FINAL REPORT: FLOOD FORECASTING AND EARLY WARNING SYSTEM (FFEW) ASSESSMENT FOR ETHIOPIA

FLOOD FORECASTING AND EARLY WARNING ENHANCEMENT PROJECT

Submitted by

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ENTRO is an organ established to implement the Eastern Nile Subsidiary Action Program within the framework of Nile Basin Initiative

Egypt, Ethiopia, South Sudan, Sudan

Executive Summary

Introduction

The Eastern Nile countries, Egypt, Ethiopia, Sudan and the South Sudan are engaged in joint investments in Eastern Nile sub-basin under the Eastern Nile Subsidiary Action Program (ENSAP). The Eastern Nile Council of Ministers (ENCOM) governs ENSAP. The four member countries and bilateral and multilateral development partners fund ENSAP.

ENTRO headquartered in Addis Ababa, Ethiopia, is the executive arm of ENSAP. It was established in 1999. ENTRO supports Eastern Nile Council of Ministers (ENCOM) and Eastern Nile Subsidiary Action Program Team (ENSAPT) in preparing cooperative water resources investment programs and projects, capacitating and strengthening institutions and providing secretariat support to its governance. Since its establishment, ENTRO has been playing significant role in advancing and enhancing cooperation among the Eastern Nile countries on water resource development and management.

Objectives of the study project

The present study project aims to ensure a robust forecasting, issuing and warning system that effectively minimize loss of life and damage by enhancing, expanding and developing a unified Flood Forecast and Early Warning (FFEW) system for EN basin. Further, to support other studies under FFEW that contribute in addressing flash flood, stakeholder analysis and flood related DSS development. The scope of work includes the following two major tasks:

Task 1: Flood Forecast System Enhancement:

- Review and analyze the gaps on the current stakeholder list at various level from data providers, forecast warning users, local communities at flood prone areas,
- Review best practice and methodologies currently available and applied in different basins and other relevant documents to be adopted
- Survey country level actors, information dissemination and action for flood early warning
- Map out current and preferred communication methods between regional, national and local levels for flood early warning and action.
- Assist and work closely with other members to specify the needs of stakeholders, communities, policy-makers, decision maker in flood disaster early warning

Task 2: Capacity building

- Deliver a training in collaboration with other team members

- Conduct and participate in consultation and validation workshops

The Method

The conceptual framework that guided the study has four components i.e, monitoring, forecasting, warning and response. A qualitative methodological approach was adopted to understand the flood forecasting and early warning practice at the national, regional, *woreda* and community levels. The study mainly focused on the dissemination and communication of warnings at all levels.

The collection of primary and secondary data was carried out. The primary data was gathered through telephone and face-to-face interviews with key informant including officials and experts involved in flood forecasting and early warning. Secondary data was obtained through reviewing of documents including NGO's reports, Disaster Risk Management and Food Security Office reports, books, internet, and other published and unpublished documents. Key informant interviews were conducted using the following three data collection instruments namely:

- Questionnaire Regarding the Early Warning Issuing Institutions;
- Questionnaire Regarding Flood Affected Communities; and
- Questionnaire for Country Level Actors in Flood Early Warning System.

An overview of the main findings

ENTRO's flood early warning in Ethiopia concentrates on three major river systems, i.e., Abbay-Blue-Main Nile, Tekeze–Setit-Atbara and Baro-Akobo-Sobat. In the Eastern Nile part of Ethiopia the well known flood prone areas are the flood plains abutting Lake Tana, Gambella plain, and Humera area (near Ethio-Sudan Boarder) of Tekeze basin and flash floods in different locations.

In the mapping of stakeholders of flood early warning system, 55 are identified and grouped under 10 main categories as national government, regional government, local government, communities, regional institutions and organizations, international bodies, non-governmental organizations, private sector, science and academic community and media.

The flood data and forecast providers identified are:

- The Eastern Nile Technical Regional Office, which prepares and communicates the flood forecast with the Ministry Water, Irrigation and Energy assuming that it will be communicated to the end users (local communities).
- The National Disaster Risk Management Commission issues the National Flood Alert and communicates to about 120 stakeholders by email including regions. Regional Disater Risk Management Commission offices will communicate to Zone and Woreda. The Woreda communicates the Kebele and local people.
- The Ministry of Water, Irrigation and Energy based meteorological data produces information for development sectors. The flood forecasting is only for riverine.
- The National Meteorology Agency gives advance warning on adverse weather conditions. The forecasting is carried out for one day, two days, three days, ten days and four months. The weather forecasts cover 34 towns.

- The non-governmental organizations including UNICEF, WFP and UN-OCHA calibrate the flood early warning obtained from the NDRMC to identify specific communities that will be affected by flood.

Vulnerability mapping

Vulnerability mapping shows the flood prone areas in Ethiopia scattered in many parts of the country along the major rivers and Lake Tana. Communities along the following rivers and Lake Tana are vulnerable to flooding.

- The Rib and Gumera rivers in South Gondar,
- Gilgel Abay river in West Gojam,
- Dirma and Megech rivers in North Gondar,
- In Gambella, Baro, Gilo,and
- Akobo and SNNPR Omo River.
- Lake Tana area

Stakeholders' gap

The flood early warning data providers

Eastern Nile Technical Regional Office

- ENTRO's flood forecast is not communicated to the flood prone areas for the last three years.
- ENTRO is not engaged in seasonal flood forecast with the lead time of 1-3 months.
- ENTRO's data sharing and collaboration with other institutions is not satisfactory
- The existing early warning system does not facilitate effective co-ordination between stakeholders.
- ENTRO is less engaged in increased dialogue between EWS suppliers and recipients of warnings to appreciate the local culture, custom, media and geography.
- There is no sound institutional arrangement for effective dissemination of the forecast.

Ministry of Water, Irrigation and Energy

- The Ministry of Water, Irrigation and Energy, being doubtful of the forecast, is not communicating and verifying the flood forecast issued by ENTRO to the stakeholders for the last three years.
- Although the National Policy and Strategy on Disaster Risk Management (NPSDRM) of Ethiopia designates the Ministry of Water, Irrigation and Energy as a lead institution with respect to floods disaster, it did not assume such responsibility yet.
- There is no forecast for rivers without reservoirs.
- The MWIE is not involved in forecasting for flash floods.
- The MWIE is not considering indigenous early warning systems although it believes in the importance. Further, the media is not utilized for flood forecasting.

National Disaster Risk Management Commission

- The Ethiopian National Policy and Strategy on Disaster Risk Management gives the lead role to the Ministry of Water, Irrigation and Energy. However, this role is being played by the NDRMC. The National policy is not translated into action
- At Woreda and kebele levels, the early warning communication system is not well structured.
- The flood EWS, at governmental level, is not well owned and the practice is characterized as a fire fighting.
- The interest to get flood alert feedback from communities did not materialize.

National Meteorology Agency

- The lack of highly specialized manpower and technology have limited the capacity of NMA to issue seasonal flood forecast with lead times of about 1-3 months
- Lack of forecasting data has forced NMA to carry out the probability forecast with limitation.
- Data sharing and collaboration between institutions, ministries and ENTRO is not institutionalized.

Non-governmental organizations

- National flood Alert as too general. It does not indicate specific localities that would be affected by flood.
- Coordination among different institutions is not institutionalized.
- The early warning system focuses on response.

The flood forecast warning users

The flood forecast warning users include national, regional, zonal and Woreda level government offices, NGOs, UN agencies and humanitarian organization. These institutions are expected to disseminate the warnings to the flood prone communities through different channels. Among the gaps reported capacity limitation, the flood alert is too general, lack of coordination, community members' reluctance to act according to the flood alert and budget constraints.

Best practices and methodologies

Countries' experience in terms of best practices and methodologies of flood early warning communication was reviewed. The best practice from Ethiopia is about the communities in Dire Dawa Administration which reduced their vulnerability to weather-related hazards following the integration of indigenous and conventional knowledge on Early Warning Systems through a joint multi-sectoral platform.

The best practice from Assam State, India indicates that the early warning system has been viewed in the context of a river basin approach where upstream, midstream and downstream activities affect the time of concentration and volume of runoff as reflected in the shape of the hydrograph. In addition, it was noted that the involvement of the entire stakeholders under FLEWS as without their active participation FLEWS could have never been a success.

Current flood early warning communication method

Eastern Nile Technical Regional Office (ENTRO) conducts daily monitoring with three-day lead-times to produce forecasts. Rainfall and hydrological data is used to model and predict flooding with greater accuracy. Daily, weekly, and seasonal flood forecast reports are generated and disseminated to different users at different levels through the ENTRO web portal, email, and mobile phone messaging.

The National Disaster Risk Management Commission (NDRMC) communicates the Flood Alert to stakeholders by telephone and email. Further, at the time of flooding frequent communications are carried out. NDRMC communicates the issued flood alert to the Regional Commission Offices by e-mail. The flood alert will be discussed by the Regional Disaster Risk Management Committee (RDRC). The regional DRMC will communicate the flood alert to zone and Woreda offices by telephone. . The Woreda in turn communicates the kebele administration by telephone, which is responsible for the dissemination of warnings at community level.

Gaps in existing communication methodology

The following gaps in the existing flood early warning communication methodology are identified.

Eastern Nile Technical Regional Office

- The Ministry of Water, Irrigation and Energy has not communicated ENTRO's flood forecast to the stakeholders for the last three years.
- Since ENRTO directly communicates the Ministry of Water, Irrigation and Energy, the participation ofthe public and non-governmental organizations in the process of warning communication is not obtained.
- The existing early warning system does not facilitate effective co-ordination between stakeholders.
- ENTRO's consultation of stakeholders to get feedback on the flood early warning is very low.
- The existing institutional arrangement does not allow carrying out effective dissemination of the forecast.

National Disaster Risk Management Commission

- At present, the woreda disaster risk management activities are carried out along with agricultural activities by the woreda agricultural office. This has resulted in poor performance in terms of early warning communication.
- EWS is not well owned and the practice is characterizes as fire fighting.
- Some rural kebeles have no access to modern communication technology. For instance, the 16 rural kebeles in Jore woreda, Gambella region, have only two police radio communications which can serve for the early warning. The local people do not have personal radios. There were incidences of flooding in Demedolo Woreda, Nuer zone without prior notice.
- Sirens are not functional (e.g Libo Kemkem, Amhara region)

- Flooding can take place without issuing warnings to the local people (Kola Deba, Amhara region).
- No evidence of of monitoring mechanisms to check whether the warning message reach, understood and interpreted into action by the community members.

None-governmental organizations

- UNICEF, WFP and UN-OCHA noted that the National Flood Alert is too general. It does not indicate specific localities that would be affected by flood.
- Coordination among institutions is not institutionalized.
- The focus is on response rather than preparedness.

Local communities

- Some community members are reluctant to accept flood warnings
- In some areas, local people do not know what EWS means (eg. Jabitchinan, West Gojjam Zone)

Proposed flood early warning communication method and technology

Realizing the gaps in the existing communication method and technology of flood early warning, this study proposed the following.

Between users of flood early warning and data providers of warnings

- For any EWS to be effective increased dialogue between EWS suppliers and recipients of warnings will help to ensure that the former understand the needs of the latter, which includes an appreciation of local culture, custom, media and geography.
- One of the most effective ways to build rapport and understanding between governments and user communities is through mutual education.
- It must understand the needs of its users, and ensure users are involved in the EWS design as well as its implementation.
- Media is an essential part of any EWS and one of many tools for the dissemination of a warning.
- Many remote, rural communities rely on VHF radios as a primary method of communication. This type of media, in particular, necessitates a concise, coherent warning message
- Multiple forms of media need to be used, but there must be coordination with those responsible for disseminating warnings must remain abreast of developments in media and communications technology
- The increase in mobile phone usage opens new possibilities for effective dissemination of a flood warning

Current response activities to flood early warning

Flooding takes place every year in Lake Tana areas and Gambella plains. The response activities to flood early warning could be grouped into three. The first group of local people responds positively to warnings by taking the necessary preparedness actions to save their lives and property. The second group of people are reluctant and do not respond to the warnings. For instance in Amhara region, in some localities of Fogera woreda the flood incidence was noted. The third group of community members is without viable options to take the necessary preparedness action. For instance, the people living in the plains of Jore woreda, Gambella region cannot resettle in safer area because the flat land is easily inundated.

Proposal on how to improve the response to early warning

To improve the response to early warning, the following are suggested.

- Government and other stakeholders should develop the capacity of disaster risk management offices at all levels.
- Sufficient budget allocation to flood prone areas must be considered.
- Regular risk awareness creation should be given to community members.
- The flood early warnings should be timely and area specific to obtain better response.
- Due attention should be given to indigenous early warning practices.
- The community-based solutions guarantee that warning communications reach communities at risk, and that vulnerable communities are therefore prepared to counteract the risk.

Gaps in the current institutional setup at regional and national

The gaps in the current institutional setup at national and local level include concentrate on institutional arrangement, technology, infrastructure, and forecasting capability, human resources and expertise.

Proposed setup for an effective early warning system

In general, the National Policy and Strategy on Disaster Risk Management of the country has clearly designated the Ministry of Water, Irrigation and Energy as the lead institution for flood disaster risk management. The preferred institutional arrangement is to implement the policy into action. In this regard, the Ministry should assume its responsibility which would facilitate the flood early communication. The study proposed a set-up at regional and national level for an effective early warning system. The institutional setup could facilitate direct communication and shortens the communication process.

Recommendations

- NDRMC and UN-OCHA underlined that flood early warning system could be sustainable if the Ministry of Water, Irrigation, and Energy assumes lead responsibilities according the National Disaster Policy and Strategy. There is no concrete action with regard to the implementation of the lead role by sector institutions according to the policy and strategy of disaster risk management. Such issue should be resolved at higher level (Prime Minister's Office) so that sector ministries could mainstream disaster in their development plan.

- To overcome capacity limitation of NRDMC, NMA and ENTRO, the provision of training and upgrading of forecasting modeling are imperative.
- ENERO should communicate the flood forecast output to a wide range of stakeholders.
- ENTRO should regularly consult stakeholders with regard to the type of information stakeholders need.
- ENTRO should be a member of Nation Early Warning Technical Committee.
- ENTRO should sign a memorandum of understanding with, NMA and other important organizations to facilitate data sharing and collaboration.
- ENTRO flood early warning message indicates to what extent the water level is raised compared to the average. It should provide detailed information with regard to the magnitude of the flooding.
- The flood early warning system focuses on response. Since the flood prone communities are known, NDRMC should give emphasis to preventive actions.
- NDRMC should continue the restructuring process so that the disaster risk management office at woreda level could be organized independently.
- The flood forecast data providers should employ high performance technology for better forecast output, which minimizes doubtfulness on the part of forecast users. Further, this effort should be supported by indigenous flood early warning practices.
- Capacity building in terms of forecasting techniques and regular awareness creation at community level should be practiced to reduce the negative impacts of flooding.
- The regional governments and NDRMC need to consider the construction of permanent structure to protect local people from flooding in Gambella area since the flood affected people do not option to resettle in safer place.

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Acronyms

BAS Baro-Akobo-Sobat

BCA Basic Cooperation Agreement

BCA Basic Cooperation Agreement

CMDRR Community Managed Disaster Risk Reduction

DRMFSS Disaster Risk Management and Food Security Sector

EN Eastern Nile

ENB Eastern Nile Basin

ENCOM Eastern Nile Council of Ministers

ENMA Ethiopian National Meteorological Authority

ENPM Eastern Nile Planning Model

ENSAP Eastern Nile Subsidiary Action Program

ENTRO Eastern Nile Technical Regional Office

ERC Emergency Relief Coordinator

FEWS Flood Early Warning System

FPEW Flood Protection and Early Warning

GHA Greater Horn of Africa

IASC Inter-Agency Standing Committee

IDEN Integrated Development of the Eastern Nile

IDP Internally displaced persons

MDGs Millennium Development Goals

MoU Memorandum of Understanding

MWIE Ministry of Water, Irrigation and Energy

MWIE Ministry of Water, Irrigation and Energy

NBI Nile Basin Initiative

NCORE Nile Cooperation for Result

NDRMC National Disaster Risk Management Commission

NELSAP Eastern Nile and the Nile Equatorial Lakes Subsidiary Action Program

NGO None Governmental Organization

NMA	National Meteorology Agency
TOR	Terms of Reference
UN OCHA	United Nations Office for Coordination of Humanitarian Assistance
UN	United Nations
UNHAS	Humanitarian Air Service
UNICEF	United Nations Children Fund
UNISDR	United Nations International Strategy for Disaster Reduction.
WFP	World Food Program
WRF	Weather Research Forecast

Local Terms

Gote	*V*illage
Kebele	The lowest administrative unit in the government structure
Killele	Regional administration

1. INTRODUCTION

Floods are considered the most destructive of all natural disasters because they are the most common cause of the greatest number of deaths, and result in the most damage (Mileti, 1999). The increasing frequency and intensity of trans-boundary flood events in the Eastern Nile region, which is likely to continue or worsen due to climate change, reinforced the importance of regional cooperation and capacity development in flood forecasting and early warning systems.

The Eastern Nile countries, Egypt, Ethiopia, Sudan and the South Sudan are engaged in joint investments in Eastern Nile sub-basin under the Eastern Nile Subsidiary Action Program (ENSAP). The Eastern Nile Council of Ministers (ENCOM) governs ENSAP. The four member countries and bilateral and multilateral development partners fund ENSAP.

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1.1 Rational and objectives of the consultancy work

- **1.1.1 Rational of the project**

The rationale behind the intended study project is based on the following gaps of the current FFEWS in terms of:

- coverage of all flood prone areas in the basin;
- robustness of the system and model;
- enhancing the system to up-to-date forecast standard; and
- using different models for the different flood prone areas in the basin, which is time consuming and hard to update; and
- the need for further in-depth understanding of most vulnerable communities, their socio-economic characteristics in order to design fit-for-purpose response and preparedness mechanisms (TOR and Scope of Services for Surveyor)

- **1.1.2 Objectives of the Project**

The objectives of the project are:

- To ensure a robust forecasting, issuing and warning system that effectively minimize loss of life and damage by enhancing, expanding and developing a unified Flood Forecast and Early Warning (FFEW) system for EN basin; and
- To support other studies under FFEW that contribute in addressing flash flood, stakeholder analysis and flood related DSS development (TOR and Scope of Services for Surveyor).

