Final Report

For

National Early Warning System Baseline Survey

Malawi

Submitted to

Department of Disaster Management Affairs

Lilongwe

19th January, 2017.

DECLARATION

We, the undersigned, hereby declare that the contents of this report is our original work. Where work of other people has been used, due acknowledgement has been made. Due diligence has been taken to ensure that all the contents, including methods and results, are of the highest accuracy and reliability possible.

Dr Chomora Mikeka (Lead Consultant)	Date
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FRONT MATTER

This Final report presents the work done for the National EWS baseline survey as of 19th January, 2017. It reports results established using the methods of analysis (as outlined in the inception report) applied on the data collected during enumeration. These results are mapped and analysed around the objectives of the assignment which were specified in the Terms of Reference (ToRs). It also assesses performance of the methods and tools used and where amendments were made to the methods and/or tools, justification for such amendments is given. It also reports logistical and technical challenges encountered during data collection in the field.

The National EWS baseline survey was undertaken by the **Consultant**, e-Communications Research Group (eCRG) Consult mandated by the **Client**, the Department of Disaster Management Affairs (DoDMA) within the specified Terms of Reference (ToRs) in the Contract Agreement (contract number IPC/4/DoDMA/2016/2017). Consequently, the Consultant is delivering this Final report to the Client as the final deliverable building on other deliverables as stipulated in the contract document.

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ABBREVIATIONS AND ACRONYMS

AWS:	Automatic Weather Station
ARL:	Automatic Rainfall Logger
ARG:	Automatic Rain Gauge
CWS:	Conventional Weather Stations
DCCMS:	Department of Climate Change and Meteorological Service
DoDMA:	Department of Disaster Management Affairs
DWR:	Department of Water Resources
eCRG:	e-Communications Research Group
EA:	Enumeration Area
EWS:	Early Warning System
HFA:	Hyogo Framework of Action
MGDS:	Malawi Growth and Development Strategy
NDRMP:	National Disaster Risk Management Policy
NSO:	National Statistics Office
SRBMP:	Shire River Basin Management Program
UN/ISDR:	United Nations Inter-Agency for International Strategy for Disaster Reduction
VCPC:	Village Civil Protection Committee
WMO:	World Meteorological Organisation

CHAPTER ONE

INTRODUCTION

A. BACKGROUND AND CONTEXT

The Government of Malawi through the Department of Disaster Management Affairs (DoDMA) under the Office of the Vice President– in collaboration with the Department of Climate Change and Meteorological Services (DCCMS) and Department of Water Resources (DWR) is implementing a project titled '*Strengthening climate information and early warning systems in Malawi for Climate resilient development and adaptation to climate change'*. The focus of the project is to enhance the capacity of hydro-meteorological institutions in the country to monitor and forecast extreme weather, hydrology and climate change as well as make efficient and effective use of hydro-meteorological information for generating useful early warning messages and alerts that would safeguard peoples life, property, livelihoods and economic development gains that the country has achieved this far. The outcome of the project will support the long-term development agenda for the Government of Malawi as stipulated in the second Malawi Growth and Development Strategy (MGDS II). As part of the implementation of the project activities, a national baseline survey was necessary to be conducted to provide the status of the EWS in Malawi as well to inform the development of monitoring and evaluation framework for the Green Climate Fund project which will upscale the interventions in the current EWs project. The e-Communications Research Group (eCRG) was engaged as the national Consultant to undertake a comprehensive baseline assessment of early warning systems in Malawi (hereinafter, the baseline survey). The terms of references (ToRs) for the baseline survey required that the Consultant to collect data and information on the use of climate/weather information and livelihoods (agriculture, livestock, fisheries, etc.) of households in Malawi. This information was required for several purposes. Firstly, it was required to estimate the impact of climate information on income (welfare). Secondly, it was required to assess the effectiveness of warning for floods, droughts and severe weather in Malawi. Thirdly, the data and information was also to be used to analyse the costs and benefits of adaptation alternatives, forecasting climate change-related impacts on the agriculture sector. Fourthly, the data was required to demand of EWS in light of climate change. Finally, indicators were required to be developed for the early warning systems to measure impact of interventions. This was successfully done and the results of the analysis tailored to these objectives is presented in chapter 3. It is shown how each result corresponds to these objectives.

In order to collect the required data, three survey tools were developed for household and institution levels, namely: the household questionnaire, the institutional questionnaire and the "Weighted value opinion data tool". It must be pointed out that even though three instruments were proposed and developed to be used, only the first two instruments were actually administered. The third instrument, called "Weighted value opinion data tool" was developed to collect historical information regarding the four elements of EWS and expert opinion on the same. However, preliminary exploration revealed the historical data on important variables required for it to be used reliably for its intended purposes was either partial or completely non-existent. Therefore, it was decided by the Consultant not roll it out for collection of expert opinion.

To facilitate the smooth flow of data collection process, a **Hybrid Mobile App** was developed specifically for data collection in the survey to allow real time data collection and synchronization for improved data integrity and credibility. As such, the household and institutional questionnaires, were administered electronically using an App (latest stable version 4.02) on SAMSUNG Galaxy Tab A_6 Tablets to ensure efficiency, cleaner data, data clerk tracking with time and GPS/Enumeration Area (EA) tagging capability. Collected data was synced to the Department of Climate Change and Meteorological Services (DCCMS) designated server and backed up online using the cloud as a service, accessible from http://www.ecrg-ews.com for real-time data entry error checking and controls, monitoring and later offline analysis. Using the household and institutional questionnaires, the assessment gathered baseline information as required by the ToRs as outlined above. The instruments were carefully designed to ensure collection of data and information of all pillars of the EWS framework listed as below:

1. Risk knowledge;
2. Monitoring and warning services;
3. Communication and dissemination;
4. Response capacity.

B. OBJECTIVES OF THE ASSIGNMENT

According to the ToRs, the Consultant was required to collect data and information on the use of climate/weather information and livelihoods (agriculture, livestock, fisheries, etc), with a view of achieving the following objectives:

Objective 1: Estimating the impact of climate information on income (or welfare) of households

Objective 2: Assessing the effectiveness of warning for floods, droughts and severe weather in Malawi.

Objective 3: Analysing the costs and benefits of adaptation alternatives.

Objective 4: Modelling demand for Early Warning Systems in light of climate change.

Objective 5: Developing indicators for the early warning systems to measure impact of interventions.

Chapter 3 presents a discussion of how these objectives have been satisfied and the results found for each objective.

C. PURPOSE AND SCOPE OF THE ASSIGNMENT

The following deliverables which were specified in ToRs have been achieved.

- Developed and implemented a work plan **(Chapter II of this Final report)** to conduct the household level surveys in ALL agro-ecological zones of the country.
- Designed an appropriate sampling methodology **(Chapter II of this Final report)** with appropriate weights to reflect the representativeness of the survey.
- Collected data **(Chapter II of this Final report)** ensuring consistency of data parameters and adherence to the Survey Guidelines and Instrument.
- Performed appropriate quality checks of data entry **(Chapter II of this Final report)** to ensure accuracy.
- Worked with a team of enumerators and supervisors **(Chapter II of this Final report)** that were jointly recruited with the EWS Project Coordinating Office.
- Conducted three day orientation training to all enumerators and supervisors **(Chapter II of this Final report).**
- Developed Specific, Measurable, Achievable and Attributable, Realistic, Time bound (SMART) early warning system indicators **(Chapter III of this Final report)** that will be used to measure progress and impact of early warning system interventions as part of monitoring and evaluation framework.

CHAPTER TWO

METHODOLOGY

A. INTRODUCTION

This chapter presents the methodology used in the EWS baseline survey in order to achieve the objectives stipulated in the ToRs and outlined in chapter one. First, it discusses the conceptual framework adopted in conducting the survey. Then, it discusses the sampling design, including the sampling frame used, the sampling technique employed and determination of sample size. Next, it discusses the data collection process, including the instruments used, data management and quality controls employed, planned vs actual amount of data collected, training and supervision of enumerators. It concludes with a discussion of the challenges during data collection and remedial actions taken.

B. THE INCEPTION REPORT

The tools of data collection, the Hybrid App and methods of analysis discussed in the subsequent sections of this chapter were presented to, discussed with and approved by the EWS project technical committee on the 24th of October, 2016 at Lingadzi Inn in Lilongwe. Figure 2.1 below shows a group photo of participants of the said presentation.

Figure 2.1: Group photo of participants at the Inception report presentation.

C. CONCEPTUAL FRAMEWORK FOR EWS

According to the United Nation's International Strategy for Disaster Reduction an early warning system is defined as "the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss" (UN/ISDR, 2005). An Early Warning system is recognised critical for reduction of disaster risk since it prevents loss of life and property if it is well designed and implemented (WMO, 2010). Therefore, internationally, establishment of Early Warning System is sanctioned by the Hyogo Framework of Action, priority area 2, to which Malawi is a signatory. In Malawi, an Early Warning system is recognised in the National Disaster Risk Management Policy (NDRMP) as a critical element of the disaster risk management (GoM, 2015). The NRDMP, under its objective (iii) and policy priority area (iii), therefore sanctions establishment and strengthening of a people-centred EWS.

In order to reduce disaster risk associated with weather-related natural hazards, several interrelated activities must take place in the EWS chain. We adopted the conceptual framework for EWS by the United Nations' International Strategy for Disaster Reduction platform for the promotion of Early Warning for thinking about these activities. This framework is shown in Figure 2.2 below.

The key elements of a EWS are risk knowledge, monitoring and warning service, communication and dissemination, and response capacity. The following description of the various components of a EWS is based on UN/ISDR (2006). Risk Knowing risks which communities face is important prioritising early warning system needs and guide preparations for disaster prevention and responses. Since risks arise from the combination of hazards and vulnerabilities at a particular location, assessments of risk require systematic collection and analysis of data on nature of hazards and vulnerabilities of communities that arise from processes such as urbanization, rural land-use change, environmental degradation and climate change. The weather-related natural hazards of focus in this study on are droughts, floods, strong winds, hailstorms earthquakes, pest infestations (locust swarm) and thunderstorms/lightening. This choice of the focal weather-related natural hazards has been guided by NDRMP, which identifies these are the most critical in Malawi (GoM, 2015).

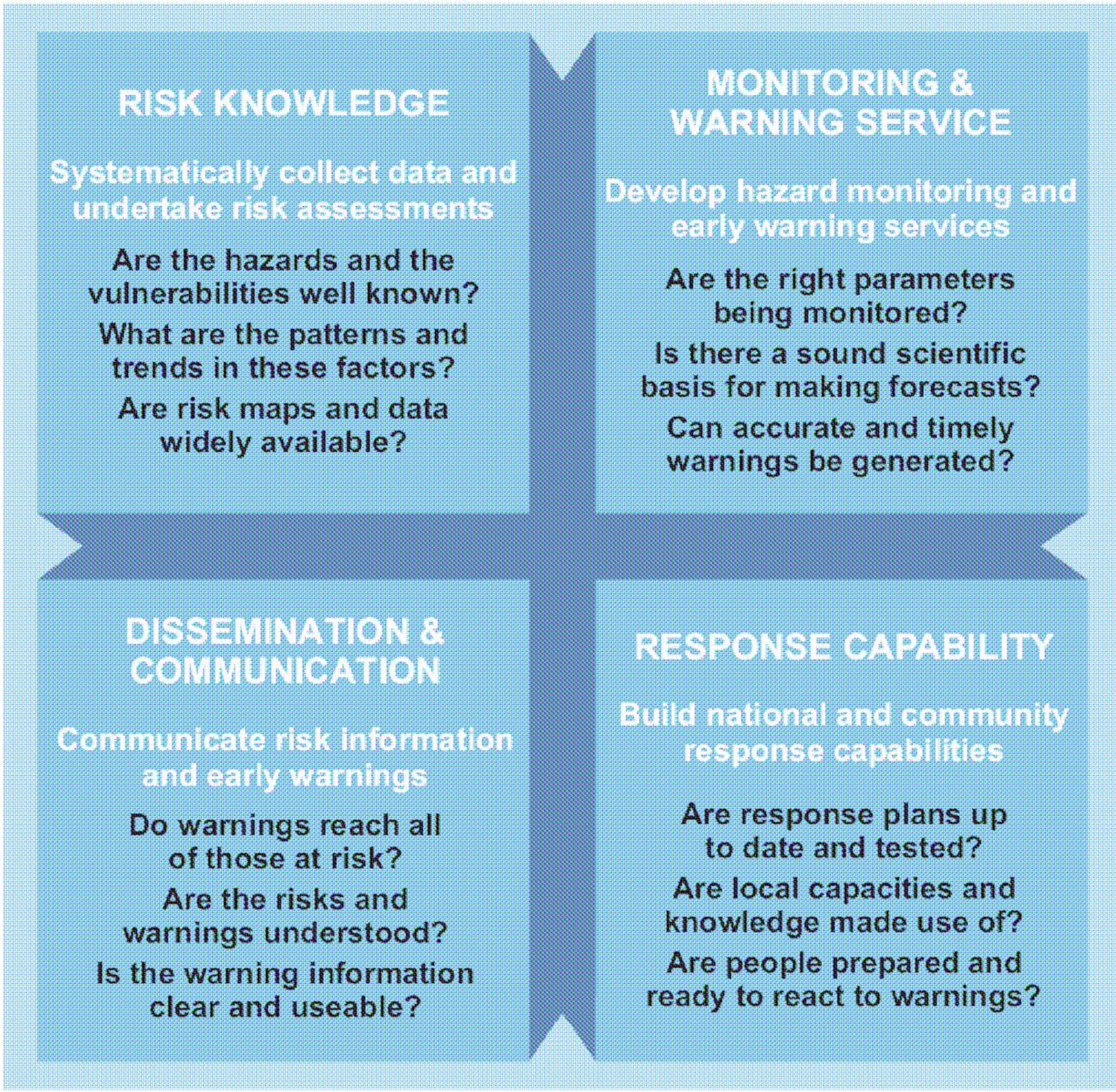
Having identified the risks, there must be a sound scientific basis for predicting and forecasting hazards and a reliable forecasting and warning system. This is the role of the second element/activity, monitoring and warning service. Its role is to generate accurate warnings in a timely manner to enable households and communities to avoid or reduce loss of life and property.

