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Assessing Effectiveness of Disaster Early Warning System in IGAD Member States: A Comparative Study of Kenya and Uganda

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DR. EUNICE NJAMBI

"Enhancing Capacity for Maritime and Infrastructure Disaster Response and Management"

Assessing Effectiveness of Disaster Early Warning System in IGAD Member States: A Comparative Study of Kenya and Uganda

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Foreword

The International Peace Support Training Centre (IPSTC) is an independent research, training and education Centre in eastern Africa that is responsive to Peace Support Operations training and education needs for the African Peace and Security Architecture (APSA). The research conducted at IPSTC covers a broad spectrum that covers pertinent issues relating to Conflict Prevention, Conflict Management, and Post-Conflict Reconstruction. The aim of the Centre is to enhance the promotion of peace, security and stability in the region, which is essential and critical for human and economic development in Africa.

The research theme for 2018 is ***"Enhancing Capacity for Maritime and Infrastructure Disaster Response and Management".*** Therefore, this paper will feature an in depth analysis of the effectiveness of IGAD Disaster Early Warning Systems in mitigating, and preventing disasters by interrogating Disaster Risk Reduction policies in IGAD Member States with a focus on Kenya and Uganda.

This Occasional Paper is titled ***"Assessing Effectiveness of Disaster Early Warning System in IGAD Member States: A Comparative Study of Kenya and Uganda".***

The research products from IPSTC are developed with the aim of informing the design of training modules at the Centre. Thus, this Occasional Paper is an important contribution to IPSTC Vision and Mission.

Brig. Patrick M Nderitu
Director,
IPSTC

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Last but not least, I would like to thank the research team and my colleagues at the PSRD who worked tirelessly to make sure all the necessary field logistics were in place for the success of the research.

List of Acronyms

IGAD	Intergovernmental Authority on Development
EWS	Early Warning Systems
AU	African Union
UN	United Nations
DRR	Disaster Risk Reduction
DM	Disaster Management
UNISDR	United Nations International Strategy for Disaster Reduction
ARSDRR	Africa Regional Strategy for Disaster Risk Reduction
ISDR	International Strategy for Disaster Reduction
EAC	East Africa Community
NECOC	National Emergency Coordination and Operations Centre
NDMU	National Disaster Management Unit
NDOC	National Disaster Operation Centre
D/CRM	Disaster/Climate Risk Management
NDM	National Disaster Management
NSCPB	National Disaster Operation Centre
IPSTC	International Peace Support Training Centre

Definition of Key Terms

Disaster Risk Reduction: Preventing new and reducing existing disaster risk; and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development.

Disaster: A serious disruption (large or small-scale, frequent and infrequent, slow-onset, sudden-onset) of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to human, material, economic and environmental losses and impacts (UNISDR 2009).

Early Warning Systems (EWS): An integrated people-centered system within the four elements of: (1) disaster risk knowledge based on the systematic collection of data and disaster risk assessments; (2) detection, monitoring, analysis and forecasting of the hazards and possible consequences; (3) dissemination and communication, by an official source, of authoritative, timely, accurate and actionable warnings and associated information on likelihood and impact; and, (4) preparedness at all levels to respond to the warnings received.

Effective EWS: Ability of the EWS to produce expected results/outcome these include: reduced disaster loses (life/injury/livelihoods), reduced disaster impact/vulnerability, resilience building and community usage of EWS information.

Emergency: A crisis or a threatening condition that requires urgent action ((UNISDR, 2009).

IGAD Member States: Djibouti, Ethiopia, Eritrea, Kenya, Somalia, The Sudan, South Sudan, and Uganda.

Multi-hazard EWS: The ability to warn of one or more hazards increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities, involving multiple disciplines for updated accurate hazards identification and monitoring.

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

Effective early warning systems (EWS) not only save lives but also help protect livelihoods and national development gains. EWS is a major element of Disaster Risk Reduction (DRR). Globally, the United Nations (UN) DRR has recognized EWS since 2004. The current EWS is based on the Sendai Framework for DRR 2015-2030 which is a follow-up of the Hyogo Framework for Action 2005-2015. The main goal of EWS frameworks is to improve prevention and resilience to all types of natural disasters and man-made disasters by using a comprehensive set of methods.

In Africa the EWS is guided by the Africa Regional Strategy for Disaster Risk Reduction (ARSDRR), which was developed by the African Union (AU, 2004). The Strategy's has six objectives: increase political commitment to Disaster Risk Reduction; improve identification and assessment of disaster risks; enhance knowledge management for Disaster Risk Reduction; increase public awareness of Disaster Risk Reduction; improve governance of Disaster Risk Reduction institutions; and, integration of disaster risk reduction in emergency response management. The EWS aims to strengthen efforts enshrined in the AU Agenda 2063, which aims at sustainable development through poverty reduction. The Regional Economic Communities in Africa are to support the development of capacities for EWS action and response (African Union, 2015).

In eastern Africa, the Inter-Governmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC) is responsible for disaster early warning for the eight IGAD member countries which include: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, The Sudan, Uganda, Burundi, Rwanda and Tanzania. The IGAD EWS is based on the DRR strategy developed and approved in 2004. Climate diagnostics, prediction and early warning and disaster risk management is among the IGAD Climate Prediction and Analysis Center's (ICPAC) nine functions. The ICPAC disaster risk management program overall objective is to establish capacities to mitigate impacts and manage disaster risks (IGAD (2016).

Kenya's EWS is under the Ministry of Interior and Coordination of National Government and National Disaster Operation Center (NDOC). The EWS is guided by the National Disaster Response Plan of 2014. One of the seven objectives is to establish a National Early warning and emergency community system (GoK, 2009; 2014).

In the Republic of Uganda, EWS is under the Office of the Prime Minister and Uganda Disaster Risk Information Centre, Department of Disaster Preparedness and Management and, National Emergency Coordination and Operations Centre (NECOC), whose goal is to establish institutions and mechanisms that will reduce the vulnerability of people and property in Uganda (GoU, 2011).

According IGAD (2010) and UN (2008), effective EWS should be timely in collection and dissemination of information through identified institutions, actively involve the communities at risk, facilitate public education on awareness of risks, effectively disseminate warnings messages and ensure a constant state of preparedness. Based on this background this study will focus on the national institutions responding to IGAD disaster EWS in Kenya and Uganda.

1.2 Background Information of Kenya and Uganda

Kenya's landscape covers a total of 583 000 km^2 of which 17% is suitable for rained agriculture and 2.2% is arable land covered by forest reserves. Kenya is grouped into geographical zones that include: savannah lands covering mostly arid and semi-arid areas, Coastal Region, Rift Valley, Highlands and the Lake Victoria Basin. The population is predominantly rural (73.94%) and relies on agricultural related activities for their daily needs. The urban population was approximated at 26.04% (UN, 2018).

Kenya experiences a number of natural hazards, which include: drought, floods, earthquakes, landslides, storms and conflict. Disasters occur when the natural hazards interact with vulnerable people, property, and livelihoods. The resulting damages depend on the level of vulnerability of the individual, group, property or livelihoods.

The most prevalent natural hazard in Kenya is drought that affects mainly the Eastern, North Eastern, parts of Rift Valley and Coastal regions. Floods are seasonal and affect various parts of the country especially in the Lake Victoria basin and in Tana River. Landslides are experienced during the long rains and are prevalent in Murang'a and areas surrounding the Mount Kenya region. Natural hazards in the recent past have increased in number, frequency and complexity. The level of destruction has also become more severe with more deaths of people and animals, loss of livelihoods, destruction of infrastructure among other effects resulting in losses of varying magnitudes (UNDP, 2015).

Uganda occupies a total area of 236,040 km^2 of which 37.8 % is arable land and 18 % is open inland waters and wetlands. Most of the economic activity is in agriculture production.

In 2018, the population was estimated to be 44.27 million people, with 75% being rural and 25% urban (UBOS, 2017). The rural population is mostly concentrated around lakes Victoria, Kyoga and Albert. This is because of abundant rainfall and fertile soils within the lakes' region.

Uganda has witnessed a number of natural and human-induced disasters that have culminated in loss of life and property and displacement of persons. The prevalent disasters includes: displacement as a result of civil strife; famine as a result of drought; traffic accidents; earthquakes; epidemics from diseases; flooding; landslides; environmental degradation; technological accidents: crop pest infestation; livestock and wildlife disease epidemics (GoU, 2011).

Flooding presents the largest risk particularly in low-lying areas. Uganda has one of the highest rates of deaths from lightning strikes in the world; Kampala experiences more lightning per year than any other city in EA. Landslides are one of the most significant hazards with the area around Mt. Elgon is the most susceptible to landslides while northern and eastern parts of the country are more prone to floods (EAC, 2012).

1.3 Problem Statement

Despite the increasing accessibility to data on disaster, information, knowledge and expertise, Kenya and Uganda experience immense challenges as a result of man-made and natural disasters (IGAD, 2016). From 1986 to date the IGAD region has remained the most prone to disasters related to hydrological, climatological, meteorological and geophysical factors. In addition, 50 % of the reported disasters globally between 2006 and 2016 occurred in the IGAD region (CRED, 2016); drought alone affected approximately 20 million people.

Disaster EWS are a major element of disaster risk reduction (DRR). The purpose of effective EWS is to enable vulnerable communities to prepare and respond accordingly to mitigate effects of the disasters. To date, there is a notable gap between the EWS technical capacity to issue the warning and the local community's capacity to respond effectively during disasters in Kenya and Uganda.

Communities in Kenya and Uganda are regularly confronted by a combination of complex disasters both natural and human-induced that include but not limited to: drought, floods, transport accidents, earthquakes, epidemics of disease, landslides, environmental degradation, technological accidents, crop pest infestation, livestock and wildlife disease and civil conflict. Often these disasters result in loss of lives, assets and livelihoods.

Disasters weaken the social support systems and erode development gains at the community and national level.

According to UNDP (2013) Kenya economic losses due to the effects of drought alone between 2008 and 2011 was estimated at Ksh. 1.2 trillion (USD 12 billion). Kenya and Uganda do not have a national law governing disaster early warning systems and risk reduction. Kenya has a draft national disaster policy; while Uganda has a national policy for Disaster Preparedness and Management (GoK, 2014; GoU, 2011).

IGAD (2016) states that there is need for governments to move from intervention to prevention. It is necessary to bridge gaps in EWS response in order to address critical limitations related to effective prevention and timely responses to crises. A study by IGAD (2010) in Kenya, Uganda, The Sudan, Ethiopia and Djibouti on disaster risk management good practices, focused on the importance of EWS but unfortunately, did not look at their effectiveness.

EWS is a tool used in DRR by local communities, national and regional institutions, with the aim of reducing loss of life, injury, damage/destruction of property and livelihoods and vulnerability from hazards. Given the importance of EWS in enhancing sustainable development and national security its effectiveness is of great importance. Based on this background there is need to examine the effectiveness of disaster EWS in Kenya and Uganda based on the UNISRD (2006) checklist of effective EWS.

1.4 Research Questions

1. What is the rate of disaster occurrence in Kenya and Uganda in the period 2008 - 2017?
2. Which institutional structures are responsible for EWS in Kenya and Uganda?
3. What is the national capacity of the four EWS components (risk knowledge, M&E services, dissemination & communication and response capability) in Kenya and Uganda?
4. What is the EWS achievement in regards to the desired goals for effectiveness?

1.5 Research Objectives

1.1.5 Broad Objective

To analyse the effectiveness of disaster Early Warning System in Kenya and Uganda

1.1.6 Specific Objectives

1. Analyse disaster occurrence in Kenya and Uganda in the period 2008 - 2017
2. Examine institutional structures responsible of EWS in Kenya and Uganda
3. Assess the national effectiveness of the four EWS components (Risk Knowledge, Monitoring & Evaluation Services, Dissemination & Communication and Response Capability) in Kenya and Uganda
4. Evaluate the EWS achievement of the desired goals for effectiveness

1.6 Scope

The study will focus on Kenya and Uganda National Disaster Management (NDM) institutions in charge of responding to the IGAD framework. In addition, the study will analyze the effectiveness of the four elements of EWS namely: risk knowledge, monitoring and evaluation, dissemination and communication and response. EWS effectiveness will be measured using people centered Early Warning Systems checklist by UNISDR (2006).

1.7 Justification

The IGAD framework of metrics provides an essential basis for post-disaster reviews of the effective EWS. Articulated in the IGAD strategic plan (2016-2020) under Pillar One, which provides for agriculture, natural resources and environmental protection. Assessing the effectiveness of EWS in Kenya and Uganda is significant since the community, national and regional institutions dealing with disaster management respond to IGAD EWS alerts.

Given the significance of EWS to social, economic, and human security well-being, it is necessary to continually monitor the effectiveness of EWS to inform the strengths, weakness, opportunities and threats of the four EWS components. This will guide the national stakeholders involved in EWS, in Kenya and Uganda, in setting priority for programming, capacity development and resource allocation.

The findings of the study will inform EWS practitioners at the community, national and regional institutions' programing on how to meet their global commitments to support EWS capabilities as articulated in the Sustainable Development Goals, the Sendai Framework and the Paris Climate Change Agreements. The study will establish and inform the determinants of effective EWS and thus make recommendations on areas of further research to improve effectiveness of EWS.

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CHAPTER 2: LITERATURE REVIEW

This chapter is grouped into five sections focusing on five areas of disaster EWS. The areas include historical development of EWS at different levels, the components and process of EWS, disasters in Kenya and Uganda, indicators used for measuring effectiveness of EWS and lastly a conceptual framework that is used for measuring the study outcome for effective EWS.

2.1 Development of EWS

Traditionally, communities employed EWS as coping strategies to disasters such as epidemics, drought and floods. According to a study on traditional EWS among the pastoralist communities in Kenya, traditional EWS date back to the 1900s and are based on three precepts (Christopher, 2000). The first principle is having detailed knowledge of when the major risk e.g. rains should occur. It is founded on understanding occurrence in wind, humidity and temperature from expected conditions. The second principle is knowledge on how to interpret the behaviour of animals and plants, which serve as valuable indicators for understated fluctuations in temperature and humidity. The third principle the local communities could forecast major rains four weeks before their arrival. The absence of these natural indicators suggested the absence of rain thus, onset of drought. They observed historical trends to allow for reasonable predictions of future weather patterns. Tradition forecasting has been less reliable than it has been in the past due to increasing severity and frequency of drought over the last decade.

A study by Oxfam (2011) established that traditional EWS indicators included the keen observation of animals, birds, insects, the solar system, winds, clouds, and human body feelings. The communities recognized unique situations associated with the behavior of the above living organisms. They also considered the locations and patterns of clouds, winds, the moon and stars. The EWS predictions were based on these indicators and the elders issued instructions that enabled the community cope with the anticipated natural hazard.