1.2 The Study Sub-basins

Flooding in Ethiopia, among others, occurs in the the major river systems, i.e., Abbay-Blue-Main Nile, Tekeze–Setit-Atbara and Baro-Akobo-Sobat. In Eastern Nile Part of Ethiopia the flood prone areas are the flood plains abutting Lake Tana, Gambella plain, and Humera area (near Ethio-Sudan Boarder) of Tekeze basin and flash floods in different locations.

- **1.2.1 Abay- Blue-Main Nile (Lake Tana area)**

Flooding is a recurrent threats occurring almost every year in Lake Tana area caused by the overflowing of the Rib, Megech, Gumaro and Gumara rivers and the spillover of Lake Tana

(Woldeab, 2006:22).

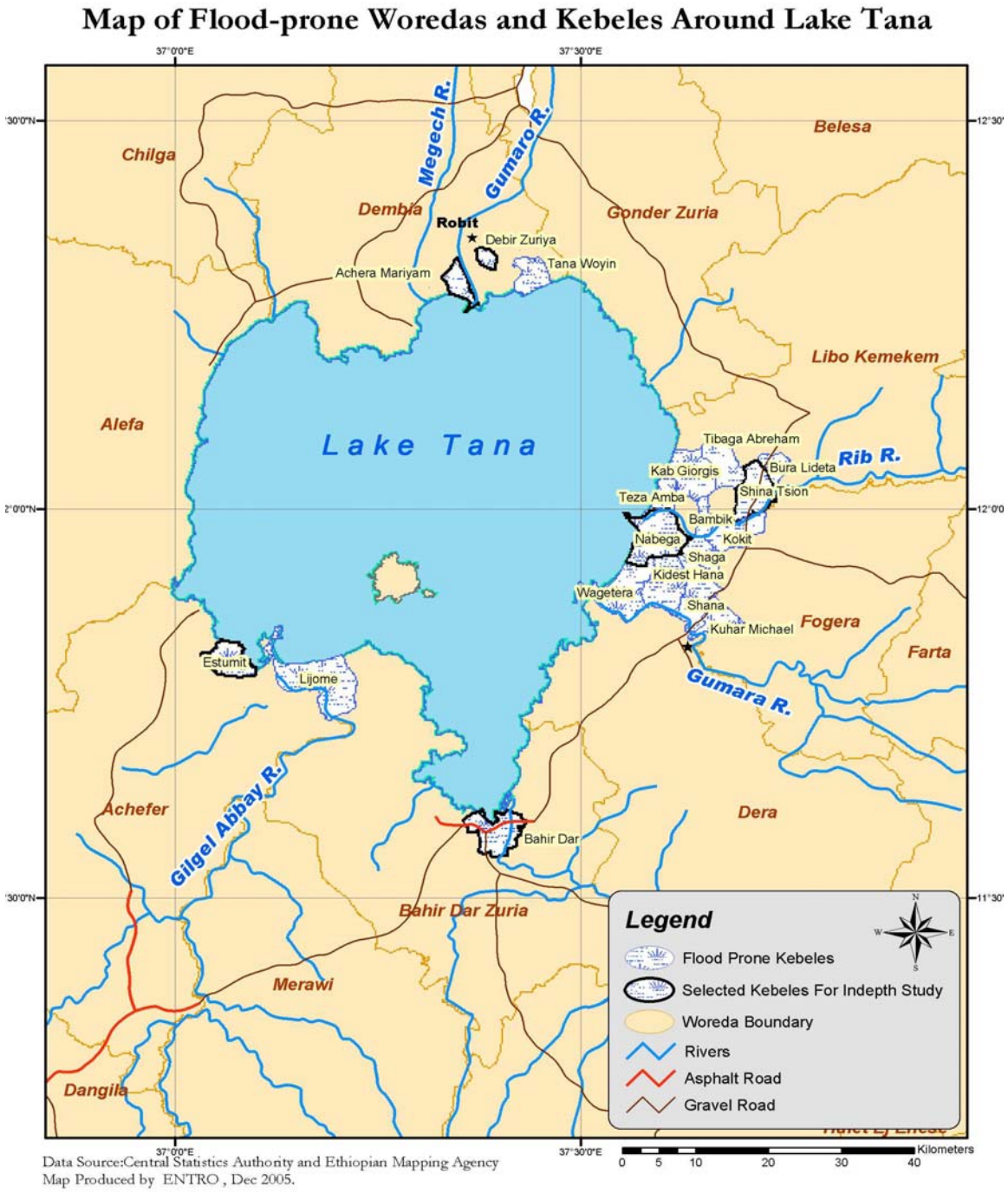


Figure 1.1 Map of flood prone-woredas and kebeles around Lake Tana

Fogera and Libo Kemkem woredas, Dembiya woreda and Bahir Dar special zone, all adjoining Lake Tana are the flood risk areas. In the urban areas of Bahir Dar, flood impacts have largely been the consequence of poor drainage systems in the city and local catchment runoff (SMEC,

2006). The large flat land between the Gumera and Ribb rivers is annually flooded and in extreme rainfall years the effect on humans, livestock, and infrastructure will be significant.

- **1.2.2 Baro-Akobo Basin (Gambella Plain)**

The plain area, belonging to the lowlands of Baro-Akobo Basin, is partially inundated by floodwaters every year. While most of the agrarian land use has adapted to the seasonal flux of flood waters, there are several towns affected by larger floods including the city of Gambella, and larger floods also cause hardship in rural areas. The Gambella plain lies in south-western Ethiopia and is part of the Baro-Akobo river basin (Sobat River in Sudan). Gambella city is the regional capital, about 800 km from Addis Ababa. Almost every year, over 35% of the Gambella plain is subject to flooding (SMEC, 2006). Major rivers in the areas are Baro, Akobo, and Gilo their origin is the highland high rainfall area around Gore and Masha. The ground surface elevation in along the watershed divide in the east, south-east and north-east varies from about 1700 m to values in the range of 2500–3000 m amsl. As one approaches the foot of the mountainous part of the catchment, one observes the steep decent down to the Gambella plain, where the elevation is of the order of 400-500 m amsl (Seid, 2004).

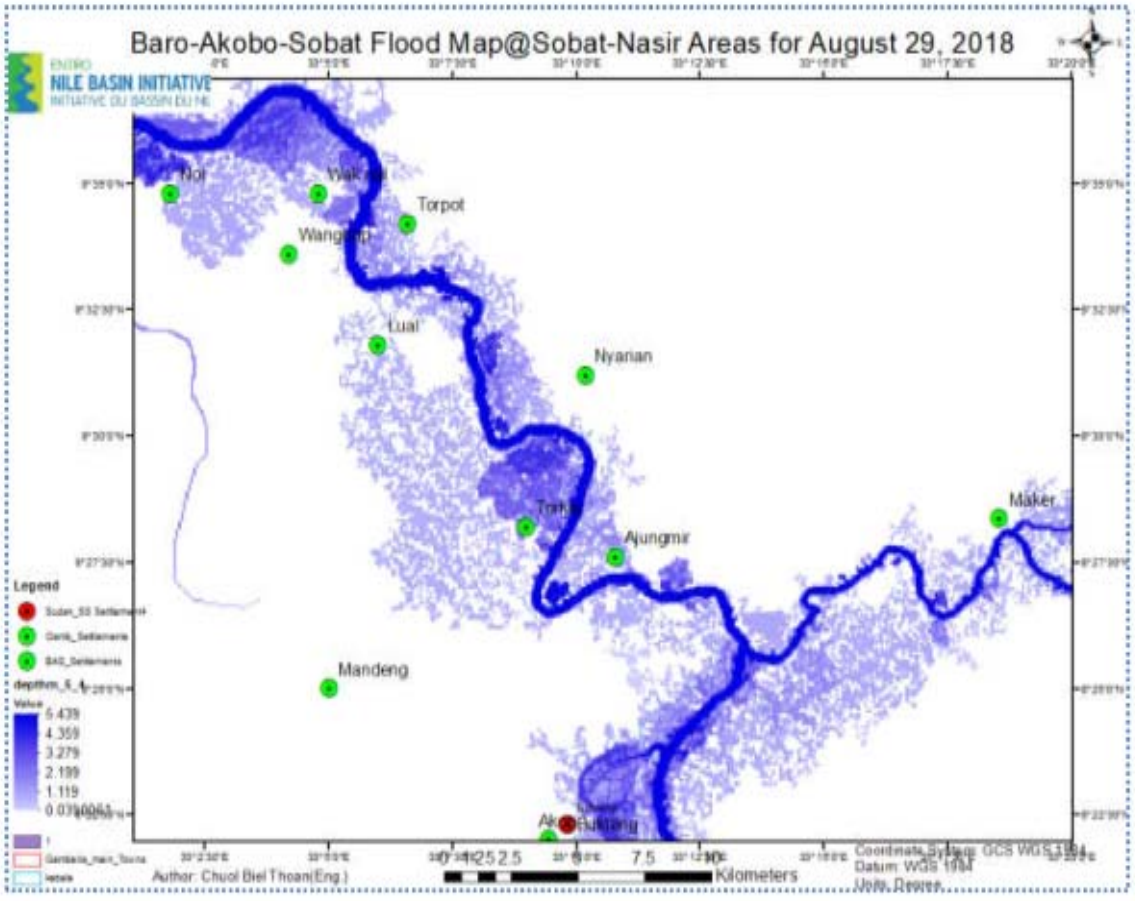


Figure 1.2: Baro-Akobo-Sobat Flood Map

- **1.2.3 Tekeze – Setit – Atbara (Humera plain)**

The flat area at Humera (near Ethio-Sudan boarder) is flooded from overflow of Tekeze River over its banks. This will occur during extreme rainfall conditions in the upper catchment of Tekeze basin.

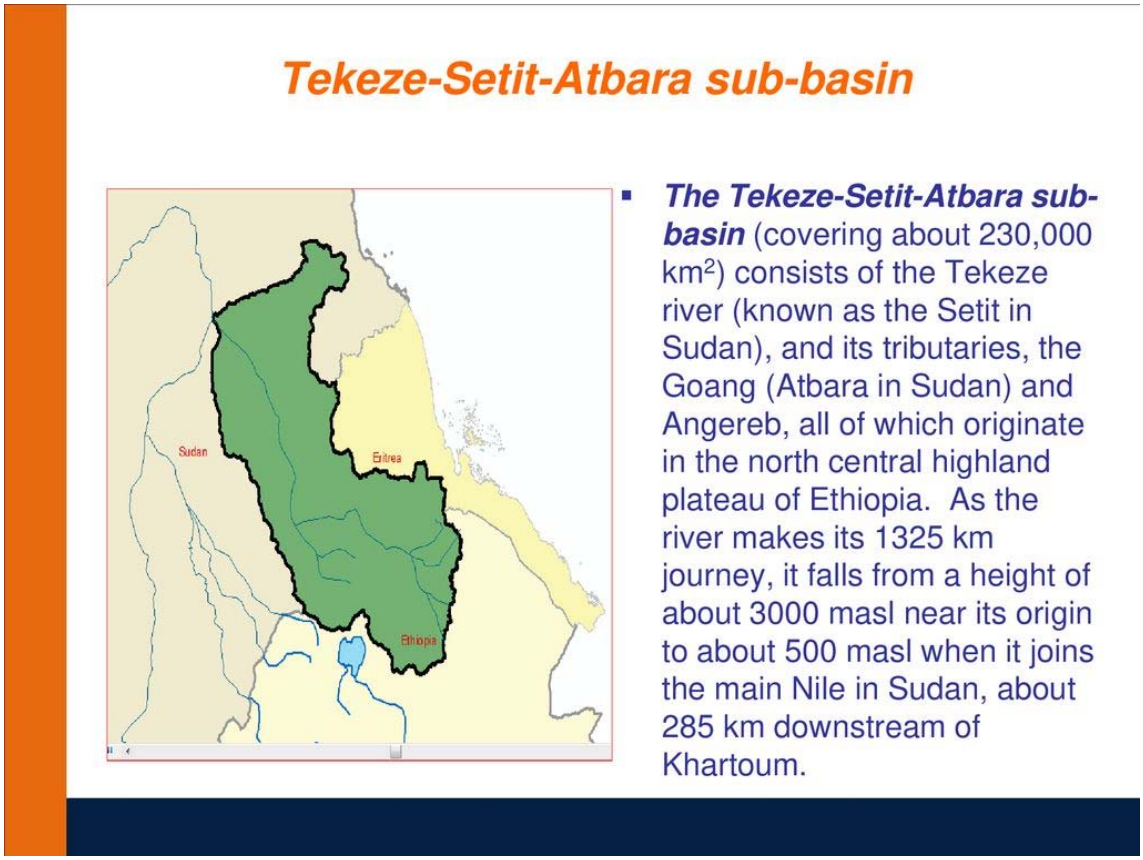


Figure 1.3 Tekeze-Setit-Atbara sub-basin

1.3 An Overview of Eastern Nile (EN) Seasonal Flood Forecast and Early Warning

Eastern Nile (EN) Seasonal Flood Forecast and Early Warning is one of ENTRO's Activities that aim to reduce human suffering caused by frequent flooding. The project emphasizes enhancing regional collaboration and national capacity in flood risk management, including flood mitigation, forecasting, early warning systems, emergency preparedness and response. The project which started in 2010 created a regional Flood Forecast and Early Warning System (FFEWS), strengthened national offices both in terms of capacity and equipment and overall reduced the risk of flood devastation for 2.2 million people in the region.

The Seasonal FFEW bring together young water resources professional from Ethiopia, Sudan and South Sudan forming a regional flood management team to jointly issue flood bulletins to their respective national water resources ministries and meteorological institutions for dissemination to local communities.

The EN Seasonal FFEW activity has been producing flood bulletins for the last seven seasons with three day lead time communicating to flood prone areas. The project utilized already available data and information from the satellite and from ground with collaboration with national and international agencies dealing with meteorological and emergency responses (ENTRO, 2018) Bulletin that shows daily real-time forecast is communicated to communities, local governments, national flood committees and humanitarian organizations.

1.4 Methodology

- **1.4.1The study approach**

The study employed a qualitative methodological approach, which involves a systematic flow of understanding of the flood forecasting and early warning practice at the national, regional, *woreda* and community levels. Focus was made on the dissemination and communication of warnings generated. Especially, how the warnings are efficient and in timely manner and in a format suited to user needs.

Both primary and secondary data were collected. The primary data was generated through telephone and face-to-face interviews with key informant including officials and experts involved in flood forecasting and early warning. Secondary data was obtained through reviewing of documents including NGO's reports, Disaster Risk Management and Food Security Office reports, books, internet, and other published and unpublished sources.

- **1.4.2 Conceptual framework of the study**

Flood early warning systems include a chain of activities: understanding and mapping flood vulnerability, monitoring rainfall and water levels, forecasting impending events, processing, and disseminating and communicating understandable warnings to decision makers and the population so that they can take appropriate and timely actions in response (UNISDR 2009).

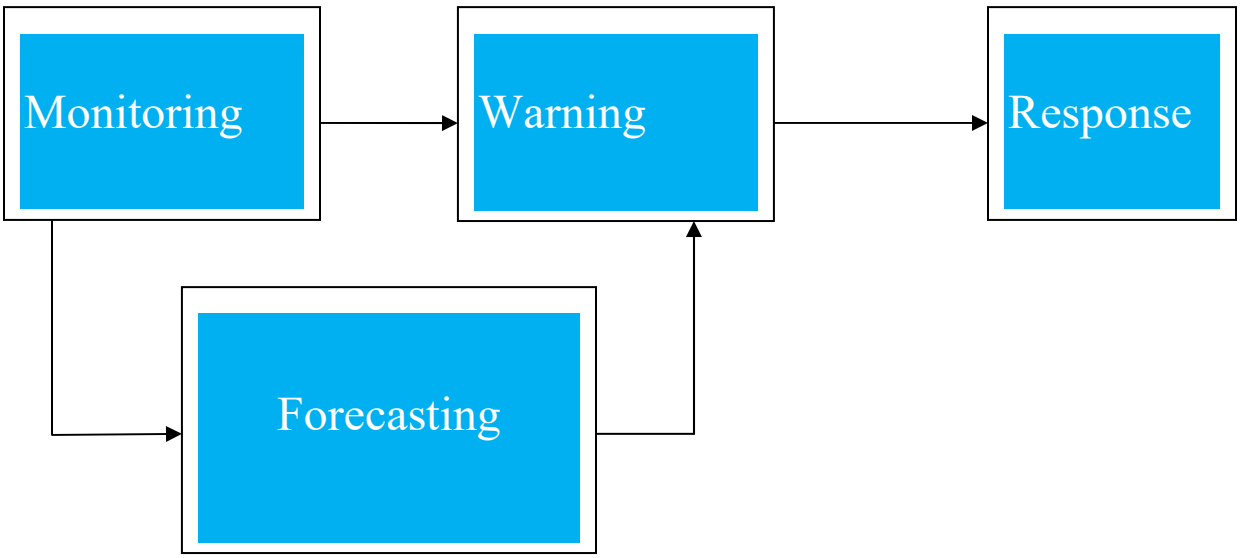


Figure 1: 4 Conceptual Framework

(Haggett, 1998), describes the principal components of a flood forecasting and warning system as shown in the above figure (taken from Lobeyo date NA)

The principal components

Monitoring: In this stage real-time data is monitored. This includes hydrological and meteorological information, climate data, weather radar etc.

Forecasting: In the forecasting stage predictions are made of the levels and flows. Typically this involves the use of hydrological models, driven using the real-time data gathered in the detection phase and forecasts of meteorological conditions.

Warning: The warning stage is the key to the success of operational flood warning. Using information from the detection and forecasting stages, the decision to warn appropriate authorities and/or properties at risk must be taken.

Response: Response to flood warnings issued is vital to achieve the aims of operational flood warning. An appropriate response must be taken following a warning to realize the potential of the warning system.

- **1.4.3 Data collection methods**

The study used both secondary and primary data collection methods. The analysis of gaps was addressed by conducting a detailed gap assessment from regional, national and to the community levels as well as NGOs involved in early warning by reviewing existing documents and systems, interviews with key informants. Further, review of best practice examples from both industrialized and developing countries on how they issue early flood warning was carried out.

- **1.4.4 Data collection instruments**

Key informant telephone and face-to-face interviews were conducted using the following three data collection instruments.