When warning have been generated, they must reach those at risk. Clear and understandable messages containing simple, useful information are critical to enable proper responses and actions that will help safeguard lives and livelihoods. This is the third key element, communication and dissemination.

Finally, communities must respect the warnings and know how to react to the messages. It is also essential that disaster management and contingency plans are in place, well-practiced and tested. The community should be well informed on options for safe behaviour and how best to avoid and minimise damage and loss to property. This is the fourth element, response capacity.

Another useful way of looking at the EWS is one in where EWS is veiwed as a system which offers some services aimed at disaster risk reduction. The services are the elements of the EWS discussed above. That is, the EWS provides risk knowledge services, monitoring and warning service, communication and warning service, and response capacity service, all of which are aimed at minimising the negative impact of weather-related natural hazards. These services are produced by various institutions and consumed by households and communities. The EWS can therefore analysed from the supply side where the agents are the institutions as well as the demand side where the agents are the households and communities.

Figure 2.1: Elements of a people-centred Early Warning system



Source: UN/ISDR, 2006

C. SAMPLING DESIGN

1. Sampling Frame

The sampling frame for the EWS baseline survey was based on the listing information and cartography from the 2008 Malawi Population and Housing Census

(PHC). The sampling frame included the three major regions of Malawi, namely North, Centre and South; and was stratified into rural and urban strata. In accordance with national-wide surveys by the National Statistics Office (NSO) such as the integrated household surveys (IHS), the urban strata included the four major urban areas: Lilongwe City, Blantyre City, Mzuzu City, and the Municipality of Zomba. All other areas will be considered as rural (non-city) areas, and each of the 28 districts were considered as a separate sub-stratum as part of the main rural stratum. The island district of Likoma was excluded from the sampling frame, since it only represents about 0.1% of the population of Malawi, and the corresponding cost of enumeration would be relatively high.

The target universe for the EWS assessment included individual households and institutions at district assembly like DCCMS, DROs (on behalf of GoM) and DWR within all the districts of Malawi except for Likoma Island. The institutions further targeted NGOs, CBOs and media both print, electronic and broadcast.

2. Sampling Technique

A stratified two-staged sampling was employed in this survey for selection of household to be interviewed.

a. *First stage selection*

In the first stage of sampling, the primary sampling unit was the enumeration area (EA) as defined in the 2008 population and housing census (PHC). The sample EAs were selected within each district systematically with PPS from the ordered list of EAs in the sampling frame. Within each district, a simple random sampling technique with equal probability was used to determine the number of EAs to be sampled. After we had identified the number of EAs in a district, then purposive sampling was employed, based on hazard maps, to determine the actual EAs to be included in the sample. This was done to ensure a balanced representation of more disaster-prone areas and less disaster-prone areas. We used an 80:20 representation ratio of more disaster-prone areas to less disaster-prone areas

b. *Second stage selection*

Following the selection of EWS sample EAs in the first stage, a listing of households was conducted in each sample EA to provide the sampling frame for the second stage selection of households. A random systematic sampling was used to select 20 primary households (and 5 replacement households) from the household listing for each sample EA.

For the institutional questionnaire, we planned to interview 116 respondents (minimum of 4 per each of the 28 districts) from institutions involved in EWS including: GoM, DCCMS, Department of Water Resources Management, District Disaster Risk Officers (DDROs) and others as were to be guided by the DDROs.

3. Sample Size

The sample size for a household survey such as the EWS baseline assessment is determined by the accuracy required for the survey estimates for each domain, in our case, a district is a domain. The accuracy of the survey results depends on both the sampling error (error due to non-representativeness of the sample) and the non-sampling error (arising from human error). Sampling error decreases with sample size while non-sampling error may increase with the sample size. It was therefore important that the overall sample size should be manageable for quality and operational control purposes. In other words, we need a sample size so that both errors are minimized. This was especially important given the challenge of collecting accurate information on impacts of climate change on household livelihoods (including agriculture, livestock and fisheries) and associated economic practices as well as the effectiveness of weather and climate forecasts and associated bulletins and warnings.

Taking into account these and other considerations, sample size for this study was calculated to be 3,920 households. To collect information from these 3920 households, a total of 196 EAs were then selected across the country. In each district, a minimum of 6 EAs were planned to be selected while in each EA a total of 20 households were planned to be interviewed. In order to increase representation of areas with higher exposure to weather-related natural hazards, we planned to sample 7 EAs in each district for all the disaster prone districts.

However, due some logistical and technical challenges discussed in section B below, there we some deviations between the planned and actual number of households interviews. These deviations are shown in Tables 2.4 and 2.5 below. The deviation do not materially alter the representativeness of the sample and validity of the results.

D. DATA COLLECTION

1. Data Collection Instruments

Data were initially planned to be collected using three instruments: a household questionnaire, an institutional questionnaire and a “Weighted value opinion data tool”. However, data was eventually collected using the first two of the three instruments. As explained earlier in chapter 1, the reason for not using the third instrument was partial availability or complete non-existence of historical data on important variables for which the tool was meant to collect data on. Therefore, it was decided by the Consultant not roll it out for collection of data on expert opinion.

The household questionnaire collected information on livelihoods of households and the impact of weather-related natural hazards on those livelihoods. Further it has collected on the use and effectiveness of climate and weather forecasts and warnings. The contents of the household questionnaire are summarised in Table 2.2 below and the questionnaire itself is attached in Appendix A.

Table 2.2: Summary of the contents of the household questionnaire

SECTION	TITLE	DESCRIPTION
A	Household demographic information	This section contained the roster of individuals living in the household, their gender, age, relationship to the household head, and information on the level of education of every member in the household. For members over 12, information on marital status was collected. Further, it contains information on the estimated monthly income.
B	Livelihoods-Agriculture	This section collected information on any crops planted during the 2015/2016 rainy season and gather details on the area of plantation, pre-harvest losses, quantity and value of crops harvested/ sold. It was designed to estimate losses suffer due to weather-related natural hazards such as droughts and floods
C	Livelihoods-Fisheries	This section collected information on output from fishing activities including: total catch, sales, consumption, and revenue generated from fishing, fish processing and fish trading for the last high season. It was designed to estimate losses suffer due to weather-related natural hazards such as mwera winds.
D	Weather-related natural hazards	This section collected information on the weather-related natural hazards experienced by households over the last three years, including whether they got warnings in good time to take appropriate action and the damage and loss suffered
E	Early warning system	This section collected information on the early warning systems for weather-related natural hazards, where they exist. It solicited information on extent risk knowledge among the communities at risk, access to weather-related information, media through which the information is accessed,

		effectiveness and timeliness of warning dissemination and communication, participation of communities in risk assessment and formulation and implementation disaster preparedness and responses plans

This information from the household questionnaire informed the construction of the demand-side indicators for monitoring and evaluating progress of the early warning system. We have developed a set of ten demand side indicators. These indicators are as listed below and fully discussed in the next chapter (chapter 3).

Indicator D1: Proportion of households aware of existence of hazard maps, vulnerability maps and risk assessments
Indicator D2: Extent of community participation in risk assessments
Indicator D3: Proportion of communities involved in monitoring and warning service
Indicator D4: Percentage of population with access to improved climate information and warnings
Indicator D5: Proportion of the population which get warnings in time
Indicator D6: Percentage of population which understand forecasts and warnings
Indicator D7: Percentage of population which trust forecasts and warnings
Indicator D8: Percentage of communities which are involved in communication and dissemination
Indicator D9: Awareness of the availability of disaster preparedness plans and contingency plans for weather-related natural hazards.
Indicator D10: Extent of community involvement in preparation of disaster preparedness plans and contingency plans for weather-related natural hazards.

The institutional questionnaire collected information on major elements of an early warning system from the supply side. The contents of the institutional questionnaire are summarised in Table 2.3 below and the questionnaire itself is attached in Appendix B.

Table 2.3: Summary of the contents of the institutional questionnaire

SECTION	TITLE	DESCRIPTION
A	Risk knowledge	This section collected information on nature of weather-related natural hazards and of vulnerability and risk of communities exposed to such weather-related natural hazards. Further, it collected information on whether risk assessments, if any, had the participation of local

		communities and whether such information is well documented and accessible by the communities at risk
B	Monitoring and warning service	This section collected information on the parameters observed for different weather-related natural hazards and frequency of such observation, the equipment and prediction models employed and, the threshold used to issue a warning.
C	Dissemination and Communication	This section collected information on the media used for disseminating warnings to the target communities, whether the warnings are understood and trusted by those at risk, whether the warnings get to the intended recipients in good time to take appropriate action to minimise damage and loss of lives and property
D	Response capacity	This solicited information on the ability and knowledge of communities to react when a weather-related natural hazard occurs, whether they know options for safe behaviour, and whether there are disaster preparedness and response plans
E	Cross-cutting issues	This section collects information on presence and effectiveness institutional and legal framework within which early warning systems operate.

The information collected by this questionnaire was relevant for the derivation of supply-side indicators for monitoring and evaluating progress of the early warning system. We have developed a set of ten supply side indicators. These indicators are as outlined below and discussed in the next chapter.

Indicator S1: Coverage of hazard maps, vulnerability maps and risk assessments

Indicator S2: Extent of knowledge of national standards for the systematic collection, sharing and assessment of vulnerability data
Indicator S3: The proportion of gauging stations that are fully operational

Indicator S4A: The proportion of automatic weather stations that are fully operational

Indicator S4B: The proportion of conventional weather stations that are fully operational

Indicator S5: The proportion of gauging stations that are fully operational

Indicator S6: awareness of existence of standard procedure for disseminating warnings
Indicator S7: Existence of feedback mechanism
Indicator S8: coverage of disaster preparedness and response plans
Indicator S9: Awareness of legislation or policy which provides a legal basis for implementing an early warning system.
Indicator S10: Proportion of Village Civil Protection Committees that are active.

2. Data Management and Quality Control

A hybrid mobile App was developed specifically for data collection in the survey to allow real time data collection and synchronization for improved data integrity and credibility. For each set of data collected (Per each questionnaire submitted), a time stamp and GPS coordinates was appended to the information being sent to the server and was used as a tool for monitoring the enumerators to avoid data forging. In order to reduce human error during data entry, the App was designed with an interactive interface that did not allow the enumerators to enter wrong information and provide them with feedback on what set or category of information is to be entered in a specific field. The App was tailor made for the project in such a way that all the designed questionnaires were inbuilt in its program to eliminate the need of software customization during data entry. This had the additional merit in that, the App reduced our carbon foot print as there was no use of papers which is in line with National Climate Change management policy to make every efforts in addressing climate change challenges facing the country. The current eversion of the App is 4.02.

3. Training of enumerators

There were 64 enumerators recruited for the survey. Initially, it was planned that these enumerators should undergo a three-day training from 26th October, 2016 to 28th October, 2016. However, a fourth day was added since the Tablets became available only in the afternoon of the third day of training. The schedule for the training is outlined in the Table 2.3 below.

