hazards identified based on information obtained from kebeles, Districts and zone, the nature of hazards and the effects caused to social, economic and environmental aspects in Borena zone are discussed as follows.

Borana indigenous knowledge of climate risk knowledge

Most of pastoralist and farmer in east Africa depend on their traditional weather forecasting system (Radeny et al., 2019a); (Granderson, 2017). Borana community have for a long time used indigenous knowledge used as method of forecasting to predict climatic events like drought, rainfall status (Winnie et al., 2002; (Iticha & Husen, 2019a)). This traditional

climate forecasting was undertaken by individual with climate indigenous knowledge without formal institutional background.

However, many traditional forecasting methods are perceived as becoming less reliable with increasing climate variability (Kagunyu, 2014). Those individual with climate related indigenous knowledge Borana communities observe clouds, wind and lightning that likely have their origins in traditional understandings of what contemporary researchers recognize as atmospheric science. Others critically and regularly follow the behavior of livestock, wild-life (their sound and behavior) and the local environmental condition.

According to Wayua & Kagunyu (2008) Borana communities observe the intestines of slaughtered cattle and shoat, the pattern of the stars and follow other seasonal pattern with their Gada system calendar and rotation. Those indigenous weather forecasting knowledge gives details of the upcoming seasons in terms its drought and rainfall intensity, for instance, when the rain will start, where it will rain and when it will end. Ethno-meteorological methods have been poorly understood but nonetheless they may be based on intrinsically scientific foundations that account for moderate observed forecast skills (Kagunyu, 2014).

Among Borana traditional weather forecasting system as part of climate risk knowledge Uchu, Waragu, Ayyaantu, are among well-known climate forecasting tools (Granderson, 2017); (Radeny et al., 2019a). Uchu was those read livestock intestine for weather forecasting system to predict future epidemics and droughts. While ayyantu is those with indigenous knowledge of counting drought cycle, detecting star, moon, and solar system to forecast weather variability, rain onset, amount, and offset.

While Waragu are those who watch livestock behaviors, condition, human behavior, vegetations conditions to predict weather (Iticha & Husen, 2018).

2.3.3. **Monitoring and Warning Service**

In the context of early warning, to monitor means to identify major changes in threats (hazards) that can affect the sources of household food or income or life and livelihood of the community (Shaw at al., 2016). According to UNISDR (2006) and WMO (2010), monitoring and warning accomplishments are the prerequisite to early warnings and response. It depends on timely, continuously and reliable data collection from early warning indicators.

Constant monitoring of hazard parameters and precursors is vital to produce accurate warnings in a timely based. Monitoring is the activity of collecting information along with a

set of indirect means variables related to risk, such as rain correlated with floods/droughts (UNDP, 2018).

In monitoring, early warning indicators were followed up to recognize hazards situation in its probability of occurrence (UNDP, 2018). According to (Damtie & Asmare (2020), most well-known indicators of early warning in Ethiopia are environment (rainfall, temperature, grazing, water source (e.g. reduction in levels at water points), crop (its stage and status) monitoring, animal monitoring (in its health, feed and water), price and market monitoring (price, supply and demands) and food security monitoring (availability, accessibility utilization and stability) of food.

Monitoring and predicting are one of part of the early warning activities. This step provides the early warning information for further process of data to make ready for early warning communication so called dissemination for those whose responsibility is to respond (UNEP, 2012). This step gives the input information for the early warning advancement and has great contribution for emergency response plan updating.

Some hazards are sudden onset and not give warning time and other are slow in its starting and having time of warning (UN, 2006 and UNEP, 2012). So, it is not easily to perform through observation especially for sudden onset hazards. For this reason, the use modern technology is best substitute to support the ground data collection (observations).

Concerning uses of the modern technology in early warning indictors monitoring, globally visible improvements have been made in quality accuracy and on time delivering the warning serves (UN, 2006). But this reality may be challenging to accept in developing countries context due to no well-developed early warning institutions and less capacity to deal with some hazards (UNDP, 2018). In case of the hazard drought, not only the level of the development of the countries but also fact that it has complex behavior its early warning systems was less developed even at global level (UN, 2006). The fact that the drought is one of slow onset hazards, due to its intricateness of its behavior its early warning system and technology application is still challenging. However, we are not denying the importance of modern technology in early warning indictors follow up. UNDP (2018) said that "modern technology provides the opportunity of compiling data from numerous monitoring sources and at high speed, creating possibilities for improving the correctness and rapidity with which disaster forecasts can be produced".

According to the report presented by Rina *et al.* (2014), several countries have weather associated information and monitoring technologies, however, may belong to failure of

organizations which result a disintegration of monitoring capacities and limiting the existing information during predictions. Uncertainty these gaps able to be filled, rapid enhancements in forecasting abilities are not promising. The promising early warning system can be arrived if rules and regulation formalized and practiced well, organizational arrangements realized, formal or informal cooperation placed (UNDP, 2018).

Furthermore, this early warning indicators monitoring, is not stopped at pre disaster only but it continuous throughout the disaster management phases because early warning system depend on strong scientific based prediction and forecasting hazards which is very important and basic for disaster risk management activities at times. Early warning indicators monitoring is the non-stop activities which continuously operates 24 hours in a day throughout the year regardless of the phases of the disaster situation (UNISDR, 2006).

2.3.4. **Dissemination and Communication of Early Warning Information**

Following the prediction and organization of early warning information, the risk information and early warning messages should be timely delivered for the stakeholders or users who are in need and prepared to hear them (UN, 2006). Messages of early warning should contain simple and useful information and important for useful response that help to safeguard lives and livelihoods (UN, 2006; IFRCRCS, 2012; UNEP, 2012). The dissemination of the information must be based on clear protocols and procedures as well as supported by adequate mechanisms of information flow which can always be based on various communication technologies (WMO, 2015; (Perry & Lindell, 2003)). Appropriate communication center must be identified and prepared in order to provide the warning messages for the vulnerable community and the stakeholders found at different levels such as community, regional and federal level and the non-governmental organizations acting at national and international levels depending on the level of identified disaster risk (IFRCRCS, 2012; UNEP,2012; Egeru, 2016). The dissemination of information must contain the spatial & temporal scales of the risks, the number of people that could be affected, the economic damage, and environmental and social impacts must be clearly indicated while communicated to the concerned stakeholders (UN, 2006). At the national level, the effectiveness of warnings depends on their timely and effective dissemination to all at risk, particularly through operational telecommunication systems but also through non-technical social networks. The latter are very important in poor communities that lack technological communications. Effective dissemination requires the establishment of a chain of command in advance to manage warning

issuance and dissemination and ensure that the information provided can be understood by those who need it and reaches all locations affected in the country.

One of the weaknesses of climate risk reduction efforts has been the utilization of inappropriate sources to communicate climate risk information. This is partly, arising from the limited understanding of operations and interactions involved, including the different actors, stressors, experiences and meanings operating at community level. An authoritative organ should be established to manage the effectiveness of early warning messages in terms of time, access of information by everyone who needs the early warning information, appropriateness of information dissemination channels and feed backs from the stack holders and types of response related to the delivered early warning information (UNISDR, 2006; IFRCRCS, 2012; Egeru, 2016).

Improved risk management and attendant diversification in pastoral areas is a complex issue requiring better access to information. For example, pastoralist risk management efforts in Kenya and Ethiopia have revealed that better access to markets and market information increased rates of livestock sales and reduced livestock losses during drought. It also provided better opportunities to re-stock when ecological conditions improved (Egeru, 2016). Knowledge sharing mechanisms relevant to local context are key for effective communication of value-added climate information.