Holly and Aden (2011) argues that traditional EWS are mainly based on qualitative measures and their knowledge form the basis for community based EWS. Their study in Ethiopia established that traditional EWS indicators included: environmental factors - rainfall, crops, pests, water availability; livestock factors - body condition, reproduction, milk production, diseases; and human factors - disease, conflict, and time for reproductive household duties.

Robert and Trogrlic (2015) documented the indigenous EWS signs of most common hazards (floods, droughts and dry spells) in Malawi. They indicated that indigenous knowledge is increasingly being seen as one of the critical components in reducing disaster risks at local levels, building resilient communities and sustainable livelihoods. According to them, indigenous EWS obtained their data by: observing the surrounding of local people's experience in terms of the history of natural hazards, nature of natural hazards, and evolution of social and physical vulnerabilities to natural hazards (Robert & Trogrlic, 2015).

In addition, Robert and Trogrlic used people's anticipation in identification and monitoring of environmental indicators (early warning signals, time thresholds, escape route and safe places for humans and cattle, key actors and skills). The traditional communities also used adaptation and ability to learn, self-organize and innovate (human, sociocultural, institutional, financial, natural and physical assets).

2.1.1 Development of Modern EWS

Prior to the Indian Ocean Tsunami in 2004 the world lacked formal EWS regarding coastal hazards. In addition, the absence of training in responding to warnings prevented the authorities and local population from executing proper protection measures. This resulted in the death of more than a quarter million people. Early warning is a major element of DRR, it aims at preventing and reducing loss of life, materials and destruction of the economy. Globally the current EWS are based on three main international agreements: The Sustainable Development Goals (SDGs), goal 13 focusing on combating climate change and its impacts; The Sendai Framework DRR 2015-2030 target G, that calls on countries to substantially increase the availability and access to multi-hazard EWS, disaster risk information and assessments to the people by 2030 and lastly, The International Strategy for Disaster Reduction (ISDR, 2005). The ISDR incorporated the 4 main components of EWS which included: (1) Risk Knowledge; (2) Monitoring and Predicting; (3) Disseminating Information; and, (4) Response Failure of any part of the system that imply failure of the whole system. In partnership with the World Meteorological Organization and the World Bank, the UNISDR's Strategic Framework 2016-2020 established the Climate Risk and Early Warning Systems (CREWS) initiatives with the aim of making cities resilient.

In Africa, the AU (2016) established a regional EWS platform for DRR and EWS based on the endorsement of the Programme of Action for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 in Africa. The East African Community developed the first regional DRR and Management Act to be passed in Africa (EAC, 2012).

This was followed by the DRR policy in West Africa and Southern Africa Disaster Preparedness and Response Strategy. Regional institutions like the ICPAC provide specialized EWS knowledge to countries that share a common geographical environment. The AU advice supports national efforts to develop and sustain EWS capabilities. International bodies provide international coordination, standardization and support provision of advisory information and technical assistance to aid the development and operational capabilities of national authorities or agencies.

In Kenya, the EWS is stipulated in the draft National Disaster Management Policy (GoK, 2009). The policy recognizes that EWS provides sufficient and timely early warning information on potential hazards that may result to disasters. The government has stated that it would facilitate the establishment of a comprehensive National EWS that will encourage the involvement of all stakeholders; to date the policy remains a draft. The Uganda Constitution (1995) recognizes the importance of EWS and obliges the state to institute effective machinery for dealing with disasters. The Uganda disaster management policy of 2010 aims at creating an effective framework for EWS focusing on saving lives, livelihoods and resources. Based on this legal framework, Uganda launched a National Emergency Coordination and Operations Centre (NECOC) to provide timely and early warning information on disasters, climate modelling and forecasting, and also help coordinate emergency responses. The Ugandan NECOC is the third such centre in Africa with the other two located in Ethiopia and South Africa.

There are several agencies implementing EWS. These include the Ministry of Agriculture Animal Industries Fisheries (MAAIF), Agency for Technical Cooperation and Development (ACTED), Famine Early Warning Systems Network (FEWS NET), Uganda National Meteorological Authority (UNMA), Ministry of Health, and NECOC.

2.2 Components and Process of Disaster EWS

Disaster management cycle has four main phases that include mitigation, preparedness, response and recovery. EWS concept is a key component of disaster risk reduction (DRR), whose activities cross cuts between mitigation and preparedness as shown in Fig 1 below.

In the mitigation phase, structural and non-structural measures are undertaken to reduce the impact of the disasters. According to UNISDR, the impacts of hazards cannot be prevented fully, but their severity can be diminished by various strategies and actions.

In the preparedness phase, measures are taken to reduce the possible losses/damage of life and property through the prompt and efficient actions of response and rehabilitation such as practicing earthquake and fire drills. Preparedness enhances individual and organizational capacity disaster response. They also involve planning, organizing, training, interaction with other organizations and related agencies, resource inventory, allocation and placement, and plan testing.

Response involves actions carried out in a disaster situation with the objective to save life, alleviate suffering and reduce economic losses. The main tool in response is the implementation of plans, which were prepared prior to the event. Response activities aim at providing emergency assistance, reducing probability of additional damage, speeding recovery operations and returning systems to normality.

In the recovery/rehabilitation phase, activities are geared towards the restoration of basic services and the beginning of the repair of physical, social and economic damage. The recovery phase also includes efforts to reduce disaster risk factors.

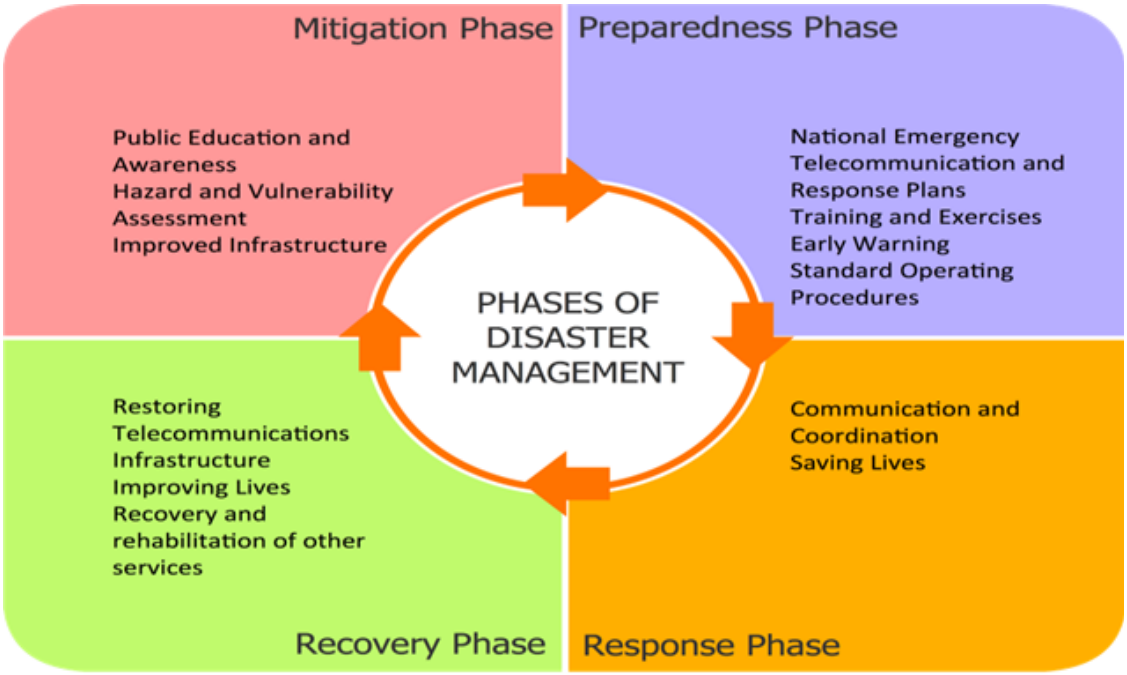


Figure 1: Disaster management cycle (Source: UN, 2006)

The framework of global EWS's four components was developed following the Tsunami along the Indian Ocean region (ISDR, 2004). According to UNISDR (2006), effective, EWS is people-centered and integrate four elements that include: (i) knowledge of the risks faced; (ii) Technical monitoring and warning service; (iii) dissemination of meaningful warnings to those at risk; and, (iv) public awareness and preparedness to act. Failure in any one of these elements can mean failure of the whole early warning system, as shown in Table 1 below.

Table 1: Four components people-centred Early Warning Systems

Risk Knowledge	Monitoring & Evalxuation Services	Dissemination & Communication	Response Capability
Hazard	Hazard Monitoring indicators	Risk communication	National
Elements at Risk	Forecasting	Warning communication	Community
Vulnerabilities	Now casting	Household warning	Evacuation Centre
Data collection	Diagnostic & prognostic services	Radio, TV	Search & rescue
Data analysis	Warning services (accurate & timely)	Social Media	Relief goods
Data management		Telephone	

Risk Knowledge: This is the process of the EWS systematic data collection and analysis on the dynamic nature of hazards and vulnerabilities that arise from processes such as urbanization, rural land-use change, environmental degradation and climate change. The upgraded ISO 9001: 2015 requires that risk information be an integral part of quality management in any institution. Hence, the need for information in risk records, risk registers and risk assessment is not only important for EWS but every aspect of life.

Monitoring and Warning Service: The process of EWS continuously monitoring hazard parameters and precursors. Where possible, warning services for different hazards are coordinated to gain the benefit of shared institutional, procedural and communication networks. The services include sound scientific prediction and forecasting hazards on a 24-hours basis.

Dissemination and Communication: This is the most critical component; it includes clear messages containing simple, useful information critical to enable proper community responses that help safeguard lives and livelihoods. Regional, national and community level communication systems must be pre-identified and appropriate authoritative voices established.

The use of multiple communication channels is necessary to ensure as many people as possible are warned, to avoid failure of any one channel, and to reinforce the warning message.

Response Capability: Community based education and preparedness programmes play a key role in enhancing effective response capability at the national and community level. The community needs to be informed on options for safe behaviour, available escape routes, and how best to avoid damage and loss of property. Key actors in developing and implementing an effective EWS require the contribution and coordination of a diverse range of individuals and groups. According to the UN/ISDR (2006), these include communities, national governments, local governments, regional institutions and organizations, international bodies, the private sector, and the science and academic community. The community is fundamental to people-centered EWS. They should be actively involved in all aspects of the establishment and operation of effective EWS. Through continuous community based education, the community is aware of the hazards and potential impacts they are exposed to and are enabled to take actions to minimize the threat of loss or damage.

2.3 Empirical Literature on Measuring Effectiveness of EWS

A study in Europe by Lopez, Di Baldassarre and Selbert (2017) used a simple stylized model to assess efficiency of Flood Early Warning Systems (FEWS) by the impact of social preparedness. The study established that FEWS contributed to mitigation of disaster damages and casualties and fostered economic benefits through the optimization of flood-sensitive economic activities. FEWS were constrained due to insufficient emphasis on the social, economic, and environmental vulnerabilities, limited forecasting technical and capabilities (Lopez et al., 2017). The study however focused only on floods despite the fact that several other disasters also emerge as a result of flooding. In Balamurugan and Santha (2015) study on public participatory in geographical information systems (PPGIS) in India, the EWS effectiveness was determined by community access to cultural specificities EWS resources. The study concluded that EWS can be used to reduce disaster risks when communities and scientists engage consistently and work together to monitor and forecast natural hazards, have continues validation of the process and information before its dissemination and response (Guru & Santha, 2015). This study assessed geographical information systems elements in cyclone, storm surge, sea surge and monsoon rain. The study focused only on the risk knowledge component, which is based on information system.

It did not assess other components of EWS such as monitoring and evaluation services, dissemination and communication, community response capability that are key for an EWS to be effective.

In Nepal, a study by Kafle (2017) assessed disaster EWS institutional and operational frameworks following the government reporting significant achievements in the development and implementation of EWS for floods, landslides, and Glacial Lake Outburst Floods. Centrally to this, this study established that EWS had covered only a few hazards and locations and had not been able to cover all the four components of the effective CBEWS. The absence of policy and legal frameworks weakened the efforts of the establishment and strengthening of effective and functional EWS in the country. The response capacity building of communities was scattered and project-based (Kafle, 2017). In Zimbabwe a study by Owour (2015) assessed factors affecting the response to FEWS the study concluded that, the EWS communication was a one-way process top bottom approach. EWS information was poorly disseminated to poor communities with limited capacity to respond. The absence of preparedness plans for evacuation, and overdependence on rain fed agriculture by locals hampered the implementation of effective EWS (Patrick, 2007). This study only focused on only two components of EWS dissemination and response, yet for any EWS to achieve its desired goals the four components must be working effectively where failure of one component affects the end result of the EWS.

World Vision (2016) reviewed EWS for early action focusing on slow on-set hazards (El Niño, famine) in Ethiopia and Somalia. The study established that barriers of effectiveness of EWS were external and mostly related to institutional structure governance. The top five limitations included: culture of risk avoidance, a reactive operational model, insufficient financing and lack of decision-making capacity (World Vision, 2016). This was a descriptive study focusing only on the limitations and strengthens of the EWS four components. The goals of the EWS were not assessed. Challenges of an EWS need to be linked to the desired results of the EWS in order to establish its effectiveness.

A regional study by Cordaid and IIRR (2011) used descriptive methodology to assess community managed disaster risk reduction as part of EWS in Kenya, Uganda and Ethiopia. It concluded that CMDRR enhanced of community organizational skills and self-confidence in utilization of techniques and skills in risks knowledge. It also improved participation in lessening the impact of drought and enabled communities to take measures until more aid was made available.

Among other recommendations the study pointed out the need to focus more on 'soft skills' and improved coordination between implementing organizations at the local level. The study did not focus on the national EWS yet these institutions are key in the development and sustainability of CMDRR.

A study in Kenya by Njogu (2014) investigated the implementation of DRR guidelines in public secondary schools. It concluded that school principals lacked disaster management training and simulation exercises, which are EWS tools in response and preparedness (Njogu, 2014). This study only focused on the implementation of the DRR guidelines, which is a component of preparedness and response of EWSs. The student who are main consumers of the school EWS were not involved in the study. A study in Uganda by Agnes (2014) examined existing EWS to specific hazards, economic and social sectors, and geographic locations and areas, and how the NECOC could integrate or redistribute these EWS channels. The study concluded that Uganda does not have an EWS (Agnes, 2014). This resulted in proliferation EWSs each monitoring different hazards and issuing their own warnings targeted at various audiences. Some of these EWSs were standalone and not linked to any other. The study used descriptive analysis and focused on the activities conducted by the EWS institutions (Agnes, 2014). The researcher did not examine where the EWS were effective or whether they had achieved the desired results.