Table 2.3: Schedule of activities during training of enumerators

DAY	ACTIVITY
ONE	1. General introduction to an Early Warning System, including its elements and its role in disaster risk reduction 2. Discussed the institutional questionnaire question-by-question
TWO	1. Discussed the household questionnaire question-by-question 2. Started translating the household questionnaire into Chichewa
THREE	1. finalised translating the household questionnaire into Chichewa

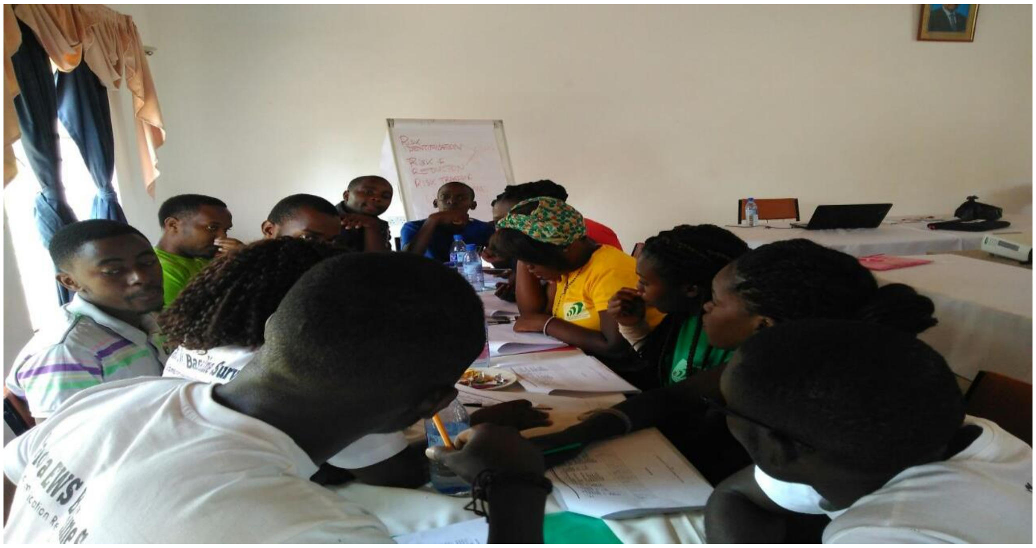
	2. Discussed Research ethics 3. Team composition and allocation
FOUR	1. Trained all enumerators on using the specially-designed App for data collection. (this App will be installed on all tablets before the training commences) 2. Trained supervisors on how use the App to check work done by their team.

Figure 2.2 below shows enumerators attentively listening to instructions during one of the sessions

Figure 2.2: Enumerators listening to instructions

The questionnaire was translated into Chichewa for easy administration. Figure 2.3 below shows enumerators in groups during translation activity.

Figure 2.3: One group of enumerators during translation activity.



4. Amount of data collected

Data collection commenced on 31st October, 2016 and was planned to finish on 15th November, 2016. However, due to problems outlined in the next section a three-day extension was sought by the Consultant and approved. Therefore data collection ended on the 19th November, 2016. The spatial distribution of the data collected as at 5:00 pm on 19th November, 2016 is shown in the Fig. 2.4 as captured from the Consultant's cloud platform (http://www.ecrg-ews.com/). It should be easily noticed that the geographical distribution reflects the national wide context of this baseline survey.

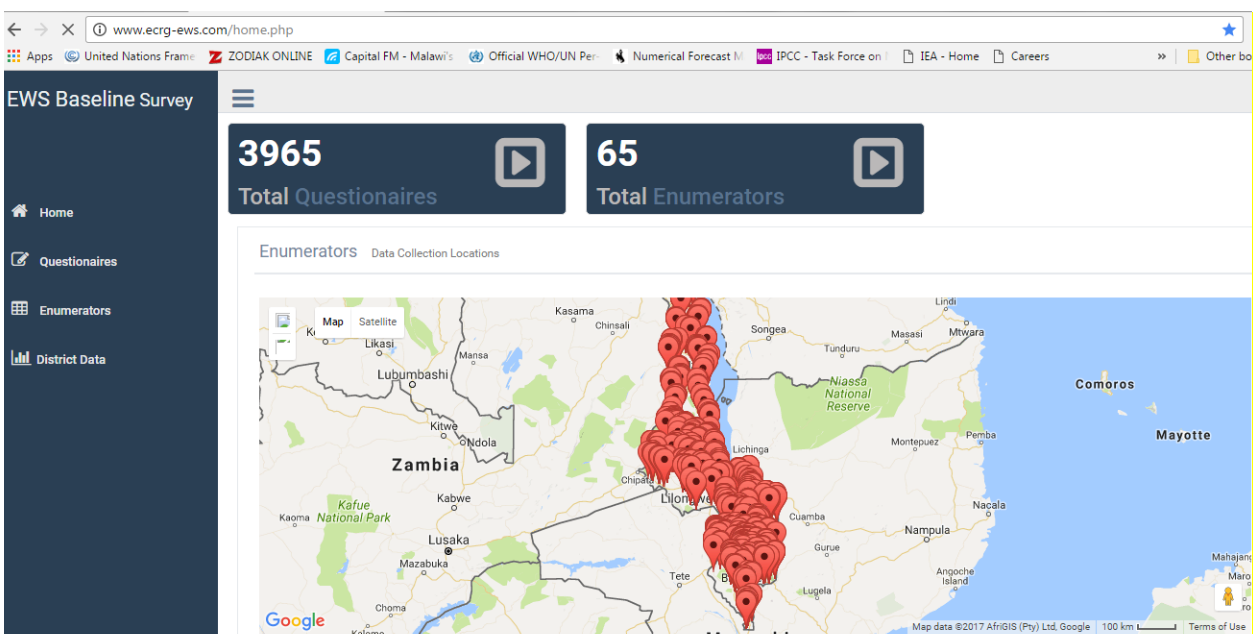


Fig. 2.4: Real-time capture of the data collection activity across Malawi; with footprint as per design.

In Fig. 2.4 the total number of successfully submitted questionnaires in the cloud server is 3,965. This number was updated in real-time as the data collection activity was being done. The total number of enumerators recruited in this national baseline survey was 64. However, a total number of 65 enumerators is recorded in Figure 2.4. This is due to the inclusion in the count by the Consultant expert managing the cloud service and assisting the enumerators with unsuccessful submission due to lack of competence or offline status due to non-existence of data networks or lost power condition on the tab. The Consultant was able to login to the remote device, access the saved questionnaires (given the household/institutional IDs and names) to recover and submit the same on behalf of the enumerator. This backup technical support was useful to encourage the confidence and performance of the data collectors in the field.

Table 2.4 shows the planned (target) versus the actual number of questionnaires administered by the close of the data collection activity. It shows that 3,870 household questionnaires were successfully submitted to the cloud server, against the target of 3,920. This represents a 99% completion rate for the household questionnaires. For the institutional questionnaires, a total of 95 were submitted against a target of116, represent a completion rate of 82%. This lower completion rate for the institutional questionnaire is attributable to the work-related travel away from office by some respondents during the survey period.

Table 2.4: Planned vs actual number of questionnaires submitted as of 5:00 pm on 19th November, 2016 (a day the activity was closed)

	Actual	**Target**	**Completion rate (%)**
Household questionnaires submitted	3,870	3,920	99
Institutional questionnaires submitted	95	116 (minimum of 4 per each of the 28 districts)	82
Total	**3,965**	**4,036**	

The information in Table 2.4 is further disaggregated by district to gauge performance by district as shown in Table 2.5.

Table 2.5: Planned vs actual number of questionnaires submitted by district

S/N	**District**	**Total Number of**	**Expected**	**Completion**

		Questionnaires	**Number based on EAs**	**rate (%)**
1	Balaka	116	140	83
2	Blantyre city	154	80	193
3	Blantyre non city	118	120	98
4	Chikwawa	106	140	76
5	Chiradzulu	166	120	138
6	Chitipa	75	120	63
7	Dedza	76	140	54
8	Dowa	100	120	83
9	Karonga	77	140	55
10	Kasungu	113	140	81
11	Lilongwe city	80	120	67
12	Lilongwe non city	193	140	138
13	Machinga	220	140	157
14	Mangochi	226	120	188
15	Mchinji	121	120	101
16	Mulanje	112	120	93
17	Mwanza	93	120	78
18	Mzimba	92	120	77
19	Mzuzu City	118	120	98
20	Neno	98	120	82
21	Nkhatabay	99	140	71
22	Nkhotakotay	146	140	104
23	Nsanje	117	140	84
24	Ntcheu	137	140	98
25	Ntchisi	255	120	213
26	Phalombe	88	140	63
27	Rumphi	70	140	50
28	Salima	135	140	96
29	Thyolo	115	120	96
30	Zomba city	56	80	70
31	Zomba non city	198	120	165
	HOUSEHOLD TOTAL =	**3870**	**3920**	**99**

5. Challenges encountered during data collection and remedial actions taken

The challenges faced in the course of data collection were largely logistical, technical and statistical.

a. Logistical

Untimely procurement of the Tablets and inadequate numbers of the same (48 procured against 64 required). The Consultant planned that the Tablets be made available before the training commenced. This was not the case as GoM experienced challenges in procuring the Tablets in time. This affected the training in use of the Hybrid App for all numerators. The training on the App would have provided an opportunity to the Consultant to identify and sort out any technical issues with the App as explained in the technical challenges below.

b. Technical

Timely procurement of the tabs was mandatory to allow the Consultant to build, install and test-run the developed App before the training of enumerators. This would have allowed the consultant to assess the stability of the App versions (from ver1.0 to the current stable ver. 4.02). Due to procurement hiccups, the Tablets were only made available on the last day of the training. This meant that it was difficult to run all the appropriate tests regarding stability of the App. As a result of unstable version at the beginning of the data collection, enumerators faced a lot of challenges in sending of the data and this delayed data collection. As such the consultant worked so hard day and night to sort out all issues while data was being collected. The Consultant made every effort to make up for 75% tabs availability and lost time in days but hasn't been able to fully make up for it.

This problem of inadequate tablets acute in the following districts; Mangochi, Machinga (Team J); Machinga, Zomba City/Rural; Chiradzulu, Thyolo (Team L) as shown in Table 2.6.

Table 2.6: Deficit of Tablets among teams

	Team Name	District	Expected number of Tabs	Actual number of Tabs	Deficit
1	A	Chitipa and Karonga	4	4	0
2	B	Rumphi and Mzimba	4	3	1
3	C	Mzuzu city and Nkhatabay	4	4	0
4	D	Nkhotakota and Salima	4	4	0
5	E	Dedza and Salima	4	4	0
6	F	Ntcheu and Balaka	4	3	1
7	G	Lilongwe (city and non-City)	4	3	1

8	H	Kasungu and Ntcheu	4	3	1
9	I	Mchinji and Dowa	4	3	1
10	J	Mangochi and Machinga	4	2	2
11	K	Machinga and Zomba	4	1	3
12	L	Chiradzulu and Thyolo	4	1	3
13	M	Mwanza and Neno	4	3	1
14	N	Phalombe and Mulanje	4	3	1
15	P	Nsanje and Chikwawa	4	4	0
16	Q	Blantyre and Chikwawa	4	3	1
		TOTAL	64	48	16

c. Statistical

Two statistical concerns arose due to this inability to reach the targeted sample size. Firstly was the fear increased sampling error. Sampling errors negatively related to the sample size. Specifically, sampling errors are inversely proportional to the square root of the sample size and is calculated as in equation (1).

$$SE = \sqrt{\sum_{h=1}^{H} \frac{n_h(1-f_h)}{n_h - 1} \sum_{i=1}^{n_h} (e_{hi} - \bar{e}_h)^2} \qquad (1)$$

Where f is the overall sampling proportion, n_h is the sample size for stratum h and e_{hi} is the weighted value of the variable y in the i^{th} cluster in the h^{th} stratum.

Equation (1) shows that with a smaller sample size, sampling error increases. This in turn means that the data from the sample may be less representative than expected. However, the distribution of this problem would not uniform across all regions. As may be noted from Table 2.3, all the teams worst hit by inadequacy of Tablets were from the southern region. This pattern has arisen since the Consultant had thought the shortfall in the number of Tablets would be sorted out in first two days of data collection. Since these teams are closest to the base of the Consultant, it was decided they should be given few tabs, since these teams would be economically efficient to reach once the Tablets were in. however, the additional Tablets were procured, making the southern region to be disproportionately under-represented when compared with the other regions, and this would lead to sampling errors in the region. This was of critical concern given that this was a baseline survey.

Further, since the sample was powered at 95% confidence, lower sample size means a lower confidence coefficient. In turn, this will likely raise the Type I error in conducting inferential analysis (hypothesis test).

d. Remedial actions

It was proposed by the consultant that the data collection period be extended by three days to allow to adequate data to be collected in the districts worst affected by inadequacy of Tablets. The proposal was approved and indeed, additional data was collected in the affected district.

E. APPROACH TO DATA ANALYSIS

When data collection was completed, it was cleaned (as scheduled soon after the data collection activity). Data cleaning was necessary to take care of the possible human error that may come with which the App could not pick up. Data cleaning enhanced the credibility of analyses since such data now purely reflected the underlying data generation process. The data was retrieved from the MySQL database into excel for easy editing. Then, data cleaning was done by the team leaders of the enumerators under the instruction and supervision of the Consultant. The cleaning process was done using STATA statistical package. This process took a maximum of five days. After data cleaning, all analyses were conducted in a STATA environment. The analyses shall were descriptive and inferential. Descriptive analysis involved computing frequencies and percentages of indicators of interest. Cross- tabulation of some variables was also undertaken to show an association between these variables. Further, comparisons were made for these indicators by type of weather-related natural hazard, region, and district.