2.3.5. **Proper response**

Generating and disseminating early warning information alone has no contribution for climate related disaster risk reduction unless appropriate responses are anticipated. Understanding of the foreseen risk, respecting warning service, understanding how to act and existence of well-practiced and up-to-date plane are the preconditions help to have a successful and effective early warning response (UNISDR, 2006; IFRCRCS, 2012).

A) Response as part of Disaster Risk Management

Response in the case of disaster risk management involves all the activities carried out during the phase of disaster to reduce loss and damage through provision of emergency aids. Concerning response to early warning message involves performing activities help to reduce risk of disaster that may affect the vulnerable community before the occurrences of a disaster (Šakić Trogrlić *et al.*, 2022). Such activities include planning, disaster risk policy development/revision, preparedness, mitigation, and prevention measures (Scolobig *et al.*, 2022). Availability of accurate, reliable, and understandable early warning information is the first

and most important ground to activate pre-disaster activities. Hence, to make the work of disaster risk management effective early warning system is mandatory for the present nation and nationalities.

B) Response as part of Emergency /Disaster

A response after an emergency happened is the type of response on which the traditional disaster managing originations had been busy in the past decades (Birtukan, 2014). These types of the responses were called proactive responses. They include humanitarian supports such as food, cloth, shelter, medicine, and water after a disaster occurred (Yilebes and Abrham, 2020). Even though, this type of responses saved many lives, they didn't save the livelihood the community as well as didn't mitigate the occurrence of the disaster. The overall early warning system going to be studied was summarized in the following diagram which shows the conceptual framework of the study.

Chapter three: Methodology

3.1. Methodology

Qualitative research approach was used to conduct the research. Qualitative research design used to meet the aims of the research are generally to seek answers to questions about the 'what', 'how' or 'why' of a phenomenon, rather than questions about 'how many' or 'how much' (Green and Thorogood, 2009). According to Yin (2018), the importance of qualitative study providing in-depth, contextually rich analyses of specific instances of the phenomena under study.

To gather data for this research, fieldwork was conducted in Ethiopia Borana pastoralist zone. The fieldwork conducted from July to the end of august 2024 in Borana, Ethiopia. The research had clear ethical considerations about my research with respondents for their safety while interviewing (Kvale and Brinkmann, 2009) and obtain permissions to interview from participants beforehand. The research conducted by using in-depth semi-structured interviews to collect data because of its flexibility and two-way communication on how the questions are addressed and how the participants can respond (Sharma, 2017) as it was a face-to-face interview.

In addition to in-depth interview, primary data collection included focused group discussion as tool of primary data collection and for triangulation of data from different sources. In this research primary data collected by in-depth interview the study respondent includes elders with indigenous knowledge, Early waning Experts at government and non-government offices to get necessary data for the study. As parts of secondary data collection method, secondary data was collected by reviewing disaster risk management office reports on drought from government and NGO offices and risk profiles at different administrative levels from pre-drought, during drought and post drought. In total, thirteen (13) respondents composed of eight (9) men and five (4) women, were interviewed, along with six (6) FGD's consists of seven (7) to ten (10) members to address research question until data saturation was achieved. The respondents participated all district Borana pastoralist community zone.

Sampling

The study used purposive sampling to get the desired respondents. To get elders those who have indigenous knowledge snowball sampling used to get elder as those who have indigenous knowledge as know each other in the community. As stated under data collection methods, in total, thirteen (13) respondents composed of eight (9) men and five (4) women,

samples were selected and interviewed address research question until data saturation was achieved. The respondents participated all district Borana pastoralist community zone. The experts from the government and non-government organization were chosen based on their experience and role related to early warning system in disaster risk management. Under Government disaster risk management office and NGO's there is structure of early warning system which early warning coordinator and staff members, therefore, I purposively select coordinator or staff on early warning system.

3.2. Methods of Data Analysis

For the achievement of objective and reliability of the research result, collected data from both primary and secondary source were analyzed through themes of early warning system. For this study, data was collected and analyzed under the research theme which put according to the research questions which was analysis of climate related risks, assessing climate related risk knowledge, investigating monitoring and warning services of climate related risk, assessing dissemination and communication of climate related risk information and finally analysis of the effectiveness of response capability to climate related risk.

The voice data was recorded and transcribed and translated to English language from "Afan Oromo". Interview data was recorded on voice recorder. Secondary data was extracted from reports and present disaster situation analysis documents. The qualitative data were organized under each objective and regrouped under main and subtopics of the analytical themes.

Core theme of the study

For easily collection and analysis of data to come up with meaningful research result as per methodology of qualitative research core theme of research was listed and described as follows.

Climate related risks: identification of climate related risk in the study area and as identified by key informant and focused group discussion the main climate related risk was drought, flood, human and livestock disease as well as factor that contribute to livestock death and human health. Data was collected from this theme to answer one research question and qualitatively.

Climate related risk knowledge: this was assessing of individual, community and other administrative system knowledge and understanding on hazards, exposure, capability, vulnerability and future possibility of risks and its effects. Data was collected from this theme

to second research question and qualitatively method of data collection and analysis to explore the role of EWS in the study area.

Monitoring and warning services of climate related risk: this was about investigation of monitoring and warning service of existed climate related hazards as one core theme to know in the detail of the role of EWS through monitoring hazards, risk indicators and recording their change and future prediction.

Dissemination and communication of climate related risk information: under this theme, data was collected from the way reporting, communicating, from the different administrative unit of government and non-government to the local community and how information and data collect from community and individual communicated and reported upward.

Response capability to climate related risk effectiveness: This theme is about the analysis of response to measure the of EWS.

Positionality and Ethical Considerations

In the research, it was advantageous for me to focus on early warning systems in the pastoralist area of Borana. Having been born and raised in Ethiopia's pastoral regions, I have a deep personal connection and understanding of these communities. being insider has an advantage in terms getting contextual relevant data for research, having local network to get in touch with respondent and secondary data. On the hand being insider have its own limitations which may lead unintentional bias, over familiarity which leads overlooking key concepts, and ethical issues. In the research I engage reflexivity, seeking more feedback and broaden literature review to overcome those challenges. The Borana pastoral area, being one of the most affected by climate change and related factors, has particularly motivated me to pursue my MA degree in Development Studies, with a major in Social Policy for Development. Throughout my studies, I took courses such as humanitarian action and climate change and development, which provided me with the knowledge and interest needed to conduct research on the early warning system for climate change. To achieve the objectives of the study, data collected from experts, those with deep experience in early warning system which is completely voluntary. Study participants will be provided with written consent prior to participation by protecting their privacy and confidentiality, and ensuring the data is not misused or exploited. The information obtained from the participants was not divulged and was held in confidence.

Chapter Four: Early Warning history in the case of Ethiopia

4.1. Description of the study area

The study was conducted in Borena pastoralist community which is in Southern part of Ethiopia around the border of Kenya. Borena is in Borana pastoralist zone that found in the Oromia regional State is bordered by Northern part of Kenya, Somali regional state of Ethiopia, Guji Agro-pastoralist community, and Southern Ethiopian people's region. It comprises 13 District and 2 town administrations. The center of Borana administrative town Yabelo is found at 570 km from Addis Ababa, the capital city of Ethiopia. According to the information obtained from Disaster Risk Management Office (DRMO)/waajjira Buusa Gonofaa in regional official Afaan Oromo language, the total population of Borena was about 1.2 million. Majority of the total population of the zone (91%) were living in rural areas while 9% of them were live in towns. Borena zone is characterized by arid climatic condition of average annual rainfall 600mm (Dandesa et al., 2017). Borena Zone has two rainy seasons called Ganna in local Borana dialects of Oromo language (large rainy season) extends from the month of March to May and Hageya (small/less rainy season) is from Mid-September to end of October.