A review of studies on community based early warming (CBEWS) by Margaret and Moses (2016) argues that most EWS are designed at the national or global level. The review concluded that CBEW have been developed mainly for natural disasters and the same principles used for the development of CBEWS for natural disasters may be utilized in the development of CBEWS for communicable diseases such as malaria (Margaret & Moses, 2016). The study focused on methodologies or characteristics and the mythologies of selected EWS at the global, national and community levels. The study did not assess the effectives of the EWS.

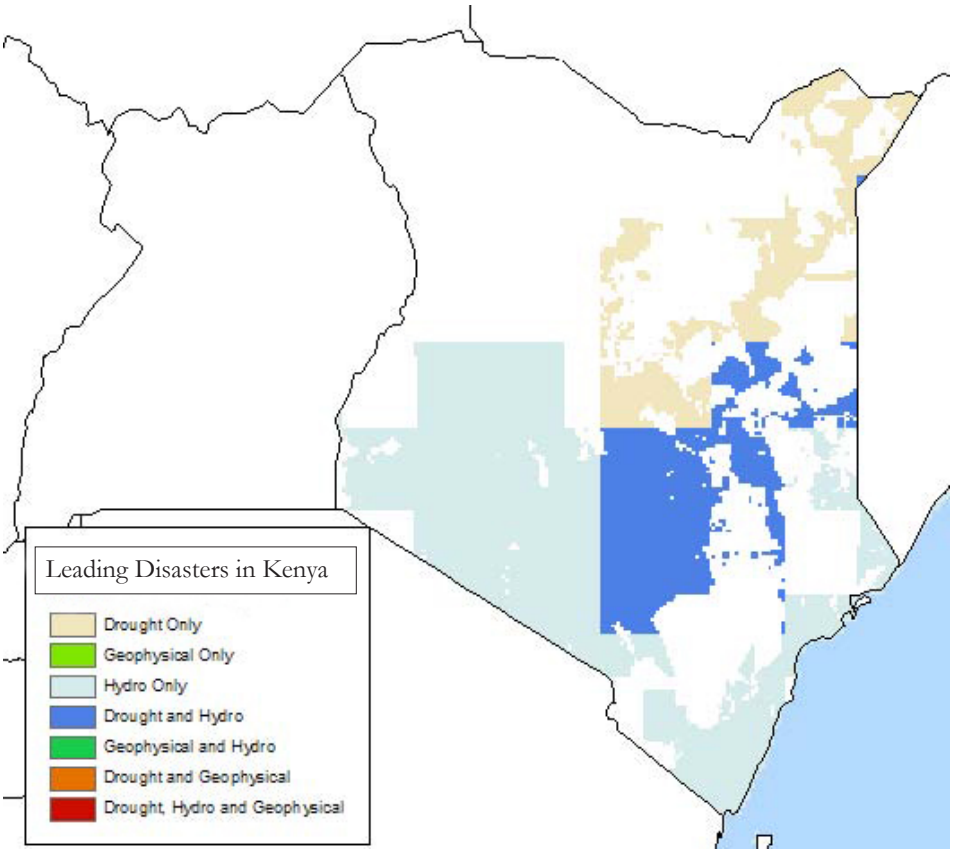
2.4 Disaster Mapping in Kenya and Uganda

2.4.1 Disasters Mapping in Kenya

Droughts and floods are the most significant hazards affecting Kenya. When weighted by Gross Domestic Product impact, droughts pose a higher risk than floods throughout the country especially in northern Kenya. When weighted by mortality, floods effects are more severe than droughts. Floods are predominant near Lake Victoria and Tana River regions.

Whereas droughts are predictable, floods in Kenya often come as a surprise. The coastal and Kisumu areas and part of the ASAL are especially prone to flooding. Over the last years, rainfalls have become more intense and also more frequent along the coast and in the northern regions, arguably as a result of climate change. The short rainy season seems to become more prolonged, whereas the long rainy season tends to become shorter or even fail completely. Severe rains and floods also increase the risk of epidemics such as diarrhea and cholera.

Earthquakes, pest infestation and vermin, conflicts, livestock diseases, environmental degradation, wild and urban fires are the main causes disasters in Kenya. Many of the conflicts taking place in Kenya are ethnically oriented; for example, during election times, ethnic divisions often tend to become magnified and are often characterized by incidents of violence as seen in the last presidential elections in December 2007. The map below gives a pictorial view of leading disasters in Kenya.



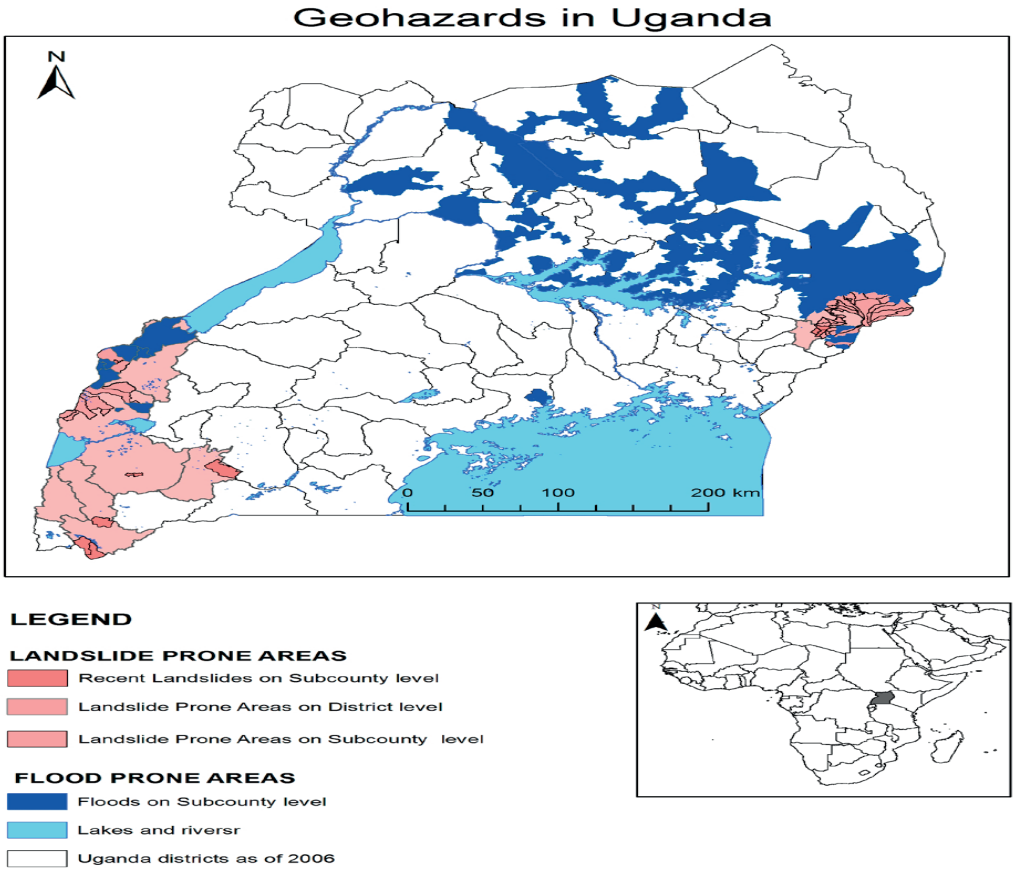
Multi-Hazard Disaster Risk Hotspots by Hazard Groups: "Droughts and floods are the most significant hazards affecting Kenya, (Center for Hazards and Risk Research at Columbia University, 2005)

2.4.2 Disaster Mapping in Uganda

Drought is a major hazard in Uganda. Approximately 12% of the population is exposed to the hazardous risk of drought. The highest drought risk is in the northeast of the country. In 2008, a massive drought affected over a million people, especially in the region of Karamoja. Due to lack of rainfall in this area cattle and food reserves were affected. Often drought and excessive flooding follow each other. Dry earth is not able to soak up rainfall after a dry period, which leads to flooding. Uganda is predisposed to flooding due environmental degradation, growing human population, unsustainable exploitation of environmental resources and poor land use planning, among other factors. Heavy rains from July to September result in flooding and destruction of crops mostly in the central and eastern regions of the country.

2.4.2.1 Landslides and Mudslides

Landslides are a common occurrence in Uganda especially in the east near the Kenyan border. The most recent mudslide was in 2010 in the district of Bududa along the slopes of Mt. Elgon. The cause of the landslides is usually heavy rainfall, soft soils and lack of proper vegetation on the slopes. There are several environmental hazards in Uganda. One of the hazards is draining of wetlands for agricultural purposes. 13% of Uganda is covered in wetlands with a third of it used for agriculture. Uganda lies in an earthquake zone but the quakes that have occurred in the past two decades have all been relatively weak. In 1994, an earthquake (6.2 on the Richter scale) struck near Fort Portal and affected about a thousand people. The quake caused extensive damages but fortunately casualties were limited. The map below gives a pictorial view of leading disasters in the country.



2.4.2.2 Summary of the Literature Review

The literature reviewed is based on empirical literature on EWS effectiveness at the global, regional national and local level. The literature obtained comprised 20 policy documents 28 journal articles both analytical and descriptive studies.The literature was guided by the objectives of the study. The idea was to identify the types of disasters that were addressed by EWS, the methodologies used to assess the EWS, the components of the EWS assessed and findings regarding the effectiveness of the EWS. This helped to identify gaps which were incorporated in this study to assess effectiveness of the national disaster EWS.

2.5 Conceptual and Operational Frameworks

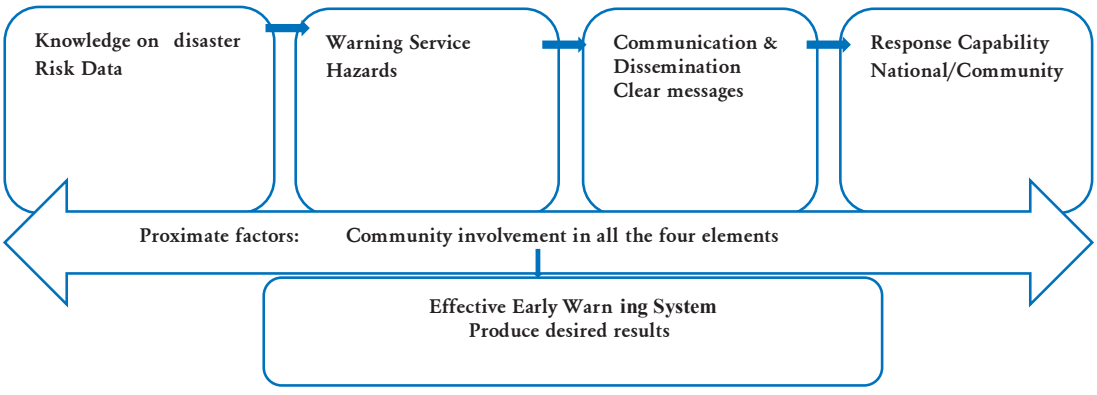
2.5.1 Conceptual Framework

This study adopted a conceptual framework based on five main EWS concepts including knowledge on risk/hazard, warning service hazards, communication and dissemination, response capability and effective early warning systems. The concepts were derived from the Theory of Planned Behaviour (TPB) by Ajzen (1991).

Individual/institutional behaviour during disasters is driven by behaviour intentions, which is a function of three determinants - attitude toward behaviour, subjective norms and perceived behavioural control. Effective EWS is a disaster preparedness behavior (DPB). DPB is a category of behaviors, not a single action and maybe influenced by many factors. This may include: risk knowledge, preparedness, responsibility, self/collective efficacy and norms, previous disaster experience, community participation, empowerment and available resources.

In this study, the conceptual framework EWS as a DPB is influenced by four main behaviour intentions that include: disaster risk data knowledge, monitoring and forecasting of the hazards and possible consequences, dissemination and communication warnings and preparedness at all levels to respond to the warnings received. EWS are effective if they produce desired outputs in terms of reduced risk and strengthened resilience and outcomes in terms of reduced disaster loss and impacts (UNISDR, 2014). Based on this conceptual framework, effectives of the national EWS institutions at the national and community level is a function of the knowledge on disasters risk data which informs the disaster warning services available and need to be given to the community facing disaster risk. The warning services available develop communication strategies for the community at risk and depending with how the messages are disseminated the institutions and communities respond based on their capability. The community involvement in all the four areas influences the desired outcome of EWS, which is to reduce the impact and loses of the disaster.

Conceptual Framework:

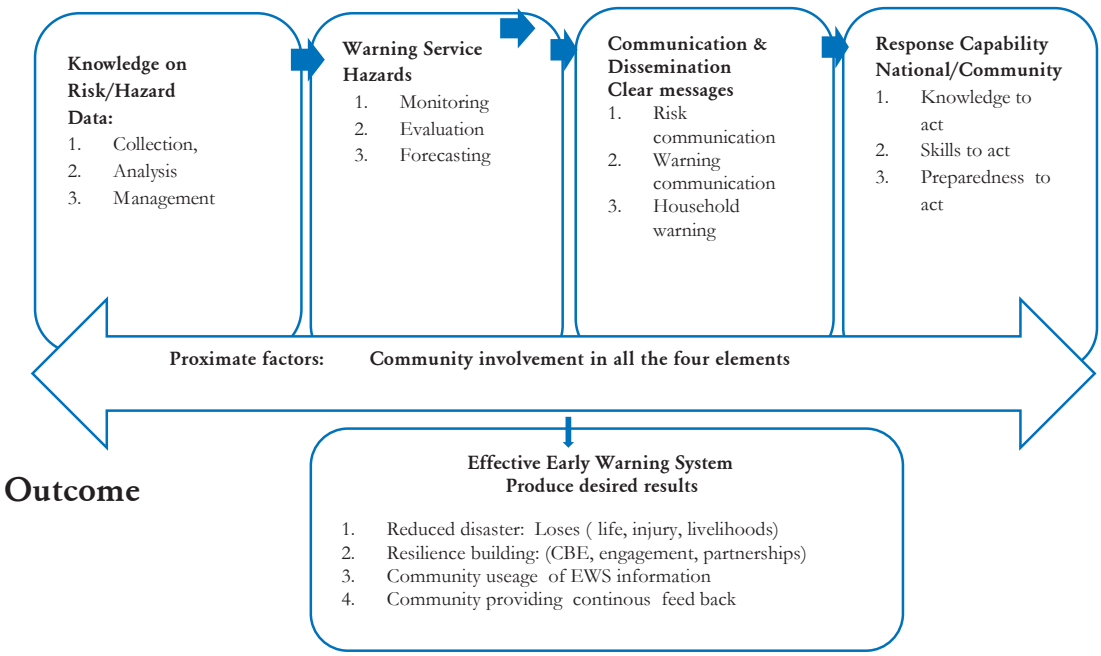


From a sustainable development perspective, effective EWS need to be measured on their capacity to support reduction of loss of life, injury and livelihoods, vulnerability reduction and resilience building, accurate and timely warnings and ability of people to use warnings, respond appropriately and provide feedback to the designated warning authority.