Inferential analysis took the form of regression analysis and simple hypothesis testing regarding differences in means. This inferential analysis was used to ascertain impact of availability of and access to climate/weather information on welfare (households' livelihoods) and model the determinants of demand for in light of climate change.

F. WORK PLAN

The Table 2.7 below shows the activities that have been carried out so far and those which remain outstanding for the Consultant to work on with support of the EWS Project Technical Committee.

Table 2.7: Work Plan

	Activity	**Time Period** *(weeks)*									
		1st	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**	**10th**
1	Inception report writing										
3	Formulating data collection tools										
4	Conduct a three-day orientation training to all enumerators and supervisors										
5	Data collection in 28 districts Co-supervising administering of questionnaires										
6	Cleaning of data										
7	Analysing of data										
8	Report writing and submission of final report. Present the final report at a stakeholders' validation workshop										
9	Submission of report										

Legend: All the scheduled work has been carried out.

CHAPTER THREE

RESULTS AND DISCUSSION

A. INTRODUCTION

The chapter presents results based on the analysis of data collected in the 2016 national EWS baseline survey. The chapter is divided into four sections. The first section presents EWS indicators from both the demand side (using data collected from households) and the supply side (using data collected from various institutions). There are ten indicators on the demand side and another ten on the supply side whose presentation is organised around elements of the early warning system framework. For each indicator, we report the current state of performance. The key findings on demand side indicators show weak performance on all elements, with exception to the communication and dissemination results. The second section deals with effects of weather-related natural hazards on households' welfare. The third section assesses the effectiveness of the EWS in Malawi. The final section models demand for EWS.

B. EWS INDICATORS

Objective number 5 of the assignment was to produce a set of indicators for Early Warning System, which would act as a benchmark against which interventions can be checked. EWS indicators that have been developed are grouped into two subsections. The first subsection (sub section 1) deals with demand side indicators while the second subsection (sub section 2) deals with supply side indicators.

1. DEMAND SIDE INDICATORS

Demand side indicators relate to the end users of the services provided by the Early warning system. These end users are households and communities. On the demand side, we have developed the following set of ten indicators as outlined below. We organise these indicators around the main elements of the early warning system framework. For each indicator, we present results at national level. To gain more insights, we also present results after data were disaggregated. Disaggregation is done by region, district and weather-related natural hazard to help the Malawi Government get value of survey information for geographical targeting interventions. Summary findings of these demand side indicators are presented in Box 3.1 below.

Box 3.1: Summary findings of demand side indicators

Indicator	Description	Current performance (%)
D1	Proportion of households aware of existence of hazard maps, vulnerability maps and risk assessments	16.42
D2	Extent of community participation in risk assessments	29.76
D3	Proportion of communities involved in monitoring and warning service	19.47
D4	Percentage of population with access to improved climate information and warnings	42.74
D5	Proportion of the population which get warnings in time	83.37
D6	Percentage of population which understand forecasts and warnings	97.53
D7	Percentage of population which trust forecasts and warnings	94.82
D8	Percentage of communities which are involved in communication and dissemination	42.10
D9	Awareness of the availability of disaster preparedness plans and contingency plans for weather-related natural hazards.	20.66
D10	Extent of community involvement in preparation of disaster preparedness plans and contingency plans for weather-related natural hazards.	89.95

a. RISK KNOWLEDGE

i. Indicator D1: Proportion of households aware of existence of hazard maps, vulnerability maps and risk assessments

Rationale

Key to the success of an Early Warning System is a sound understanding of the risks faced by households and communities, both spatially and inter-temporarily. Risk assessments and maps help to motivate people, prioritise early warning system needs and guide preparations for disaster prevention and responses (UN/ISDR. 2006). The NDRMP recognises risks assessment as the first step towards reducing disaster risks. Accordingly, both the HFA and NDRMP underscores the need for risk assessments. The Hyogo

Framework of Action under priority number 2 (Identify, assess and monitor disaster risks and enhance early warning) require that countries conduct risk assessment both at national and local level. Specifically, it requires that countries develop, update periodically and widely disseminate risk maps and related information to decision-makers, the general public and communities at risk in an appropriate format. The NDRMP, under objective (ii) and policy priority area (ii), calls for the establishment of a system for effectively identifying, assessing, monitoring and mapping disaster risks at all levels. The system must have the capacity to track hazards, monitor, regularly update, document and disseminate disaster risk assessment information and also to develop integrated risk maps to identify areas and communities at risk (GoM, 2015). This indicator sought to determine the Proportion of households aware of existence of such hazard maps, vulnerability maps and risk assessments

National Level

Table 3.1 below shows the proportion of respondents at national level who knew of the existence of hazard maps, vulnerability maps and risk assessments for those hazards prevalent in their area.

Table 3.1: Awareness of existence of hazard maps, vulnerability maps and risk assessments

	YES (%)	**NO (%)**	**DON'T KNOW (%)**	**TOTAL (%)**
Hazard maps	9.28	72.17	18.55	100
Vulnerability maps	14.53	67.07	18.44	100
Risk assessments	16.42	63.66	19.92	100

Key finding: On average, the proportion of the Malawi national population aware of the existence of hazard maps is 9.28%, while that for vulnerability maps and risk assessments are at 14.53% and 16.42% respectively.

As Table 3.1 above shows the awareness levels are very low ranging from 9% to 16%. Clearly, this is a worrisome situation since the performance of the EWS rests on sound risk knowledge by those households and communities at risk. Several factors have contributed to this state of affairs. Firstly, and as recognised in the NDRMP, Malawi does not currently have a system for identifying, assessing, monitoring and mapping disaster risks (GoM, 2015). As a result, where risk assessments have been conducted, they have not been comprehensive and standardised. Secondly, the use of GIS in DRM is still limited. Thirdly, it is highly likely that institutions that have attempted to generate these risk maps are not doing enough to make the information on risk available to those who need it. It is therefore necessary to put in place a system for risk assessment and mapping, improve the use of GIS in DRM and ensuring that that information relating to risk assessments seamlessly flows to the end users.

Disaggregation by Hazard, Region and District Levels.

The statistics presented above are informative at the national level. However, they mask important differences regarding the variation in the level of risk knowledge across hazards, regions and districts. The data was therefore disaggregated and analysed along the aforementioned dimensions.

Table 3.2 below shows awareness of risk assessments by hazard while the subsequent tables show awareness levels by region and district.

Table 3.2: Awareness of risk assessments by hazard type

HAZARD TYPE	YES (%)	NO (%)	DON'T KNOW (%)	TOTAL (%)
Drought/erratic rains	15.1	63.64	21.26	100
Floods/flash floods	21.72	60.65	17.63	100
Earthquakes/earth tremor	16.14	52.36	31.5	100
Storm surge/ mwera winds	14.49	64.65	20.87	100
Hailstorm	11.92	70.39	17.69	100
Thunderstorm/lightening	12.37	68.55	19.09	100
Locust swarm	26.23	42.62	31.15	100
Other (specify)	16.46	63.66	19.88	100

It is very clear from Table 3.2 that there is great variation in awareness of risk assessments by hazards. It is highest for locust swarm at 26.23% and lowest for hailstorm at 11.92%. Awareness levels for droughts and floods are at 15.1% and 21.72% respectively. Therefore, while all weather-related natural hazards require attention in terms of improving awareness of risk assessment activities, more effort has to be placed on hailstorms, droughts and floods

The information is summarised graphically in Figure 3.1 below in order to give a quick glance of the variations from lowest to highest.

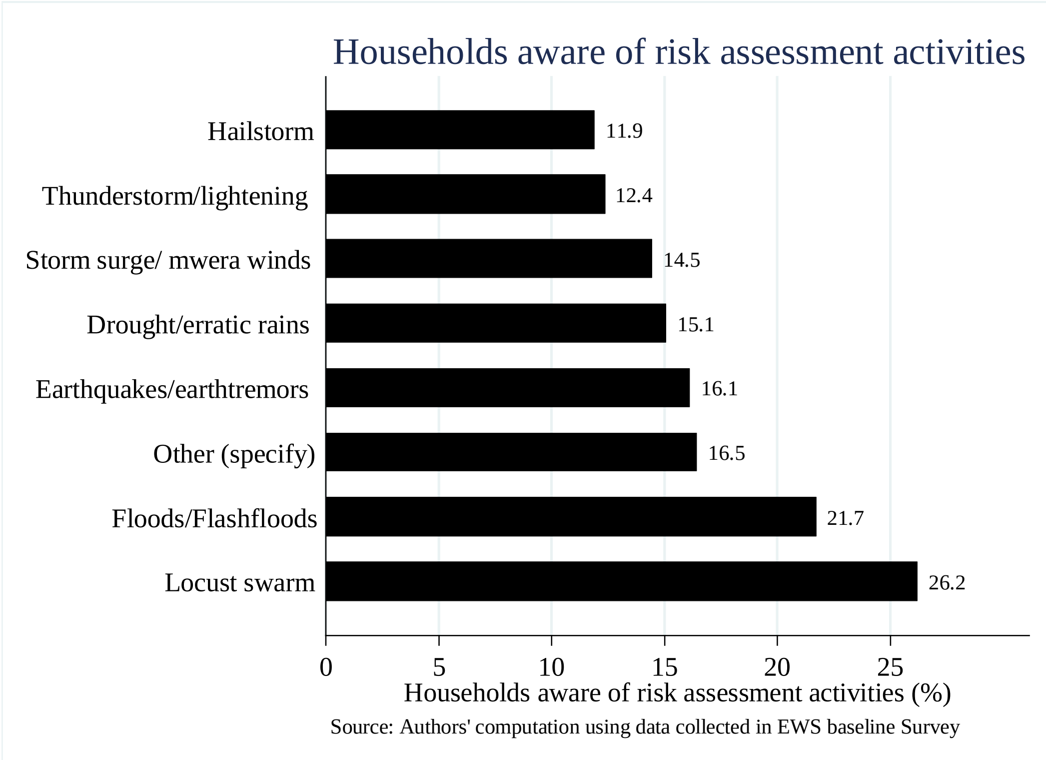


Figure 3.1: Awareness of risk assessment by hazard type.

Similar to Table 3.2, Table 3.3 below show considerable variability in awareness levels across region. It is highest for the Northern region at 23.64%, followed by Southern region at 18.28% and Central region at 9.2%.

Table 3.3: Awareness of risk assessments by Region

	YES (%)	**NO (%)**	**DON'T KNOW (%)**	**TOTAL (%)**
Northern region	23.64	55.92	20.44	100
Central region	9.2	71.71	19.09	100
Southern region	18.28	60.39	21.33	100

The information in Table 3.3 is summarised graphically in Figure 3.2 below in order to give a quick glance of the variations from lowest to highest.

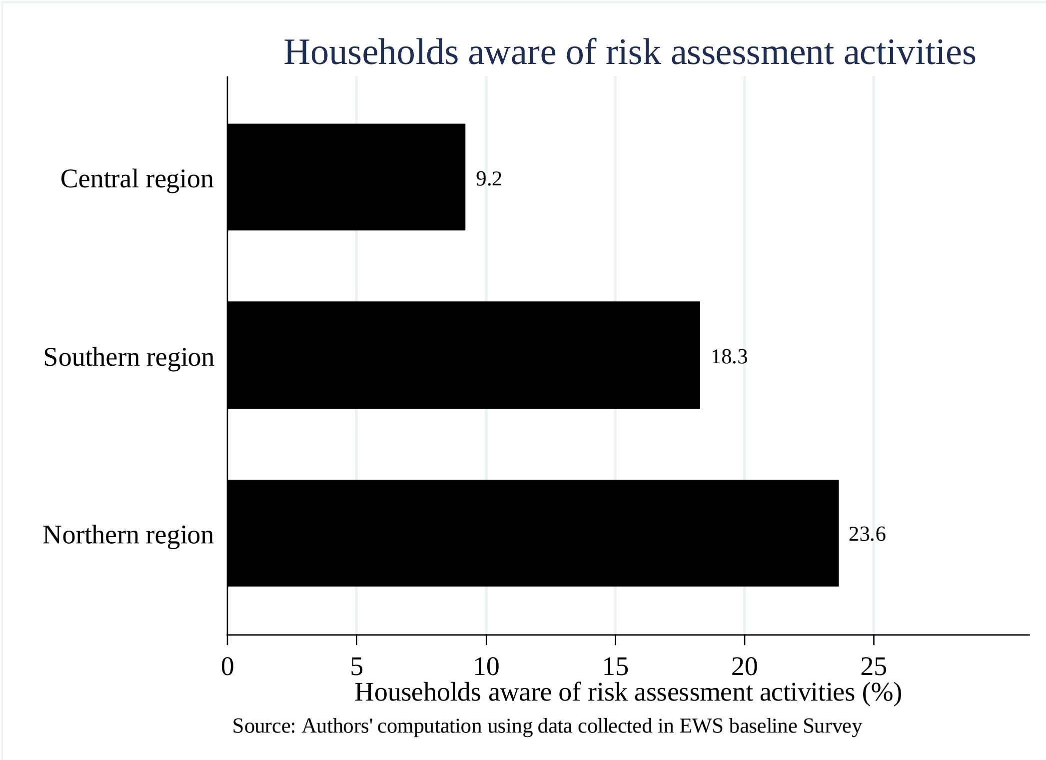


Figure 3.2: Awareness of risk assessment by region.