Questionnaire Regarding the Early Warning Issuing Institutions

The questionnaire was developed to collect data with regard to flood warning issues including the type of warning (riverine/flash), warning message content and coverage, sustainability of early warning system, support need from ENTRO, coordination, collaboration, participation , consideration of indigenous knowledge and limitations

Questionnaire Regarding Flood Affected Communities

The questionnaire was designed to collect information such as the location of stakeholders/households affected by flood, frequency of flooding, level of impact, warning communication means and its effectiveness and involvement of the community members.

Questionnaire for Country Level Actors in Flood Early Warning System

The questionnaire was constructed to obtain information including which agencies provide, receive and relay flood early warning and what are their specific mandates on flood early warning, the content of warnings, communication of warning, sustainability of early warning

systems, consideration indigenous early warning, participation, coordination and collaboration of institutions.

2. MAPPING OF STAKEHOLDERS IN FLOOD EARLY WARNING SYSTEM

There are many stakeholders in flood early warning system. As indicated in tables below, we can identify the stakeholders that could be categorized as regional, national, regional states and Woreda level government offices, communities, regional institutions, international bodies, non-governmental organizations, private sectors, the science and academic communities and media. These stakeholders have different involvement with regard to the four pillars of early warnings system, namely risk knowledge, monitoring and forecasting, warning communication and preparedness and response capability.

Stakeholders in flood Early Warning System

		Four pillars of EWS			
	Stakeholders under each category	Risk Knowledge	Monitoring & Forecasting	Warning Dissemination /communication	Preparedness & Response Capability
Table 2.1 National Government					
	Ministry of Water, Irrigation and Energy	X	X	X	X
	National Meteorology Agency		X	X	X
	National Disaster Risk Management Commission	X	X	X	X
	Ministry of Health				X
	Ministry of Education			X	X
	Ministry of Agriculture		X	X	X
	Abay Basin Authority		X	X	X
	Baro-Akobo		X	X	X

Table 2.2 Regional Government					
	Amhara Regional Government			X	X
	Gambella Regional Government			X	X
	Amhara Region Meteorological Service Centers		X	X	
	Meteorological Service Centers				
	Regional DRMC		X	X	X
Table 2.3 Local Government					
	Zonal Administrations			X	X
	Woreda Administrations			X	X
	Kebele Administrations			X	X
	Zonal DRMC			X	X
	Woreda Agriculture Office			X	X
Table 2.4 Communities					
	Idir			X	X
	Farmers associations			X	X
	Women's Associations			X	X
	Youth Associations			X	X
Table 2.5 Regional institutions and organizations					

	ENTRO IGAD	X X	X X	X X	
Table 2.6 International Bodies					
	UN OCHA		X	X	X
	UNICEF		X	X	X
	World Food Program		X	X	X
	FAO		X	X	X
	WHO		X	X	X
	IOM		X	X	X
Table 2.7 Non-governmental Organizations					
	SCI		X	X	X
	Save children international		X	X	X
	CARE		X	X	X
	World Vision Ethiopia		X	X	X
	FHE food for the hungry		X	X	X
	GOAL		X	X	X
	CONCERN		X	X	X
	Oxfam		X	X	X
	CRS		X	X	X
	Ethiopian Red Cross Society		X	X	X
	FEWS Famine Early		X	X	X
	Warning NET		X	X	X
	Red Cross		X	X	X
			X	X	X

Table 2.8 The Private Sector					
	Commercial agricultural companies		X	X	X
Table 2.1.9 The science and Academic Community					
	Agricultural Research Center IWMI ILRI	X X X	*X* *X* *X*		
Table 2.10 The Media					
	Ethiopian Broadcasting Corporation FM Radios			X X	

2.1 Data and Forecast providers

In this section, the discussion focuses on the flood early warning data providers namely Eastern Nile Technical Regional Office (ENTRO), Ministry of Water, Irrigation and Energy (MWIE), National Disaster Risk Management Commission (NDRMC) and National Meteorology Agency (NMA).

- **2.1.1 Eastern Nile Technical Regional Office**

The Integrated Development of the Eastern Nile (IDEN) was the first ENSAP project agreed by the member countries in 2002. Currently, ENTRO is implementing the 2nd 2014-2019 Strategic Plan, with the aim of facilitating Cooperation, promoting water Resources management and planning, promoting water resources development and power trade, and institution building.

The EN Flood Protection and Early Warning Project (FPEW) is one of the IDEN Projects, which aims to reduce human suffering caused by frequent flooding, while preserving the environmental benefits of floods. The project emphasis on enhancing regional collaboration and national capacity in flood risk management, including flood mitigation, forecasting, early warning systems, emergency preparedness, and response.

The FPEW project that ran until 2010 operated in Egypt, Ethiopia, and Sudan. After the completion of FPEW project ENTRO initiated with Eastern Nile countries and created a regional Flood Forecast and Early Warning (FFEW) system under the Eastern Nile Planning Model project (ENPM) and the FFEW activity continued under the current Nile Cooperation for Result project (NCORE). The FFEW, since its establishment, has been an important part of ENTRO's activity that continuously been conducted for the last six year flood season (June September). The FFEW has helped the Eastern Nile countries in reducing the loss of life and money by preparing flood forecast bulletins for the Lake Tana (Blue Nile -Ethiopia), the Blue Nile-Main Nile (Sudan) and Baro-Akobo-Sobat (BAS) sub-basins flood prone areas. The FFEW activity have strengthened national offices in terms of capacity and overall reduced the risk of flood devastation for 2.2 million people in the region (TOR and Scope of Services for Surveyor).

ENTRO prepares the flood forecast, by engaging young professionals (flood management team) from the Sudan, South Sudan and Ethiopia. The team members are experienced in flood forecasting. The Ethiopian Ministry of Water, Irrigation and Energy provides to ENTRO observed data and NMA's weather data. Based on these data, the team gives daily and weekly forecast by producing bulletin on behave of ENTRO. ENTRO communicates the forecast with the Ministry assuming that it will be communicated to the end users (local communities).

- **2.1.2 Ministry of Water, Irrigation and Energy**

The Ministry of Water, Irrigation and Energy of Ethiopia is a federal organization established to undertake the management of water resources, water supply and sanitation, large and medium scale irrigation and electricity. The ministry is a regulatory body which involves the planning, development and management of resources, preparation and implementation of guidelines, strategies, polices programs and sectoral laws and regulations. The Ministry, inter alia, administers dams and water structures constructed by federal budget.

The National Policy and Strategy on Disaster Risk Management (NPSDRM)(2013:22) of Ethiopia has designated the Ministry of Water, Irrigation and Energy "as a lead institution with respect to especially floods and other water supply, and water dams related hazards and associated disasters".

According to the NPSDRM (2013:7) "a lead sector government institution shall be assigned for every hazard and related disasters; the designated lead institution shall be responsible for the implementation of major disaster risk management activities ranging from disaster risk monitoring to response; it shall have an appropriate structure and preparedness capacity to enable it to fulfill its leading role. The lead sector government institution shall prepare and implement sector specific disaster risk management plans and programs" Further, the Policy documents that "lead sector institutions shall be assigned for every hazard at Federal, Regiona, Zonal, Woreda as well as at Addis Ababa and Dire Dawa City Administration levels and they will be responsible for undertaking activities ranging from monitoring to response. There shall be a dedicated structure in those lead institutions to be assigned for performing such tasks.

The key informant, Semunesh Golla, the Director of Hydrology and Water Quality Directorate of the MWIE, reported that the Directorate is mainly responsible for surface and ground water. Effective utilization of meteorological data obtained from different sources both international and national including NMA has been made in the management of surface and ground water, reservoir management and community-based flood early warning. Upon getting meteorological data the water sector produces information for development sectors. Issuing of flood early forecasting is the responsibility of the Directorate. The flood forecasting is only for riverine.

- **2.1.3 National Meteorology Agency**

The National Meteorological Agency (NMA) was established in accordance with proclamation No. 201/1980. NMA is designated, among others, to the following powers and duties.

- Exchange meteorological data in accordance with international agreements to which Ethiopia is a party ;
- Establish and operate communication systems, in accordance with the law for the collection and dissemination of meteorological data;
- Publish and disseminate analyzed and interpreted meteorological data and meteorological forecasts; and
- Give advance warning on adverse weather conditions; disseminate advice and educational information through the mass media; and provide, upon request meteorological services to any person.

Key informant, Aderagew Admasu, Director, Meteorological Forecast and Early Warning Directorate reported that NMA is mandated, among others, to give advance warning on adverse weather conditions. The forecasting is carried out for one day, two days, three days, ten days and four months. The weather forecasts cover 34 towns. NMA provides early warning when heavy rain is expected. The advance warning covers all the country. If heavy rain distribution is recorded, the Early Warning Directorate together other directorates of NMA could forecast the possibility of flooding. The Nile Basin and Gambella area are covered in the 34 towns,

particularly in the three days weather forecast. Weather data collection centers are available in the Nile Basin and Gambella.

- **2.1.4 National Disaster Risk Management Commission**

The Government of Ethiopia a has demonstrated its commitment to the development of a comprehensive DRR approach by passing a Law that established the National Disaster Risk Management Commission (NDRMC) in 2015 and developing the National Policy and Strategy of Disaster Risk Management, to provide DRM guidance and support to line ministries, regions and districts.

The Regulation No. 363/2015 states that the NDRMC should "ensure that disaster risk management is mainstreamed into Government development policies, strategies, development plans and programs, and in the plans of the private sector as well as in the school curricula; and provide support, as may be necessary, to concerned bodies in relation to such issues". Further, NDRMC is expected to "ensure and follow-up the inclusion of disaster risk management in the plans of the executive organs which are identified as lead sector institution in the Disaster Risk Management Policy and Strategy document". Further the Proclamation Article 6.11 states that NDRMC should "lead and coordinate the Federal Early Warning and Emergency Coordination Center by supporting it with modern technologies; support the establishment of similar centers in lead sector institutions at Federal, Regional, Zonal and Woreda Administration levels, as required. At present, the Commission is under reorganization to address its duties and responsibilities at national level.

Flood disaster is one the areas in which NDRMC is responsible to manage. Key informant, Almaz Demessie, Director, Early Warning and Emergency Response, Directorate, reported that DRMC gets weather seasonal forecast from NMA, in which the early warning is based. Report of wet condition is important because flooding is expected. DRM Technical Committee composed of sector offices and NGOs meets every month. There is a flood task force under the DRM Technical Committee. When wet condition is forecasted, the Flood Task Force will be reactivated. Members of the task force are Health, Education, Agriculture, NMA, Water and UN organization including WFP, FAO UNOCHA. Alert is prepared and communicated to about 120 stakeholders by email including regions. Regional Commission offices communicate to Zone and Woreda. The Woreda communicates the Kebele and local people.
After the flood alert is prepared, flood contingency plan is worked out. Estimation of affected and displaced population will be carried out. Operational plan will be worked out based on priority of flood prone areas. With regard to the communication of early warning, the practice is to communicate down to the community level. However, the communications system is not well structured. Now NDRMC is trying to restructure itself after it is established as a commission

- **2.1.5 Non-Governmental Organizations**

United Nations Children's Fund (UNICEF)[1]

[1] https://www.unicef.org/about/who/index_introduction.html downloaded on 1/21/2019

UNICEF promotes the rights and wellbeing of every child, in everything we do. Together with our partners, we work in 190 countries and territories to translate that commitment into practical action, focusing special effort on reaching the most vulnerable and excluded children, to the benefit of all children, everywhere.

In all of its work, UNICEF takes a life-cycle based approach, recognizing the particular importance of early childhood development and adolescence. UNICEF programs focus on the most disadvantaged children, including those living in fragile contexts, those with disabilities, those who are affected by rapid urbanization and those affected by environmental degradation.

UNICEF was created with a distinct purpose in mind: to work with others to overcome the obstacles that poverty, violence, disease and discrimination place in a child's path. We advocate for measures to give children the best start in life, because proper care at the youngest age forms the strongest foundation for a person's future.

At the end of the Second World War, Ethiopia embarked on a program to modernize its economy and social infrastructure. International organizations were invited to support this effort and, starting in 1952, United Nations officials, including UNICEF staffers, began to frequently visit the country to deliver medical supplies and organize vaccinations of children. In 1958, UNICEF established its first office in Addis Ababa and in 1963 signed a formal Basic Cooperation Agreement (BCA) with the Government.

From inception, UNICEF was guided by the vision of a better future for all children. Through some of the country's most difficult times, and as the country achieved one milestone after another, UNICEF was there to provide policy advice, render technical support, and improve service delivery.

UNICEF is one of the stakeholders in the flood early warning system in Ethiopia. Key informant, Gebre Egziabher Lema, Humanitarian Officer, at UNICEF and member of National Flood Task Force representing his office reported that data for flood early warning comes National Meteorological Agency, Ministry of Water, Irrigation and Energy, National Disaster Risk Management Commission, Eastern Nile Technical Regional Office and UNICEF field offices. ENTRO, in particular, provides data on Gambella and Tana areas with regard to rivers levels. UNICEF attempts to triangulate the flood early warning data with the information obtained from the UNICEF field offices.

World Food Program (WFP)[2]

The United Nations World Food Program (WFP)is the world's largest humanitarian agency fighting hunger worldwide, delivering food assistance in emergencies and working with communities to improve nutrition and build resilience. In 2013, WFP assisted more than 80 million people in 75 countries.

[2]https://www.undp.org/content/dam/unct/ethiopia/docs/UN%20agencies%20profile/WFP%20profile%20design. Downloaded on 1/21/2019

WFP started its operations in Ethiopia in 1965. The guiding principle of WFP in Ethiopia is to support government programs by addressing hunger through direct food assistance where it adds value and support to the government's capacity. WFP development interventions in the country are relevant to and consistent with the national policies and programs as well as with the Millennium Development Goals (MDGs) and UNDAF priorities. WFP's main government partners are the Disaster Risk Management and Food Security sector (DRMFSS) of the Ministry of Agriculture, Ministry of Health, Ministry of Education and Ministry of Finance and Economic Development. WFP's country program of activities has consistently focused on food deficit areas, addressing land degradation, human resources development, urban HIV/AIDS, refugees and humanitarian relief. The Country Office has a well-developed vulnerability assessment mapping (VAM) unit which uses data to support emergency food needs assessment and the planning of development assistance. WFP is also managing the UN Humanitarian Air Service (UNHAS).

Key informants, Alemteshay Alemu, Vulnerability Analysis Team Leader and Abey Wogders, GIS Specialist at WFP reported that WFP is member of the National Flood Task Force. WFP triangulates the information of National Flood Alert, weather forecasts from NMA and IGAD, river and dam water levels from Ministry of Water, Irrigation and Energy with the information from field offices. FAO collects data from field level offices, uses drone technology and satellite images to compare the rainfall data to the average. Although it is not forecasting, such exercise helps to understand the magnitude and issue alert to the concerned communities.

UN OCHA[3]

OCHA is the part of the United Nations Secretariat responsible for bringing together humanitarian actors to ensure a coherent response to emergencies. OCHA also ensures there is a framework within which each actor can contribute to the overall response effort.

OCHA's mandate stems from General Assembly (GA) resolution 46/182) of December 1991, which states: "The leadership role of the Secretary-General is critical and must be strengthened to ensure better preparation for, as well as rapid and coherent response to, natural disasters and other emergencies." To this end, it also establishes the role of the Emergency Relief Coordinator (ERC), who works with the Secretary-General and the Inter-Agency Standing Committee (IASC) in leading, coordinating and facilitating humanitarian assistance. OCHA is the office that provides support to the ERC and the Secretary-General to meet the leadership and coordination responsibilities charted in GA resolution 46/182.

GA resolution 46/182 assigns a clear leadership and coordination role to the ERC for international humanitarian assistance to respond to the needs of affected people. This mandate extends to affected people in internally displaced persons (IDPs) situations and was reinforced by related GA resolutions (including GA resolution 70/165). This was also formally recognized in the Secretary-General's 1997 reform agenda, which assigned the ERC with responsibility for the overall coordination of assistance to IDPs. The GA expressed support for the reform agenda,

[3]https://www.undp.org/content/dam/unct/ethiopia/docs/UN%20agencies%20profile/WFP%20profile%20design. Downloaded on 1/21/2019

and in subsequent resolutions it has emphasized 'the central role of the ERC' for coordinating the protection of and assistance to IDPs.

OCHA coordinates humanitarian action to ensure crisis-affected people receive the assistance and protection they need. It works to overcome obstacles that impede humanitarian assistance from reaching people affected by crises, and it provides leadership in mobilizing assistance and resources on behalf of the humanitarian system. OCHA is not an operational agency directly engaged in the delivery of humanitarian programs, and its added value is as an honest broker, facilitator, thought leader and global advocate, providing support to the humanitarian system. In fulfilling its coordination mandate, OCHA is guided by the humanitarian principles of humanity, neutrality, impartiality and independence.

Melaku Gebre Michal, Humanitarian Affairs Officer at UN OCHA reported that OCHA co-chairs the National Flood Task Force. In the identification of flood risk Woredas, his organization relies on NMA's rainfall forecast, National Flood Alert, river and dam water level data from the Ministry of Water, Irrigation and Energy, and field offices information concerning flooding incidences. Thus, based on this information, OCHA identifies specific localities that would be affected by flood. In this regard, OCHA supports the National Flood Task Force. Feedback of the forecast is obtained since OCHA monitors what is on the ground.

2.2 Forecast Warning Users

The flood forecast warning users include national, regional, zonal and Woreda level government offices, NGOs, UN agencies and humanitarian organization. These institutions are expected to disseminate the warnings to the flood prone communities through different channels.

• 2.2.1 National Government

The government organizations that use the flood forecast at national level includes Ministry of Health, Ministry of Education, Ministry of Agriculture, Basin Authorities (Awash, Abay, Tekeze, Baro-Akobo, etc) and Ministry of Transport and Communications. For instance, the Ministry of Health could take the necessary health related actions in terms of response and preparedness at community level to minimize the negative impacts of flooding.

• 2.2.2 Regional, zonal and woreda governments

The regional, zonal and woreda administrations are flood forecast users under the Ethiopian government structure. These administrations obtain technical support from the branch offices of NDRMC established at different levels. Although the structuring is not complete, at present there are independent offices at region and zone levels with the exception of woreda administration. At Woreda level, the activities of NDRCM are carried out by a Work Process (work team) organized under the Woreda Agricultural Office. Further, there are disaster risk management and preparedness committees composed of various offices at regional, zonal, woreda and kebele levels.