The EWS effectiveness metrics, is based on three main international agreements; the Sustainable Development Goals (SDGs), the Paris Climate Change Agreements and the Sendai Framework for Disaster Risk Reduction; in particular, the indicators under Target G of the Sendai Framework. Target G calls on countries to "substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030. In addition, to the four elements, cross-cutting issues are critical in order for EWS to be effective. These include governance and institutional arrangements, a multi-hazard approach to EWS and involvement of local communities (UNDRR, 2013).

2.5.2 Operational Framework Background factors

Background factors



Source: (Njambi, 2018)

2.6 Definition of Operational Variables

The following operational variables will be assessed in this study.

- The independent variables were the four components of EWS based on the UNISRD (2013) tool.

- The Knowledge on risk/hazard/vulnerability: Five key variables were assessed; these included: assessing exposure, vulnerabilities, capacities and risks, identifying roles and responsibilities of stakeholders, risk information consolidations, incorporating risk information properly into the early warning system,

- Warning Service Hazards: Three variables were assessed they included: monitoring systems; institutional forecasting; and, warning services mechanisms in place. The focus was on multi-hazard monitoring and forecasting services on a scientific and technological basis.

- Communication and dissemination: Three main variables were assessed on EWS organizational decision-making processes, operational communication systems equipment in place and the impact of the communication based on effective prompt action by the local community means in which communities and institutions receive warnings in advance and facilitating community, national and regional coordination and information exchange.

- Response Capability National/Community: Two main variables were assessed: developed/operational disaster preparedness measures/response plans and public awareness education campaigns, which enable the local communities and instructions to act early and respond to a warning.

Proximate factors: Community involvement in all the four elements. Outcome (Dependent Variable) Effective of EWS

Three variables were assed to measure the ability to produce the four desired results of an effective EWS these included:

- Reduced Disaster Loses (life/injury/livelihoods) was assessed using disaster data for 2008 to 2017.

- Reduced Disaster Impact/Vulnerability was assessed using disaster UNISRD data 2008 to period 2008 -2017 duration.

- Resilience building was assessed by the EWS activities of building community's ability to prepare for, respond to and recover from disasters.

This study focused on four indicators which included: on-going community based education (CBE) on preparedness, risks and resources before, during, and after a disaster engagement; community self-sufficiency, this involves enabling and supporting individuals and communities to assume responsibility for their preparedness; Partnership involves increasing and enhancing the linkages and collaborations between local communities, government and non-governmental organizations (NGOs). Partnership enables the community to engage in participatory decision making in the cycle of the EWS - planning, response and recovery activities.

Community usage of EWS information was measured by the community ability to continuously give feedback to the EWS. This was assessed by available friendly community based feedback mechanism used by the community to give feedback on the usage of the given EWS information. The feedback mechanisms assessed from the top bottom approach were media of communications used by the national EWS to reach the community. The bottom up approach feedback mechanisms assessed was communication strategies the community uses to give feedback to the national EWS.

In both national and community EWS the feedback assessed was before, during and after the disasters given that EWS is a contentious process. The study considered the community use of monthly, quarterly or annual reports given out by community radio or TV stations, before, during and after the disasters.

CHAPTER 3: METHODOLOGY

This section describes the methodology used to conduct the research study. The section discusses the study site and research design, study population and sampling procedure, data collection tools and methods, data analysis procedures and ethical considerations. Lastly the limitation and opportunities encountered during the field research.

3.1 Study Design

The descriptive comparative study method using both qualitative and quantitative methods for data collection and analysis was used.

3.2 Study Area

The study was conducted in Kenya and Uganda.

3.3 Study Populations

The study population included national public service officers and practitioners dealing with disaster EWS. They were drawn from fourteen national and regional institutions from Kenya and Uganda. A total of 38 key informants participated in the study. A total of 2 international and 11 national institutions participated in the study. A total of three focus group discussions (FGDs) were conducted with a total of 51 discussants involved as indicated in Table 1 below.

3.4 Sample Size Determination

Table 2: Sampling frame for KII				
Institution	Location	M	F	Sample
1. National Disaster Operations Centre (NDOC)	Kenya	2		2
2. National Disaster Management Unit (NDMU)	Kenya	9	1	10
3. Kenya Metrological Department	Kenya	1		1
4. Conflict and Early Warning Response Unit	Kenya		2	2
5. Kenya Red Cross	Kenya	1		1
6. IGAD Climate Prediction & Applications Centre (ICPAC)	Kenya	1		1
7. Regional Disaster Management Centre of Excellence (RDMCOE)	Kenya	1		1
8. Department of disaster preparedness and Management (OPM)	Uganda	4	1	5
9. National Drought Management Authority (NDMA)	Uganda		1	1
10. Uganda Red Cross	Uganda	2		2
11. Uganda Metrological Department	Uganda	2		2
12. Uganda Conflict Early Warning and Response Unit	Uganda	1		1
13. Care	Uganda		1	1
Total		**24**	**6**	**30**
FGD				
FGD NDMU	Kenya	9	1	10
FGD Department of disaster preparedness and Management (OPM)	Uganda	6	5	11
FGD OPM Multispectral DM Coordination stakeholders	Uganda	20	10	30
Total		**35**	**16**	**51**

3.5 Sampling Procedure

The purposive sampling method was used to determine the quantitative and qualitative population for key informants and focus group discussants. The institutions sampled were dealing with one or more of the four EWS components (hazard/risks knowledge, monitoring & evaluation services, dissemination, communication and response).

3.6 Inclusion and Exclusion Criteria

Only the officers working at the national institutions and involved in disaster EWS were included in the study. Officers working at the County level in Kenya and District level in Uganda were not included.

3.7 Data Collection, Analysis and Presentation

3.7.1 Data collection

This study employed mixed methods for data collection; both quantitative and qualitative data was collected. Quantitative data was collected using semi-structured questionnaire, which focused on the four components of EWS. In addition, time series on disaster for Kenya and Uganda was used. The data was obtained from UNISDR data set from 2008-2017.

Quantitative methodology was used to collect primary data from key informants working at the national and regional institutions dealing with disaster EWS. A structured questionnaire was administered to the sampled key informant respondents in Kenya and Uganda. A self-administered questionnaire was emailed to the respondents who were not accessible during the time of the field research. Respondents to the KII tool were senior officers in the national and regional disaster EWS institutions in Kenya and Uganda. A total of 30 KIIs were interviewed (table 1).

Qualitative data was collected through a focus group discussions (FGDs) guide. Three FGDs were conducted. The discussants were drawn from the Kenya National Disaster Operations Centre (NDOC) and Uganda Department of disaster preparedness and Management (OPM) and FGD OPM Multispectral DM Coordination stakeholders. A total of 51 discussants participated in the FGDs. The FGDs were used for identifying needs and constraints that were missed through the quantitative responses and KII interviews. The aim was to help clarify findings from the secondary data and questionnaires as well as to gain a deeper understanding of the challenges faced and the lessons learned in disaster EWS.

Content analysis was also conducted of international regional and national policy frameworks dealing with disaster EWS. The following policy documents were reviewed: draft National Policy for Disaster Management in Kenya (GoK, 2009); The National Policy for Disaster Preparedness and Management (GoU, 2010); Disaster Risk Reduction and Management Strategy: 2012-2016 (EAC 2012); Disaster Risk Reduction for Sustainable Development in Africa (AU, 2004); Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters (UN, 2008); and, Sendai Framework for DRR 2015-2030 (UN, 2015).

3.7.2 Data Analysis

Quantitative data was analyzed using descriptive analysis to establish the distribution of the study variables based on the study objectives. The mean, median and mode were used to describe the magnitude of the study variables. The data is presented in tables and graphs using the statistical Package for Social Scientists (SPSS) and Microsoft Excel packages.

EWS effectiveness was measured using a Likert scale of 1-5 (1 being not effective and 5 being very effective). To be effective, EWS needed to actively involve the people and communities at risk from a range of hazards, facilitate public education and awareness of risks, disseminate warning messages efficiently and ensure that there is a constant state of preparedness and that early action is enabled and disaster loses are reduced.

Qualitative data was used to support the quantitative findings. The data was analysed using a three-step data analysis process. Step one involved documentation of all the issues as recorded during FGD sessions.
Step two involved clustering of all the issues under specific thematic areas while step three involved development of meanings and conclusions from the thematic areas in relation to the study objectives. Emerging issues were clustered into thematic areas upon which meanings and conclusions were drawn.

3.8 Quality Control and Ethical Consideration

3.8.1 Tool and Content Validity

Tool validity determines whether the research measures the intended outcome and how truthful the research results are. Content validity was done to ascertain connections between the independent and dependent variables. Subject matter experts were consulted during the technical proposal as well as during the tool development process.

Research assistant training was conducted at IPSTC. The tools were pretested and adjusted to ensure that they captured all the study objectives and study variables. The field logistics were discussed, clarified, explained and agreed upon by the research team. All logistics during the data collection was the responsibility of the research team. The principal investigator put in place various measures to ensure that the quality of the study was achieved.

The data entry specialist in the team cleaned the data by examining filled questionnaires for completeness, consistency and errors in entry. Any questions arising thereof were addressed immediately.

3.9 Ethical Considerations

Clearance to conduct the study was given by the IPSTC Director. In addition, a research permit was obtained from National Commission for Science, Technology and Innovation in Kenya. Consent to conduct the study was also obtained from the Office of the Prime Minister (OPM) Uganda. Informed consent was obtained from the respondents before the interviews were conducted. Ethical issues on confidentiality were emphasized and adhered to throughout the research duration.

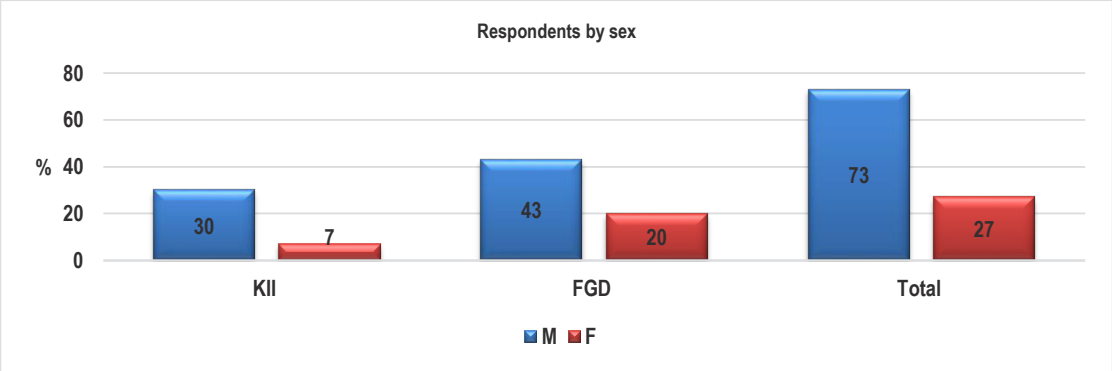
CHAPTER 4: FINDINGS and DISCUSSION

This chapter presents findings of the study based on the objectives and operational variables. The broad objective of the study was to evaluate the effectiveness of the disaster EWS in Kenya and Uganda. The first section describes the general characteristic of the respondents and gives a descriptive analysis on the distribution of the disasters, NDM institutional structures responsible of EWS and the national EWS process. The second section gives the analysis of the four capacities of four EWS components (risk knowledge, monitoring and evaluation services, dissemination and communication and response capability). The third section is a discussion of the findings based on the study objectives and the findings.

4.1 Major Characteristics of the Respondents

A total of eighty-one people participated in the study in both the KIIs and FGDs. Ten KIIs were from national and three (2) from regional/international institutions. The male respondents were the majority 59 (73%) compared to the female 22 (27%). Uganda had more female respondents 18 (22%) compared to Kenya's 4 (5%).

Figure 2: KII and FGD Respondents by Sex



The HFA (2005 -2015), which was the global plan for DRR where EWS is emphasized, highlights the importance of gender perspective in building resilience. HFA calls for gender integration into all disaster risk management policies, plans and decision-making processes, including those related to EWS (risk assessment, early warning, information management and education and training). Sendai Framework for DRR (2015-2030) also emphasizes on women participation as critical for effective management of disaster risk in designing, resourcing and implementing gender-sensitive DRR policies, plans and programmes.

Adequate capacity building measures need to be taken to empower women for preparedness as well as building their capacity for alternative livelihood means in post-disaster situations (UNISDR, 2014).

Gender discriminatory practices in disaster management can hinder women from being involved in decision-making structures throughout the disaster cycle especially in EWS response mechanisms. As a result, women's contributions that can inform EWS are missed. EWS needs to integrate gender balance in its four components and in the collection of data and formulation of responses and at all levels - regional, national and community. A study in Asia by UNISDR (2014) clearly supports the fact that women are not adequately recognized in EWS especially inclusion in decision making; yet they play a significant role throughout the DM cycle.

4.2 Disaster Occurrence by Type in Kenya and Uganda: 2008 - 2017

In both Kenya and Uganda, the top two leading disasters in the year 2008-2017 included rains, floods and drowning that accounted for 1715 (30%). Drought accounted for 1136 (19%) of the disasters. In Kenya, the third most frequent disaster was fires at 514 (9%); in Uganda, storms accounted for 746 (13%) incidences as shown in Table 1 below.

Table 3 : Reported disasters in Kenya and Uganda	Kenya	%	Uganda	%	Total	%
Disasters	**Freq**	**(49)**	**Freq**	**(51)**	**Freq**	**(100)**
1. Rain, Flood, flash, drowning	877	15.3	838	15	1715	30
2. Drought	569	10	567	9	1136	19
3. Fire, forest	514	9	146	3	660	12
4. Accident	383	6.7	184	3.3	567	10
5. Epidemic, Plague	302	5.5	136	2.6	438	8
6. Landslide, Mudslide, subsidence, Earthquake	54	1.1	268	4.9	322	6
7. Storm (thunder, hail, wind, cyclone, lighting)	54	1	746	13	800	14
8. Structural collapse	22	0.38	1	0.02	23	0.4
9. Other (electrocution, Animal attack)	10	0.16	29	0.44	39	0.6
Total	**2785**	**49**	**2915**	**51**	**5700**	**100**
Source: UNISDR https://www.desinventar.net						

Source: UNISDR https://www.desinventar.net

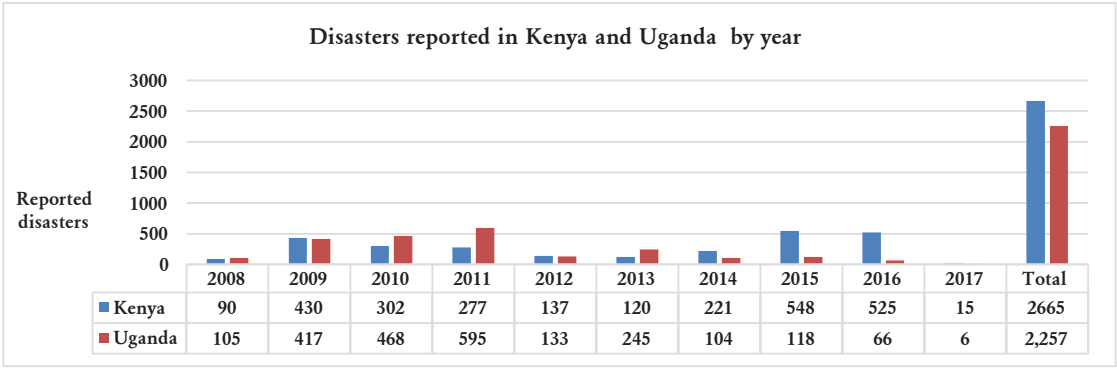
During the FGDs and KIIs, it was empathized that floods had increased in Kenya and Uganda and the impact was felt by both rural and urban communities.