The differences in the awareness were tested to ascertain whether they are superficial or real. We used the t-test under the assumption that the different regions have equal variance. The null hypothesis was that there is no difference in the mean awareness levels across the regions. That is, $H_0 : \text{diff} = \text{mean(region 1)} - \text{mean(region 2)} = 0$. Table 3.4 presents the results.

Table 3.4: Two sample t test of equality of awareness levels risk assessments

Region 1	**Region 2**	**p-value**		
		H1: diff!=0	**H1: diff>0**	**H1: diff<0**
South(0.2364)[1]	**Centre (0.0920)**	0.000	0.000	1.000
South(0.2364)	**North(0.1828)**	0.000	0.000	1.000
Centre (0.0920)	**North(0.1828)**	0.000	1.000	0.000

Note: [1]Means in parentheses.

These results show that mean awareness level for the Southern region is significantly higher than that of the Central and Northern region. Further mean awareness level for the Northern region is significantly higher than that of the Central region. This result may reflect low levels of presence of institutions (including NGOs) at the grassroots levels in the central region. Therefore, while there is general need for increased presence of institutions at the grassroots and intensified awareness campaigns across all region, the need is particularly dire in the Central region.

Figure 3.3 below further disaggregates the variation in awareness of risk assessment activities by districts. This disaggregation is useful for geographical target interventions. The Graph of Figure 3 shows that particular focus for intervention must be Dowa, Ntchisi, Mwanza, Ntcheu, Mchinji, Thyolo, Lilongwe (City and non-City) and Neno whose level of aware is below 10%.

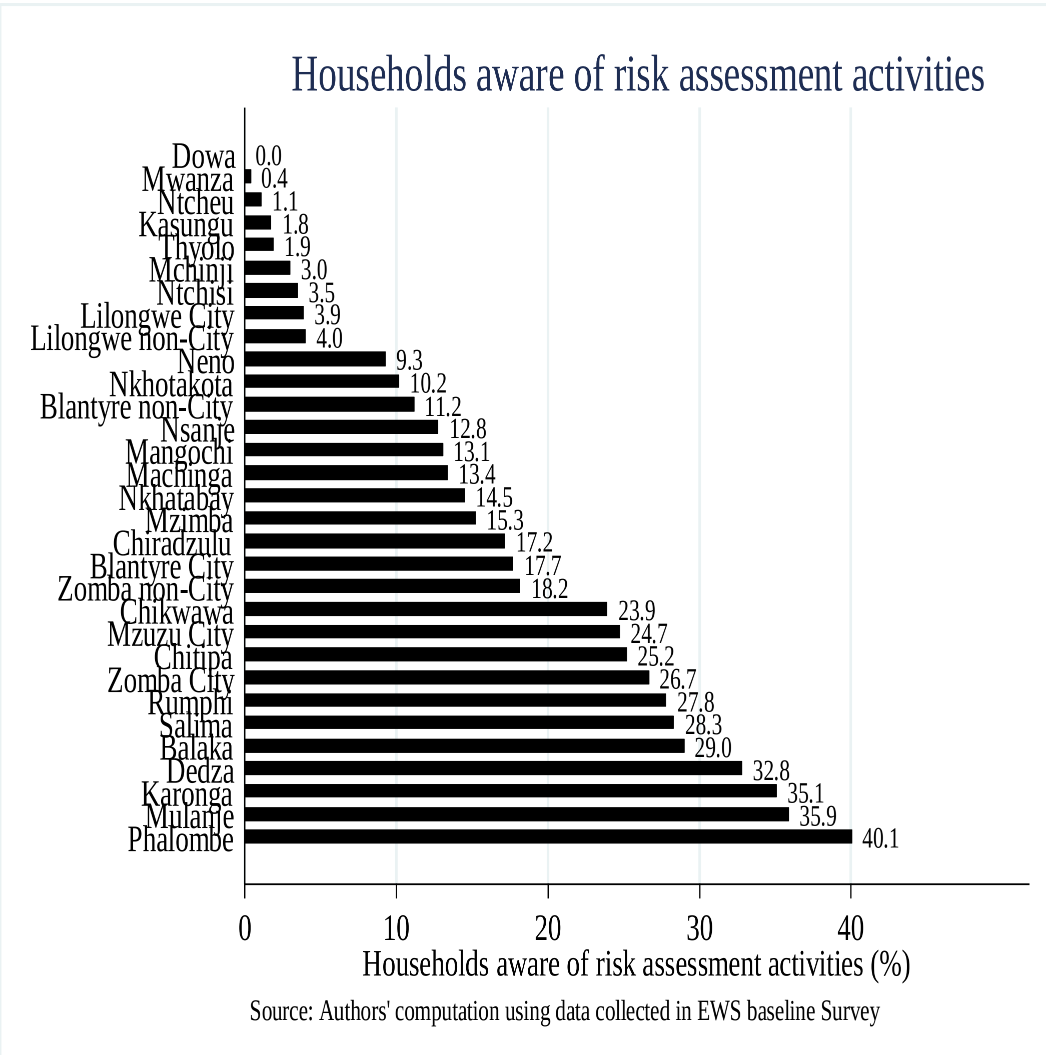


Figure 3.3: Awareness of risk assessment by district.

ii. Indicator D2: Extent of community participation in risk assessments

Rationale

For any EWS to be effective, it must be people centred. That is, communities at risk must be involved at every stage in the EWS chain. This reduces the possibility of injury and loss of lives and livelihoods, and enables them to take measures to limit damage to property and the environment (GoM, NDRMP, 2015). Without the involvement of local authorities and communities at risk, government interventions and responses to hazard events are likely to be inadequate. A local, 'bottom-up' approach to early warning, with the active participation of local communities, can contribute to the reduction of vulnerability (UN/ISDR, 2006). The Hyogo Framework of Action under priority number 2 (Identify, assess and monitor disaster risks and enhance early warning) require that countries develop early warning systems that are people-centred. This is also stipulated in the NDRMP, under objective (iii) and policy priority area (iii). This indicator sought to determine the extent of community participation in risk assessments

National level

Table 3.5 below shows the extent to which communities are involved in risk assessment activities. From Table 3.5, only 4.16% of the respondents acknowledged that their communities are always involved in risk assessments. The proportion is even lower for the almost always (most times) involvement at 3.26%. Adopting a broad definition involvement to include all-time involvement, most-time involvement and some-time involvement, then the proportion of communities involved in risk assessments is 29.76%. The vast majority, accounting for more than 70%, reported of their communities either never being involved or not being sure of such involvement.

Table 3.5: Community involvement in risk assessment activities

	Proportion
Always	4.16
Most times	3.26
Sometimes	22.34
Never	50.59
Don't know	19.66
TOTAL	100

Key finding: On average, only 29.76% of communities are involved in risk assessment activities

This result shows that the *EWS is not really people or community-centred with regard to risk knowledge. Possibly the approach has been top down with greater than 70% being an imposition on the communities. This approach often creates challenges in that it lacks practice by the communities due to lack of knowledge, understanding or interest in the matter. Therefore, creative, innovative, exciting, sustainable participatory approaches are desired in this area.*

This result, that communities are not involved in risk assessment activities, contributes to the situation of low levels of risk knowledge observed under indicator D1. It partly explains the findings of an earlier that which established that a high proportion of the population do not fully understand the causes of such natural hazards as floods and droughts (DoDMA, 2015). It is therefore important that in the design of the system for identifying, assessing, monitoring and mapping disaster risks as proposed under indicator D1, deliberate effort be made to make it people-centred by encouraging participation of communities at risk.

Disaggregation by Hazard, Region and district

Table 3.6 below shows the level of involvement by hazard. Broadly defined, communities are more involved in risk assessment activities related to floods (39.98%), locust swarm (38.33%) and droughts (29.07%). It very limited for intense weather condition such as thunderstorm/lightening and earthquakes.

Table 3.6: Level of involvement in risk assessment activities by hazard type

Hazard type	Always (%)	Most times (%)	Some times (%)	Never (%)	Don't know (%)	Total (%)
Drought/erratic rains	5.1	3.19	20.78	51.45	19.48	100
Floods/Flash floods	4.36	5.35	30.27	43.39	16.62	100
Earthquakes/earth-tremor	0.81	2.82	13.31	39.52	43.55	100
Storm surge/ Mwera winds	0.77	2.54	23.46	49.73	23.51	100
Hailstorm	5.93	2.54	13.06	58.89	19.59	100
Thunderstorm/lightening	1.06	3.45	13	62.07	20.42	100
Locust swarm	6.67	3.33	28.33	31.67	30	100
Other (specify)	7.07	0.92	27.52	54.43	10.09	100

Results for disaggregation by regions are shown in Table 3.7 below. The Southern region ranks highest in community involvement (36.51%) followed by Northern region (28.04%) while Central region lags behind (20.04%).

Table 3.7: Level of involvement in risk assessment activities by region

	Always (%)	Most times (%)	Some times (%)	Never (%)	Don't know (%)	Total (%)
Northern region	6.12	4.02	17.9	45.71	26.24	100
Central region	2.69	2.27	15.08	58.38	21.58	100
Southern region	4.1	3.9	28.51	46.04	17.45	100

At the district level, the variations in the levels of involvement are shown in Figure 3.4 below. The figure shows that Kasungu, Mwanza, Mchinji, Lilongwe (City and non-City), Ntchisi, Dowa, Machinga, Balntyre non-City and Thyolo have the lowest involvement levels.

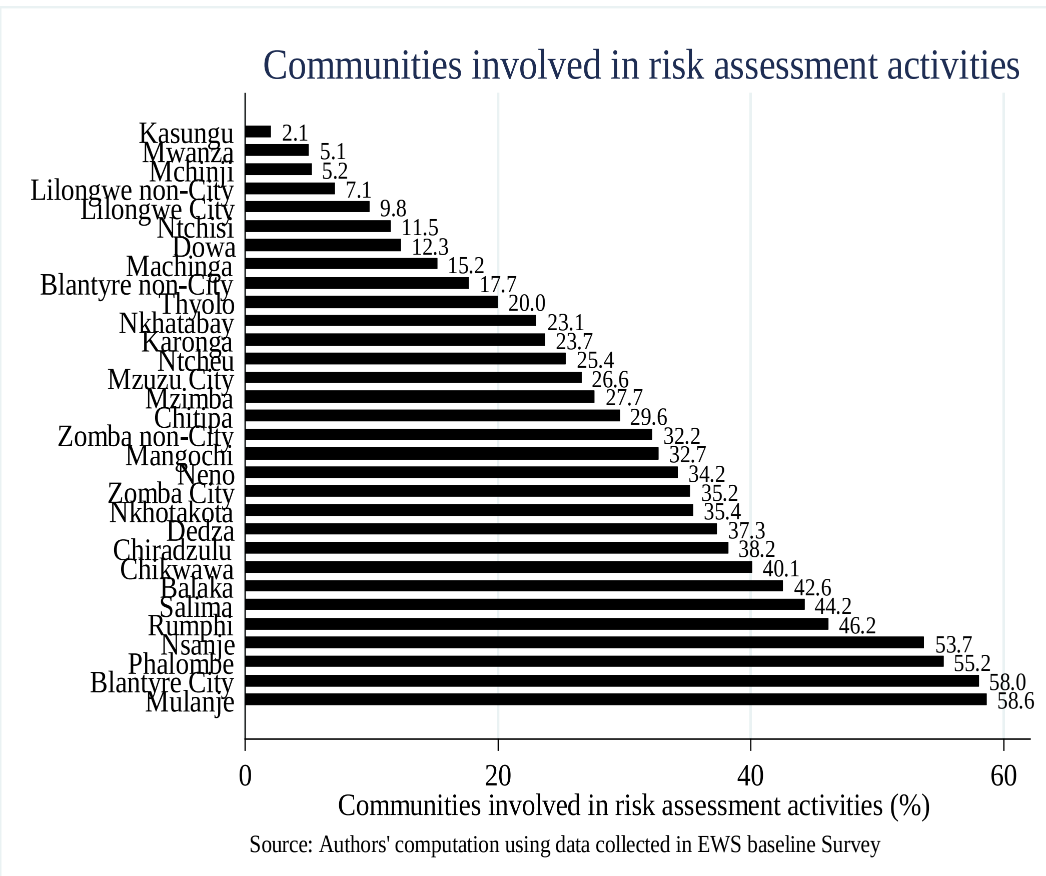


Figure 3.4: District level variations in the levels of involvement in risk assessment.