Key informant, Sisay Kassa, Team Leader, Disaster Prevention and Early Warning Work Process at Libo Kemkem Woreda who served for five year alone, underlined that the early warning system should be strengthened by employing professionals. At present three people are working in woreda office. Since the disaster preparedness and early warning activities are carried out along with agricultural activities, priority is given to the later. This institutional arrangement is not conducive to discharge the responsibilities of implementing the disaster early

warning and preparedness activities. He underlined that the disaster risk management office should be organized independently.

Key informant, Emenesh Aseres, Team Leader, Disaster Prevention and Early Warning Work Process at Fogera Woreda reported that "flood task force used to get training before three years. All concerned people from Kebele and Woreda had a meeting once in a year. This practice was helpful to evaluate our activities and prepare ourselves for the coming flood season. At present, we simply communicate individual kebeles without having such meetings".

Birhanu, et al (2016:26) conducted a study in Libo Kemkem, Jabitehinan and Kalu Woredas located in South Gondar, West Gojjam and South Wollo Zones respectively in the Amhara National Regional State. The researchers identified that "from the zone to the kebele levels of the study areas, experts are with little knowledge of different risks and hazards. They lack comprehensive training on risk knowledge and hazards. Risk knowledge is acquired and built up on personal effort: through reading and attending trainings rather than being trained from the concerned department in higher education institutions". Further they noted that trainings which are directed towards improving experts' knowledge were uncoordinated, meager and too short. In this regard, experts from Libo Kem Kem Woreda explained that "It was only for three days in a year that they were trained by the zonal early warning Office about the concept of early warning". Experts in all three zones from the zone to the kebele levels explained that, because they do have skill and knowledge gap, when they collect early warning data from the different concerned offices; there exist data discrepancies each month".

Key informant, Agegehu Asmare, Team Leader, Misrak Dembia Woreda Disaster Early Warning and Response Work Process reported that the case of Tana affected kebeles, they have repeatedly reported to higher authorities about the damage caused by the backflow of Lake Tana. The workers responsible for checking the level of water in Lake Tana respond by saying that we will not discharge water from the lake unless the water level reaches the alarming level. Further he noted that the higher authorities are not willing to see the damage.

- **2.2.3 Non-Governmental Organizations**

The non-governmental organizations are flood forecast users. They obtain the flood forecast from NDRMC and NMA. Many of them calibrate the forecast obtained with the information collected from their field offices to address the specific flood affected communities according to their mandates.

UNICEF is one of the flood forecast users. Key informant, Gebre Egziabher Lema, Humanitarian Officer, at UNICEF and member of National Flood Task Force, noted the limitation of the National flood Alert as too general. It does not indicate specific localities that would be affected by flood. Usually, the flood task force is activated when flood is about to come. There is no ample time to conduct deep analysis to identify the impact of the expected flood. ENTRO flood early warning message indicates to what extent the water level is raised compared to the average. It does not have detailed information with regard to the magnitude of the flooding. Further, the forecast is not user friendly. UNICEF along other information attempts to identify specific localities that are going to be affected by flooding. FEW activity is a campaign work which is not a regular activity for the whole year. Early preparation is not practiced. It is a fire fighting activity. The FEWS should employ high performance technology for better forecast output,

which minimizes doubtfulness on the part of forecast users. Further, this effort should be supported by indigenous flood early warning practices.

Gebre Egziabher noted that the ownership of FEWS, is not decided according to National Disaster Policy and Strategy. The policy gives the mandate to the Ministry of Water, Irrigation and Energy to handle water related hazards. In practice, NDRMC is handling such responsibility. NDRMC should give technical support to line ministries. He also suggested that the National Flood Task Force should be strengthened. Different NGOs have EWS which is based on their interest. There was an attempt to create one EWS which serves all parties, which did not materialize.

Key informants, Alemteshay Alemu, and Abey Wogders, reported that World Food Program (WFP) does not receive flood forecast from ENTRO. The flood early warning message is general to take site specific actions. It does not consider indigenous knowledge and mainly focuses on response. Coordination among different institutions is not institutionalized.

- **2.2.4 Local Communities**

The flood affected local communities located in Amhara and Gambella regions. are the social beneficiaries of the flood forecasting and early warnings. The disaster and preparedness workers at woreda level have indicated the specific communities affected by flood.

- ***2.2.4.1 Amhara Region***

Flooding is one of the natural the disasters that affect the Amhara Region. Key informant, Jemberu Desse, Director, Disaster Preparedness and Early Warning Directorate, Amhara Disaster Preparedness, Food security and Special Support Coordination Commission identified the zones and Woreda that are vulnerable to flooding in the region. The Woredas are found in West Gojam, Central Gondar, South Gondar, North Wollo and South Wollo. He indicated the flood prone woredas under Central Gondar zone, Denbia, under South Gondar zone, Fogera, Dera and Libo Kemkem, and Achefer in West Gojam zone.

The regional disaster prevention committee is composed of the President of Amhara Region, chairman and health, water, agriculture, education are members and the secretary is the Regional Commissioner for the commission for Disaster Preparedness, Food Security and Special Coordinator Commission. Further, a technical committee is setup chaired by the Director of Disaster Preparedness and Early Warning Directorate with members from NMA, Agriculture, and Water. This committee is responsible for the communication of flood alert to Zone and Woreda administrations. In addition, it is engaged in disaster preparedness by coordinating sectoral offices.

Lake Tana Area

Libo Kemkem Woreda

Libo Kemkem Woreda is one of the flood affected areas in Centeral Gondar Zone, of the Amhara Regional Government. Sisay Kassa, Team Leader, Disaster Prevention and Early Warning Work Process at the , Libo Kemkem Woreda Agricultural Office indicated the kebeles that are frequently affected by flood including Gura, Shena Tsion, Bambiko, Genda Wuha, Teza Amba, Tinaga and kab.

Fogera Woreda

Fogera Woreda is located in Central Gondar Zone, which is frequently affected by flood. Key informant, Emenesh Aseres, Team Leader, Disaster Prevention and Early Warning Work Process at the Fogera Woreda Agricultural Office reported that there are six kebeles which are fully affected by flooding. They are Nabega, Agatera, Kidest Hana, Shena, Shaga and Aquako. Partially affected are Agua Michale and Duba. The back flow of Tana could damage 600 hectares of cultivated rice. About 29,000 people could be affected by flooding in the Fogera Woreda.

Misrak Dembia Woreda

Misrak Dembia Woreda is located in Central Gondar Zone which is flood prone area. Key informant, Agegehu Asmare , Team Leader, Misrak Dembia Woreda Disaster Early Warning and Response Work Process reported that 10 kebeles are affected every year by flood in East Dembia Woreda. These kebeles are affected because of the backflow of Tana Laka and when the rivers namely Megech, Derma, Sudan Gedel and Neddit Rivers over flow their banks. Megech River affects kebles such as Addisge, Dingel, Deber Zuria, Arebi Abalibanos, Gur Amba Michale and Tana Wyne. Derma River affects Gebeban, Gur Amba, Bata, Kola Deba town, Keran, Gabzo Terara, Magnego. Sudan Gedel River affects Jangua, Neddit River affects Gur Amba, Achera, Terra Diablo, Gur Amba Michale. Tana lake affects Achera Tana Wyne and Addisge Dingel.

- ***2.2.4.2 Gambella Region***

Key informant, Lule Jone Public Relations Officer at the Gambella Disaster Prevention and food Security Agency reported that flooding affects two zones namely Nuare and Aguack. Under Nuare Zone: the Woredas affected are Etang, Lare , Jikaw , Wantua and Mapue. Under Aguack Zone: Gof and Jore Woredas are affected. The flooding comes during Kirmet season. Early warning steering committee is available at Killele, Zone, Woreda and Kebele levels. Flood alert is communicated through FM radio in five local languages. In addition, telephone calling and workers go to the flood affected areas. Lule believes that the communication is effective. Local people know that flooding will occur when there it rains all day. Many people do not own mobile phone. The message communicated is trusted.

Thowat Tiach Kuon, key informant, Water Resource Officer, the Gambella Water & Irrigation Bureau was a member of the Gambella Early Warning and Preparedness committee. He said out of 12 Woredas of Gambella Killele, 8 are affected by flooding. Gambella town is also minimally affected. The victims are mainly rural Woredas. The frequency of flooding in the region is once in a year, during kiremt season (July to first week of September). It causes dislocation of local people, crop fields are inundated and outbreak malaria.

Lare Woreda

Jone Kon**,** keyinformant**,** Coordinator of early warning in Lare Woreda, Gambellareported that **t**here are 28 kebeles in Lare Woreda. Most of them are affected by flood. The kebeles are Wushinkur, Tangha, Nif Nif, Mamok, Talbon, Watercon, Botonech, Kutin, Malo, Etanbur, Hilut, Kormancho and Kenakoch. There is a steering committee at Woreda administration composed of health, agriculture, education, women affairs offices. The Woreda gets flood early warning from Killele and zone offices. It communicates the kebele chairman to call a meeting of local people. The steering committee informs the people about the flooding. It advises people to leave the area if the flooding is going to be devastating.

2.3 Vulnerability mapping for settlement on flood prone areas

The flood prone areas in Ethiopia are scattered in many parts of the country along the major rivers. Rib and Gumera rivers in South Gondar, Gilgel Abay river in West Gojam, and Dirma

and Megech rivers in North Gondar can cause flooding in surrounding areas. In Gambella, Baro, Gilo, and Akobo and SNNPR Omo River flooding cant take place. The National Flood Alert No.2 which covers the Kiremt season, i.e. June to September 2019 identified the flood risk areas in Ethiopia as follows.

Gambella Region-

Neur zone - Wantawa, lare, Akobo, Makuwey and Jikawo Woredas. Ankwak zone - Gambella Zuria, Gambella town, Dima, Jore, Goge and Abobo Woredas. Mejenger zone -Mengeshi Woreda and Itang special Woreda.

Benishangul Gumuz Region:

Assosa Woreda.

Oromia Region:

West Hararghe- Habru, Hawi Gudina and Oda Bultum Woredas. East Hararghe -Golo Oda, Goro gutu, Jarso, Gursum, Deder and Meta Woredas. West Arsi - Shalla, Arsi Negelle, Siraro, Kofele, Nensebo, Kore and Yaya Gulele Woredas. Arsi - Ziway, chole, dugda, gololcha, Robe and Seru Woredas. Bale - Agarfa, Legehida, Gasera, Gololcha, Ginnir, Seweyna, Goro, Berbere and Guradamole Woredas. Borena - Das, Dire, Arero, Miyo, Moyale, Yabello and Dubluk Woredas. West Shewa – Ejere Woreda. South West Showa – Illu and Ginchi Woredas. Guji- Adola, Urga, Bore, Anasora and Dima Woredas. East Shewa -Boset, Adama town, Adama Woreda, Adame tulu, Jido Kombolcha, Fentale and Lume Woredas. Illu Ababora – Becho Woreda.

Amhara Region:

South Gonder -Libo Kemkem, Fogera and Dera Woredas. Central Gonder- Dembia, Gonder Zuria and Alefa Woredas. West Gojjam -Bahir Dar Zuria and Dega Damot Woredas. Oromia special zone- Jile Tumuga, Artuma fursi and Dawa Harawa Woredas. North Showa -Antoskia Gemza, Ataye town, Shewa Robit, Kewet, Efrata Gidim and Ensaro Woredas. South wollo -Ambassel, Kombolcha and Kalu town Woredas.

Somali Region:

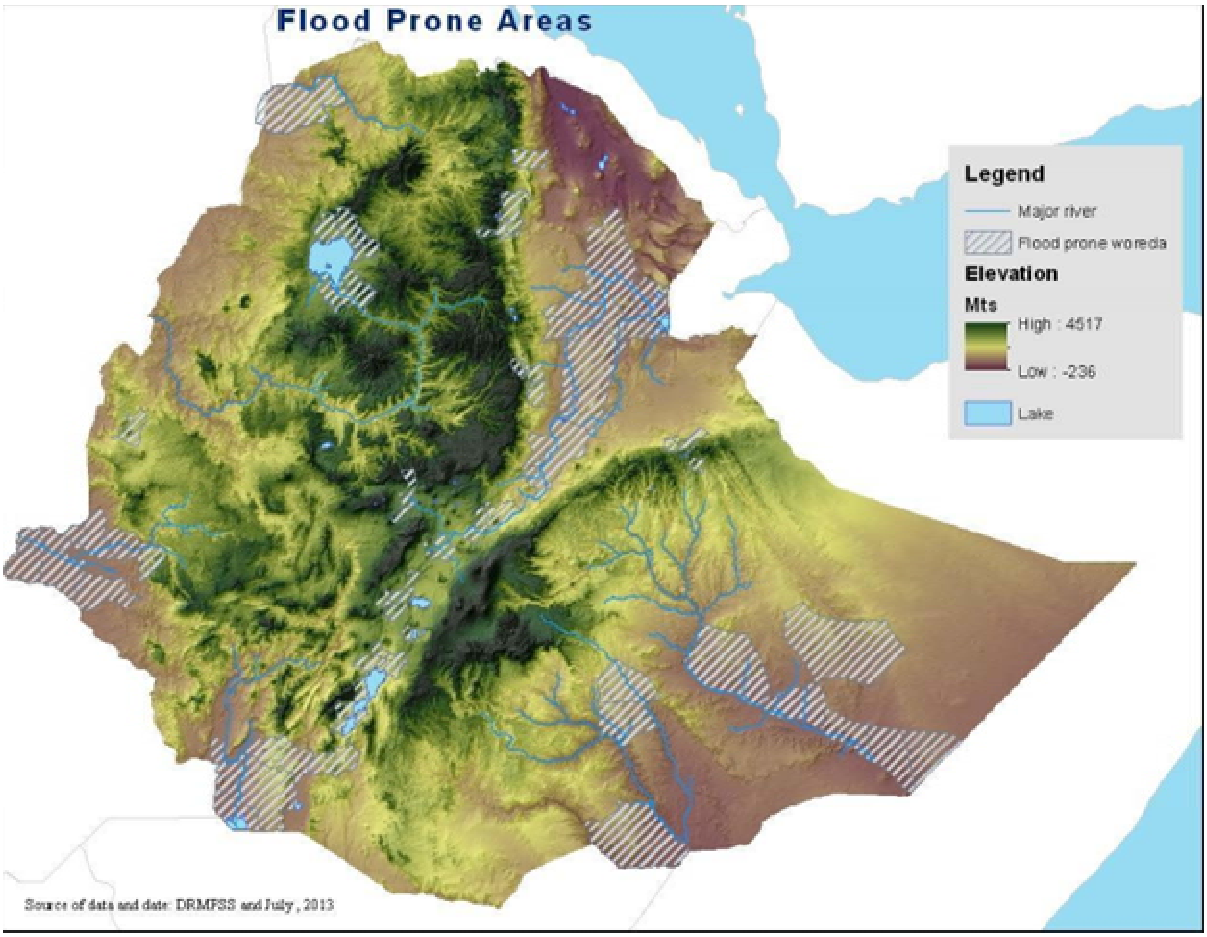
Shebele - Kelafo, Mustahil, Ferfer, Gode, Berano, DehunAdadile and East Imey Woredas. Afder - W/Imey, Chereti, Dollobay and Hargelle Elkeri Woredas. Liben - Dollo Ado Woreda. Dollo – Warder Woreda. Fafen – Jijiga, Togochale, Kebribeyah Woredas. Siti – Afder, Ayisha, Erer, Miesso and Shinile Woredas.

Afar Region:

Zone -1 - Dubti, Asayita, Mille, Chifra and Afambo Woredas. Zone 3 - Amibara, Gewane, Bure Mudayitu, Dulecha and Awash Fentale Woredas. Zone 2 - Abala, Berhale, Megale and Koneba Woredas. Zone 4 – Ewa Woreda.

Tigray Region:

W/Tigray – Humera and Tsegede Woredas. Southern Tigray - Alamata Woreda. Raya – Azebo, Enda- Mehoni and Maichew Woredas.



Map of flood prone areas in Ethiopia

SNNPR:

South /Omo- Dasenech, Nanghatom, Hamer and Selamago weredas. Hdiya – Shashego and Mirab Bedewacho. Wolayta – Humbo, Damot Waydie, Dugna Fango, Kindo Didaye, Kindo Koysha and Boloso Bombe. Halaba Special wereda – Halaba. Sidama – Loka Abaya, Hawassa Zuria, Hawassa Town; SilteDalocha, Sankura and Silte weredas. Guragie- Meskan, Mareko and Kochere.

Dire Dawa:

Dire Dawa city

Harari Region:

Harar city

Addis Ababa:

Flood prone sub cities

3. ANALYSIS OF STAKEHOLDERS' GAP IN FLOOD EARLY WARNINGS

3.1 Data and Forecast providers

In this section, the discussion focuses on the flood early warning data providers namely Eastern Nile Technical Regional Office (ENTRO), Ministry of Water, Irrigation and Energy (MWIE), National Disaster Risk Management Commission (NDRMC) and National Meteorology Agency (NMA)

- **3.1.1 Eastern Nile Technical Regional Office**

Eastern Nile Technical Regional Office (ENTRO) communicates the issued flood forecast with the Ministry of Water, Irrigation and Energy (MWIE) expecting that the flood early warning will be communicated to the end users (local communities) by the Ministry. Further, ENTRO sends the flood forecast to Amhara, Gambella regions and Abay Basin. However, ENTRO is not sure whether it reaches the end users. The current practice is that ENTRO's flood forecast is not communicated to the flood prone areas as expected. Semunesh Golla, Director of Hydrology and Water Quality Directorate, the Ministry of Water, Irrigation and Energy noted that the flood forecast of ENTRO is not communicated to the stakeholders and verified for the last three years. The Ministry is doubtful of the forecast model HEC –HMS. ENTRO, realizing the limitation, had promised to improve the modeling. She underlined that ENTRO should provide a reliable flood forecast to support the issuing of flood early warning to the target communities.

Different flood forecasting systems are employed for Lake Tana, Gambella and BAS areas. This practice needs the employment of three professionals for the respective forecasting areas, which is expensive for ENTRO; and thus, the enhancement of the forecasting system needed.

ENTRO is not engaged in seasonal flood forecast with the lead time of 1-3 months because of financial constraints. There is a project in progress that address seasonal forecast at Easter Nile Basin level.

There is lack of documentation (e.g. forecasters handbook) for systematic verification of products through the forecast chain. Forecasting professionals come from the MWIE during rainy season. After they completed their work they go back to the Ministry.