Impacts of floods have been felt in urban economy, fishing, agriculture, forest, public health, education. Information and alert warning equipment are needed to improve information, infrastructure and instruction. There is need to know who does what? (FGD quote)

4.2.1 Disaster Trends in Kenya and Uganda by Year

A total of 5,700, disasters were recorded between 2008-2017. Uganda recorded the number of highest disasters at 2,915 (51%) as compared to Kenya at 2,257 (49%). The years 2009, 2010 and 2011recorded the highest number of disasters accounting for 17% (847), 16% (770) and 18% (872) respectively (see Fig. 2). The 2009, 2010 and 2011 droughts were the worst in the last 60 years in the East Africa region. In Kenya, damages and losses from the droughts were estimated at 12.1 billion USD; the cost for recovery and reconstruction were estimated at 1.77 billion USD (GOK, 2012). The Kenyan Cabinet in 2012 approved a Country Programme Paper (CPP) as the strategy for ending drought emergencies (EDE). The GOK (2017) notes that a common programming approach to end drought was adopted due to the large number of stakeholders involved in the EDE. The government funds drought EWS and is in the process of modernizing it. In addition, an objective online drought response mechanism has been set up for early and/no-regrets action to reduce the slide into emergencies.

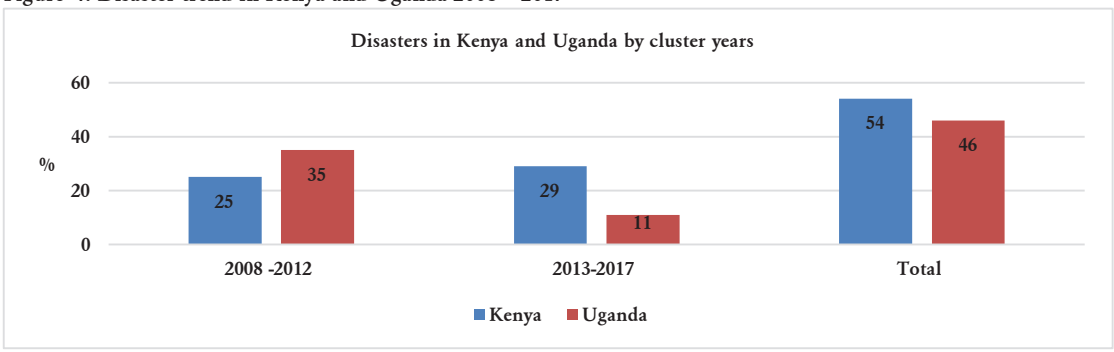
Figure 3: Disasters reported in Kenya and Uganda between 2008 - 2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Kenya	90	430	302	277	137	120	221	548	525	15	2665
Uganda	105	417	468	595	133	245	104	118	66	6	2,257

The data was clustered into two clusters of five-year duration to establish the disaster trends. In years 2013-2017, Kenya recorded a 4% disaster increase as compared to Uganda which recorded a 24% decrease in the same period. Kenya national disaster preparedness policy remains in draft form and the majority of counties do not have disaster preparedness polices and mostly relying on the national government to respond whenever disasters strike.

Figure 4: Disaster trend in Kenya and Uganda 2008 -2017



The increase of disasters can be attributed to several factors among them being the fact that Kenya does not have policies on disaster preparedness at either the national level or in the majority of counties. As result of this, disaster EWS and especially the preparedness component, suffers from weak political will, coordination and engagement of stakeholders. The EWS also suffers from competing priorities in the National Assembly and lack of a champion within the Executive.

According to Development Initiatives (2017), access to data on disasters, risks and weather information does not seem to be a key challenge in Kenya. The weakness lies in the lack of legal guiding principles, coordination and preparedness among the different disaster stakeholders. There are multiple coordination platforms across the various actors that are perceived as useful however; they rely on goodwill and relationships to work. Various systems are in place, such as the Famine and Early Warning Systems Network (FEWS) but no political goodwill for EWS. A study by UNDP (2014) in Uganda established that, the existing enabling environment for better management of disasters and climate risks, has led to reduced disaster occurrences. The environment has allowed the development and enactment of policies and frameworks that allow improved engagement of stakeholders and implementing partners of a DRR national platform where they regularly meet and engage. Additionally, Uganda has national policies on Disaster/Climate Risk Management (D/CRM).

4.2.2 Disaster losses by years between 2008 - 2017

Most of the disasters in Kenya and Uganda can be broadly grouped into four broad areas namely: environmentally-triggered: climate-related - droughts, floods, storms landslides,

geologic disasters includes volcanic eruptions, Tsunamis, earthquakes; human induced disasters such as socio- economic, technologic industrial, human and biologically epidemics i.e. disease, pests affecting human beings, livestock, crops and wildlife. Five main loses were analyzed in this study as shown in Table 3 below; they included: deaths, houses destroyed/damaged, damages to crops and loss of Cattle. The years 2009, 2010, 2011 and 2015 recorded the highest loses. In 2009 alone, Kenya recorded high loses of; destroyed/ damaged houses (12,704) and damaged crops hectare per ha (40,456)). In 2010, the highest loses were deaths (1,377) in Uganda. In Kenya in year 2011 and 2015 the highest loses were lost cattle (45,362) and injuries (952).

Table 4: Disaster loses in Kenya and Uganda by year

Table 4: Disaster loses in Kenya and Uganda by year							
	Year	**Deaths**	**Injured**	**House destroyed/ damaged**	**Direct/indirect affected**	**Damages in crops Ha.**	**Lost Cattle**
KE	**2008**	62	513	2,305	334,529	12,728	2,000
	2009	282		12,704	3,753,728	40,456	15
	2010	148	15	9,318	288,846	1,893	1,085
	2011	36	27	1,377	3,119,711	300	45,362
	2012	24	7	3,103	676,591		
	2013	172	13	368	43,514		50
	2014	224	111	455	67		
	2015	723	952	4,187	3,900		1,603
	2016	672	605	472	4		
	2017	21	8	5			
	Total	2,364	2,251	34,294	8,220,890	55,377	50,115
Uganda	**2008**	163	14	2,729	14,309	2,673	
	2009	55	130	1,126	1,303,699	1,271	
	2010	1,377	16	4,249	923,774	19,075	7
	2011	535	426	5,859	516,558	20,733	56
	2012	15	40	19	16,233	259	
	2013	30	29	312	23,168	3,471	
	2014	7	5	625	19,443	1,500	
	2015	1		24	21,004	9,152	
	2016	6		1,894	9,746	37	
	2017				350		
	Total	2189	660	16,837	2,848,284	58,171	63

Based on Table 3 below, loses were grouped in two clusters of 5-year periods within which disasters trends were analyzed. In Kenya, four out of five loses (deaths, injured, houses destroyed, cattle lost) increased in the year 2012-2017 as compared to Uganda that experienced a decrease in loses.

Table 5: Disaster loses in Kenya and Uganda by cluster years

Table 5: Disaster loses in Kenya and Uganda by cluster years						
Cluster years	**Deaths**	**Injured**	**House destroyed/ damaged**	**Damages in crops Ha.**	**Lost Cattle**	**Direct/indirect affected**
2008-2012	552	562	28,807	55,377	48,462	8,173,405
2013 -2017	1,812	1,689	5,487		1,653	47,485
Total	**2,364**	**2,251**	**34,294**	**55,377**	**50,115**	**8,220,890**
Uganda						
2008-2012	2,145	626	13,982	44,011	63	2,774,573
2013 -2017	44	34	2,855	14,160		73,711
Total	**2,189**	**660**	**16,837**	**58,171**	**63**	**2,848,284**

In 2008-2011, Kenya experienced severe drought; the cost of the losses was estimated at over Ksh. 968.6 billion (GOK, 2012). The impact of the drought was felt mostly in the livestock sector. In 2012, Kenya experienced heavy rains starting in early April. The rains caused flash floods and landslides across the country resulting in widespread destruction of property and infrastructure - disrupting farming and education activities.

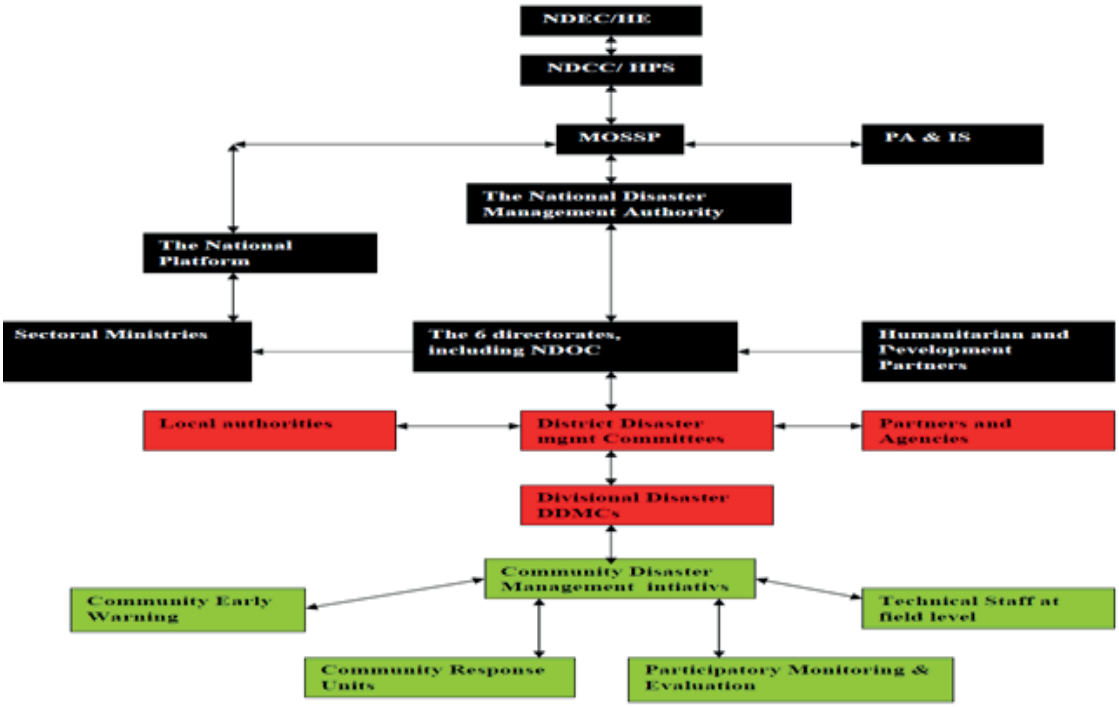
In 2008, Uganda was affected by a major drought and in 2010, a major landslide in Bududa district in the Mt. Elgon region resulted in flooding after the banks of river Manafwa were broken. Heavy rains triggered the landslide.

4.3 National EWS Institutional Structures in Kenya and Uganda

4.3.1 Kenya Disaster EWS Institutional Structures

In Kenya, the national EWS institutional structures are specified in the draft national Policy, as shown in Fig 4. Since the policy has not been enacted as law the EWS remains as proposed institutional structures without a legal mandate (GoK, 2009).

Figure 5: Kenya NDM Organizational Structure



Source: Draft National Disaster Management (Gok, 2009)

Based on the proposed structure, one out of the twelve NADMA mandates will be to operate an effective and efficient National Early Warning/Disaster Monitoring Information System. NADIMA will have the following six Directorates: Directorate of Early Warning and Disaster Risk Profiling; Directorate of Institutional Coordination; Directorate of Disaster Response, Relief and Recovery; Directorate of M & E, Research and Planning; Directorate of DM Education, Training & Capacity Building; and, Directorate of Finance and Administration . Apart from finance and administration the rest focus on EWS; that is, risk knowledge, monitoring and evaluation services, dissemination and communication, and response.

The structures recognize Community EWS and describe its role of response and participatory monitoring and valuation (GoU (2011).

The Directorate of Early Warning and Disaster Risk Profiling will be the main institution whose responsibilities are directly linked to EWS. The Directorate will conduct the following functions related to the four components of the EWS GoU (2011).

- Regular M&E collection, analysis of information on the most frequent disasters in Kenya
- Coordination EWS/information service providers to harmonize available DM information
- Production of regular Early Warning Disaster Management bulletins and publications
- Establish/maintenance of national disaster information data base trends
- Development of hazard maps and disaster risk profiles, M&E, yearly base line and update the information for future scenario planning in collaboration with stakeholders.

4.3.2 Uganda Disaster EWS Institutional Structures

Uganda has a National Policy for Disaster Preparedness and Management (GoU, 2010). Two out of eight of the policy mandates focus on EWS they include: establishing an effective monitoring and evaluation system and providing for an effective information management system to facilitate collection, storage, analysis and dissemination of disaster management information. The National Emergency Coordination and Operations Centre (NECOC) is responsible for effective coordination and networking of various emergency response institutions in the country (OPM, 2011).

With respect to EWSs National/technical tasks, such as modeling of a particular hazard is carried out by the relevant organization (e.g. flood forecasting and modeling is carried out by the MoWE). The current structure of NECOC is as shown in Fig 6 & 7 below.