Note has to be taken that even though most of the households are not aware of risk assessment activities, the survey revealed that they are fairly knowledgeable about factors which increase their risk to the various and can sensibly rank important risk factors for various hazards.

b. MONITORING AND WARNING SERVICE

iii. Indicator D3: Proportion of communities involved in monitoring and warning service

Rationale

Monitoring of parameters associated with occurrence of weather-related natural hazards is a central element of any EWS. Involvement of local communities in this process enables communities to predict such occurrences. It also makes communication of early warnings easy and timely. This indicator aims to determine the proportion of communities involved in monitoring and warning service

National Level

Regarding involvement of communities in monitoring parameters associated with occurrence of weather-related natural hazards, 2.68% of the respondents acknowledged that their communities are always involved, 2.78% reported involvement most times and 14.01% involvement sometimes. This means that, even allowing for a broad definition of involvement (to include sometime-involvement and most-time involvement in addition to all-time involved), only 19.47% of the population is involved. More than 80% of the population is either never involved (61.13%) or don't know if there is such involvement (19.39%).

Key finding: On average, only 19.47% of the population (communities) is involved in monitoring of parameters associated with occurrence of weather-related natural hazards. This shows a greater need for community based monitoring systems

Such a finding shows lack of people-centredness of the EWS with respect to monitoring and warning service. As noted earlier, lack of people-centric approach may render efforts to reduce disaster risk ineffective. Of necessity, it underscores the need for greater participation. This results also points to the need for community based monitoring systems. It is noteworthy that even though involvement in monitoring using conventional scientific equipment is minimal, communities considerably rely on the use of indigenous knowledge for monitoring and predicting occurrence of weather-related natural hazards. This accounts for approximately 39% of communities use indigenous knowledge: 4.9% always, 8.76% most times and 25.07% some times. These community based monitoring system can be used to complement the traditional system, hence yielding synergies.

Disaggregation by Hazard, Region and District Levels

As was the case with risk knowledge, we also analysed data for monitoring and warning service at disaggregated levels. We disaggregated data in a similar fashion: by hazard, region and district.

Table 3.8 shows the results by Hazard. It shows a consistent pattern across all hazards. All-time and most-time involvement is very minimal relative to some-time involvement. The majority of the population is never involved.

Table 3.8: Community involvement in Monitoring and Warning service by hazard type

	Always (%)	Most times (%)	Some times (%)	Never (%)	Don't know (%)	Total (%)
Drought/erratic rains	3.79	2.78	14.22	60	19.2	100
Floods/Flashfloods	2.55	3.52	18.04	56.84	19.05	100
Earthquakes/Earth tremour	2.78	2.38	8.73	43.25	42.86	100
Storm surge/wera winds	0.52	3.2	13.78	64.5	18.01	100
Hailstorm	3.96	1.61	7.91	71.08	15.45	100
Thunderstorm/lightening	0.55	1.11	5.82	69.25	23.27	100
Locust swarm	8.2	3.28	16.39	50.82	21.31	100
Other (specify)	0	0	12.07	67.49	20.43	100

Table 3.9 shows results when disaggregated by regions. Using the broad definition of involvement, the region with the highest level of involvement is Southern region (24.14%) followed by Northern region (17.8%) and is lowest in the Central region (12.9%).

Table 3.9: Community involvement in Monitoring and Warning service by region

	Always (%)	Most times (%)	Some times (%)	Never (%)	Don't know (%)	Total (%)
Northern region	6.07	3.87	7.86	51.55	30.65	100
Central region	1.81	2.76	8.33	68.08	19.02	100
Southern region	2.29	2.67	19.18	59.19	16.67	100

Results from disaggregation by district are shown in Figure 3.5 below. The worst performing districts in this regard include: Lilongwe (City and non-City), Kasungu, Mwanza, Mchinji, Ntchisi, Dowa and Mzimba. Worst is defined by having involvement level below 10%.

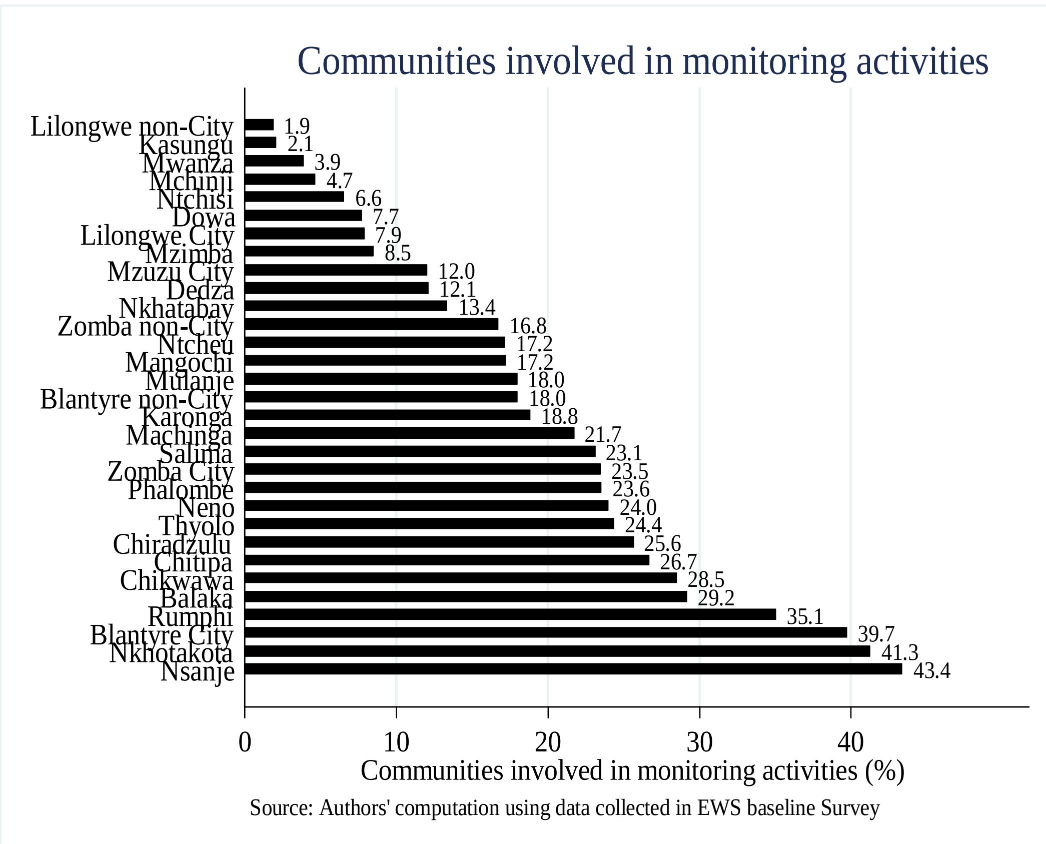


Figure 3.5: Community involvement in Monitoring and Warning service by district

c. COMMUNICATION AND DISSEMINATION

iv. Indicator D4: Percentage of population with access to improved climate information and warnings

Rationale

More than just generating the warnings, ensuring that these warnings reach the communities to be affected by weather-related natural hazards is critical. Receiving warnings is a necessary condition for reducing loss of lives and property. The HFA, under priority area 2, calls on countries to develop communication and dissemination systems to ensure people and communities are warned in advance of impending weather-related natural hazard events (UN/ISDR, 2006). This indicator sought to determine the percentage of population with access to improved climate information and warnings.

National level

Less than half of the respondents reported to have received warning prior to occurrence of weather-related natural hazards. Specifically, 42.74% received the warning while 57.26% did not.

Key finding: On average, only 42.74% of the population receives warnings prior to occurrence of weather related hazards.

This result, that only 42.74% population receives warning, shows that there is a serious shortcoming in terms communicating and disseminating warnings in the EWS chain. The NDRMP recognises that dissemination of early warning information to communities is a challenge (GoM, 2015). This is not very surprising since the existing EWS structures are fragmented and not well coordinated. With only less than half of the population able to receive warnings, effective reduction of loss and damage due to weather-related natural hazards is hampered. There is therefore need to develop and strengthen a comprehensive and integrated EWS with clear strategies for increasing coverage of those warned of impending hazards. This is crucial to minimises damage and loss of property and life

In thinking about strategies for effective communication and dissemination of warning, it is worth to note that of those who did not receive warnings, the most commonly cited reason for not receiving the warning was not having radio. Second in ranking to not having a radio, a lot of people are not aware of how warnings are communicated. This means that in order to increase the proportion of the population reached with warning, use of radio broadcasting is effective and could be implemented through the broadband linking of community radios to District Climate Information Centers (DCICs) which electronically exist in the same cloud online with the Department of Climate Change and Meteorological Services (DCCMS) servers. This cloud co-existence enables real-time weather and climate data offloading at the community radio broadcasting network in the on-air studios to allow for community level broadcasting of regular and mission critical weather information.

Some of the respondents indicated even though they had radios, they could not always power them. Therefore, considerations for consistent supply of power need to be made for the radios to be power always. However, this is a broader problem which required concerted efforts with other stakeholders outside the EWS.

Further, it is also important to increase awareness campaigns on media channels through which warnings are communicated.

Disaggregation by Hazard, Region and District

The proportion of households that received the warnings varies by hazards, region and district. Table 3.10 below shows the proportion of people that received warnings by hazards.

Table 3.10: Proportion of people that receive warnings by hazard type

Hazard type	YES (%)	NO (%)	TOTAL (%)
Drought/erratic rains	44.87	55.13	100
Floods/Flash floods	43.94	56.06	100
Earthquakes/earth tremor	24.26	75.74	100
Storm surge/mwera winds	41.98	58.02	100
Hailstorm	35.36	64.64	100
Thunderstorm/lightening	27.65	72.35	100
Locust swarm	16	84	100
Other (specify)	47.22	52.78	100

Table 3.10 shows that the proportion is lowest for locust swarm at 16%. The respective proportions for droughts and floods stand at 44.87% and 43.94% respectively. It is noteworthy that locust swarm which had best performance in terms of community's awareness of risk assessment activities has the lowest performance in terms of people

that received warnings about the same. This points to strength in the risk assessment element and weakness in the communication chain for this hazard

Table 3.11 below shows the proportion of people that received warnings by region.

Table 3.11: Proportion of people that receive warnings by region

	YES (%)	**NO (%)**	**TOTAL (%)**
Northern region	42.28	57.72	100
Central region	38.96	61.04	100
Southern region	44.52	55.48	100

Table 3.11 shows that 44.52% of households in the Southern region received warnings prior to weather-related natural hazards happening. The corresponding proportions for the Central and Northern region are 38.96% and 42.28% respectively.

Figure 3.6 below shows the proportion of people that received warnings by districts. It shows that the districts with lowest proportion of households the receive warnings are Kasungu, Nsanje, Ntcheu, Rumphi, Chikwawa, Mwanza, Karonga and Chitipa.

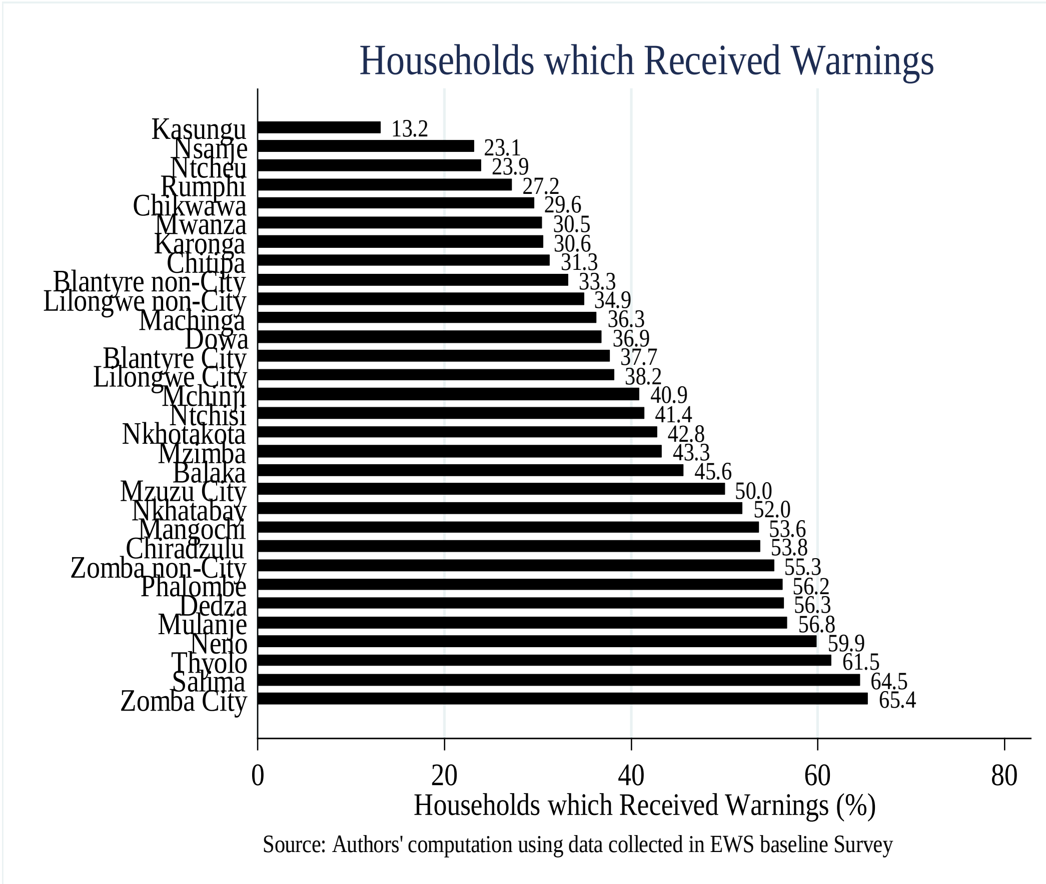


Figure 3.6: Proportion of people that receive warnings by district

For those who received the warning, the most used channel is radio. Table 3.12 below shows the media channels through which households receive warning.