ENTRO's data sharing and collaboration with other institutions is not satisfactory. Individual relationship matters to facilitate the exchange of data. To support the issuing of the flood early warning, ENTRO would like to get actionable information from stakeholders. To this end, a sound institutional arrangement at national and regional levels that would facilitate data sharing is imperative. Although ENTRO gets weather data from National Meteorology Agency (NMA) through the Ministry, it needs to have a direct relationship with NMA. The importance of cooperation between ENTRO and NMA has been underlined in the ENRTO's Flood Preparedness and Early Warning Seasonal Report (2018:29) which states that "It is advisable to enhance and modernize the WRF numerical weather model, verify results and use of it for the flood forecast and used for the hydrologic model. To verify the model results, ENTRO should cooperate with the Ethiopian National Meteorological Agency (NMA) in order to facilitate real time precipitation data exchanges in addition to capacity building of the experts'. Thus, ENTRO

may need a Memorandum of Understanding with NMA for number of reasons including data sharing and utilization of NMA's high performance computer for the forecasting.

Key informant, Azeb, water specialist at ENTRO, also indicated that flood early warning issued by ENTRO does not consider indigenous flood early warning practices. In addition, verification of the forecast is not carried out because of budget constraint. Flood early warning is not issued on flash flood because of lack of budget. Further, the warning practice does not encourage the participation ofthe public and non-governmental organizations. She also noted that the existing early warning system does not facilitate effective co-ordination between stakeholders. The emphasis of the EWSs is response rather that preventive actions. Further, that existing EWSs does not address the most important issues of local communities. In this regard, ENTRO assumes that the MWIE will address such issues.

In terms of timing, probability and areas to be affected, the flood early warning message is satisfactory. With regard to flood forecasting chain, ENTRO did not identify implicit authors or mediators regarding flood disaster in the community. There is no effort made to reduce the complexity of forecasting at the supplier end of the chain.

With regard to mobile phone usage to disseminate flood early warnings, Azeb Mersha noted that at first stage of the project ENTRO has distributed mobile phones in Lake Tana area by identifying focal persons to text forecasts message.

The existing flood EWSs is not technically sustainable since the institutional arrangement is not clear. The Ministry wants to establish its own forecast center. Conversely, ENTRO may face a problem when, in the middle of the year, asks and engage the professionals of the Ministry to work out the flood forecasting activities. Further, to carry out effective dissemination of the forecast, a sound institutional arraignment should be in place. Within ENTRO, there is infrastructure problem such as absence of high performance computer; internet connection is poor to download global data for six hours and more. Further, the power interruption is a bottleneck. The stakeholders list for flood forecast dissemination is outdated. In addition, the impact of the forecast is not known.

- **3.1.2 Ministry of Water, Irrigation and Energy**

The Ministry of Water, Irrigation and Energy (MWIE) is one of the flood early warning data providers. Although the National Policy and Strategy on Disaster Risk Management (NPSDRM) of Ethiopia designates the Ministry of Water, Irrigation and Energy as a lead institution with respect to floods disaster, it did not assume such responsibility yet. At present, the National Disaster Risk Management Commission (NDRMC) plays the lead role. The Review of Disaster Risk Reduction Practices in Ethiopia (2016:5) notes that "relatively good policies, systems, plans, or regulations are in place but seem to be ignored, or make little impact on DRR practices. For policies to make an impact they must be constantly taken into account in routine decision-making and must be institutionalized (legislated and integrated into the laws, practices, and customs of the society)" Further, the Review indicated that "coordination and cooperation among government and non-governmental organizations is not strengthened to the desired level to enable the integration of DRR into development planning. Functions and responsibilities do not seem to be formalized and accepted by all involved entities".

The Ministry of Water, Irrigation and Energy, being doubtful of the forecast, is not communicating and verifying the flood forecast issued by ENTRO to the stakeholders for the last three years. Although the Ministry has a compelling reason not to communicate the flood early warning, it should have discussed with ENTRO to fill the gap created.

Flood forecasting for the rivers with reservoir is well practiced. There is no forecast for rivers without reservoirs. Real time flooding could be communicated, which river needs gauge. However, since there is no prediction data, forecasting is not carried out. The public needs the forecasting.

The MWIE is not involved in forecasting for flash floods because of limited capacity in forecast modeling. In the flood early warning process, the MWIE is not considering indigenous early warning systems although it believes in the importance. Further, the media is not utilized for flood forecasting.

Further, the MWIE, realizing its capacity limitation, would like to get from ENTRO capacity development; in terms of providing forecast software and training of manpower and knowledge sharing that would enhance local input verification and communication and joint professional work.

- **3.1.3 National Meteorology Agency**

The discussion with key informant, Aderagew Admasu, Director, Meteorological Forecast and Early Warning Directorate indicated the gaps of NMA. The lack of highly specialized manpower and technology have limited the capacity of NMA to issue seasonal flood forecast with lead times of about 1-3 months. Further, lack of forecasting data has forced NMA to carry out the probability forecast with limitation. Data sharing and collaboration between institutions, ministries and ENTRO is not institutionalized. The collaboration takes place when the need arises. Further, the flood early warning coordination between NMA, ENTRO and national and regional governments is not satisfactory. Aderagew expressed that there is capacity limitation in the national institutions to create functional and comprehensive meteorological and hydrological networks to generate accurate forecasts and guidance. Government or donors' investment in leadership and soft skills to improve flood EWS is low.

Data sharing and collaboration between institutions, ministries and ENTRO is weak. The collaboration is not on regular basis. When the need arise, collaboration among institutions takes place.

NMA would like to get the following actionable support from ENTRO:

- NMA is involved in weather forecast, which is vital for flood forecast. On the other hand, ENTRO collects water level data from river gauges. NMA needs river water data from ENTRO. Thus, if the two organizations work together the flood forecasting output could be more accurate.

- WRF Hydro is important for flood forecast, which is internationally accepted. If NMA and ENTRO collaborate in modeling, better output could be achieved.

- The rich NMA's modeling experience could be useful for ENTRO.

- The radar in Tana Beles area is not operational due to absence of electricity. If ENTRO makes an effort to provide power to the radar, it could be beneficial since NMA has weather data collection station in the area. The radar could provide electromagnetic data which could be calibrated with NMA's data

- **3.1.4 National Disaster Risk Management Commission**

The Ethiopian National Policy and Strategy on Disaster Risk Management (2013:11) states that " a decentralized disaster risk management system that clearly identify and assign the roles and responsibilities of each level of government, concerned organizations at all levels, communities and individuals in accordance with disaster risk management activities shall be set up". To this end, the National Disaster Risk Management Commission (NDRMC), after it was re-established in 2105 by the Regulation No. 363/2015, is re-structuring itself. It has opened independent Regional Commissions and Zonal Offices. However, at Woreda level, disaster risk management is organized under the Woreda Agricultural Office as a Work Process lead by a Work Process Team Leader with few workers. Key informant, Almaze Demessie, Director, Early Warning and Emergency Response Directorate has underlined that "the communication system is not well structured" noting the weakness at Woreda and kebele levels. Further, Almaz indicated that flood EWS, at governmental level, is not well owned and the practice is characterized as a fire fighting process. At Woreda level, lack of skilled manpower and high turnover and limited budget allocation are some of the problems encountered.

The Ethiopian National Policy and Strategy on Disaster Risk Management gives the lead role to the Ministry of Water, Irrigation and Energy. However, this role is being played by the NDRMC. The National policy is not translated into action. Key informant, Abera Kassa, Director, Disaster Risk Reduction Directorate at NDRMC , noted thatuntil nowthere is no concrete action with regard to the implementation of the lead role by sector institutions according to the policy and strategy of disaster risk management. Such issue should be resolved at higher level so that sector ministries could mainstream disaster in their development plan. Currently, when disaster occurs, the practice is to push it to NDRMC.

Key informant, Beletu Tefera, noted that although there was an interest to get flood alert feedback from communities, which did not materialize, should be given the due attention. The Flood Alert is too general, which does not indicate a particular area that could be affected by flood. Further, she underlined the importance of incorporating indigenous early warning practice in the early warning system. At present, the emphasis of EWS is on response rather than on prevention. Although NRDMC has owned EWS the operation appears to be fire fighting. Beletu, to overcome capacity limitation of NRDMC, suggested the provision of training, upgrading of forecasting modeling and annual forecasting.

The actionable information NDRMC would like to get from ENTRO to support the issuing of the flood early warning are: ENTRO should continue to send flood forecast output to NDRMC. ENTRO should regularly consult stakeholders with regard to the type of information stakeholders need. It can benefit from such consultation to develop its forecast output. It has to be participatory. ENTRO should be a member of Nation Early Warning Technical Committee.

NDRMC is interested to support ENTRO in its regional flood early warning practices. ENTRO could use NDRMC communication system, which would enable ENTRO to understand stakeholder's interest.

3.2 Forecast Warning Users

The flood forecast warning users include regional, zonal and Woreda level government offices, NGOs, UN agencies and humanitarian organization. These institutions are expected to disseminate the warnings to the flood prone communities through different channels.

- **3.2.1 National Government**

The national government is one the flood forecast users. At federal level, the ministries such as Ministry of Health, Ministry of Education, Ministry of Agriculture and Basin Development Authority use flood forecast to minimize the negative impacts of flooding. For instance, the Ministry of Health, could take the necessary health related actions in terms of response and preparedness before and after the occurrence of flooding in a particular community.

- **3.2.2 Regional, zonal and woreda administrations**

The regional, zonal and woreda administrations are flood forecast users under the Ethiopian government structure. These administrations obtain technical support from the branch offices of NDRMC established at different levels. Although the structuring is not complete, at present there are independent offices at region and zone levels with the exception of woreda administration. At Woreda level, the activities of NDRCM are carried out by a Work Process (work team) organized under the Woreda Agricultural Office. Further, there are disaster risk management and preparedness committees composed of various offices at regional, zonal, woreda and kebele levels.

Sisay Kassa, key informant, Team Leader, Disaster Prevention and Early Warning Work Process at Libo Kemkem Woreda who served for five year alone, underlined that the early warning system should be strengthened by employing professionals. At present three people are working in woreda office. Since the disaster preparedness and early warning activities are carried out along with agricultural activities, priority is given to the later. This institutional arrangement is not conducive to discharge the responsibilities of implementing the disaster early warning and preparedness activities. He underlined that the disaster risk management office should be organized independently.

Key informant, Emenesh Aseres, Team Leader, Disaster Prevention and Early Warning Work Process at Fogera Woreda reported that "flood task force used to get training up to three years ago. All concerned people from Kebele and Woreda had a meeting once in a year. This practice was helpful to evaluate our activities and prepare ourselves for the coming flood season. At present, we simply communicate individual kebeles without having such meetings".

Birhanu, et al (2016:26) conducted a study in Libo Kemkem, Jabitehinan and Kalu Woredas located in South Gondar, West Gojjam and South Wollo Zones respectively in the Amhara National Regional State. The researchers identified that "from the zone to the kebele levels of the study areas, experts are with little knowledge of different risks and hazards. They lack comprehensive training on risk knowledge and hazards. Risk knowledge is acquired and built up on personal effort: through reading and attending trainings rather than being trained

from the concerned department in higher education institutions". Further they noted that trainings which are directed towards improving experts' knowledge were uncoordinated, meager and too short. In this regard, experts from Libo Kem Kem Woreda explained that "It was only for three days in a year that they were trained by the zonal early warning Office about the concept of early warning". Experts in all three zones from the zone to the kebele levels explained that, because they do have skill and knowledge gap, when they collect early warning data from the different concerned offices; there exist data discrepancies each month".

Agegehu Asmare, key informant, Team Leader, Misrak Dembia Woreda Disaster Early Warning and Response Work Process reported that the case of Tana affected kebeles, they have repeatedly reported to higher authorities about the damage caused by the backflow of Lake Tana. The workers responsible for checking the level of water in Lake Tana respond by saying that we will not discharge water from the lake unless the water level reaches the alarming level. Further he noted that the higher authorities are not willing to see the damage.
There are many projects at wordea level. However, these projects do not include disaster early warning and response. There is no much attention to such activities.

- **3.2.3 Non-Governmental Organizations**

The non-governmental organizations are flood forecast users. They obtain the flood forecast from NDRMC and NMA. Many of them calibrate the forecast obtained with the information collected from their field offices to address the specific flood affected communities according to their mandates.

UNICEF is one of the flood forecast users. Key informant, Gebre Egziabher Lema, Humanitarian Officer, at UNICEF and member of National Flood Task Force, noted the limitation of the National flood Alert as too general. It does not indicate specific localities that would be affected by flood. Usually, the flood task force is activated when flood is about to come. There is no ample time to conduct deep analysis to identify the impact of the expected flood. ENTRO flood early warning message indicates to what extent the water level is raised compared to the average. It does not have detailed information with regard to the magnitude of the flooding. Further, the forecast is not user friendly. UNICEF along other information attempts to identify specific localities that are going to be affected by flooding. FEW activity is a campaign work which is not a regular activity for the whole year. Early preparation is not practiced. It is a fire fighting activity. The FEWS should employ high performance technology for better forecast output, which minimizes doubtfulness on the part of forecast users. Further, this effort should be supported by indigenous flood early warning practices.

Regarding the ownership of FEWS, it is not decided according to National Disaster Policy and Strategy. The policy gives the mandate to the Ministry of Water, Irrigation and Energy to handle water related hazards. In practice, NDRMC is handling such responsibility. NDRMC should give technical support to line ministries. National Flood Task Force should be strengthened. Different NGOs have EWS which is based on their interest. There was an attempt to create one EWS which serves all parties, which did not materialize.

Key informants, Alemteshay Alemu, and Abey Wogders, reported that World Food Program (WFP) does not receive flood forecast from ENTRO. The flood early warning message is

general to take site specific actions. It does not consider indigenous knowledge and mainly focuses on response. Coordination among different institutions is not institutionalized.

- **3.2.4 Local Communities**

The local communities are the social beneficiaries of the flood forecasting and early warnings. The disaster and preparedness workers at woreda level, working closely with the social beneficiaries, in Lake Tana and Gambella areas have expressed their views which show gaps related to flood forecasting and early warning practices.

Kello Oku, key informant, early warning worker at Jore Woreda Early Warning and Food Security, Gambella Region, reported that although there are local people who respond to the early warning and prepare themselves by constructing canals, there are some who are reluctant and assume that they can do the protection later. Such community members were flooded in two days rain. Further, Kello noted that flooding can happen without communicating early warning. The 16 rural kebles of Jore woreda have only two police radio communications which can serve for the early warning. The 14 kebles do not have communication means. Local people do not have personal radios. The other communication means is by writing a letter.

Form Libo Kemkem woreda a key informant noted that there used to be sirens which are not function. Further, it was reported that the Rib irrigation scheme has rechanneled the rivers to Baihr Dar Gondar road. These rivers are flooding the crop fields. It was also reported that the Amhara Regional DRMC does not get flood forecast from ENTRO.

When disaster strikes, the woreda communicates the zone and killel. Without issuance of early warning flooding can occur. It the rain comes at night flooding can take place without early notice. For instance, in the flooding that took place in Kola Deba town was without notice. The public was not aware of it since it has never happened in town.

By and large, the communication system is not well organized and there are people who are reluctant after they received the flood early warnings. The construction of permanent structure to protect local people from flooding in Gambella area needs considerations since the flood affected people do not option to resettle in safer place.

A study by conducted by Birhanu, et al (2016) in West Gojjam Zone clearly indicates the knowledge gap in terms of understanding the concept of EWS among the communities.

Box 1:

Knowledge gap observed at the expert level is also common among the local community at the kebele levels .though they have identified some of the risks and willing to develop knowledge they are not supplemented with appropriate trainings from the experts. Discussants from “Abasem Zeguay” kebele, Jabitehinan Woreda of West Gojjam Zone clearly stated that they do not know what EWS mean and about the existence of early warning committee in the kebele. Neither of the discussants remembers anybody who gives them early warning education. Almost all discussants in the selected kebele levels explained that there is no attempt to build their risk knowledge and about early warning. Experts on their side stated that there is no mechanism for early warning education to the community. Even it is not incorporated in the plan of the process. They

complain that the government is allocating no money for the desk, except salary. Because there is no early warning education, the communities lack deep knowledge on risks in respective Kebles except their long established indigenous knowledge system.

Berhanu et al (2016) further reported that "there is no evidence of monitoring mechanisms to check whether the warning messages reach, understood and interpreted into action by the community. Informants from West Gojjam Zone for instance stated that almost all kebeles in the zone have telephone; however information delay is very common because of network related problems"

In addition, for some Woredas, especially for Bahir Dar Zuria Woreda, which has well organized early warning committee at the kebele level, bells, phones and "tirunba" are purchased and supplied by a SNIF project. Kebele level meetings are the other methods of information dissemination and communication. However, in some kebeles of the Zone people are reluctant to attend meetings of such a kind and only the elderly and women used to attend meetings. In the case of south Wollo Zone All the warnings were not reached and agreed by all of those at risk. Government officials and communities did not understand all the warnings and the risks. The warning information was not clear and usable to all. There were no uniform and systematic dissemination and communication strategies established at all levels. However, in the selected Woreda there were established dissemination and communication strategies and early warning system modalities for timely responses of risks. As one of the informants said, "there was emergency coordination forum (NGOs, GO;) in the Woreda to disseminate and communicate early warning information to concerned parties including Current situation analysis of the area, action point and Implementation strategies, and designed response actions for disaster risk"

Birhanu, et al. (2016:26) indicated community members' low level of early warning concept since "discussants from "Abasem Zeguay" kebele, Jabitehinan Woreda of West Gojjam Zone clearly stated that they do not know what EWS mean and about the existence of early warning committee in the kebele. Neither of the discussants remembers anybody who gives them early warning education. Almost all discussants in the selected kebele levels explained that there is no attempt to build their risk knowledge and about early warning. Experts on their side stated that there is no mechanism for early warning education to the community". Further Berhanu et al. (2016:26) noted that "because there is no early warning education, the communities lack deep knowledge on risks in respective Kebeles except their long established indigenous knowledge system".

The Review of Disaster Risk Reduction Practices in Ethiopia (2016:6) revels that "there are gaps in properly approaching the community through existing traditions, culture, knowledge and local capacities and enable them choose their development options. Using local knowledge to improve DRR is yet to be developed".

4. COMMUNICATION METHODOLGOY FOR FLOOD EARLY WARNING

4.1 Best practices and Methodologies in Flood Early Warning Communication

- **4.1.1 Ethiopia**

Ethiopia is one of the flood affected countries in East Africa. Flooding occurs in various parts of the country. Dire Dawa City Administration is among the flood prone areas located in the Eastern part of the country.