The rural community of Borena zone is sedentary pastoralist, whose livelihood is mainly dependent on livestock rearing mainly Cattle, sheep, goat, camel and donkey and small crop cultivation in very few areas. Existing information of the Borena zone DRMO shows that the total livestock population of the area was about 6.8 million in number.

4.2. History of Early warning system in Ethiopia

The Ethiopian economy is dependent on subsistence agricultural production and any climatic abnormalities can have a direct effect on food production and ultimately on food availability. Therefore, food production monitoring became a key component of the EWS.

Ethiopia like several other states of the world, has established its own organization presently called National Disaster Risk Management Commission (NDRC) operating at federal, regional, zonal, District and community level, whose main objective is to initiate developmental activities for the prevention and mitigation of the root causes of the disasters. The establishment of early warning system in Ethiopia was old in age. Most of the literatures reviled that it was established in 1974 following the occurrence of the 1973/94 famine in Ethiopia (Birtukan, 2014, Rashid et *al*, 2013). Ethiopian early warning system was found a

relief-oriented system and was depending on continuous monitoring and rapid assessments disaster indicators. Similarly, it tried to work on identification the reasons of catastrophes in the country (Damtie & Asmare, 2020).

Trough time the Ethiopian EWS evolved in terms of its objectives, inclusiveness of hazards, use of authority, involvement of stakeholders and sectors. Its objective of saving lives evolved from relief based to disaster risk reduction or disaster risk management. Its inclusiveness of hazard evolved from drought focused to multi-hazard. In terms of stakeholder involvement, it evolved to multi sectored based and mainstreaming disaster risk management into different sectors but due to the lack of motivation and accountability the objectives of Ethiopian EWS are not successfully addressed (Damtie & Asmare, 2020), Rashid *et al*, 2013). Hence, the EWS of Ethiopia faced a number of weaknesses and including, centralization of the system, weak evidence collection, obtain information late, relationship between various organization was poor, duplication of early warning information, mostly focused on emergency aid, conflict between the local and federal officials on resource uses (Birtukan, 2014). The system has a distinguished of general early warning system which is problematic to deal with the features of all threats at a time (Damtie & Asmare, 2020). Lack of adequate number of well qualified manpower is also mentioned as additional and most important factor pulled the system behinds and made it in effective (Damtie & Asmare, 2020).

The following table gives a summery prepared based on information obtained from different literatures, NDPPS, (1989), NPSDRM, (2013) and Regulation No. 363, (2015) and others to show how Ethiopian EWS evolved through time.

Table 1: Historical development of Ethiopian Early warning system

Year	How Ethiopian EWS and DRM institutions evolved
1970s	Migration of people was used as the key (late) indicator for the presence of famine. Information of famine and death of people was hidden from the international community. Disaster response was to avert massive displacement and widespread mortality (Birtukan, 2014)
1973/4	Relief and Rehabilitation Commission (RRC) focused on disaster response and the distribution of relief supplies was established, the concept and importance of EW was conceived during this period. Contemporary early warning systems (EWS) were

	introduced in 1976, after the famine of 1974/5. Response was much let, and significant number of human lives was lost. Food aid used to be thrown from the air to the most affected areas
1978	The RRC established the Emergency Food Security Reserve (EFSR). It was aimed to coordinate and mobilize resources for relief and rehabilitation purpose. The EFSR started to give function since 1982.
1989	The National Disaster Prevention and Preparedness Strategy (NDPPS) focused on assessing best measures to be taken in disaster prevention, preparedness was developed (NDPPS, 1983)
1993	The Government of Ethiopia revised its disaster management strategy and ratified National Policy on Disaster Prevention and Preparedness Management (NPDPM).
1995	RRC was restructured and renamed to establish the Disaster Prevention and Preparedness Commission (DPPC), with significant changes in the mandate, i.e., giving particular emphasis to linking relief to development.
2004	DPPC was renamed the Disaster Prevention and Preparedness Agency (DPPA), with a revised and more restricted mandate to focus on acute cases of emergency response. The responsibility to coordinate employment generation which is one of the major strategies that link relief with development was reassigned from DPPC to the newly created Food Security Coordination Bureau (FSCB). FSCB addressed national food security through a productive safety nets program, other food security-related projects that attempted to enhance assets and livelihoods, and a voluntary resettlement program. At the institutional level, DPPA was responsible for transitory vulnerability, while FCSB dealt with chronic vulnerability.
2007	Following the introduction of Business Process Reengineering (BPR), the rights and obligation of the DPPA were transferred by proclamation to the Ministry of Agriculture and Rural Development (MoARD), which led to the establishment of the Disaster Risk Management and Food Security Sector (DRMFSS) within the MoARD. This new institutional arrangement brought a paradigm shift in the approach to disaster management in terms of moving from a drought and relief focused approach to a more pro-active multi-sectoral and multi-hazard Disaster Risk Management (DRM) approach. DRMFSS

	oversees two directorates: the Food Security Program Directorate (FSPD) and the Early Warning and Response Directorate (EWRD).
2013	Based on the lessons learned from previous experience, the Government of Ethiopia has ratified a comprehensive DRM policy. The policy includes the necessity of a multi-hazard approach grounded in a deep understanding of specific disaster risk, and its link to development and vulnerability; emphasis on prevention, mitigation, preparedness and post-disaster modalities and capacities; de-centralization of resources and structures; a clear determination of DRM responsibilities, supported by the capacity for legal enforcement and a high degree of accountability. In particular, it moves away from the 1993 policy's focus on drought and aims to the improvement of information on community vulnerability and flood preparedness.
2015	The National Disaster Risk Management Commission was established by the Council of Ministers Regulation No. 363/2015, done at Addis Ababa on 14th December 2015. Through this proclamation the mandates of DRMFSS was shifted to the newly established NDRMC.

Chapter Five: Findings

5.1. Climate related risk knowledge

"Even if the government and NGO do not inform us, we, as individuals and communities, know the upcoming hazards by monitoring star, camel bull behaviors, goat and cattle intestines and know whether there is drought, heavy rain and conflict" said one the elder with indigenous knowledge of weather forecasting" (Molu, R1). In Africa, indigenous knowledge is fundamental of life, from day-to-day livelihood to longer-term actions of life (Leal Filho et al., 2017, 2021, 2022).

As the study by, (Bekele and Amsalu, 2012) raises, the informant interviewed at DRM office (Abbe, R2) told that there is evidence of the high frequent occurrence of drought in Borena pastoralist area from decades to decades and year to year by its magnitude and intensity. As part of risk knowledge, FAO, Mercy Corps and Ethiopian meteorology agency (EMA) are three main organizations involved in forecasting and monitoring climate change in eastern Africa, which includes raining time, amount, and area coverage. Guyo (R3) also mentioned that the information we received as part of risk knowledge and understanding regarding on climate hazards has its own limitation, based on risk and knowledge for preparation part risk knowledge generation. The risk knowledge of early warning systems was effective if it is relevant with the reality happening on ground (Lautze et al., 2005). Gurro (R4) from Oromia disaster risk management commission stated, they collected the data from different varies sources of organization sectors (Agriculture, Metrology, Health, and NGO's) to create district-based risk profile and mapping which takes time for timely knowledge creation and creates warning.