Table 3.12: Media channels through which households receive warning

	Radio	**Television**	**Internet**	**Newspaper**	**TOTAL**
Northern region	97.3	2.07	0.48	0.16	100
Central region	98.32	0.65	0.09	0.93	100
Southern region	99.49	0.1	0.41	0	100

v. Indicator D5: Proportion of the population which get warnings in time

Rationale

Receiving warnings is a necessary but not sufficient condition to reduce damage and loss caused by a weather-related natural hazard. One of the sufficient conditions is timeliness with which the warnings are received. The NDRMP recognises that effective disaster response requires that communities and households at risk have access to timely and meaningful early warning information that enables them to act timely and appropriately (GoM, 2015). This indicator sought to gauge the proportion of the population which get warnings in time

National level

A warning is considered timely if the recipient receives the warning with adequate lead time to take appropriate action. Using this definition, 83.37% of those who receive warnings, receive them in time while 16.13% do not receive them in time as shown in Table 3.13. This is good. However all efforts must be made to ensure every household gets the warnings in good time.

Key finding: On average 83.37% of the households that do receive warnings receive them with adequate lead time.

The results shows that even though the proportion that receive warning is relatively small asper indicator D4, for those communities that receive the warnings, there is an above average performance in terms of timeliness with which those warnings are received to allow for execution of appropriate action. This is encouraging as it increases the likelihood of minimising loss and damage. However, there is target should be that the messages reach every recipient in time. That is, the proportion of communities that receive warnings with adequate lead time should increase to 100%.

Disaggregation by Hazard, region and district

Table 3.13 below shows the proportion of the population which receive warning on time by hazard type. With the exception of earthquakes/earth tremors, the pattern is consistent across hazards in the sense that more than 80% of the population that receive warnings, do so in good time.

Table 3.13: Proportion of the population which receive warning on time by hazard type

Hazard type	**YES (%)**	**NO (%)**	**TOTAL (%)**
Drought/erratic rains	83.41	16.59	100
Floods/Flash floods	83.45	16.55	100

Earthquakes/earth tremor	62.5	37.5	100
Storm surge/ mwera winds	86.27	13.73	100
Hailstorm	85.78	14.22	100
Thunderstorm/lightening	80.28	19.72	100
Locust swarm	66.67	33.33	100
Other (specify)	84.41	15.59	100

Regional variations are shown in Table 3.14 below. The Northern regions performs relatively badly when compared with the central and southern region.

Table 3.14: Proportion of the population which receive warning on time by region

	YES (%)	**NO (%)**	**TOTAL (%)**
Northern region	64.98	35.02	100
Central region	86.4	13.6	100
Southern region	86.52	13.48	100

We further disaggregate by district, the results of which are shown in Figure 3.7 below. Districts with the lowest proportion of households which receive warnings in good time are Kasungu, Mzimba, Chitipa, Nkhatabay, Nsanje, Rumphi, Mchinji and Lilongwe (City and non-City). In all these aforementioned districts, the proportion of households receiving warnings on time is less than 70%.

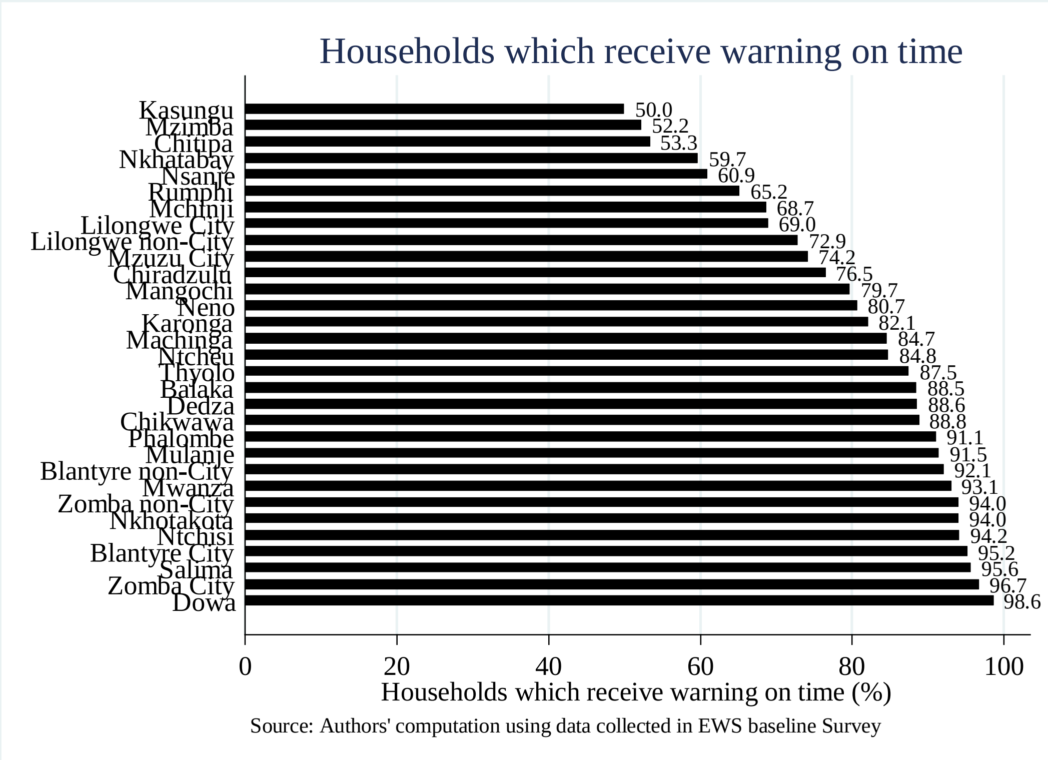


Figure 3.7: Proportion of the population which receive warning on time by district

vi. Indicator D6: Percentage of population which understand forecasts and warnings

Rationale

In addition to receiving warnings with adequate lead time, the second sufficient condition for warnings to be effective in minimising losses is for the recipient to understand the contents of the warnings. Both the HFA and NDRMP make clear cases for the contents of the warnings to be easily understood by the recipients, in priority area 2 and priority area 3 respectively.

National level

In respect of understanding warnings, 97.53% of the respondents who received warnings reported to have understood the warnings while only 2.47% report the opposite as shown in Table 3.15.

Key finding: On average, 97.53% of the households that do receive warnings understand the contents of the warnings

This is remarkably a good outcome in that the majority of the population is able to understand the contents. It is however important to remember that about 58% of the population does not get warning (and therefore not included in these computations) and that this positive picture may change if they are accounted for. It still important to ensure that the messages are understandable to everyone. Attention must therefore be paid to the reasons why the warnings may not by understood. The most commonly cited reasons for not understanding the contents of warnings were inconsistency in the format in which warnings are disseminated (35.21%), lack of familiarity with warning signals (29.58%) and communication being made in a language(s) they are not fluent in (21.13%). There is therefore, need for developing national standards or codes for disseminating warnings, training and educating the communities on the signals used in disseminating warnings and diversifying the number of languages in which warnings are disseminated. Since radios are the most used media it is important to ensure that radios do broadcast warnings in all local languages. Use of community radios, which usually use the local language used in the area they broadcast to, may also be the very effective.

Disaggregation by hazard, region and district

Table 3.15 below shows the proportion of population which understand warnings by hazard type while Table 3.16 shows the proportion by region. Just as at the national level, the disaggregated picture, both by hazard type and by region, show that the vast majority of the recipients understand the contents of warnings which they receive.

Table 3.15: Proportion of population which understand warnings by hazard type

	YES (%)	**NO (%)**	**TOTAL (%)**
Drought/erratic rains	97.59	2.41	100
Floods/Flash floods	96.73	3.27	100
Earthquakes/earth tremor	100	0	100
Storm surge/mwera winds	99.29	0.71	100
Hailstorm	95.96	4.04	100
Thunderstorm/lightening	93.42	6.58	100
Locust swarm	100	0	100

Other (specify)	97.29	2.71	100

Table 3.16: Proportion of population which understand warnings by region

	YES (%)	NO (%)	TOTAL (%)
Northern region	92.42	7.58	100
Central region	98.26	1.74	100
Southern region	98.5	1.5	100

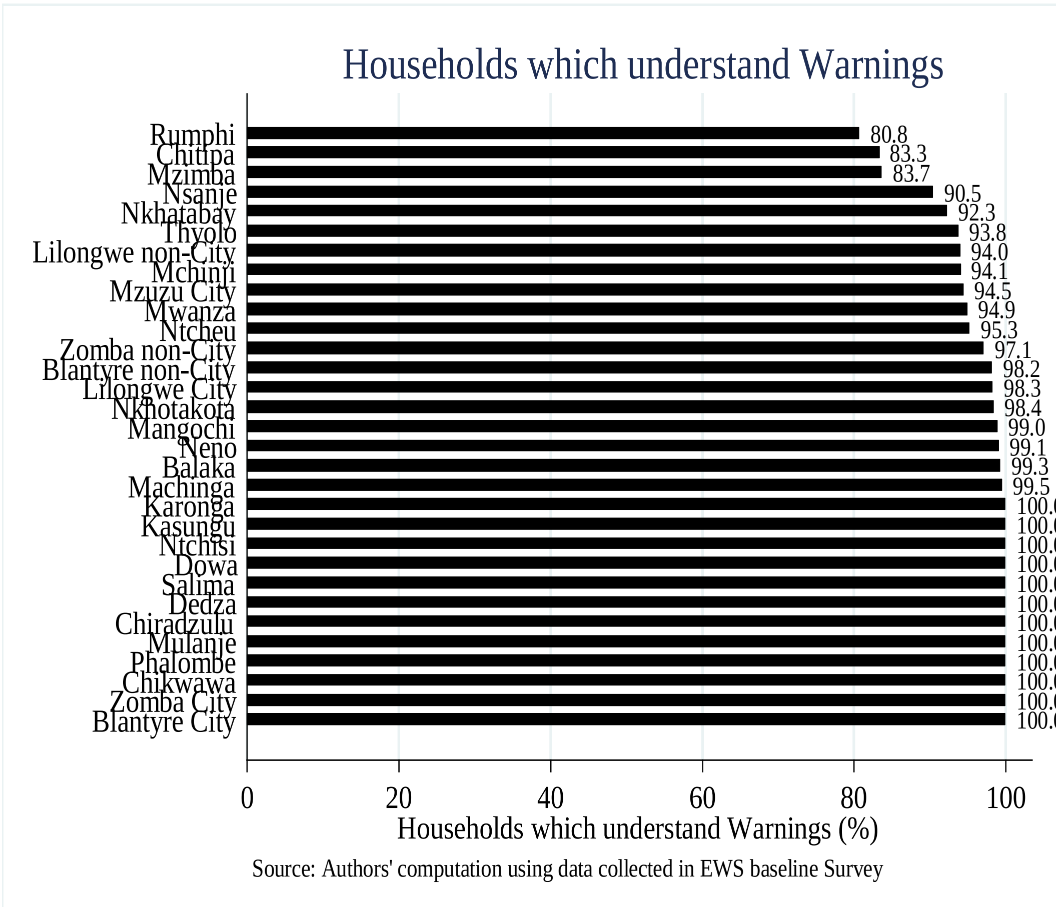


Figure 3.8: Proportion of population which understand warnings by district

vii. Indicator D7: Percentage of population which trust forecasts and warnings

Rationale

Understanding contents of a warning is critical. However, it is trusting of the warning which elicits response. That is, households will only take action when they consider the warning reliable. This is recognised by both the HFA and NDRMP.

National level

In this survey, 94.82% of the respondents reported that they trust the warnings they receive. This paints a good picture for institutions that generate the messages since the recipients are very likely to take appropriate action once they receive the warnings.

Key finding: On average, 94.82% of the households that do receive warnings trust the warnings.