The report of Ashenafi Dejene and Yetayal Amsalu (date NA) indicates that how communities in Dire Dawa Administration, Eastern Ethiopia, have reduced their vulnerability to weather-related hazards following the integration of indigenous and conventional knowledge on Early Warning Systems through a joint multi-sectoral platform. About 13,000 households living upstream and downstream Dire Dawa have developed appropriate coping mechanisms for the frequent and cyclic flooding by establishing a community-based weather forecasting capacity.

In 2013, the Community Managed Disaster Risk Reduction (CMDRR) committees were initiated and facilitated by the Partners for Resilience (PFR) program. These committees were established in the upstream divisions of Ejeaneni, Adiga Felema and Lege Bira with a total of 6,400 beneficiaries. The community-led initiatives compliment the Ethiopian government's major investments in flood control. Based on, the upstream and downstream CMDRR Committees implemented Early Warning Systems (EWS).

The Partners for Resilience (PFR) program followed the following method to establish the flood early warning system.

Step 1: Conducting community risk assessment conducted in the project site.
Step 2: Establishing community Managed Disaster Risk Reduction (CMDRR) committees.
Step 3: Strengthening the indigenous early warning systems.
Step 4: developing locally appropriate communication strategies to disseminate weather and climate information including included using sirens, hand held megaphones and mobile phones.
Step 5: establishing a joint multi-sectoral platform for sharing climate information for Early Warning. Each of the eight organizations involved in the joint platform, signed a Memorandum of Understanding (MoU) pledging to collaborate and share weather and climate information through the joint multi-sectoral platform.

Step 6: Through this partnership with PFR, seven Community Information Centers were established within the target communities to facilitate grassroots-level information sharing and cross learning on weather forecasting and alerting capacity. The centers were equipped with sirens, a hand held megaphone and mobile phones by the project.

Step 7: Partners for Resilience, through Cordaid also strengthened the CMDRR committees by facilitating their registration as legal entities. The program conducted trainings on Early Warning Systems for local community members.

The communication process:

During floods, the CMDRR committees from the Oromia region upstream notify their downstream counterpart committees in Dire Dawa city by mobile phone using designated emergency phone numbers. Then the downstream Dire Dawa committees use sirens and megaphones to relay the emergency weather and climate information and also to prompt responsive action by the most-at-risk community members. As an innovation, the local communities combined the indigenous early warning signals with the conventional Early Warning Systems primarily disseminated by government agencies, non-governmental and private-sector organizations.

- **4.1.2 Assam State, India[4]**

The best practice reported here is based on the report titled Flood Early Warning System: A warning Mechanism for Mitigating Disasters during Flood" date (N.A) is a project initiated by Assam State Disaster Management Authority in collaboration with North Eastern Space Application Center

Assam is the gate way to the northeastern part of India. Occurrence of flood has been an age-old phenomenon in the riverine areas of the region. The frequency and intensity of flood has grown over the years primarily because of the increased encroachment of flood plains. There are mainly two river systems in Assam i.e. Brahmaputra and Barak River. Flood is an annual event in the State of Assam. More than 40 percent of its land surface is susceptible to flood damage. The total flood-prone area in Brahmaputra valley is about 3.2 million ha.

The main purpose of the initiative was to develop a location specific early warning system which could help the administration in taking advance precautionary measures an issue flood alerts to the those specific areas so that necessary measures can be undertaken by the people.

Major Technical Components of the Project

1. The meteorological components comprises of the two major sub components of Weather Research Forecast (WRF) model for grid based rainfall prediction through numerical schemes and multi-parametric (CTT, CMV, Vortices etc.) synoptic weather monitoring for overall probability of rainfall in a particular basin.
2. The hydrological component comprises of a hybrid approach of lumped grey box model known a Rational model in combination with a quasi-distributed hydrological model know as the HEC-HMS in Arc-GIS platform. While the first approach provides the forecast of the peak value for a river basin, the distributed model provides the forecast for the daily hydrograph for that basin. Comparing both the forecast with the established flooding thresholds for that river, issue of flood warning is decided.

[4]The flood early warning system designed as a warning mechanism for mitigating disasters during flood in Assam State in India was selected as the best practice by the Department of Administrative Reforms & Public Grievances, Ministry of Personnel, Public Grievances and Pensions of Government of India.

3. The third component is the post flood identification of the embankment breaches and general monitoring of embankments.

Figure 4.1 Flow chart of overall methodology of FLEWS

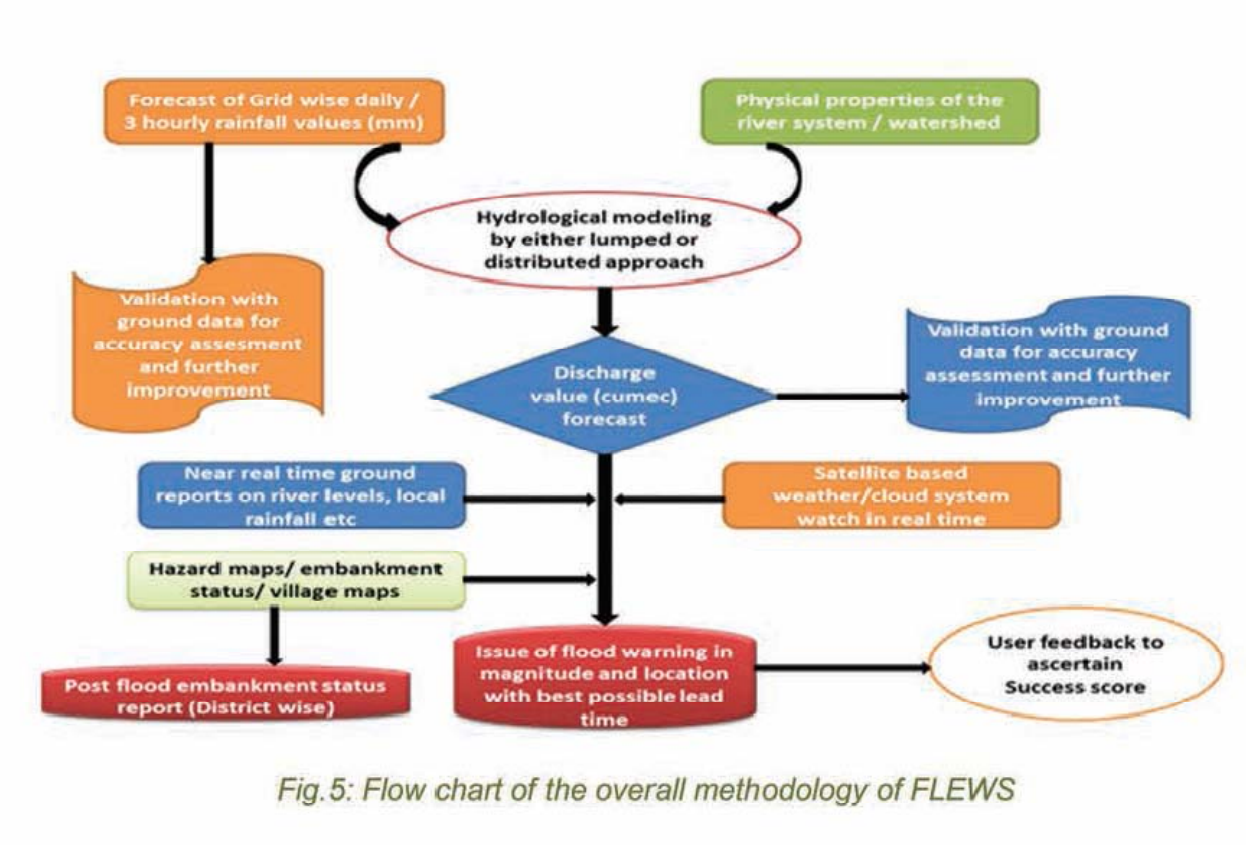


Fig.5: Flow chart of the overall methodology of FLEWS

Methodology for dissemination of flood warning alerts to districts

Once the Flood Warning Alert is received at the State HQ, the same is disseminated to the District Deputy Commissioners and the District Project Officer (Disaster Management) for alerting the concerned Circle Officers, Water Resource Department PWD (Roads) Department, through SMS, phone/mobile and personnel messenger. The flow chart for Flood Warning dissemination as indicated in the following figure shows two way communications between the North Eastern Space Application Centre (NESAC) which issues flood alters and GAON BURAS/PRI/TASK FORECES/NGOs/CBOs at GP and Village.

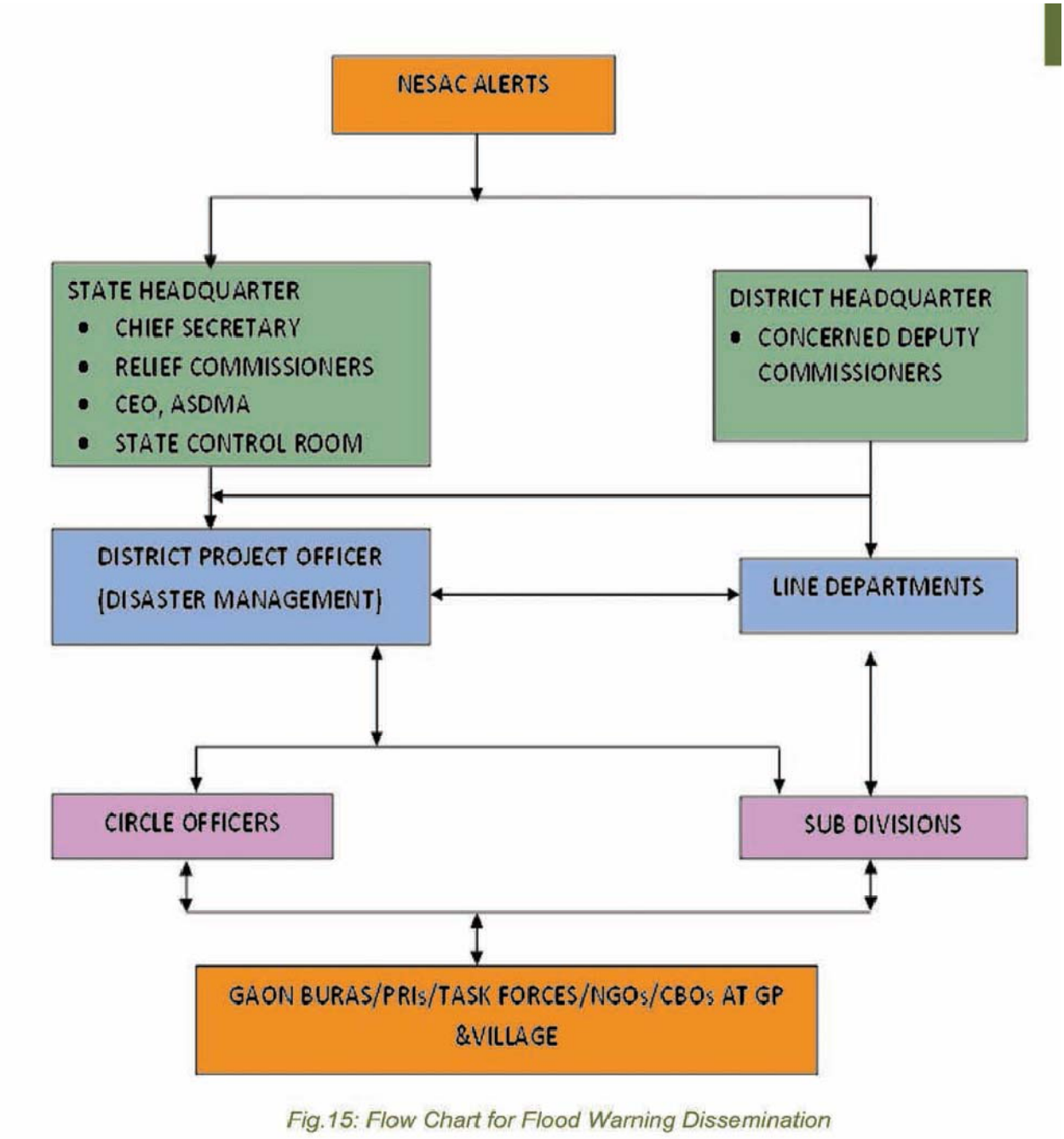


Figure 4.2: Flow chart for flood warning dissemination

Organizations/stakeholders involved

FLEWS is an integrated effort of different stakeholders viz. Indian Meteorological Department (IMD), Central Water Commission (CWC), NEEPCO, Water Resources Department, NESAC and ASDMA to achieve a common goal of effective management of flood in Assam. The Assam State Disaster Management Authority (ASDMA) takes the lead role in bringing all the stakeholders together in a common platform for developing this system. Prior to development of

FLEWS each stakeholders were working independently within their own domains for flood management and it was ASDAMA that played the catalyst role in getting all on board and brought in the North East Space Application Center to develop the location specific FLEWS model. Since then each department has been contributing significantly for effective implementation of the FLEWS and thereby making it a success.

Strategies adopted for bringing about the transformation and its impact

1. The first strategy in the establishment of FLEWS is the consideration of the flood prone districts on a basin or catchment. The early warning system has been viewed in the context of a river basin approach where upstream, midstream and downstream activities affect the time of concentration and volume of runoff as reflected in the shape of the hydrograph.

2. The second strategy adopted in FLEWS is providing location specific early waning advisory bulletin. The warnings issued by NESAC provide information about the revenue circles and the probable villages that may be affected due to flood. This information is of great help to the administrative machinery for preparedness and response activity. The flood alert is also disseminated to the community through revenue circle officers and gaon buras.

3. The third strategy is the involvement of all the stakeholder under FLEWS as without their active participation FLEWS could have never been a success.

The model developed by North East Space Application Center for flood early warning has an accuracy rate of around 60 %.

4.2 Current Flood Early Warning Communication Method

- **4.2.1 Eastern Nile Technical Regional Office**

ENTRO conducts daily monitoring with three-day lead-times to produce forecasts. Rainfall and hydrological data is used to model and predict flooding with greater accuracy. Daily, weekly, and seasonal flood forecast reports are generated and disseminated to different users at different levels through the ENTRO web portal, email, and mobile phone messaging.Daily, weekly, and seasonal flood forecast reports are generated and disseminated to different users at different levels through the ENTRO web portal, email, and mobile phone messaging.

ENTRO has direct relations with the Ethiopian Ministry of Water, Irrigation and Energy. It sends the English version of flood early warning to the Ministry by e-mail to provide early warning information to local government (woreda) authorities to aid in flood preparation and response.

Further, an attempt is made to widen the dissemination of the forecast by sending the forecast to the National Disaster Risk Management Commission (NDRMC), Red Cross and other NGOs. The Flood forecast of 2018 issued by ENTRO is indicated in the following Box 2.

Box: 2

In Lake Tana floodplains, the methodologies for flood forecasting processes were used combined hydro-meteorological| flood models. The WRF rainfall forecast for the EN is issued for the 2018 flood season from third week of June to end of August, the Configured Hydrologic Modeling System (HEC-HMS) to produce the corresponding runoff forecasts, and the Hydraulic River Analysis System (HEC-RAS) model used for routing the runoff forecast on the LT floodplain areas. Then, the flood inundation maps were produced that shows the degree of inundation depths and the number of flood affected households residing on the LT floodplain. This was done using the simulation results from the hydrodynamic model and HEC-GeoRAS mapper in arc-GIS interface. In the FEWS-Sudan, integrated forecasting models were used and run, including HEC-HMS hydrological model of the Upper Blue Nile catchment (upstream of El Deim gauging station). HEC-RAS model of the Blue Nile between El Deim and Khartoum, and Linear Correlation Models between El Deim and Dongola in the Blue and Main Nile river systems. USGS-RFE and TRMM 3B42satellite based rainfall estimates for upper Blue Nile, Dinder, Rahad, Sitet and Atbara catchments were used as forcing data for the HEC-HMS hydrological model. In addition, there are three days rainfall forecasts of WRF from NOAA and inundation maps library for the Blue Nile River based on the discharge at El Deim station. In the development of BAS flood forecast model, WRF rainfall forecast is used as an input to the configured hydrologic model for BAS (Gambella floodplain and Sobat Floodplain) and the anticipated relative peak runoff during the forecast period were used as an input to hydrodynamic model component that was developed for Gambella Floodplain and the Sobat areas. Hence, verification was done with mean daily gauge readings from Gambella and Itang Stations. Alternatively, Global Flood Tool from USGS was used to model the inundation patterns for different depths of the rivers. Source:
ENRTO (2018) Flood Preparedness and Early Warning Seasonal Report

- **4.2.2 National Disaster Risk Management Commission**

The National Disaster Risk Management Commission (NDRMC) communicates the Flood Alert to stakeholders by telephone and email. Further, at the time of flooding frequent communication is carried out. For instance, in 2014 the emergency coordination center of NDRMC implemented the National Incidence Management System (NIMS) from USA. Depending on the urgency of the disaster we use every possible communication system. Recently a pilot project called Woreda Net in about 35 Woredas with computers provided the Commission with data. The information collected is helpful for situation update. The flood forecast issued by NDRMC covers all the

country. The institutional arrangement for flood early warning and dissemination is indicated in the following figure.