Figure 6: Uganda NDPM Institutional Structure

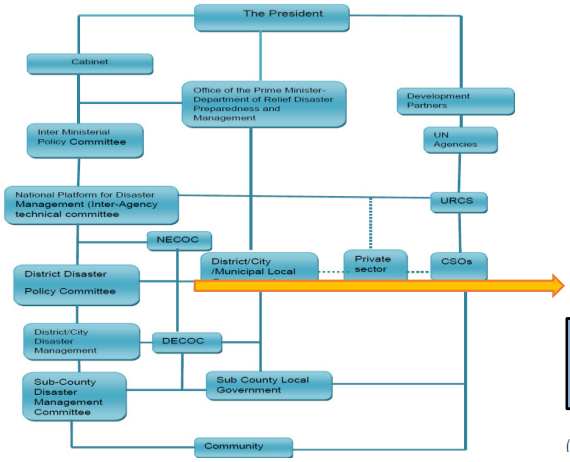
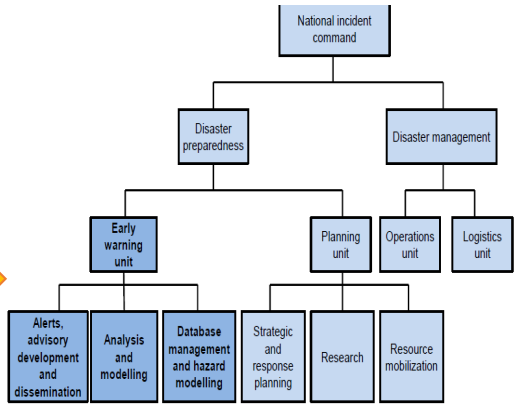


Figure 7: Structure of NECOC with respect to EWS



(Source: OPM. 2011)

Two out of fourteen mandates of the NECOC are directly related to EWS components, they include: disseminating EW information to stakeholders (responsible ministries, local governments, communities) and coordinate disaster response, search, rescue and evacuation operations.

4.3.3 EWS Process by Responsible National Institutionsin Kenya and Uganda

Table 6: National institutions by EWS components

Table 6: National institutions by EWS components						
Cluster years	**Deaths**	**Injured**	**House destroyed/ damaged**	**Damages in crops Ha.**	**Lost Cattle**	**Direct/indirect affected**
2008-2012	552	562	28,807	55,377	48,462	8,173,405
2013 -2017	1,812	1,689	5,487		1,653	47,485
Total	**2,364**	**2,251**	**34,294**	**55,377**	**50,115**	**8,220,890**
Uganda						
2008-2012	2,145	626	13,982	44,011	63	2,774,573
2013 -2017	44	34	2,855	14,160		73,711
Total	**2,189**	**660**	**16,837**	**58,171**	**63**	**2,848,284**

4.4 Rating the four EWS components in Kenya and Uganda

The respondents were asked to rate the effectiveness of the EWS's four components on a scale of 1-5 (1 being not effective and 5 being very effective). Four key elements of the EWS were assessed, they included: risk knowledge, monitoring and warning service, dissemination and communication and response capability.

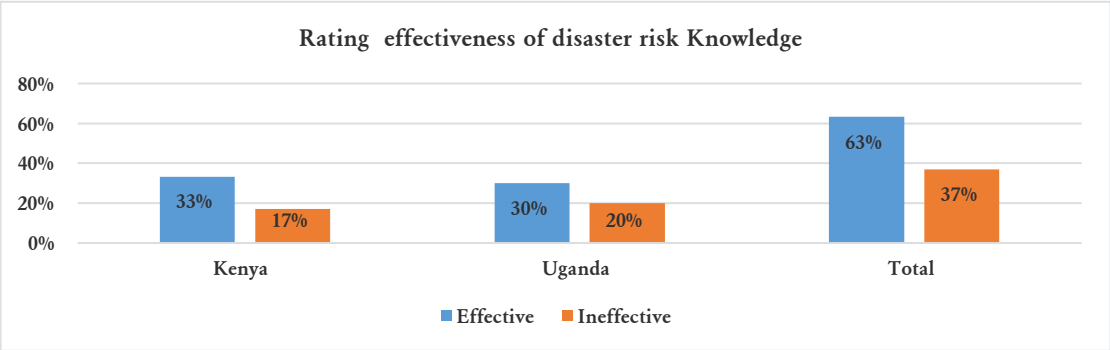
In all the four elements cross-cutting issues related to governance and institutional arrangements were examined in addition to the institutional, legislative and policy frameworks that support the implementation and maintenance of effective early warning systems. In each of the EWS components a total score was obtained and an average score was given for each component.

4.4.1 Rating Disaster Risk Knowledge Component

Risk knowledge assessed the systematic, standardized process to collect, assess and share data, maps and trends on hazards and vulnerabilities. The respondent rated effectiveness of 21 knowledge indicators which were grouped into five sub themes: Key hazards and related threats identification; Assessing exposure, vulnerabilities, capacities and risks; Identifying roles and responsibilities of stakeholders; Risk information consolidations; and, Incorporating risk information properly into the early warning system. Slightly more than half (63%) of the respondent rated disaster risk knowledge as effective.

With effectiveness being rated higher (33%) in Kenya than Uganda (30%) as shown in Fig 8 below.

Figure 8: Rating effectiveness of disaster risk Knowledge component

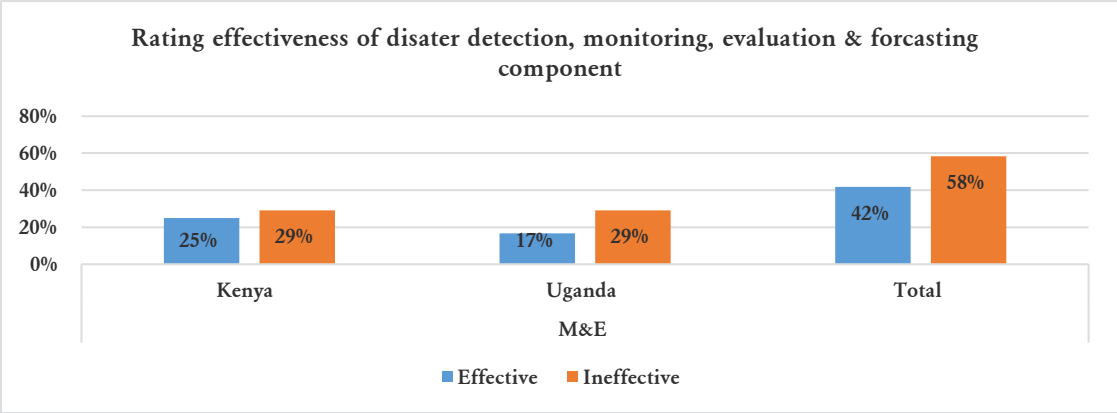


4.4.2 Rating Monitoring and Evaluation Services Component

Monitoring and warning service assessed the effective hazard monitoring and warning service with a sound scientific and technological basis. The respondents rated effectiveness of 25 monitoring and evaluation indicators which were grouped into three sub themes: Monitoring systems in place; forecasting and warning services in place; and, institutional mechanisms in place. Slightly less than half (42%) of the respondent rated monitoring and warning as effective.

With effectiveness being rated higher (24%) in Kenya than in Uganda (17%) as shown in Fig 9 below.

Figure 9: Rating Monitoring and Evaluation Services

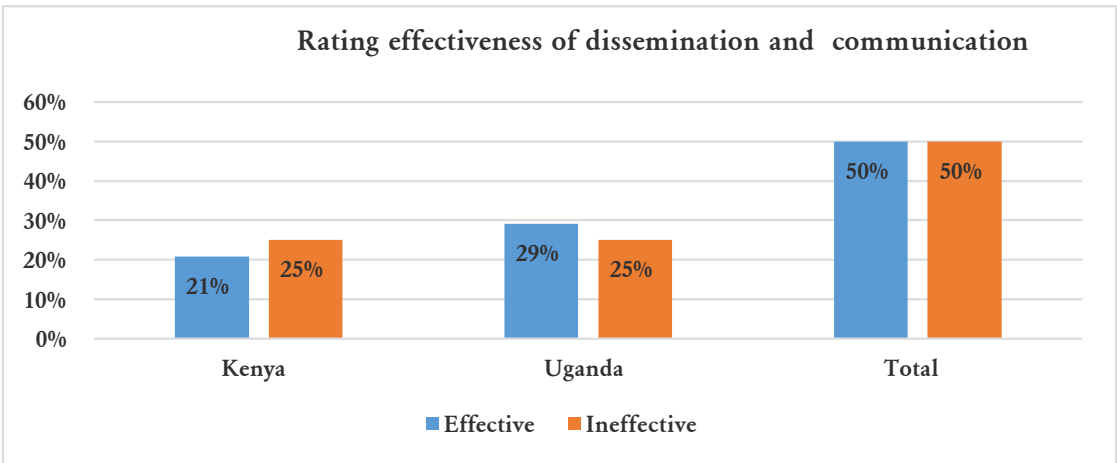


4.4.3 Rating Dissemination and Communication Component

Dissemination and communication assessed the communication and dissemination systems to ensure people and communities are warned in advance of impending natural hazard events and facilitate national and regional coordination and information exchange. The respondents rated effectiveness of 22 knowledge indicators which were grouped into three sub themes: organizational and decision-making processes in place; operational, communication systems and equipment in place; and, operational, impact-based early warnings communicated effectively to prompt action by target groups.

Half (50%) of the respondents rated dissemination and communication as effective. With effectiveness being rated higher (29%) in Uganda that in Kenya (21%) as shown in Fig 9 below.

Figure 10: Rating Dissemination and Communication Systems

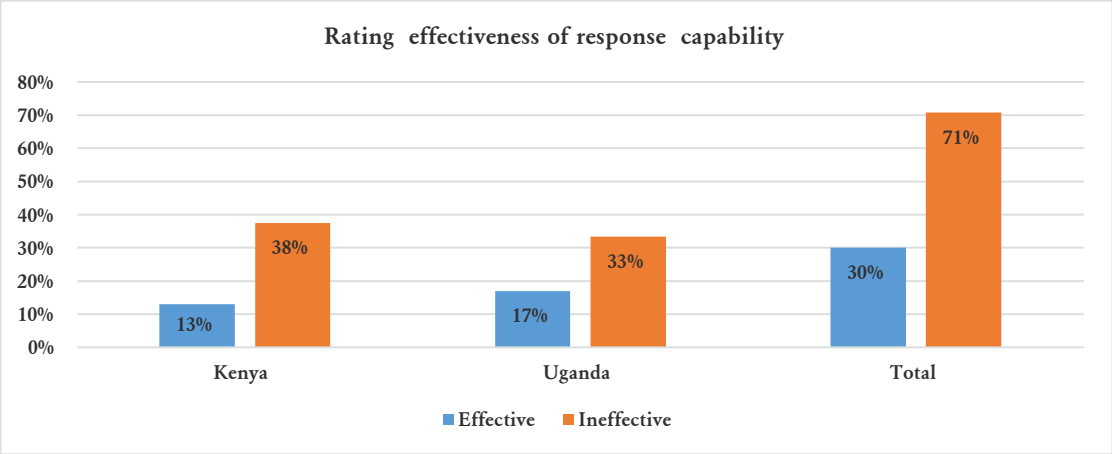


4.4.4 Rating Response Capability Component

Response capability assessed the ability of national institutions and communities to respond to natural disasters through enhanced education of natural hazard risks, community participation and disaster preparedness. The respondents rated effectiveness of 16 response capacity indicators, which were grouped into two sub themes: developed/operational disaster preparedness measures/response plans, public awareness and education campaigns.

Only 30% of the respondents rated response capability as effective. With effectiveness being rated higher (17%) in Uganda that in Kenya (13%) as shown in Fig 11 below.

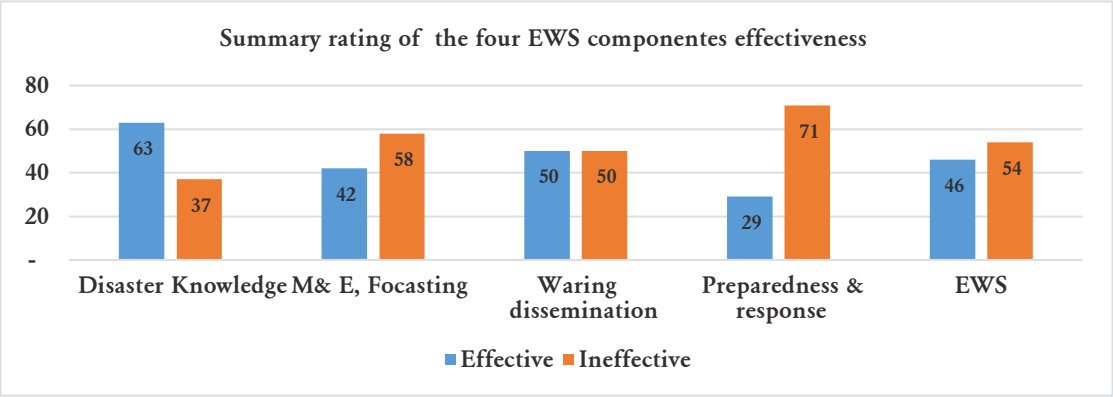
Figure 11: Rating EWS Response



4.4.5 Overall Rating of the Four EWS Effectiveness

Based on Table 11 below out of the four components assessed, disaster knowledge was the most effective at 63% and the least effective was preparedness and response capabilities.

Figure 12: Overall rating of the four EWS effectiveness



The KII and the FGD discussants were in support of the quantitative findings. A majority of the discussants stated that the four EWS components needed improvement especially the preparedness and response. Having in mind that the failure of one component affects the preparedness and response capabilities, there is need therefore to look at all the four components and how they affect each other.

Regarding preparedness and response most of the discussants stated that the component was the weakest. A discussant stated that:

> *NSC doesn't do the response but they usually bring together the authorities that cater to response examples include Red Cross, they (NSC) will however respond in linking, they NSC have a huge database thus are able to link with various stakeholders, they also offer various public education though they are limited by funding.*

> *They experience challenges in skills learning and capacity building engagement and also lack of trust between the community and committee officers. They also attribute delay on response capabilities to the governance structures. There is a disconnect of what is on the ground and what metrological products e.g. metrological department need to bring up issues of reality to ground together a linkage that can be understood by the local people (consumers).*
> *There is not much sensitization of the weather focusing concepts. The Metrological department needs to work together with other stakeholders to bring service to users. Explain the scientific map and synergies to normal issue. Analysis to link with disaster, connect with actual issue from scientific to address social economic and psychosocial community issues (FGD quote)*

4.5 Effectiveness of the EWS in Kenya and Uganda

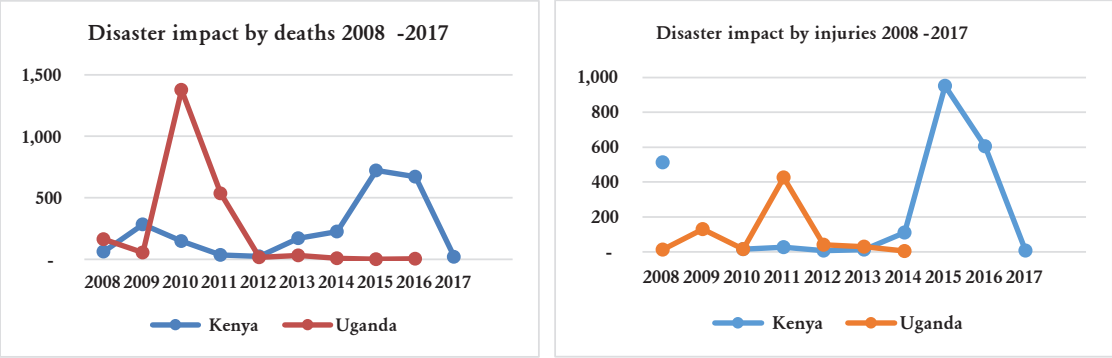
4.5.1 Indicators of Effective EWS

EWS is effectiveness when it achieves the four desired outcomes in managing disaster risks at the community or national level. This includes reducing (deaths/injury), reducing disaster impact in vulnerability livelihoods (damaged/destroyed houses, destroyed crops lost cattle) and building community resilience, which enable (community usage of EWS information). Four variables were assed in the period 2008-2017 based on the UNISRD disaster time series data for Kenya and Uganda.