Adding on that collection of early warning data is paper based, and reports are also not supported by technology. But the interviewees from Borana zone DRMO stated that even though there is technology-based (mass media) data center at district level to obtaining up-to-date EWS information from district, four of which I visited during fieldwork were not give functioning. In general, the respective national and regional offices reports, and risk profile have found drought as the top climate induced disaster risks in Borana area followed by floods and prioritized according to their severity and frequency of its occurrence. As part of risk knowledge, based on the priority from risk profile risks identified include drought, flood, landslides and animal and human diseases (DRMO, 2023). Even though report shows availability of risk knowledge, as core point of risk knowledge is risk mapping and how it updates (Šakić Trogrlić *et al.*, 2022; Prudhomme *et al.*, 2024). Galma (R5), the respondent from Melbana village of Miyo District told that "*even if there is risk knowledge on drought, rain*

pattern changes from time to time and from season to season". This shows that climate variability has impact on the existing climate risk knowledge. *Abbe (R2), the expert from Miyo district DRMO added on the risk knowledge by stating "climate change patterns, rain time, livestock disease coming with drought change its normal systems which needs timely updated risk mapping and district-based risk profile and strong monitoring system for good risk knowledge, but the risk mapping and profile updated in five years' time by federal government"*.

The respondents participated on the commonly mentioned drought, flood, livestock diseases and desert locust swarms as the most concerned hazards in their Districts. They added flood hazard as one of the climate related hazards which need attention as it can have damage on lives and livelihoods immediately after heavy rainfall which prompts flash floods in few areas like Moyale District locations which killed 34 camels. *"After flood past two-week later experts told us there is heavy rain coming and all herders should have to settle away from water canal" Jilo (R6)*. This raises the question on clear risk knowledge, pattern and trends of hazards prediction.

Figure 3: Camel died of flash flood in Moyale District, (Source: Moyale district DRMO, 2022)

Word bank (2019) Africa risk profile report on part of risk knowledge shows that Ethiopia has its own risk knowledge. But during my field work visit, district's disaster risk management office doesn't have clear risk profile with full content and not even updated for 10 years. Availability and accessibility of the disaster risk profile document at all levels and for all stakeholders is helpful for planning of various activities such as training, awareness creation and disaster risk mitigation, preparedness, response and rehabilitation planning, since

risk profile documents have list of hazards, vulnerable elements and level of vulnerability, existing capacity and risk priority (UNDP, 2024).

Sora (R8), one former owner of more than 300 cattle's (Dureessa Ciccita in local name means the wealthiest man) before 2022 drought, who have 14 cattle now stated that *"we know everything about the hazards (upcoming drought) but knowing itself is nothing unless I cannot save the life of my cattle's"*

As part of risk knowledge understanding individual and social vulnerability is one thing must take into consideration, as being dependent on cattle production itself with no other livelihood diversity itself in increase the chance of vulnerability. Finally, the existing risk knowledge is general knowledge which shows that drought or other hazards existence in certain region from historical background, but not specific knowledge supported by technology and ground data which is based on exact week of heavy rain, rain by millimeter and exact season of heavy drought (Radeny et al., 2019b; Ebhuoma & Leonard, 2022).()

Professional and stakeholders' involvement

Ethiopian Disaster risk management policy identified stakeholder office and technical experts as member of committee. These technical experts are focal person from pastoral development office, agricultural and natural resource development office, women and children's affaires offices, health office, education office, water and energy and district administrative office were involved in early waning data collection and analysis. These experts were the technical committee members at both district and zonal level early warning committee. Community members, location (kebele) level early warning committees and NGOs were involved to collect early warning primary data as part of drought assessment and risk knowledge generations.

As part of human resource involved, the Borana zone disaster risk management office which I visited have fifteen staff and among those three of them have graduated with field of study related to disaster risk management and early warning system the rest are supportive staff from stakeholder office.

"A Although the early warning committee members come together from different offices and departments, coordination and achieving full participation as planned is challenging. sometimes data from some offices were missed said" Girma (R7).

Identified Risks followed drought

Since the drought was extended for several months, further death of livestock, food and water scarcity; inflation, rise of food price, reduce livestock price, human disease, outbreaks of livestock diseases are the major risk identified in the analyzed documents and reports.

The data used in situation analysis were obtained only from field observation, community and reports by District early warning committee (DRMO head). He also added, during drought *"data and information for situation analysis and reports, were made on daily, weekly, every two weeks and monthly basis from local administrative unit (kebele) to District, from District to zone and from zone to region and then to the federal level via emergency command post established for reporting purpose DRMO head"*.

5.2. Monitoring and warning services of climate related risk

According (ICDR, 2006, P-2) for monitoring and warning service it requires right parameters being monitored, sound scientific basis for making forecasts, accuracy and timely warning generates as key starting point measuring monitoring and warning of early warning system.

In the case of Borana pastoralist this can be done in the main ways of formal and informal monitoring and warning systems (DRMO, 2023). Formal channel of monitoring and warning system was undertaken through government and non-government organizations by using metrology agency, **LEAP** (Livelihood, Early Assessment and Protection) satellite model which uses several data inputs collected from various sources that includes rainfall data, crop data, soil data, and evapotranspiration data. While the informal monitoring system is the way pastoralist uses indigenous ways of monitoring warning system by monitoring rainfall pattern (amount, intensity, distribution and patterns), star pattern, livestock intestine check, and monitoring human and livestock behavior ((Iticha & Husen, 2019b);Tafesse, 2021).

The national disaster risk management commission (NDRMC) obtain information and monitoring indicators through reports (daily, weekly and monthly) its channel of disaster risk management offices at different level form federal to district level and from partner sectors like National metrological Agency, Agricultural office, human health sectors, water and irrigation sectors. Reports are presented for the NDRMC through its structure established in the ways it reaches to District level. "Girma (R7) "*Expert at Borana zone DRMO stated, that DRMO don't have representative's expert of disaster risk/ early warning system to at local level like other*

sectors such as health and agricultural offices to monitor early and risk indicator from the ground". They depend on Development agents of other sectors to obtain its regular reports of hazards indicators by monitoring drought, livestock mobility, water and pasture status.

Monitoring and warning of climate related disaster risks were evaluated based on the three phases of disaster risks which are pre-disaster, during disaster and post disaster (Adams et al., 2022). Abbe (R2) explained that *"the absence of a local staff at kebele level contributes to gaps in monitoring on group hazard indicators, such as tracking livestock body conditions, mobility, and the availability of pasture and water".* Instead of early response action, Ethiopian early warning and disaster risk reduction and management action skewed toward disaster response, emergency, and relief after disaster happened and affect the lives and assets (Beyi, 2011).

Study by Kelman and Glantz, 2014; Šakić) shows that, existing EWS was unable to early respond to disaster hazard due to the technical and institutional challenges of creating on time risk knowledge, generating warning alert, weak on time response to warning, lack of coordination and stakeholder involvement, lack of risk mapping and strong monitoring and evaluation bounded by legal ground responsibility.