Current flood early warning institutional arrangement and communication method

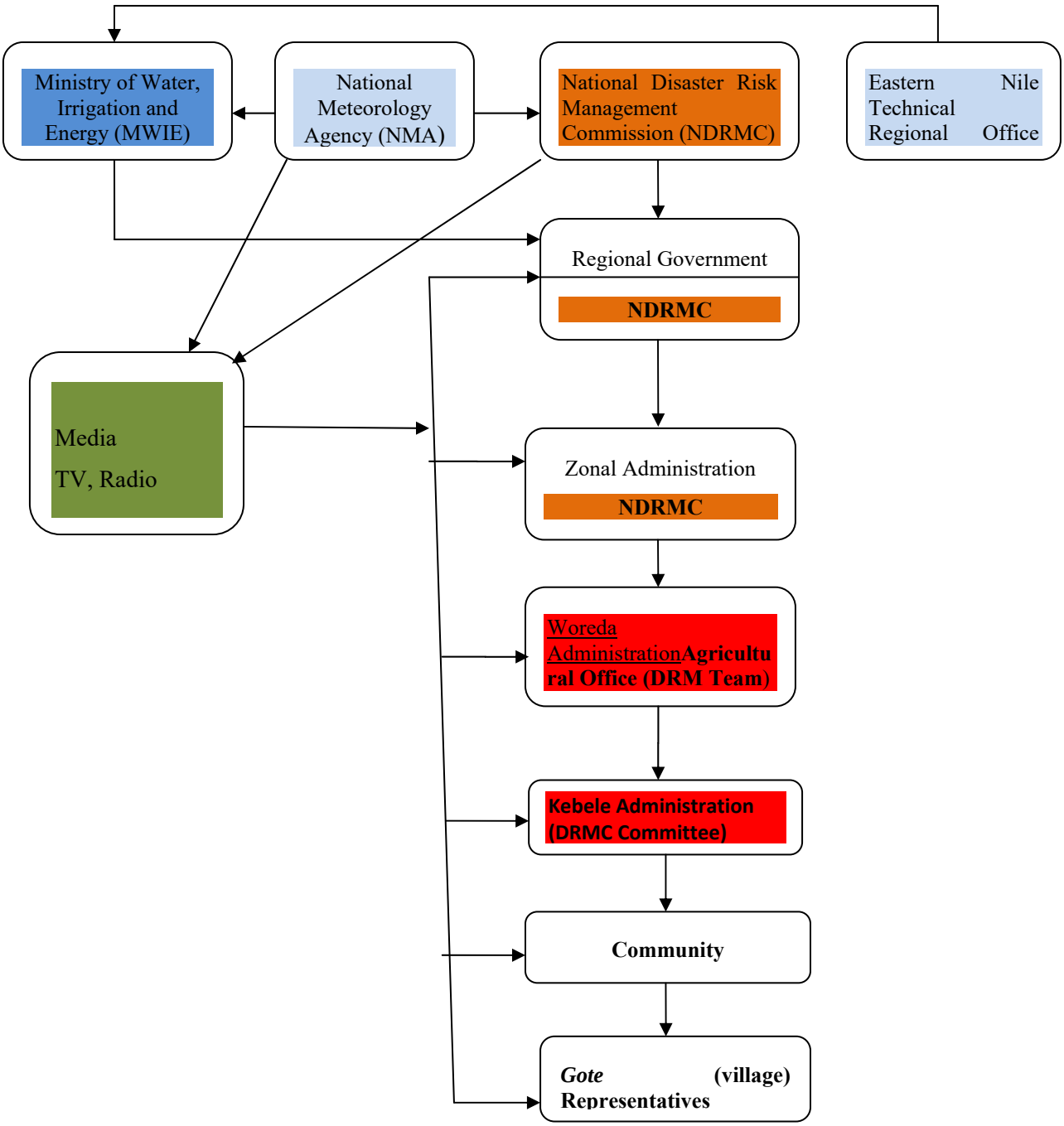


Figure 4. 3 Flood Early Warning Communication and Dissemination Chain

Flood Alert No.2

This National Flood Alert # 2 covers the Kiremt season, i.e. June to September 2019. The National Flood Alert # 1 was issued in April 2019 based on the NMA belg Weather Outlook. This updated Flood Alert is issued based on the recent NMA kiremt Weather outlook to highlight flood risk areas that are likely to receive above normal rainfall during the season and those that are prone to river and flash floods. This flood Alert aims to prompt early warning, preparedness, mitigation and response measures.

During the months of May and June 2019, 33 Woredas (in seven regions) were affected by flood forcing 42,249 families to displacement, significant number of livestock death, and property damage, i.e. crop, houses, schools and other vital infrastructure.

In SNNP region, 13 Woredas were affected by flood whereby 5,901 families were displaced and 4616 ha covered with crops was flooded. There are also reports of significant damage such as destruction of 150 houses and other key infrastructures. In addition, there were reports of flooding which affected 13 schools in the above mentioned Woredas.

In Afar, 36,000 families were reportedly displaced due to flood while significant number of livestock deaths were reported.

Similar flood incidents were reported from Amhara, Gambella, Oromia, Somali and Tigray regions.

FLOOD RISK AREAS

The 2019 Meher season flood risk areas list was developed based on the NMA 2019 Meher season weather forecast, and historical data.

Gambella Region- Neur zone - Wantawa, lare, Akobo, Makuwey and Jikawo Woredas. Ankwak zone -Gambella Zuria, Gambella town, Dima, Jore, Goge and Abobo Woredas. Mejenger zone -Mengeshi Woreda and Itang special Woreda.

Benishangul Gumuz Region: Assosa Woreda.

Oromia Region: West Hararghe- Habru, Hawi Gudina and Oda Bultum Woredas. East Hararghe -Golo Oda, Goro gutu, Jarso, Gursum, Deder and Meta Woredas. West Arsi - Shalla, Arsi Negelle, Siraro, Kofele, Nensebo, Kore and Yaya Gulele Woredas. Arsi - Ziway, chole, dugda, gololcha, Robe and Seru Woredas. Bale - Agarfa, Legehida, Gasera, Gololcha, Ginnir, Seweyna, Goro, Berbere and Guradamole Woredas. Borena - Das, Dire, Arero, Miyo, Moyale, Yabello and Dubluk Woredas. West Shewa – Ejere Woreda. South West Showa – Illu and Ginchi Woredas. Guji- Adola, Urga, Bore, Anasora and Dima Woredas. East Shewa -Boset, Adama town, Adama Woreda, Adame tulu, Jido Kombolcha, Fentale and Lume Woredas. Illu Ababora – Becho Woreda.

Amhara Region: South Gonder -Libo Kemkem, Fogera and Dera Woredas. Central Gonder- Dembia, Gonder Zuria and Alefa Woredas. West Gojjam -Bahir Dar Zuria and Dega Damot Woredas. Oromia special zone- Jile Tumuga, Artuma fursi and Dawa Harawa Woredas. North

Showa -Antoskia Gemza, Ataye town, Shewa Robit, Kewet, Efrata Gidim and Ensaro Woredas. South wollo -Ambassel, Kombolcha and Kalu town Woredas.

Somali Region: Shebele - Kelafo, Mustahil, Ferfer, Gode, Berano, DehunAdadile and East Imey Woredas. Afder - W/Imey, Chereti, Dollobay and Hargelle Elkeri Woredas. Liben - Dollo Ado Woreda. Dollo – Warder Woreda. Fafen – Jijiga, Togochale, Kebribeyah Woredas. Siti – Afder, Ayisha, Erer, Miesso and Shinile Woredas.

Afar Region: Zone -1 - Dubti, Asayita, Mille, Chifra and Afambo Woredas. Zone 3 - Amibara, Gewane, Bure Mudayitu, Dulecha and Awash Fentale Woredas. Zone 2 - Abala, Berhale, Megale and Koneba Woredas. Zone 4 – Ewa Woreda.

Tigray Region: W/Tigray – Humera and Tsegede Woredas. Southern Tigray - Alamata Woreda. Raya –Azebo, Enda- Mehoni and Maichew Woredas.

SNNPR: S/Omo- Dasenech, Nanghatom, Hamer and Selamago weredas. Hdiya – Shashego and Mirab Bedewacho. Wolayta – Humbo, Damot Waydie, Dugna Fango, Kindo Didaye, Kindo Koysha and Boloso Bombe. Halaba Special wereda – Halaba. Sidama – Loka Abaya, Hawassa Zuria, Hawassa Town; SilteDalocha, Sankura and Silte weredas. Guragie-Meskan, Mareko and Kochere.

Dire Dawa: Dire Dawa city

Harari Region: Harar city

Addis Ababa: Flood prone sub cities

NDRMC communicates the issued flood alert to the Regional Commission Offices by e-mail. The flood alert will be discussed by the Regional Disaster Risk Management Committee (RDRC). The regional DRMC will communicate the flood alert to zone and Woreda offices. The woreda disaster preparedness committee is composed of Chief Woreda Administrator, water, health, education, finance and economy, women affairs and transport. The Woreda in turn communicates the kebele administration by telephone, which is responsible for the dissemination of warnings at community level. There are agriculture extension workers at kebele that are responsible for dissemination of information. Further, there is disaster prevention and early warning committee composed of the chairman of kebele who chairs this committee, agricultural workers, heads of kebele security and social activities. These members spread the flood alert message in different ways including through got leaders, calling meetings, by word of mouth in churches and market places.

In Amhara Region, the kebele administration is sub-divided in to *Gotes* (villages) to mobilize the local people for development and other activities. The kebele calls a meeting of *Gote* representatives to inform the flood alert. The *gote* representatives will communicate the flood alert to their respective *gote* people. In addition, in some Woredas the chairman of can call a general meeting of the local people to communicate the flood alert. In some cases the agricultural extension workers can communicate the people. In some instances the people who received mobile phone can disseminate the flood alert. The informal way of communication could be from relatives or friends who live in the high lands areas. These people can inform about the

rain and the volume of river water to their friends and relative who live down stream by mobile phone or any other means. There were instances in which some areas were flood without communication of flood alert such as Kola Deba town, Misrak Dembia Woreda, which was flooded by Derma River.

ENTRO has distributed four small boats to Dembia, Fogera, Libo Kemkem and Dera Woredas which are highly affected by flooding. The boats are used to conduct flooding assessment during the rainy season and they also transport people from one area to another which are difficult to cross by foot. The assessment is helpful to launch early warning. The Amhara region covers fuel and per diem during the assessment. Further, ENTRO has given 40 mobile phones to the above mentioned kebeles to communicate flood alert. The region re-charges these mobile phones during *keremt* season. The people with the mobile phones communicate with Woreda administration with regard to flooding. In addition, wooden poles which show flooding level and sirens which alert people the prevalence of flooding are installed by ENTRO. However, the wooden poles have fallen. When the flooding problem is pressing, the Woreda can directly communicate Killel or Federal authorities.

The communication is effective. The public understands the message. Relatives in the area can give calls of early warning. There is involvement of the public on the ground. No one is legally liable if he fails to communicate flood early warning. The victims usually demand various types of support after the flood damage. Before three years, there was a practice every year by calling kebele disaster committee members at Woreda level to give short training about disaster. Now due to budgetary constraint there is no training.

In Gambella region, the practice of early warning communication is similar to Amhara region. The formal government structure down to kebele is employed. The slight difference is the means of communication when the flood alert is communicated to the community. The first major communication of flood alert is to use FM radio broadcasting service in five local languages. Further, telephone calling and the early warning committee goes to the flood affected areas to inform the community members. The case of rural kebeles, with communication problem, including Jore Woreda with 16 rural kebles have only two police radio communications which can serve for the early warning. The 14 kebles do not have communication means. Local people do not have personal radios. There were incidences of flooding without prior notice which were reported by the local people to the concerned authorities, For instance, Demedolo Woreda, Nuer zone, was affected by flood.

The existing EWSs don't take into consideration indigenous early warning systems. However, it encourages the participation of the public and non-governmental organizations. The National Early Warning Technical Committee is a tool for coordination. There is data sharing and collaboration among institutions when the Flood Alert is prepared. It should be strengthened. With regard to awareness creation on the use of flood forecasting products, training is given regularly to Woreda. Region also gives training to Woreda. Every year there is a plan to train at Woreda level. As to the elements contained in the early warning message, Almaz noted that the Timing **w**hen is the hazard due to strike is included. The areas which are going to be affected are indicated. The magnitude of the hazard is predicted. Further, what should at-risk populations do to protect themselves is communicated.

4.3 Gaps in Existing Communication methodology

The following gaps in the existing flood early warning communication methodology are identified.

- ***4.3.1 Eastern Nile Technical Regional Office***
  - The Ministry of Water, Irrigation and Energy has not communicated ENTRO's flood forecast to the stakeholders for the last three years.
  - ENTRO has not verified the flood forecast.
  - ENTRO does not consider indigenous flood early warning practices.
  - Since ENRTO directly communicates the Ministry of Water, Irrigation and Energy, the participation ofthe public and non-governmental organizations in the process of warning communication is not obtained.
  - The existing early warning system does not facilitate effective co-ordination between stakeholders.
  - ENTRO's consultation of stakeholders to get feedback on the flood early warning is very low.
  - The existing institutional arrangement does not allow carrying out effective dissemination of the forecast.
  - The stakeholders list for flood forecast dissemination is outdated. In addition, the impact of the forecast is not known.

- ***4.3.2 National Disaster Risk Management Commission***

  - At present, the woreda disaster risk management activities are carried out along with agricultural ones since they are carried out by the woreda agricultural office. This has resulted in poor performance in terms of early warning communication.
  - The manpower assigned at woreda level is not enough both in terms of number and skill.
  - EWS is not well owned and the practice is characterizes as fire fighting.
  - The NDRMC's annual short training on early warning at woreda level has discontinued.
  - Some rural kebeles have no access to modern communication technology. For instance, the 16 rural kebeles in Jore woreda, Gambella region, have only two police radio

communications which can serve for the early warning. The local people do not have personal radios. There were incidences of flooding in Demedolo Woreda, Nuer zone without prior notice.

- Sirens are not functional (e.g Libo Kemkem, Amhara region)
- Flooding can take place without issuing warnings to the local people (Kola Deba, Amhara region).
- No evidence of of monitoring mechanisms to check whether the warning message reach, understood and interpreted into action by the community members.

- ***4.3.3 None-governmental organizations***
  - UNICEF, WFP and UN-OCHA noted that the National Flood Alert is too general. It does not indicate specific localities that would be affected by flood.
  - Early warning Indigenous knowledge is not considered
  - Coordination among institutions is not institutionalized.
  - The focus is on response rather than preparedness.
- *4.3.4 Local communities*
  - Some community members are reluctant to accept flood warnings
  - In some areas, local people do not know what EWS means (eg. Jabitchinan, West Gojjam Zone)

4.4 Preferred/Proposed Flood Early Warning Communication Method and Technology

Realizing the above mentioned gaps in the existing communication method and technology of flood early warning, the following is proposed based on the report of (Wilton Park, 2016:pp.6-7)

Wilton Park[5] brought together many of the stakeholders involved in the flood early warning including representatives from NGOs, intergovernmental institutions, the United Kingdom (UK) Met Office, the World Meteorological Office (WMO), World Bank and meteorologists and hydrologists from a variety of backgrounds. The aim of this collaboration was to discuss the current frameworks and guidance that exist regarding flood forecasting, EWS and disaster risk reduction (DRR). Through constructive dialogue participants also examined why EWS need to be more effective for countries in the Greater Horn of Africa (GHA) and identified ways to help EWS in the GHA progress as well as the barriers to change that must be overcome if greater efficacy is to be realized.

Between users of flood early warning and data providers of warnings

[5]**Wilton Park** is an executive agency of the UK Foreign and Commonwealth Office providing a global forum for strategic discussion. It organizes over 50 events a year in the UK and overseas, bringing together leading representatives from the worlds of politics, business, academia, diplomacy, civil society and media. Events focus on issues of international security, prosperity and justice.

- For any EWS to be effective increased dialogue between EWS suppliers and recipients of warnings will help to ensure that the former understand the needs of the latter, which includes an appreciation of local culture, custom, media and geography.
- In order to reach the User Groups at the "Last Mile" located on the margins of society at the grassroots level, the government must enact a policy or resolution that recognizes incorporation of Indigenous Knowledge (IK) and Traditional Forecasting Systems (TFSs) as well as their conveyance into the scientific forecasting methods including service delivery, advocacy, communication and outreach program
- One of the most effective ways to build rapport and understanding between NMHSs, governments and user communities is through mutual education.
- it must understand the needs of its users, and ensure users are involved in the EWS design as well as its implementation.
- Primary education in particular can be instrumental in building long-term trust and understanding of the risks of flooding in a community, and what actions they can take
- Re-education of user communities regarding both the risks of flooding and the courses of action available to them is also important.
- Visual reminders of disaster threats help to improve the longevity of communities' memories of those disasters
- User communities must also be educated in what action they can take in the event of a flooding event.

Media

- Media is an essential part of any EWS and one of many tools for the dissemination of a warning.
- Knowledge of the types of media that user communities possess (and favor) is essential for governments and NMHSs when disseminating a warning
- Many remote, rural communities in the GHA rely on VHF radios as a primary method of communication. This type of media, in particular, necessitates a concise, coherent warning message
- It is important that the media involve the communities to help disseminate warnings. Here, knowledge of community demographics is important to ensure that every group is targeted by some form of media
- For example, one community may rely heavily on radio or television, whereas others are better reached through local religious institutions or by their community elders visiting their homes in person
- Multiple forms of media need to be used, but there must be coordination with those responsible for disseminating warnings must remain abreast of developments in media and communications technology
- The increase in mobile phone usage in the GHA opens new possibilities for effective dissemination of a flood warning
- Flood early warning communication method to be effective it must understand the needs of its users, and ensure users are involved in the EWS design as well as its implementation.

- Increased dialogue between early warning suppliers and recipients of warnings will help to ensure that the former understand the needs of the latter, which includes an appreciation of local culture, custom, media and geography.
- In order to reach the User Groups at the "Last Mile" located on the margins of society at the grassroots level, the government must enact a policy or resolution that recognizes incorporation of Indigenous Knowledge (IK) and Traditional Forecasting

4.5 Existing Indigenous Flood Early Warning Practice

In the flood prone areas, indigenous flood early warnings are practiced. For instance, in Libo Kemkem woreda, Amhara region, the local people forecast flooding when the rain comes from the Debre Tabor direction. In Fogera Woreda, the local people forecast flooding when they see dark clouds massed on the horizon and strong wind blowing from north to south.

Key informant, Jemberu Desse, Director, Disaster Preparedness and Early Warning Directorate, Amhara Disaster Preparedness, Food security and Special Support Coordination Commission reported that the local people have their own indigenous forecasting system. For instance, they may watch how the rain starts and forecast how the rain will be heavy or not. Further, he suggested that it is important to encourage the community people to mobilize the flood affected people using their indigenous knowledge with regard to flooding. He also noted that NDRMC did not attempt to utilize indigenous knowledge of flood forecasting. The flood early warning practice could be strengthened if new flood forecasting software are available, provision of training, experience sharing forum, evaluation of performances regularly.

5. CURRENT RESPONSE ACTIVITIES TO FLOOD EARLY WARNING

5.1 Performance of Current Response to Flood Early Warning

- **5.1.1 Amhara Region**

Key informant, Jemberu Desse, Director, Disaster Preparedness and Early Warning Directorate, Amhara Disaster Preparedness, Food security and Special Support Coordination Commission indicated that the communication channel may not be effective since some members of the community may be reluctant to take action according to the warnings given. This is mainly because the flooding occurs every year. In this regard, concerted effort to raise their awareness should be taken.