4.5.2 Reduced Disaster Loses and Impacts/Vulnerability

Based on Fig 12, EWS was able to reduced disaster loses (life deaths/injuries) in Uganda but in Kenya loses were on the increase.

Figure 13 Reduced disaster loses (life deaths/ injuries)



4.5.3 Reduced disaster impact/vulnerability (houses damaged)

Based on Fig 13 and 14, EWS reduced disaster impact/vulnerability (damaged crops & cattle) are not able to constantly reduce impact and vulnerability however, this depends on the magnitude of the disaster.

Figure 14: Disaster impact/vulnerability (houses damaged)

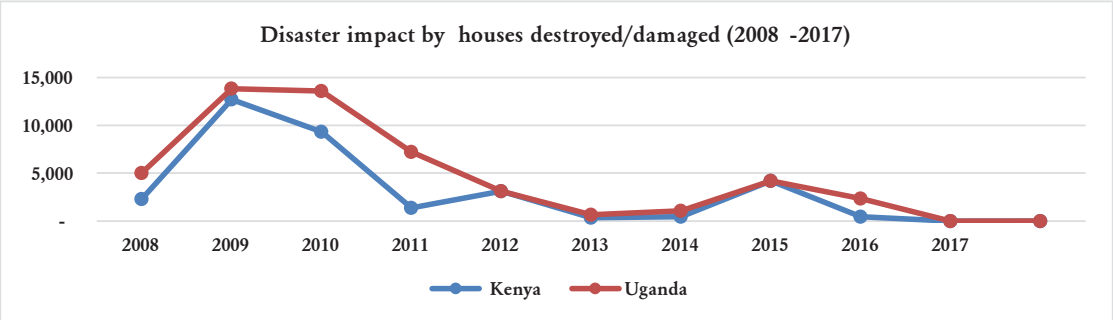
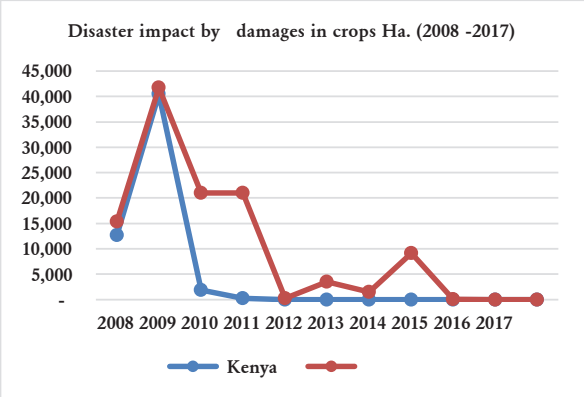
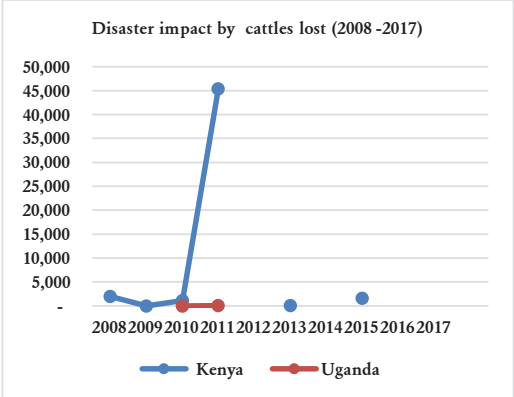


Figure 15: Reduced Disaster impact/vulnerability (damaged crops & cattle)



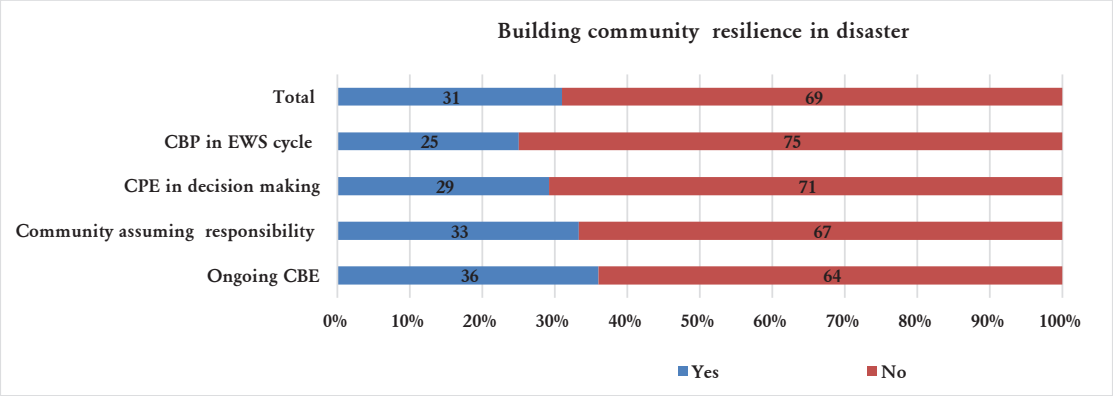


4.5.4 Resilience Building

Four indicators were used to assess strategies used by the EWS in building community resilience. The respondents were asked to state if the EWS was engaged in building resilience in the four areas which included: On-going CBE in DRR; community participating decision making in planning; response and recovery activities; and, communities assuming responsibility in preparedness and community based partnership.

All the four variables were assessed and an average score was obtained to get a score on building community resilience. Based on Fig 15 below, building community resilience was low, only 31%. On-going community based education was the highest (36%) activity in building community resilience with the lowest (35%) being community partnership in the EWS cycle.

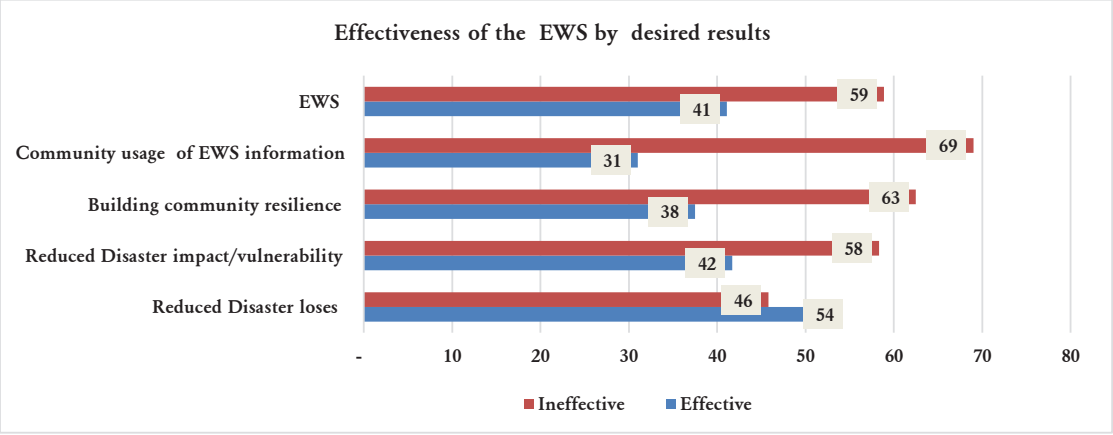
Figure 16: Resilience building in Kenya and Uganda



4.5.5 Community Usage of EWS information

Community usage of EWS information was measured using two indicators: the community ability to utilize the EWS in response activities and giving continuous feedback to the EWS. Based on Fig 16 below, community usage of EWS was low (31%); a majority of the community did not use the EWS despite receiving EW messages.

Figure 17: Community usage of EWS in Kenya and Uganda

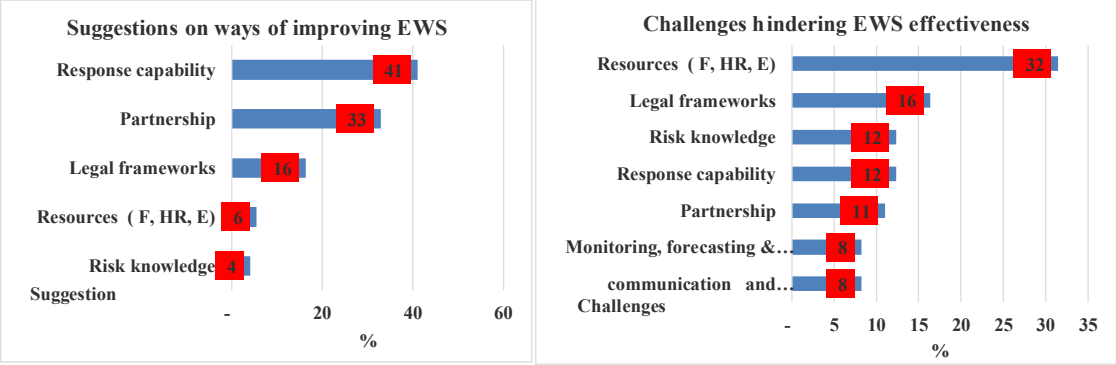


Community may ignore to use the EWS information because of many factors, which may include but not limited to economic reasons, ambiguity in the message and also due to presumptions that official warnings are not infallible. In Kenya and Uganda, sometimes it is a challenge to deliver effective warnings on small scale hazards in the shortest lead-time.

4.5.6 Overall effectiveness of the EWS in Kenya and Uganda

The overall effectiveness of the EWS was assessed by taking a total of the final and getting an average score for the four desired outcomes of an effective EWS. This includes reduced disaster loses, reduced disaster impact in vulnerability livelihoods and building community resilience. Based on the Fig. 17 below, EWS effectiveness was below average at 41%. The highest effectiveness was observed in reduced disaster loses at 54% and the lowest was community usage of EWS information at 31%.

Figure 18: Effectiveness of the EWS in Kenya and Uganda



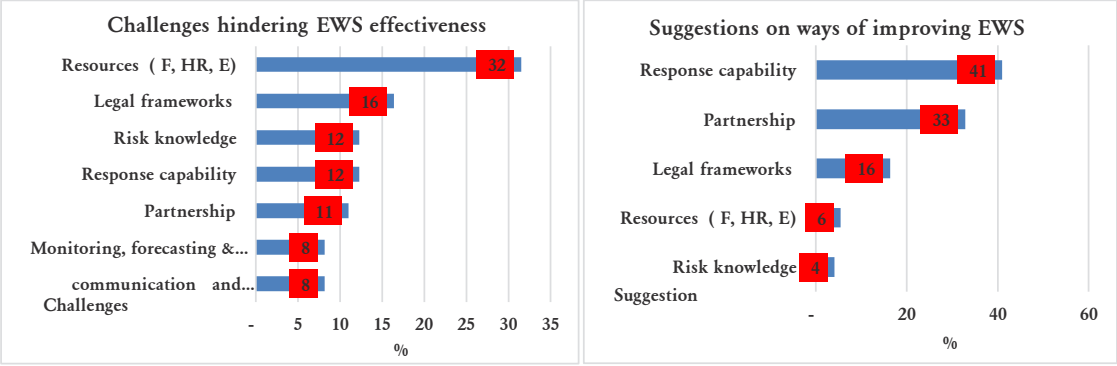
EWS are affected by the "crying wolf" syndrome, where people distrust or disown formal EW. Accuracy and ease of use are supposed to be the most important elements of a good EWS; this is often lacking. People at risk require specific, accurate information that inform whether: the individuals at risk; the hazard will reach their place of residence and if their houses will be affected or not; and, if evacuated how far and where they should go. On many occasions, there is very little time to review and receive warnings (Guru & Santha, 2015).

4.6 Challenges and ways of improving EWS in Kenya and Uganda

4.6.1 Key Challenges Hindering Effective of EWS

The respondents were asked to state the major challenges facing EWS in their respective countries. A total of 30 challenges were mentioned, which were further grouped into the four components of the EWS. Slightly more than half (55%) of the respondents stated that most challenges were related to response capability, followed by M & E forecasting and warning services at 20%, risk knowledge at 15% and the least were on communication andissemination at 10%.

Figure 19: Challenges facing EWS in Kenya and Uganda by components



CHAPTER 5: CONCLUSION and RECOMMENDATION

5.1 Conclusion

The main objective of the study was to analyse the effectiveness of disaster EWS in Kenya and Uganda. In addition, it sought to analyse disaster occurrence between 2008-2017, examine institutional structures responsible of EWS, assess the national capacity of four EWS components (risk knowledge, monitoring & evaluation services, dissemination & communication and response capability) and evaluate the EWS achievement of the desired goals. Based on the findings, the study concludes that Kenya and Uganda EWS are not effective; the EWS achieved only one out of four desired goals of effectiveness, which was reducing disaster losses. The least effective of the four components was building community resilience, followed by building resilience, and reduced disaster impact.

In the period 2008-2017, the total number of reported disasters in Kenya increased while in Uganda, they reduced. Institutional structures dealing with disaster EWS at the national level are present in both Kenya and Uganda. In Kenya, the legal framework for operationalizing EWS is lacking since the disaster management policy is still in draft form. In Uganda the disaster management policy was enacted in 2011. The preparedness and response capability is the least effective of the four components of the EWS.

5.2 Recommendation

5.2.1 Policy

1. There is need for developing advocacy among policy makers in Kenya so that the draft disaster management policy can be enacted.
2. National/County government to develop policy action plans on resilience building based on specific disasters/community profiles.
3. The Ministry of Education to develop EWS to improve disaster management at the school level especially in Kenya, which has experienced school related disasters in the last decade.
4. The DITTO to mainstream EWS from primary school to university level.
5. Establishment of a disaster risk management database.
6. Kenya EWS national institutions (NDOC, NDMU) to mainstream gender in all the four components of EWS to enable women to meaningfully engage in disaster EWS.

5.2.2 Program/Partnership:

1. National/County governments, NGOs, CBOs to scale up resilience building at the community level to enhance the community response to disasters.

2. IPSTC to upscale simulation for EWS for both community and EWS practitioners. HPSS AMANI village gives NDOC opportunity to train at the countries.