Pre-Disaster Monitoring and Warning Services

The District DRMO gathered pre-disaster monitoring of early warning data from local development agents and through surveys, after which the data was compiled and analyzed. After that, collected and compiled data was transferred to the zone and regional offices and to the federal DRMC electronically if the internet is available said sora (R8). The data collected from all districts was compiled by zone and the sent to Regional/ Oromia disaster risk management commission (ODRMC) and finally to the NDRMC through hard copies for further discussion on the collected data and to act. In addition to this normal reporting channel the emergency, shock and new trends like deserts locust report was undertaken by focal person at each districts said Girma (R7).

"The federal DRMC compiled and analyzed together with additional information collected from line ministries and other information sources, notably the National Meteorology Agency. At time climate hazards and vulnerabilities of the communities were identified further by sending experts to those droughts affected areas to assess the level and magnitude of the possible damage Bule" (R10). Luka (R9) NGO staff explained the situation by stating "*Concerning data availability, there were no well-developed and sequentially organized and accessible data in kebeles, Districts and Borena because of absence of data base centers and existing data is also organized according to risk profile to monitor risk indicator and prepare for upcoming hazards".*

For early warning indicators monitoring and climate risk assessments, the NDRMC uses **LEAP** (Livelihood, Early Assessment and Protection) model to get rainfall data, crop data, soil data, and evapotranspiration data, as well as uses reports of Districts (monthly early warning indicators) and additional data from other sectors.

The LEAP model is the strongest predictor of drought conditions according to the experts, but the case in pastoral areas is still at an infant stage to integrate the pastoral environment and way of life (Hoefsloot & Calmanti, 2012). The accuracy of early warning information is dependent on the quantity and quality of input data, and the robustness of the tool in predicting a disaster (ibid). With the use of LEAP tools' efforts have been made to predict the likelihood of disaster events in Ethiopia by the commission but it is important to focus on data quality, timeliness of the data, further refinement of the tools to incorporate emerging conditions and consider livelihood options particularly pastoral communities is very essential to enhance forecasting capacity of the tools for early response (Leal Filho et al., 2017).

"Data collection techniques and analysis methodologies are very traditional mainly at kebele, District and zonal levels as it depends mostly on disaster losses and damages. As a result, there is a gap in properly predicting future risk" Luka (R9.

There are limitations of measuring the intensity (damaging capacity), extent (area coverage), starting and ending date of disastrous events of drought and level of vulnerability of communities and sensitive economic and environmental elements at most levels of Ethiopian EWS (FGD participants).

For monthly report, data collection for monitoring is made manually and filled in similar format in each agro-climatic zone (DRMO, 2023). Some questions found on the report format as investigated during my fieldwork in Dire and Miyo District, indicated that qualitative data were collected and reported for measurable data which is inappropriate report format of data monitoring. For example, as shown on the report format indicated in figure 4A, the question on A3 asked the amount of monthly rainfall, which is measurable in millimeter (mm), but the reporter answered it as "Low" based on the given choices. In figure 4B, question B48 asked about the body weight of livestock compared to the expected average body weight of the livestock during the month of the report which is measurable, and the expert reported "Low" based on the given alternatives on the report format. Similar approach was followed in Moyale District to collect daily rainfall data as shown in table 2. But the indicator, "Low" can be different for different individuals and in different areas; for example, as the amount of rain fall in lowlands and high lands of Ethiopia are quite differs from region to

regions. In addition, what is perceived as "Low" by someone maybe "High or moderate" for others and what is "High" in east may be "Moderate or Low" in west. This type of approach leads to a hasty generalization by undermining the local and the ground truths, especially when reports of several areas aggregate together at zonal, regional and national levels. This is also raised by two my respondents Girma (R7).

"Understanding the language of the data collection and reporting format is also challenging factor for many DAs and zonal experts in recording data and preparing a report" said Dido (R10). The DRMO's found at District, zonal and regional levels including DAs assisting the job of early warning at kebele level are using Afan Oromo for communication as it is official language. Dido added "*peaking and understanding of Amharic language is difficult for many DAs and office experts. The situation leads to miss understanding of the concepts and aim of the required data".*

Figure 4: A sample of early warning reporting format (the year written by pen is in Ethiopian calendar) source fieldwork 2024

Table 2: A sample of rainfall data collection format obtained from Dirre District during Hageya 2023 at field level

S. N.	**Kebele**	**Number of rainy days**	**Amount of rain fall**	**Rainfall distribution across the kebele**
1	Mega	3	Below normal	Not uniform
2	Dida Mega	4	Below normal	Not uniform
3	Haralo	4	Below normal	Not uniform

"*The Ethiopian NMA has been trying to deliver early warning information on climatic conditions such as rainfall, humidity and temperatures which was predicted only for few numbers of days, through existing national media such as TVs, radios and newspaper and most of the predicted messages were not found accurate and local Borana pastoralist doesn't understand the national language. Not only metrology but also indigenous method climate detection is now not accurate like before" Molu (R1).*

5.2.1. Monitoring and Warning Services during drought hazard

Concerning warning services, most of the climate related disasters occurred in the absence of early warning information in Ethiopia (Tafesse 2021)

"Even though it was long time since the establishment of Ethiopian EWS, it was weak in predicting and disseminating/communicating the timely based warning information and monitoring technology for indicator detection contributed to the reduction of losses of life and damages to property because of lack of technology" Luka (R9) and FGD discussant.

"Early warning indicators data collection and reporting become active and continues during disaster phase in Ethiopia, and this indicates that the Ethiopian EWS is made more focused on response and emergency rather than pre- disaster indicators analysis Abbe (R2).

In Borena both at District and zonal levels the change in condition of the disaster situation were updated and reported at daily, weekly and biweekly and monthly bases when drought reach at high level (ibid). Hence, the result achieved in the case of late monitoring and reporting the outcome for the concerned authorities was found hopeless.

"Rainfall, pasture, livestock body and healthy condition, agricultural crop condition and production, livestock mobility/migration and deaths, livestock production and productivity, water sources, school

absenteeism, human health, market condition, and food security situation are indicators monitored in the study area both at pre-disaster and during disaster phases, but monitoring was very active during the disaster phase and lowered at pre-disaster and post-disaster phases FGD".

Lately generated warning messages generated have less contribution for disaster preparedness and hazard mitigation, yet they have contribution to predict how long the disaster will sustain, how the disaster changes in its intensity and extent (area coverage), additional number of populations need emergency aid, and additional resource required in the affected areas and to make choice of effective response depending on the character of the ongoing disaster Girma (R7).

"*With existing EWS there is not enough proper response due to contingency budget at Borana zone level for early response"* said zonal disaster risk management office head".

Post disaster warning and monitoring services

To plan for the next disaster risk reduction, early warning indicators monitored at this phase should be the combination early indicators and late indicators (Ebhuoma & Leonard, 2022). The early indicators are used to generate early information, and the late indicators are used to evaluate impacts resulted from the past disaster and used to predict possible impacts possibly expected from the next impending disasters (Wisner & Gaillard, 2012).

"But historical evidence and the present study showed that, less attention was given for monitoring early warning indicators mostly after disasters were over" Guyo R3.

"FGD participant indicated that the actors who had been participating in data collection, analysis and reporting reduce the activities and get to be relaxed as if the disaster has gone forever".

5.3. Dissemination and Communication of Climate Related Risk Information

According to (ICDR, 2006, P-2) for dissemination and communication of early warning to be effective the following point must be considered, how warnings reach all of those at risk? how risks and warnings understood? Is the warning information clear and useable?

In Ethiopia, warning message is delivered to the community and other stakeholders through different structures and institutions using different medium of communication depending on forecasted climate risk from Kebele to the NDRMC (FDRE, 2013).