In Libo Kemkem woreda, every year there is flooding. However, the impact is minimized since the community constructs dikes. The boat given by ENTRO is not functional since the motor is stolen. However, the Woreda borrows boat from Killel for flood assessment.

In Fogera Woreda, there are some people who are reluctant to take preventive actions assuming that flooding will not create a problem. However, the flooding could damage their crops and cattle.

In Misrak Dembia Woreda, for instance, Derma River has affected the town of Kola Deba. Earlier, a dyke was constructed to prevent the town from Derma River flooding. The river has overflowed the dyke and affected a number of households. At present the government has allocated 1.2 million birr to construct dyke. The budget is small and it was released lately after the rain has started.

- **5.1.2 Gambella Region**

In Jore Woreda, since the land is flat, flooding occurs every year. In 2005 (EC), because of the flooding people were moved to another area which was considered safe. However, the flooding has continued in the new area. Although the local people have constructed canals to minimize the flooding, the land is inundated when the water overflows the canals. At present the river Gilo has caused flooding in five kebles namely Omoge, Alaw, Kento, Kento gira and Tu. About two thousand people are affected by the flooding. Crop fields are inundated. The flood early warning has been communicated to the community in April and May, 2019. The flood early warning message contains that the regular rain has started and later volume of rain will increase and as a result overflowing of the Gilo River could take place. Thus, the community has to construct canals early. By and large, the community has accepted the message. However, the overflowing of the constructed canals is beyond the capacity of the people. There is no other place to relocate the people. The local administration has assumed the present location as safer. The current flooding has damaged the crop fields, houses, and incidence of malaria has taken place. The flood affected people are in a shelter where 318 people were living. At present, additional 300 people have joined the earlier displaced people. Thus all the 618 people are crowded in one area. The local people understand the message. The regular rain starts in April and later the volume of rain increases which contributes to the overflow of Gilo River. Since the

people live in a low land, there is no safe place to relocate them. The solution according to Kello is to construct a permanent structure that channels the water.

5.2 Proposal on how to improve the response to Early Warning

An early warning system can fail even if the infrastructure is installed and functional and the warnings are issued and disseminated correctly; a warning alone mightn't be sufficient to prompt a response. Public and institutional preparedness, including institutional response capacity, have to be developed to a sufficient degree to allow for an organized, risk-mitigating reaction to warnings. Risk-mitigating reactions and the preparedness of institutions and the broader public can be difficult to achieve, especially if the time between warning and disaster is short or not used efficiently. Moreover, if the priorities of different response actions are not well delineated, warnings can give place to chaotic and interfering actions.
In sum, to improve the response to early warning, the following are suggested.

- Government and other stakeholders should develop the capacity of disaster risk management offices at all levels.
- Sufficient budget allocation to flood prone areas must be considered.
- Regular risk awareness creation should be given to community members.
- The flood early warnings should be timely and area specific to obtain better response.
- Due attention should be given to indigenous early warning practices.
- The community-based solutions guarantee that warning communications reach communities at risk, and that vulnerable communities are therefore prepared to counteract the risk.

6. INSTITUTIONAL ARRANGEMNET

6.1 Gaps in the current institutional setup at national level

The gaps in the current institutional setup at national and local level include:

- ***Institutional arrangement:*** The Ministry of Water, Irrigation and Energy is not play the lead role in water related disaster including flooding according to the Ethiopian National Policy and Strategy on Disaster Risk Management. Institutional coordination and collaboration is of paramount amount for early warning and communication activities. However, stakeholders have noted the limitation in this regard. The existing institutional arrangement does not allow carrying out of effective dissemination of the forecast and ENTRO and MWIE is case in point. Gaps in institutional and co-ordination frameworks can prevent the operation of flood early warning system and the integration of risk information into decision-making across all sectors. The National Disaster Risk Management Commission organizational structure at woreda level is mixed up with the Ministry of Agriculture. This has hindered effective early warning and communication at local level.

- ***Technology, infrastructure, and forecasting capability***: technology plays a key role for EWS, especially for its monitoring, forecasting, and warning dissemination components. Yet in the context of Ethiopia, the necessary infrastructure and capabilities are lacking. Stakeholders including ENTRO, MWIE, NMA and NDRMC have noted the limitations in this regard.
- ***Human resources and expertise:*** The effectiveness of EWS goes well beyond the efficiency and availability of early warning technology. Personnel responsible for maintaining and operating the systems also have to be competent and well trained. In Ethiopia, the public sector lacks human resources with the necessary experience and skills.
- ***Public engagement and empowerment*:** For EWS to truly serve the public and be effective, communities have to be involved in the process of designing and implementing EWS. The current practice shows that the public as simple recipient of flood early warnings. Engaging and empowering communities can be difficult due to cultural and linguistic barriers, as well as political realities. Further challenges include physical distance and lack of effective communication networks that can create difficulties delivering messages to rural settlements and nomads and/or transhumant. The content and presentation of warnings also have to be customized, depending on how communities perceive risk, what degree of detail can be understood, and how prompt actions can be effectively induced.

6.2 Proposed setup for an effective Flood Early Warning System

In general, the National Policy and Strategy on Disaster Risk Management of the country has clearly designated the Ministry of Water, Irrigation and Energy as the lead institution for flood disaster risk management. The preferred institutional arrangement is to implement the policy

into action. In this regard, the Ministry should assume its responsibility which would facilitate the flood early communication.

Communication is an essential component in any EWS chain and must be improved/ consolidated at all levels if a warning is to be timely, relevant and effective. Good communication is also required if coordination between actors is to be increased. Effective flood early warning has to be communicated and disseminated to people to ensure communities are warned in advance of impending flood hazard and to facilitate national and regional coordination and information exchange.

Regional

Eastern Nile Technical Regional Office (ENTRO)

The Eastern Nile countries namely Egypt, Ethiopia and the Sudan (South Sudan joined in 2012 following its independence) launched the Eastern Nile Subsidiary Action Program (ENSAP) to initiate concrete joint investments in the Eastern Nile (EN) sub-basin.

ENTRO as technical office prepares flood forecast for Ethiopia (Tana area and Gambella), Sudan and Egypt. It prepares the flood forecast by engaging professionals (flood management team) from the water resources ministry from the member countries

ENTRO communicates the forecast with the concerned water resource ministries. Further, an attempt is made to widen the dissemination of the forecast by sending the forecast to the Ethiopian Ministry of Water, Irrigation and Energy, National Disaster Risk Management Commission (NDRMC), Red Cross and other NGOs.

The World Meteorological Organization (WMO 2011: 17-20)) suggested the following areas for considerations in setting up collaborative arrangements for international and cross-border exchange of warnings.

Weather warnings are intended to alert the public in dramatic or attention-grabbing fashion and are usually issued in plain language. For international exchange, translation into a single agreed language or coded format such as XML is necessary for practical reasons. Communication among neighboring countries enables consistent warnings about the hazards be issued to the public and concerned organizations. The efficient exchange of warnings of severe phenomena with the potential for cross-border impacts must clearly be a high priority component of any well-coordinated system for multi-national disaster preparedness and response.

The thresholds for issuing weather warnings vary from one country and one region to another, usually for reasons of climatology and vulnerability. Thresholds and intensities for which these phenomena are considered potentially harmful should be decided by mutual agreement. These initial alerts should be followed by regular updates as the timing, scale and intensity can be more accurately observed and forecast. In practice the most effective mitigating actions are usually taken from three (3) to six (6) hours before an event. Within the limits of current forecasting capabilities, realistic objectives for forecasting the onset of a severe weather event would be:

- Three (3) days for initial alerts for large-scale events; and,
- Three (3) hours for details on intensity, duration and location

Communication methods for the exchange of warning information may include:

- Global telecommunication system (GTS);
- Telephone;
- Facsimile;
- Direct link for bilateral exchange;
- Web form;
- E-mail; and/or
- Satellite system.

The essence of any warning is to give timely notice that a risk exists. It therefore follows that mechanisms for exchange of information must be as fast and reliable as possible. To achieve effectiveness and consistency, the system should be designed around the most reliable technology that is mutually available.

Maximum benefit and success of any program of cooperation in exchange of warnings will be realized if there are regular reviews of the process and if all operational staff is adequately trained. Reviews of the process should be held at least once per year and it is highly recommended that they also take place after a significant event. Through these review meetings, shortcomings and training needs could be identified and steps could be taken.
The review should also include the continual assessment of the following:

- User requirements;
- Means to meet those requirements;
- Ensuring that the users know how to make best use of the products and services provided by the NMHSs; and,
- Assessing the accuracy and usefulness of those products and services.

6.2 Proposed set-up for an effective early warning system national and regional and local

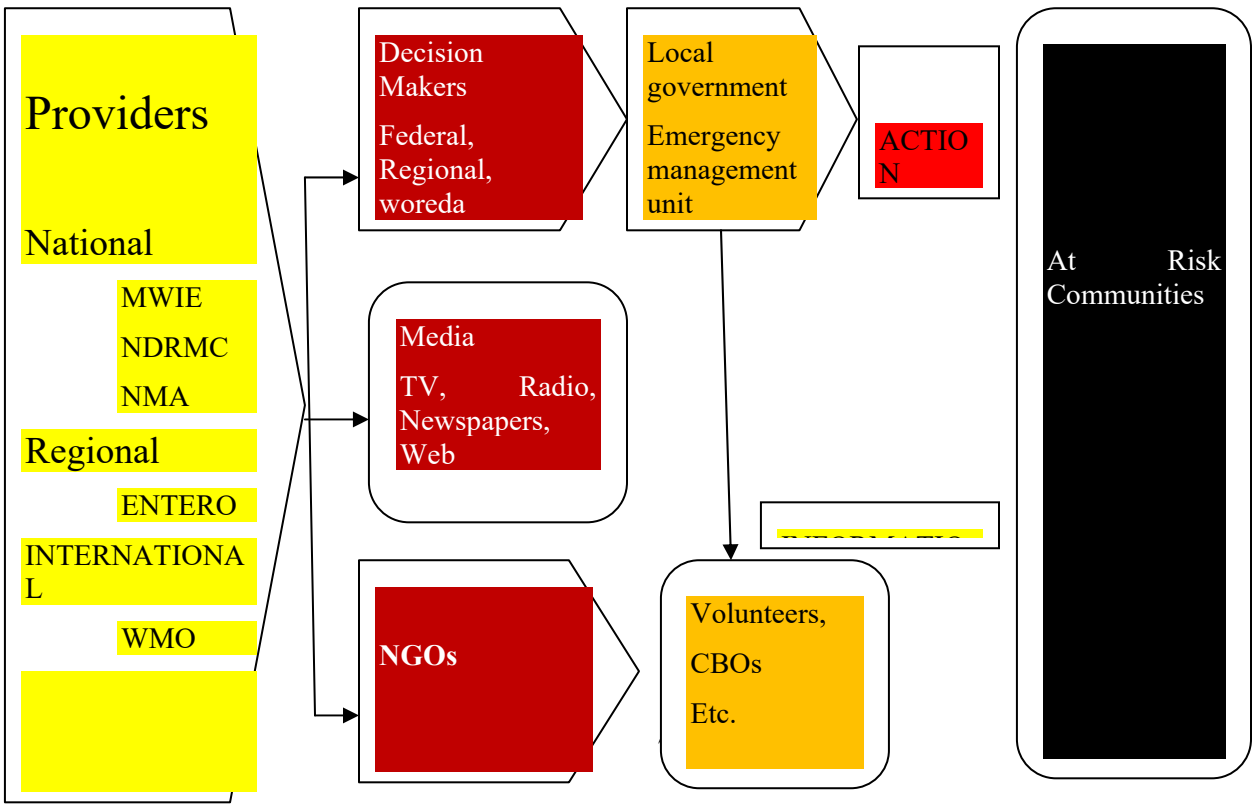


Figure 6.1 Proposed institutional setup for early warning system

The institutional setup proposed shortens the communication channel in terms of early warning and communication. It is suggested that the data providers can issue flood alert directly to decision makers, media and NGOs. The decision makers can communicate the woreda emergency management unit to take action for the community at risk. Simultaneously, the local emergency management unit can provide information to volunteers and CBOs in order to mobilize them for action along with the local emergency management unit.

7. CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

The main findings of the study include:

- The EN Seasonal FFEW activity has been producing flood bulletins for seven seasons with three day lead time communicating to the Ethiopian Ministry of Water, Irrigation and Energy by e-mail. However, ENTRO's flood forecast has not been communicated to the flood prone areas for the last three years.
- In the flood early warning system, the data and forecast providers include ENTRO, MWIE, NDRMC, NMA, UNICEF, WFP and UNOCHA.
- The Flood Alert issued by NDRMC is too general, which does not indicate a particular area that could be affected by the flood
- ENTRO's data sharing and collaboration with other institutions is not satisfactory.
- The existing early warning system does not facilitate effective co-ordination between stakeholders. Data sharing and collaboration between institutions, ministries and ENTRO is not institutionalized.
- The emphasis of the EWSs is response rather that preventive actions. Further, it does not consider indigenous flood early warning practices
- There is lack of awareness creation forum such as workshop, training or field visit.
- With regard to flood forecasting chain, implicit authors or mediators regarding flood disaster in the community are not identified.
- The existing flood EWSs is not technically sustainable since the institutional arrangement is not clear.
- The Ministry of Water, Irrigation and Energy did not assume the role of a lead institution with respect to floods disaster. The National policy on disaster risk management is not translated into action. NDRMC is playing the lead role.
- Capacity limitation prevails in the national institutions to create functional and comprehensive meteorological and hydrological networks to generate accurate forecasts and guidance. Government or donors' investment in leadership and soft skills to improve flood EWS is low.
- Disaster risk management is organized under the Woreda Agricultural Office. The communication system is not well structured at Woreda and kebele levels. At Woreda level, lack of skilled manpower and high turnover and limited budget allocation are some of the problems encountered.
- The interest to get flood alert feedback from communities did not materialize.
- There is lack comprehensive training on risk knowledge and hazards.
- The non-governmental organizations calibrate the forecast they obtain from NDRMC and NMA with the information collected from their field offices to address the specific flood affected communities according to their mandates.
- Flooding can happen without communicating early warning. For instance, in Jore woreda, Gambella Region, 14 kebles do not have communication means. Local people do not have personal radios. The other communication means is by writing a letter.

- In some areas, people are reluctant to take action after they received the flood early warnings. No evidence of monitoring mechanisms to check whether the warning messages reach, understood and interpreted into action by the community.
- Best practices and methodologies in flood early warning from Ethiopia and India are identified.

7.2 Recommendations

- NDRMC and UN-OCHA underlined that flood early warning system could be sustainable if the Ministry of Water, Irrigation, and Energy assumes lead responsibilities according the National Disaster Policy and Strategy. There is no concrete action with regard to the implementation of the lead role by sector institutions according to the policy and strategy of disaster risk management. Such issue should be resolved at higher level (Prime Minister's Office) so that sector ministries could mainstream disaster in their development plan.
- To overcome capacity limitation of NRDMC, NMA and ENTRO, the provision of training and upgrading of forecasting modeling are imperative.
- ENERO should communicate the flood forecast output to a wide range of stakeholders.
- ENTRO should regularly consult stakeholders with regard to the type of information stakeholders need.
- ENTRO should be a member of Nation Early Warning Technical Committee.
- ENTRO should sign a memorandum of understanding with, NMA and other important organizations to facilitate data sharing and collaboration.
- ENTRO flood early warning message indicates to what extent the water level is raised compared to the average. It should provide detailed information with regard to the magnitude of the flooding.
- The flood early warning system focuses on response. Since the flood prone communities are known, NDRMC should give emphasis to preventive actions.
- NDRMC should continue the restructuring process so that the disaster risk management office at woreda level could be organized independently.
- The flood forecast data providers should employ high performance technology for better forecast output, which minimizes doubtfulness on the part of forecast users. Further, this effort should be supported by indigenous flood early warning practices.
- Capacity building in terms of forecasting techniques and regular awareness creation at community level should be practiced to reduce the negative impacts of flooding.
- The regional governments and NDRMC need to consider the construction of permanent structure to protect local people from flooding in Gambella area since the flood affected people do not option to resettle in safer place.
- The communication method at kebele administration level is not well organized. Thus, the method should consider the issues mentioned under section 4.4 Proposed Flood Early Warning Communication Method and Technology.

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Annex

List of interviewed stakeholders

No	Interviewed person	Position/specialized field	Institution
1	Eng. Azeb Mesaye	Water specialist	ENTRO
2	Semunesh Golla	Hydrologist Director of Hydrology and Waster Quality Directorate,	Basin Development Authority, Ministry of Water, Irrigation and Energy
3	Almaz Demessie	Director, Early Warning and Emergency Response, Directorate	National Disaster Risk Management Commission
4	Surafel Mamo	Flood Modeler	ENTRO/Ministry Water, Irrigation and Energy
5	Thowat Tiach Kuon	Water Resource and Water Quality Officer	Gambella Water & Irrigation Bureau
6	Lul Jone	Publications Officer	Gambella Disaster Prevention and Food

			Security Agency
7	Jone Con	Coordinator, Woreda Disaster Prevention and Food Security Agency	Lare Woreda Disaster Prevention and Food Security Agency
8	Aderajew Admassu	Director, Meteorological Forecast and Early Warning Directorate	National Meteorology Agency
9	Tesgaye Ketema	Director, Development Meteorology Service Directorate	National Meteorology Agency
10	Kello Oku	Early warning worker	Jore Woreda Early Warning and Food Security
11	Agegehu Asmare	Team leader, Disaster Early Warning and Response Work Process	Misrak Dembia Woreda Agricultural Office
12	Beletu Tefera	Former chair of National Flood Task Force, retiree	National Disaster Risk Management Commission
13	Abera Kassa	Director, Disaster Risk Reduction Directorate	National Disaster Risk Management Commission
14	Sisay Kassa	Team Leader, Disaster prevention and Early Warning Work Process	Libo Kemkem Woreda Agricultural Office
15	Emnesh Asres	Team Leader, Disaster prevention and Early Warning Work Process	Fogera Woreda Agricultural Office
16	Jemberu Desse	Director, Disaster Preparedness and Early Warning Directorate	Amhara Disaster Preparedness, Food Secuirty and Special Support Coordination

			Commission
17	Gebre Egziabher Lema	Humanitarian Officer and member of the National Flood Task Force	UNICEF
18	Alemteshay Alemu	Vulnerability Analysis Team Leader	World Food Program
19	Abey Wogders	GIS Specialist	World Food Program
20	Melaku Gebre Micheal	Humanitarian Affairs Officer	UN OCHA