3. IPSTC to establish partnerships with institutions dealing with EWS at the regional, national and community level. This may include but not limited to ICPAC, NDOC in Kenya and with the OPM office in Uganda and the Metrological Departments and Red Cross in both Kenya and Uganda.

4. IPSTC to upscale partnership with primary schools especially on disaster management.

5.2.3 Further Research

1. Joint regional (EAC) research to document EWS best practices

2. Conduct a TNA in building community resilience

3. Develop Curriculum on building community resilience

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Annexes

Annex 1: KII/ Focus Group Discussion Tool

Introduction:

IPSTC is undertaking a study on Assessing Effectiveness of Disaster Early Warning System in IGAD Member States: A Comparative Study of Kenya and Uganda.

Broad objective: To analyze the effectiveness of IGAD disaster early warning system in Kenya and Uganda.

Specific objectives

1. Examine occurrence of disaster's Kenya and Uganda between 2012 to 2017
2. Assess NDM institutional structures responsible of IGAD EWS in Kenya and Uganda
3. Evaluate the national EWS process in Kenya and Uganda
4. Analyze the national capacity in the four EWS components (risk knowledge, monitoring & evaluation services, dissemination & communication and response capability) in Kenya and Uganda)

I kindly request you to participate in the study by signing as a way of giving consent. I will take approximately 25 Minutes of your time. Thank you for your participation.

Identification Page

Country…….....……..

Institution ……..……....…….

Interviewee consent sign…….....

Interviewer……. Sign…….....…….....

Supervisor ……... Sign ……

Section 1: Personal Data

1. (Ms/Mr/ Rank/ Title):_____
2. Gender :(1.Male2. Female)_____
3. Current position _____
4. Functional deployment :_____
5. Number supervised (if any):_____
6. How long have you been working (In years):

   a) On disaster management and EWS issues _____

   b) In your current position? _____

7. What are your 3 key current duties/responsibilities?
   1. _____
   2. _____
   3. _____

Section 2: Key Element 1: Risk Knowledge

Key actors in EWS

1. In your opinion who are the main Key Actors in gathering risk knowledge at the community, national and international stakeholders and their roles and functions under the four EWS pillars (Multiple response question)

Institutions	Function 1. Risk Knowledge 2. Monitoring & Forecasting 3. Warning Dissemination 4. Preparedness & Response	Responsibility
International / Regional		
National		
Community		

Focus Group Discussion Guide

Early warning is a major element of disaster risk reduction. It can prevent loss of life and reduce. The economic and material impacts of hazardous events including disasters. To be effective, early warning systems need to actively involve the people and communities at risk from a range of hazards, facilitate public education and awareness of risks, disseminate messages and warnings efficiently and ensure that there is a constant state of preparedness and that early action is enabled.

1. Based on this background how would you rate the effectiveness of each of the 4 components of EWS in Kenya / Uganda

a. Disaster risk knowledge: Comprehensive information on all the dimensions of disaster risk, including hazards, exposure, vulnerability and capacity, related to persons, communities, organizations and countries and their assets

b. Detection, monitoring, analysis and forecasting of the hazards and possible consequences: Multi-hazard monitoring and forecasting services with a sound scientific and technological basis

c. Warning dissemination and communication: Communication and dissemination systems and dissemination systems (including the development of last-mile connectivity) ensuring people and communities receive warnings in advance of impending hazard events, and facilitating national and regional coordination and information exchange

d. Preparedness and response capabilities at all levels: Institutions and people enabled to act early and respond to a warning through enhanced risk education

2. How would you rate the overall effectiveness of EWS in Kenya / Uganda

3. What are some of the key challenges hindering the EWS to be effective?

4. Give suggestions on how to improve effectiveness of the EWS in Kenya and Uganda based on the 4 components

Component of EWS	Challenge	Suggestion on improvement
1. Disaster risk knowledge		
2. Detection, monitoring, analysis and forecasting		
3. Warning dissemination and 4. communication		
5. Preparedness/response capabilities at all levels		

Annex 2: Key Informant Interview Guide

Key Informant Interview Guide

Introduction:

IPSTC is undertaking a study on Assessing Effectiveness of Disaster Early Warning System in IGAD Member States: A Comparative Study of Kenya and Uganda

Broad objective: To analyze the effectiveness of IGAD disaster early warning system in Kenya and Uganda

Specific objectives

5. Examine occurrence of disaster's Kenya and Uganda between 2012 to 2017
6. Assess NDM institutional structures responsible of IGAD EWS in Kenya and Uganda
7. Evaluate the national EWS process in Kenya and Uganda
8. Analyze the national capacity of four EWS components (risk knowledge, monitoring & evaluation services, dissemination & communication and response capability) in Kenya and Uganda)

I kindly request you to participate in the study by signing as a way of giving consent. I will take approximately 25 Minutes of your time.

Thank you for your participation

Identification Page

Country……..

Institution …….

Interviewee consent sign……..…….....

Interviewer……. Sign…….....…….....

Supervisor …….. Sign ……

Section 1: Personal Data

1. (Ms/Mr/ Rank/ Title):_____
2. Gender :(1.Male2. Female)_____
3. Current position _____
4. Functional deployment :_____
5. Number supervised (if any):_____
6. How long have you been working (In years):

a) On disaster management and EWS issues _____

b) In your current position? _____

7. What are your 3 key current duties/responsibilities?
    1. _____
    2. _____
    3. _____

1. In your opinion who are the main Key Actors/stakeholders of the EWS in Kenya/ Uganda.

What are their functions and responsibility based on the four EWS pillars

Institutions	Function 1. Risk Knowledge 2. Monitoring & Forecasting 3. Warning Dissemination 4. Preparedness & Response	Responsibility
International Regional		
National		
Community		

2. How you would describe the operational level your institutions

International / Regional, National, Community…….....…….

3. As an Key Actors in EWS what is your institutions the main area of operation in the

4 EWS pillars (Risk Knowledge, Monitoring & Forecasting, Warning Dissemination, Preparedness & Response)

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To be effective, EWS need to actively involve the people and communities at risk from a range of hazards, facilitate public education and awareness of risks, disseminate warnings messages efficiently & ensure that there is a constant state of preparedness and that early action is enabled.

4. How would you rate the effectiveness of the four components of the EWS in Kenya / Uganda on a scale of 1-5 (1 being not effective and 5 being very effective)

MULTI-HAZARD FOUR ELEMENTS OF PEOPLE-CENTRED EWS	Effectiveness scale				
DISASTER RISK KNOWLEDGE	**1**	**2**	**3**	**4**	**5**
Key hazards and related threats identification					
1. Identify of key hazards characteristics geographical, magnitude, intensity, disease transmissibility,frequency, probability)					
2. Developing hazard maps (dynamic and multi-hazard, when possible)					
Assessing exposure, vulnerabilities, capacities and risks					
3. Assessment and quantification of exposed people, services mapping					
4. Assessment of impacts to critical infrastructure and secondary risks associated with these impacts are evaluated					
5. Assessment of vulnerability factors; gender, disability, economic diversity, societal inequalities, environmental					
6. Assessing vulnerabilities of key economic sectors at national to local levels assessed					
7. Assessment and evaluation of activities that increase or compound risk (urbanization and land use)					
8. Assessment of risk and integrating into local risk management plans/warning messages warning messages to the local people					
9. Assessing and identifying legislation and cultural norms gaps that may increase vulnerability					
10. Developed process to actively engage rural and urban communities in local hazard and risk assess					
11. Developed scientific and technical experts to assess and review the accuracy of risk data and information					
Identifying roles and responsibilities of stakeholders					
12. Involving key national government agencies involved inrisk assessments					
13. Risk maps dynamic and multi-hazard widely available					
14. Risk information is consolidated					
15. Characteristics of key hazards documented and analysed					
16. Historical data evaluated and potential future risks assessed					
Risk information consolidations					
17. Central standardized repository (including GIS) established to store all event/disaster and risk information					
18. National standards established for the systematic collection, sharing and assessment of risk information					
19. Standardized vulnerability data and information disaggregated by sex, age and disability					

Incorporating risk information properly into the early warning system					
20. Information on the geographical extent of hazards used to define safe areas and evacuation zones					
DETECTION, MONITORING, ANALYSIS AND FORECASTING OF THE HAZARDS AND POSSIBLE CONSEQUENCES	**1**	**2**	**3**	**4**	**5**
Monitoring systems in place					
1. Established monitoring network that monitors hazards in the country					
2. Relevant measurement parameters/specifications documented for each hazard					
3. Technical equipment, suited to local conditions and circumstances, in place and personnel trained in its use and maintenance					
4. Processing monitoring and availability of data received, in an interoperable format in real time or near real time					
5. Monitoring data routinely curated with quality controls, archived and accessible for verification, research purposes and other applications					
6. Monitoring data and metadata routinely curated with quality controls, archived and accessible for verification, research purposes and other					
7. Monitoring hardware and software maintenance to ensure optimal operation of the system over time					
8. The system is able to combine and benefit from new and older technology allowing for exchange of data among countries					
Forecasting and warning services in place					
9. Data management (collection, analysis, processing, modelling, prediction and warning products generated based on accepted scientific and technical					
10. New data analysis processing, modelling, prediction and warning products and integrated easily in the system as science and technology evolve					
11. Warning centers are operational at all times (24/7) and staffed by trained personnel appropriate national and international standards					
12. Warning messages are clear, consistent, include risk impact information, linking threat levels to emergency preparedness / response actions					
13. Software and data analysis for the received data updated periodically and to high security standards					
14. The state of the monitoring and data analysis systems continuously monitored for any data gaps, connection issues or processing issues					
15. Warnings generated and disseminated in an efficient and timely manner for each type of hazard					
16. Warning system(s) subjected to regular system- wide tests and exercises					

17. Process established to verify that warnings have reached the principal stakeholders and people at risk					
18. Fail-safe systems in place, such as power backup, equipment redundancy and on-call personnel systems					
19. Strategies developed to build credibility and trustin warnings. False alarms minimized and improvements communicate to maintain trust					
Institutional mechanisms in place					
20. Plans/documents for monitoring networks available, agreed upon with experts					
21. Standardized process, roles and responsibilities of all organizations (MOU)					
22. Agreements and interagency protocols established					
23. A multi-hazard coordination strategy established to obtain					
24. Warning system partners, (local authorities, media) are aware of and respect which organizations are responsible for generation issuance of warnings					
25. Cross-border exchange of warnings and observation data realized through					
WARNING DISSEMINATION AND COMMUNICATION	**1**	**2**	**3**	**4**	**5**
Organizational and decision-making processes in place and operational					
1. Functions, roles and responsibilities of each actor in the warning dissemination process enforced through government policy o					
2. Coordination dissemination of warning communication strategies at the national, subnational local levels					
3. Regular coordination, planning and review meetings between the warning issuers, the media and other stakeholders					
4. Professional and volunteer networks established to receive and disseminate warnings widely					
5. Feedback mechanisms in place to verify that warnings have been received and to correct potential failures in dissemination and communication					
6. Mechanisms to update the information are in place and are resilient to the event					
Communication systems and equipment in place and operational					
7. Trust between stakeholders established					
8. Communication and dissemination systems tailored to the different needs of specific groups					
9. Understanding of last-mile connectivity to know which population groups can be reached by different services,					

10. Warning communication/dissemination systems ability to reach the entire population (seasonal popu, remote locations)					
11. Communication strategies evaluated to ensure messages are reaching the population					
12. Agreements developed to utilize private sector resources where appropriate					
13. Equipment maintained and upgraded to utilize new technologies					
14. Backup systems and processes in place in the event of failure					
15. Resilience of communication channels and early warning system hardware					
16. Coverage of communication channels and multiple- channel systems assessed					
Impact-based early warnings communicated effectively to prompt action by target groups					
17. Warning messages provide clear guidance to trigger reactions					
18. In the case of events with a short time-frame for reaction (e.g. earthquake early warning), automated systems should be in place to mitigate impacts					
19. Early warnings should take into account the different risks and needs of subpopulations, including differential vulnerabilities					
20. Public and other stakeholders are aware of which authorities issue the warnings and trust their message					
PREPAREDNESS AND RESPONSE CAPABILITIES	**1**	**1**	**3**	**4**	**5**
Developed/operational disaster preparedness measures/response plans					
1. Disaster preparedness, including plans or standard operating procedures, developed in a participatory manner					
2. Disaster preparedness measures/plans/standard operating procedures, account forth needs of people with different degrees of vulnerability					
3. Utilizing multi-hazard risk assessments to develop/design evacuation strategies (routes, safe areas/location of temporary shelters)					
4. Community's ability to communicate in response to early warnings assessed					
5. Contingency planning developed in a scenario-based manner following forecasts or likely scenarios across different timescales					
6. Early action and response options across time and geographical scales are linked to the provision of funding to support them					
7. Strategies implemented to maintain preparedness for longer return-periods and cascading hazard events					
8. Strategies implemented to maintain preparedness for longer return-periods and cascading hazard events					

9. Protocols incorporated in the plans or standard operating procedures to reach emergency and health services					
10. Protocols established to activate and mobilize last-mile operators (local police, firefighters, volunteers, health services)					
11. Regular exercises undertaken to test and optimize the effectiveness of early warning dissemination processes, preparedness and response to warnings					
Public awareness and education campaigns					
12. Ongoing public awareness and education programmes on hazards that could impact the population					
13. Public education provided to recognize hydro meteorological and geophysical hazard signals and disease signs and symptoms					
14. People educated on how warnings will be disseminated, which sources are reliable and how to respond					
15. Utilization of the most effective media (established broadcasting media, social networks, alternative media) to improve public awareness					
16. Public awareness and education campaigns tailored to the specific needs of vulnerable groups(e.g. women, children, older people and people with disabilities					

5. What are some of the key challenges hindering the EWS to be effective?

Please give suggestions on how to improve effectiveness of the EWS in Kenya and Uganda based on the 4 components

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Conclusion

Kindly give any other observations you feel would be used to improve the effectiveness of EWS in Kenya /

About the Author

Dr. Eunice Njambi holds a PhD and a Master's Degree in Community Health and Development from Great Lakes University, with further training in health systems management from Galilee International Management Institute, Israel. She is community development specialist, with expertise in research consultancy. Eunice is a regional facilitator in development of partnerships stakeholder engagement, strategic leadership planning and systems strengthening through applied policy research Currently working with IPSTC as a researcher and curriculum designer Eunice has published 4 Occasional papers and 4 Issue briefs in peace and security.

She has been a principle investigator in national and regional research with USAID, KIPPRA, Concern World Wide South Sudan, AMREF/ Ministry of Health, UNCHR/UNICEF/Action Against Hunger, DONONE Baby Nutrition. To date she has supervised Master's degree research for over 50 Students who have graduated

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