While early warning messages deliver to reach community there is a gap of equipment and technologies for information communication and adequate trainings at grassroot levels including Lack of office, office facilities, adequate budget and well-trained manpower especially at the lower level of the structure that is, kebeles and Districts are one of the major bottlenecks for dissemination and communication of early warning information (Girma R7).

This was indicated as one of the gaps and challenges identified by UN (2006), and also the below house pastoralist information center but resident told during field work it doesn't give function for long time.

Figure 5: pastoralist early warning information center source (fieldwork 2024)

In addition to the formally established structure of EWS, the community of Borena pastoralist has its own traditional EWS and information communication (Guye et al., 2022; Leal Filho et al., 2022; Radeny et al., 2019c). The use of this communication channel effectively disseminates early warning information to the community as informal communication mechanisms (Guye et al., 2022; Debela et al., 2021)

Traditional communication and dissemination of early warning information has been taking place informally by individuals who have indigenous knowledge of climate forecasting and monitoring and sometimes(Iticha & Husen, 2019c). Guyo (R4) stated that *"Traditional communication of early warning system was widely used in Borana pastoralis. The sources of early warning information in traditional EWS of Borena are individuals with indigenous knowledge. Individuals who have indigenous knowledge of predicting about future conditions are classified as Ayyantu, Uuchu and Waragu".*

Ayantu's observe the star patterns; Uuchu's read the intestine of slaughtered animals while Waragu's observe the animal and human behaviors. Based on their observations Uuchu's, Ayantu's and Waragu's forecast about future rainfall, drought, peace and security

conditions likely to occur in their areas (Iticha & Husen, 2019). Once individuals with the indigenous knowledge had forecasted about the future condition, the forecasted information are analyzed carefully with the clan leaders and others and latter disseminated to the community by local traditional leaders on any public gathering and livestock watering points to make all the necessary preparations. The presence of traditional prediction and communication of climate related risk information is a common method used by pastoralists in other parts of Africa (Oba & Kaitira, 2006; Egeru, 2016; Oba, 2012).

Figure **6**: goat intestine Uchu read to detect weather conditions source (fieldwork 2024)

*But the problem is absence of well and timely predicted early warning information (*Guyo R4).

Early warning information is accessed in the area, either too late or during the disaster phase in the case of formal government institution. At this condition preparedness and risk mitigation is difficult. Hence, there is weakness in generating and communicating early warning information that gives enough time for preparedness and to conduct disaster mitigation activities in the case of formal early warning system. So, weakness of government structure to properly making early warning information available before the onset of disaster was identified as one of the key bottlenecks in Ethiopia especially for drought which manifests itself slowly. Weak government structures in information generation and delivery to the target community is one of the characteristics of developing countries (UN, 2006; Zommers & Singh, 2014).

Although the formal approaches to information dissemination have been used by the government structure, there was still a high reliance on the informal and traditional approaches to climate related risk information dissemination. This could be attributed to the fact that within the pastoral communities the accumulated traditional knowledge of dealing with climate risk has always worked as decision makers often manage risk holistically (Egeru, 2016). It also provides the pastoralists with a sense of identity as well as a sphere of control founded on experience and familiarity spectrum.

"Concerning the traditional early warning system, the predicted and what has happened become contradictory in some instances. For these reasons, the communities reduced trust on these institutions regarding early warning information disseminated and the necessary preparation were not made accordingly" (Abbe, R2).

5.4. Response capability to climate related risks

After disaster risk is identified and early warning messages disseminated and communicated, effective responses result to the reduce predicted loss followed in disaster risk management program (Wisner & Gaillard, 2012). Most expected responses to early warning messages include, mitigation, preparedness, community capacity building through resource assembling for emergency response, public education and awareness creation and emergency response strategies and action plans development or reviewing the existing ones (UN, 2006*). "But due to limitation of timely based disaster risk prediction, communication and dissemination of warning messages, responses of community, governmental and non-governmental organizations were found late to respond to severe drought"* (Jilo R6).

Girma (R7) discussed the response drought in Borana area as follows "*The responses to the drought situation were very weak due to the slow rate of decision making on one hand and the low capacity of the government resources to respond to the level of crisis. Lack of market for the livestock to destock the existing herd was also a major problem as the risks were widely reported which misinformed the marketing chain along the line. Since the past few years, the security situation in the Middle East has deteriorated and the livestock market (such as camel, sheep and goat) to that destination quitted. Similarly, the change in the political landscape within the country has also its contribution in reducing the livestock traders and hence the price of livestock deteriorated.*

"The formal response system to climate risks especially drought in the case of Borena zone was constrained by structural obstacles which require an early response from federal government contingency fund by the decision of the prime minister office" Bule (R10). These has been witnessed by several studies across pastoralist communities in Africa as both traditional and formal climate related

disaster risk information dissemination is becoming a common form as found by (Egeru 2016). This highly centralized system of EWS started during the 1973/74 & 1984/85 drought periods Birtukan et al., (2014) and was the culture of the day where long chains of administrative structures should be passed along the line of government offices which require a long duration of time and make the response delayed.

5.4.1. Response to Early warning Messages in Borena zone

Mitigation

"Since there were no opportunities to move the livestock to better areas of range and water as drought happened in all part of Borana, efforts made to mitigate disaster risks were not considerable" Sora R8. Gurroo (R4) also added, *"Pond and micro-dam construction for flood harvesting, traditional water management, soil and water conservation strategies, traditional climatic condition forecasting and early warning system are well known and mitigation strategies of the Borena community but recently due to changing conditions of numerous factors in the area and its regions, the system is becoming less capable in mitigating disaster risks".*

Preparedness

The starting of livestock insurance, organizing of emergency fund (contingency plan), grass harvesting and storing or hay making, and runoff/flood water harvesting are the common preparedness practices found in the study area (DRMO, 2022). *But since large number of livestock possessed by most households, the stored hay and harvested flood water did not last more than 2-3 months. Compensations for died livestock were also not paid during the recent drought. The emergency fund that was allocated by the district administration is not substantial when compared to the effects of disasters (*Girma, R7). To mention few examples, the emergency fund allocated for Moyale and Elwaye District was 600,000 Ethiopian Birr which was not exceeding 12,000 Dollars for each. The Elwaye District used 400,000 Birr to buy fuel for water transporting trucks; 200,000 Birr for community services and for purchasing of different types of drugs/medicine but the severity of existing disaster and its effects need millions of dollars (Ibid,2022). Supplementary feeding of cattle is likely to be more effective if instituted early, before mortalities and reduced production are caused by the drought as evidence by studies (Cossins & Upton, 1988).

Disaster/Emergency response

"*Mostly emergency response was provided by the national government after the drought happened and livestock started dying"* (Guyo R3). *The late response was put in place after social and private media exposed the devastating drought effects and this is due to the absence of early warning information and late report for authorized bodies to activate emergency response, and emergency response resources* (Abbe, R2). Abbe also

added "*If resources for disaster response are found at the lower administration level, magnitude and intensity drought on community may reduce".*

This arises from the limited monitoring of early indicators and existing conditions and time-consuming bureaucratic processes in emergency response decision making. The political will to provide early warning information is usually at the center of disaster risk reduction to communities but such will be weak in disasters with the nature of slow onset such as drought. Hence many damages are anticipated regularly (Zommers & Singh, 2014). There is delayance of disaster response as seen in Borena zone during the recent drought disaster (2021/22). Emergency aids came to the area after large number of livestock died, many of them weakened and after most of the Borena pastoralist community lost their sources of livelihoods and after most of them lost what to eat and drink.

As part of disaster risk management, disaster response/emergency response is a very crucial phase of disaster risk management carried out during the time of disaster to reduce number of lives to be lost and resources to be damaged. Following the drought disaster occurrence during 2020/21 in Borena zone, various stakeholders such as governmental organizations, NGOs, private companies and individuals participated in providing emergency aids including food, water, fodder, cash and medicine (Figure 5.)

Figure 7: Animal feed aid for Dubluk District community (Source: Dubluk District DRMO, 2022 report)

5.4.2. Community Response to Disaster

"Even though the pressure of the drought has severely weakened the community at time of drought, the Borena communities were struggling to sustain their lives and livelihoods using their own resources, capacity and indigenous knowledge in addition to external support "Guyo R3). Attempts made to feed the

livestock with tree leaves, fruits (figure 6) and mobility were the most known response measures practiced by the community in the area.

Figure 8: Local community while trying to collect acacia tree leaves for starved livestock in Moyale District (Source: Moyale District DRMO, 2022)

"In addition to the above response strategies, Borena pastoralist communities have strong social capitals which assist them to survive during the period of disaster events by sharing resources (such as food, live animal, mammary cow & goat, taking care of the resources of old people who cannot go along with their livestock to other areas)" (Jilo, R6). Such social capital is found to be a common denominator for pastoralist communities elsewhere in Africa (Cossins & Upton, 1987; Swallow, 1994). "*The change in livestock composition from cattle & sheep to camel & goat is another response to frequent drought because these animals can resist the drought condition"* (Molu, R1).

Mobility

Mobility is part and parcel of extensive livestock production in Sub-Saharan Africa. Livestock owners undertake mobility, ranging from daily herd movement to seasonal transhumance or migration (Cossins & Upton, 1988; Swallow, 1994; Wario et al., 2016). Mobility with livestock from drought affected area to relatively better one was a major response to drought disasters in Borena zone for centuries. Such response to drought disaster was found to be effective in reducing the effects of drought. This practice was effective when there was low population density of human and livestock in the area. But, recently since the population number of both human and livestock increased and change in frequency of occurrence and severity of droughts, existing condition of the area and available natural resources (in terms of range land, water and favorable climatic conditions) failed to support the increased human and livestock population.

Other factors such as conflict for land resources with neighboring ethnic groups and unsolved boundary between Oromia and Somali regional states issues limited the mobility of the community except within their own defined territory. Government policy which popularizes sedenterization and shifting from purely pastoral system to agro-pastoral and education services are limiting mobility of the communities apart from other important factors.

Molu also added "Although, mobility exists, the scale to which happens is very limited within small areas and cannot be a long-term coping strategy to drought disaster. The strategy is becoming ineffective to be used as a response mechanism to drought as it has been used for so long period of time in the past. It has reached almost on its pre-phase-out time".

In general community responses to disaster in various ways within their capacity are one of the important elements of response capability and this was evidenced by several findings (Cossins & Upton, 1988; Abate et al., 2009; Debsu & Pfeifer, 2013; Zommers & Singh, 2014; Wario et al., 2016).

Response by NGOs

As reported by Borena zone DRMO, more than 24 NGOs have intervened in different disaster/emergency response such as water rationing, water scheme maintenance and sanitation and hygiene, education, health and nutrition, cash transfer, livestock feeding and provision of emergency veterinary drugs. For the above-mentioned responses more than 180,000,000 birr was secured as reported by the zonal DRMO during the time of data collection. Apart from NGOs, the supported obtained from individuals, religion and higher educational institutions, diasporas, and the wider international communities.

Conclusion

The research has explored the Exploring the Role of Early Warning Systems in Enhancing Early Response to Climate Disasters in Lowlands Ethiopia: The Case of Borana Pastoralist Area. By focusing on the by four key elements early warning system of Risk knowledge, monitoring and warning system, communication and dissemination system, and response capacity to mitigate the adverse impacts of climate-related risks, particularly droughts under formal and informal EWS. The question research is, "How early is early warning system and its role in Borana pastoralist community enhancing early response to drought disasters?" has been addressed through qualitative research methodologies, including in-depth interviews and focus group discussions. Based on the research question the finding of research shows that integrating traditional and scientific EWS creates framework for disaster risk reduction.

The study also found that early warning provides early and on time alerts regarding upcoming hazards, community and individual effectiveness of warning message influenced by community's risk knowledge, understandable and accessibly warning messages, mean of communication and existing response capacities. Furthermore, the study finding shows that indigenous knowledge plays vital role in the early warning system of Risk knowledge, monitoring and warning system, communication and dissemination system, and response capacity to complement formal early warning system mechanisms. The study contributes to the issues of climate change induced disasters as main area in the development studies program by emphasizing on the role of EWS to enhance the resilience of vulnerable communities. The Borana pastoralists have their indigenous knowledge systems to know, interpret and make decision to drought risk management. Recognizing and incorporating this indigenous knowledge into formal EWS can develop more effective policy and strategies for disaster risk management.

The study finding also shows that the response to drought Borana pastoralist area is delayed at early stages and starts as the drought become more severe levels. It also highlights the need for technology in risk assessment, monitoring, and communication to follow-up indicators early, identify drought sooner and communicate effectively to mitigate the severity and intensity of drought events. The study was conducted in limited pastoralists of Borana which may limit to generalizing other region facing similar climate challenges. Additionally, while qualitative approach used in this study, it may not capture quantitative data for a comprehensive analysis of EWS effectiveness. Future research could benefit from combining qualitative with quantitative data to provide a more holistic understanding of EWS in different contexts. The implications of this research extend beyond the local context. As climate change continues to pose significant threats to food security and livelihoods in many parts of the world, enhancing the effectiveness of early warning systems is crucial for global disaster risk reduction efforts.

Recommendations

Based on the findings of this study, I propose the following recommendations to effectively address the challenges of Ethiopian EWS to climate risk hazards in the lowlands of Ethiopia particularly in Borena zone

Decentralization of early response resources (such as emergency response food, finance, and nonfood items) based on the hazard specific data obtained at district and Kebele level

which could reduce the risks before it is becomes disaster. Establish a reliable and efficient provision of climate change related risk information to communities as a basis for decision making process at household, community, Kebele, and district level structure. Building resilient communities through introducing drought resistant crop varieties, changing livestock compositions such as shifting the mix of herd from cattle and sheep to camel and goat.

Creating awareness through training for community, experts and individuals with traditional EW knowledge (Ayantu, Uchu and Waragu) and integrating formal and traditional EWS based on their relevance, reliability and efficiency. Establishing data centers from which climate risk information can be collected, analyzed and reported on a regular basis and improving access to local based quality data with up-to-date information and timeliness per risk profile and risk mapping. Strengthening of woreda-net internet infrastructure which will increase the speed and transmission of EW information from the community national level and vice versa. Enhancing of advanced technologies such as models and software's that could indicate specific location with risk bearing events in such a way that it can be easily accessed and monitored by the concerned body especially ODRMC & NDRMC.

Early/timely response to reduce the consequences of disaster on lives and livelihoods before it reaches to the level of high cost for coping and rehabilitation is necessary to make communities resilient from the climate related disaster risks. Encouraging policy that reducing the number livestock holding per household and focusing on quality breeds, livestock productivity, marketing livestock and its processed products such as meat, milk, & skins.

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Annex

Declaration of Consent

Sir/madam,

I am Tura Gagna Diba, I am currently pursuing a master's degree in development studies on the major of social policy for Development at the International Institute of social Studies, Erasmus University Rotterdam, the Netherlands. I am conducting research on climate disaster early warning system in the Borana pastoralist community. I am interested in exploring the role of early warning system in disaster early response. I am going to ask you the question pertaining to your experience on the drought disaster and early warning systems. Therefore, your expert answers would be momentum to broaden my knowledge on the problem and at the same time make recommendations to policymakers. Please note that all the responses and any personal information will be kept secret and will not be used for other purposes. Before we begin, I would like to request your permission to record this interview. The purpose of recording is to ensure accuracy in capturing our conversation and to assist me in accurately reporting your insights. The recording will be used purely for the purpose of this research and your personal information will be kept strictly confidential.

Is it okay if I record the interview? If yes, please feel comfortable to stop me at any point if you wish to discontinue this interview.

I appreciate your availability and voluntary participation, and I believe that your opinions will be instrumental in this work.

With regards

Questionnaire

Section 1: question for expert (both government and NGO staff)

Organization Name:

System Overview

a. Please describe for me your organization's involvement in early warning systems in the climate related disaster.
b. Are the hazards and the vulnerabilities well known? Listed? Prioritized?
c. What are those hazards and vulnerabilities?
d. What type of early warning system does your organization use?
e. How did you know these hazards and vulnerabilities?
f. Did you get training and orientations?

g. What are the patterns and trends in these factors?

h. Are risk maps and data available for each district area? By what time risk maps updated?

MONITORING & WARNING SERVICE (Develop hazard monitoring and early warning services/Early warning Data Collection and Analysis/

a. What types of data sources does the early warning system utilize?

b. How is data collected and processed?

c. What analytical tools and methods are used to interpret the data?

d. How frequently is the data updated and analyzed?

e. What is the role of the gender issues and how women involved?

f. What was hazard specific indicator of the hazards?

g. Are the right parameters being monitored?

h. How early is early warning ? especially in relation to the timing of the warning compared to the timing of the hazard—and of the vulnerability?

i. What constitutes a 'warning'—just the information about the hazard or more?

j. How is that warning triggered?

k. What is meant by a 'system': formal, informal, quantitative, qualitative, or anecdotal?

l. is there a sound scientific basis for making forecasts?

m. Can accurate and timely warnings be generated?

Section 4: Communication and Dissemination (Communicate risk information and early warnings)

a. How are warnings communicated to stakeholders?

b. What platforms or channels are used to disseminate warnings?

c. Who is responsible for disseminating the warnings?

d. How do you ensure that the warnings reach the most vulnerable populations?

e. Do warnings reach all of those at risk?

f. Are the risks and warnings understood and by which language?

g. How report prepared and when? Weekly, monthly, quarterly etc.?

h. Is the warning information clear and useable?

RESPONSE CAPABILITY (Build national and community response capabilities)

a. Are there response plans? Contingency plan and budget?

b. Are local capacities and knowledge made use of?

c. Are people prepared and ready to react to warnings?

d. What actions are taken by the community in response to drought warnings?
e. How effective have these response actions been in mitigating the impact of drought?
f. How do you evaluate the response capability of local communities when an early warning is issued?
g. What training or preparedness programs are in place to strengthen community response to early warnings?
h. In your experience, how do cultural factors influence community responses to early warnings?

Effectiveness and Challenges

a. How do you see the role of your early warning system?
b. What are the key success factors of your early warning system?
c. What challenges have you encountered in implementing and maintaining the early warning system?
d. How have you addressed these challenges?
e. Can you provide a detailed example of a recent drought event where the early warning system was used?

Feedback, Improvement, Recommendations and Future Directions

a. How do you collect feedback from users of the early warning system?
b. What have been the main points of drought feedback from users?
c. What future improvements or expansions are planned for the early warning system?
d. How do you plan to incorporate new technologies or methodologies into the system?
e. What role do governmental and non-governmental organizations play in coordinating early warning efforts in the Borana area?
f. How effective is the governance framework in supporting the implementation of early warning systems?
g. Can you identify any gaps in the institutional arrangements that hinder effective early warning and response?
h. What recommendations would you make to improve early warning systems in the Borana pastoralist area?

Closing

Thank you for your valuable insights. Your responses will contribute significantly to understanding the role of early warning systems in enhancing disaster response in the Borana pastoralist area.

Questionnaire

Section 1: question for local elders

Organization Name:

System Overview

a. Did you know early warning system?
b. How did you know it?
c. What are the hazards and vulnerabilities?
d. What type of early warning system does your organization use?
e. How did you know these hazards and vulnerabilities?
f. Did you get any training and orientations on EWS? By which organization?

MONITORING & WARNING SERVICE (Develop hazard monitoring and early warning services/Early warning Data Collection and Analysis/

a. What types of method you use to monitor climate change?
b. Is there any hazard specific indicator of the hazards?
c. How frequently you monitor the climate system?
d. How early is early warning? especially in relation to the timing of the warning compared to the timing of the hazard—and of the vulnerability?
e. What constitutes a 'warning'—just the information about the hazard or more?
f. Can accurate and timely warnings be generated?
g. What is the role of the gender issues and how women involved?

Section 4: Communication and Dissemination (Communicate risk information and early warnings)

a. How are warnings communicated to you?
b. What platforms or channels are there used to disseminate warnings?
c. Who is responsible for disseminating the warnings?
d. How do you ensure that the warnings reach the most vulnerable populations?
e. Do you think warnings reach all of those at risk?
f. Are the risks and warnings understood and by which language?
g. Is the warning information clear and useable?

RESPONSE CAPABILITY (Build national and community response capabilities)

a. Are you ready to react to warnings?
b. What actions are you taken in response to drought warnings?
c. How effective your response actions are in mitigating the impact of drought?
d. How do you evaluate the response capability of local communities when an early warning is issued?
e. In your experience, how do cultural factors influence community responses to early warnings?

Effectiveness and Challenges

a. How do you measure the effectiveness of early warning system?
b. What are the key success factors of your early warning system?
c. What challenges have you encountered in implementing and maintaining the early warning system?
d. How have you addressed these challenges?
e. Can you provide a detailed example of a recent drought event where the early warning system was used?
a. What role do governmental and non-governmental organizations play in coordinating early warning efforts in the Borana area?
b. How effective is the governance framework in supporting the implementation of early warning systems?

Closing

Thank you for your valuable insights. Your responses will contribute significantly to understanding the role of early warning systems in enhancing disaster response in the Borana pastoralist area.

I have read the information letter. I understand what the study is about and what data will be collected from me. I was able to ask questions as well. My questions were adequately answered. I know that I am allowed to stop at any time. By signing this form, I

1. consent to participate in this research.
2. consent to the use of my personal data.
3. confirm that I am at least 18 years old

4. understand that participating in this research is completely voluntary and that I can stop at any time; and
5. understand that my data will be pseudonymous for publication, education, and further research.

Check the boxes below if you consent to this.

Data

I consent to the researcher's collection, use and retention of the following data:

Audio recording ☐

I consent to the interview being audio recorded.

I consent to the sharing of my data with Erasmus University Rotterdam in the Netherlands. ☐

Use for educational purposes

I hereby consent to having my personal data under a pseudonym stored and used for educational purposes and for future research, also in other areas of research than this research. ☐

My answers in the article with my name

I give permission for my name to be used with my answers in an article.