This is a good outcome in that the majority of the population is trust the warnings. This means that warnings elicit the required responses from households and communities at risk. Just as under indicator D6, it is important to remember that about 58% of the population does not get warning (and therefore not included in these computations) and that this positive picture may change if they are accounted for. It is still important to ensure that the messages are trusted by everyone. Attention must therefore be paid to the reasons why the warnings may not by understood. The most commonly cited reason for not trusting the warnings was false alarms (52.27%). There is therefore, need for reducing false alarms by investing in more accurate equipment for monitoring parameters and developing national standards for issuing warnings.

Disaggregation by hazard, region and district

When disaggregated by hazard, a picture consistent with the national-level findings emerges as shown in Table 3.17. On all hazards, more than 90% of the respondents trust the warnings received.

Table 3.17: Proportion of population that trust warnings received by hazard type

	YES (%)	**NO (%)**	**TOTAL (%)**
Drought/erratic rains	94.39	5.61	100
Floods/Flash floods	95.43	4.57	100
Earthquakes/earth tremor	91.43	8.57	100
Storm surge/mwera	94.13	5.87	100

winds			
Hailstorm	96.71	3.29	100
Thunderstorm/lightening	94.58	5.42	100
Locust swarm	92	8	100
Other (specify)	96.51	3.49	100

A similar picture emerges when data were disaggregated by region. This is shown in Table 3.18. Across all regions, the proportion of the population exceeds 93%.

Table 3.18: Proportion of population that trust warnings received by region

	YES (%)	**NO (%)**	**TOTAL (%)**
Northern region	94.58	5.42	100
Central region	93.89	6.11	100
Southern region	93.65	6.35	100

However, disaggregation by district yields some variation in the performance on this indicator. From Figure 3.9 below, Kasungu, Nsanje, Lilongwe City and Machinga have proportion trusting warnings lower than 90%. Therefore, while the overall proportion which trusts warning is relatively high, attention need be paid to these districts.

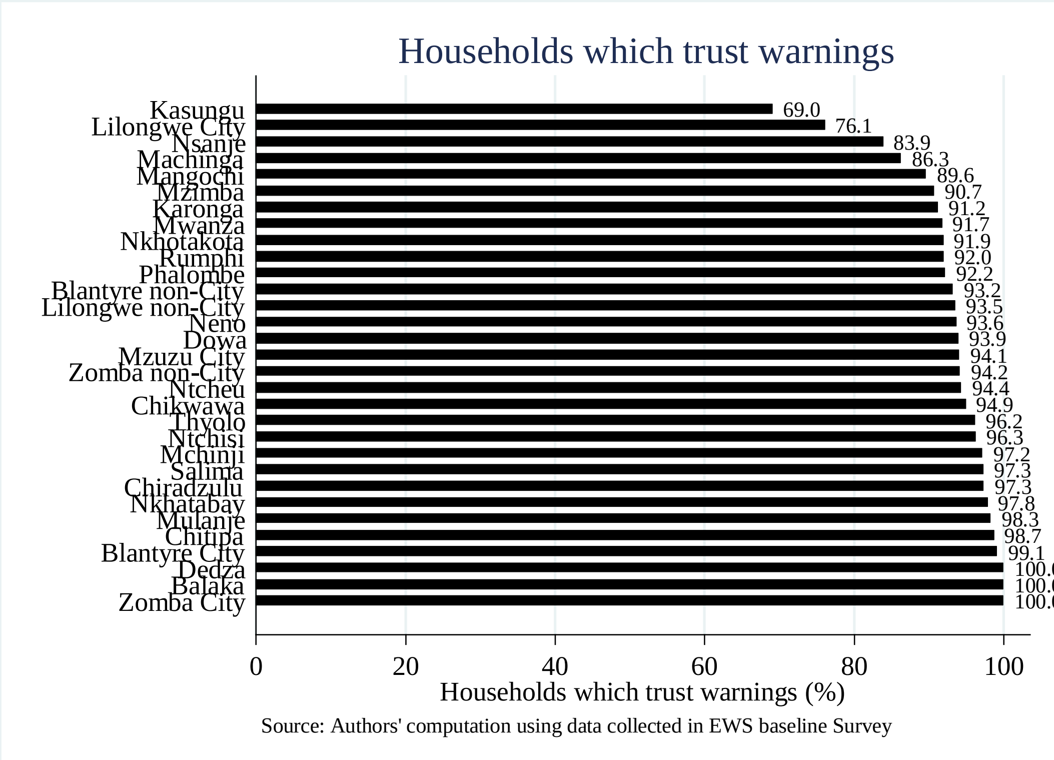


Figure 3.9: Proportion of population that trust warnings received by district

viii. Indicator D8: Percentage of communities which are involved in communication and dissemination

Rationale:
The justification for considering this indicator is similar to that given in indicators D2 and D3

National level

With regard to involvement of communities in the communication and dissemination process, the survey established that only 42.1% of the communities are involved.

Key finding: Only 42.1% of the communities are involved in communication and dissemination activities.

This level of community participation is higher when compared with that for risk assessment and monitoring activities. However, more effort is required to increase this involvement. Increasing participation of communities in communication and dissemination of warnings can used as a strategy not only for increasing the proportion of the population which receive warnings but also enhancing timeliness, understanding and trust.

Disaggregation by hazard, region and district

When analysed by hazards, levels of involvement in communication vary considerably. Table 3.19 below shows that involvement is highest for locust swarm (66.07%) and lowest for earthquakes/earth tremors (31.63%). Droughts and floods perform moderately at 37.34% and 49.47%.

Table 3.19: Levels of involvement in communication and dissemination by hazard type

	YES (%)	NO (%)	DON'T KNOW (%)	TOTAL (%)
Drought/erratic rains	37.34	50.01	12.65	100
Floods/Flash floods	49.47	41.19	9.34	100
Earthquakes/earth tremor	31.63	30.7	37.67	100
Storm surge/mwera winds	47.51	44.48	8.01	100
Hailstorm	41.55	49.8	8.65	100
Thunderstorm/lightening	33.82	55.64	10.55	100
Locust swarm	66.07	25	8.93	100
Other (specify)	38.17	50.16	11.67	100

Analysis by regions yields considerable variability too, as shown in Table 3.20. The best performer is the Southern region followed by the Northern region. Central region is the worst performer. This result may reflect low levels of presence of institutions (including NGOs) at the grassroots levels in the central region.

Table 3.20: Levels of involvement in communication and dissemination by region

	YES (%)	NO (%)	DON'T KNOW (%)	TOTAL (%)
Northern region	38.46	41.85	19.7	100
Central region	30.87	55.87	13.26	100
Southern region	49.74	42.34	7.92	100

Results of analysis by districts are shown in Figure 3.10 below. Ntchisi, Kasungu, Lilongwe (City and non-City), Mchinji, Dowa and Mzimba are the worst performers with involvement level of less than 20%. Most of these districts are low risk districts and it is therefore very likely that there are few instituions (NGOs) involved in engaging the local masses.

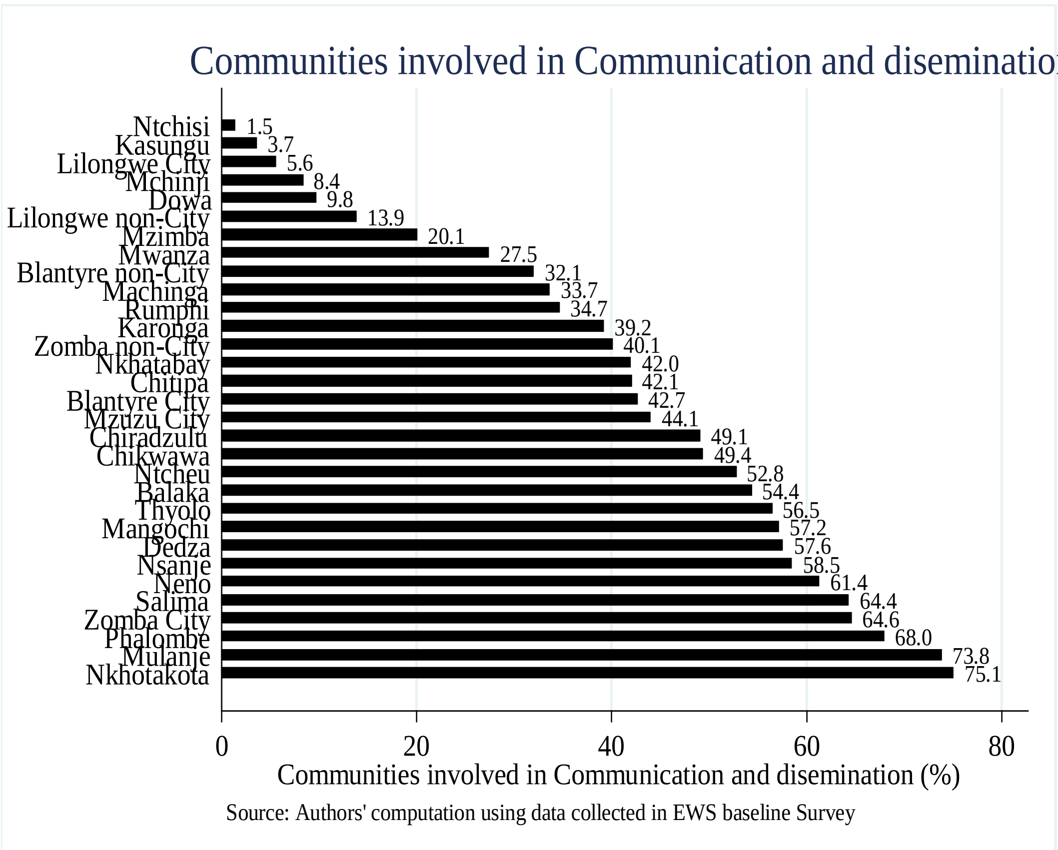


Figure 3.10: Levels of involvement in communication and dissemination by district

d. RESPONSE CAPACITY

ix. Indicator D9: Awareness of the availability of disaster preparedness plans and contingency plans for weather-related natural hazards.

Rationale

Strengthening preparedness capacity is key to ensuring rapid and effective response. Effective disaster response and recovery is dependent on stakeholders and communities being in a state of preparedness to deal with different types of disasters which the country is prone to (GoM, 2015). The importance of preparedness capacity is underscored in the HFA and NDRMP. The HFA and NDRMP call for strengthening of disaster preparedness for effective response at all levels priority area 5 and priority area 6 respectively. This indicator sought to gauge the level of Awareness of the availability of disaster preparedness plans and contingency plans for weather-related natural hazards.

National level

With regard to awareness of availability of disaster preparedness and contingency plans for weather-related natural hazards, an average of 20.66% of the respondents confirmed this.

Key finding: On average, only 20.66% of the communities have disaster preparedness and contingency plans for weather-related natural hazards.

This means almost 80% are not aware of disaster preparedness plans. The implication is that this part of the population cannot ably and timely respond to weather-related natural hazards to minimise losses. Two related factors are likely to have contributed to this state of affairs. First, most districts and communities simply do not have multi-hazard contingency plans in place (GoM, 2015). Secondly, in the few districts that have the plans, resources are not allocated for their implementation and review. Needless to say, this situation must be improved. There need to ensure that all districts have disaster preparedness plans. It is also important to set up emergency operations centres to facilitate operationalisation of these plans.

Disaggregation by hazard, region and district

When disaggregated by hazard type, the patterns of low levels of awareness existence of disaster preparedness plans and contingency plans are evident across all hazards and regions. Table 3.21 below shows awareness of availability of disaster preparedness plans and contingency plans by hazard type while Table 3.22 shows awareness of availability of disaster preparedness plans and contingency plans by region.

Table 3.21: Awareness of availability of disaster preparedness plans and contingency plans by hazard type

	YES (%)	NO (%)	DON'T KNOW (%)	TOTAL (%)
Drought/erratic rains	18.44	60.79	20.78	100
Floods/Flash floods	26.98	53.36	19.66	100
Earthquakes/earth tremor	17.39	46.96	35.65	100
Storm surge/mwera winds	20.62	62.59	16.79	100
Hailstorm	13.63	66.38	20	100
Thunderstorm/lightening	11.04	70.78	18.18	100
Locust swarm	8.89	44.44	46.67	100
Other (specify)	27.69	57.58	14.73	100

Table 3.22: Awareness of availability of disaster preparedness plans and contingency plans by region

	YES (%)	NO (%)	DON'T KNOW (%)	TOTAL (%)
Northern region	10.09	58.62	31.28	100
Central region	13.55	69.07	17.38	100
Southern region	25.56	57.67	16.77	100

Disaggregation by districts reveal wide disparities in the levels of awarewness of availability of disaster preparedness plans. This shown in Figure 3.11 below. The worst performing are Thyolo, Blantyre City, Kasungu, Dowa, Mzimba, Chitipa, Ntchisi, Mwanza, Rumphi and Mchinji. This can be attributed to the fact that most of these districts do not have contingency plans in place and/or, that where the plans exist, there is inadequate funding for their implementation and review.

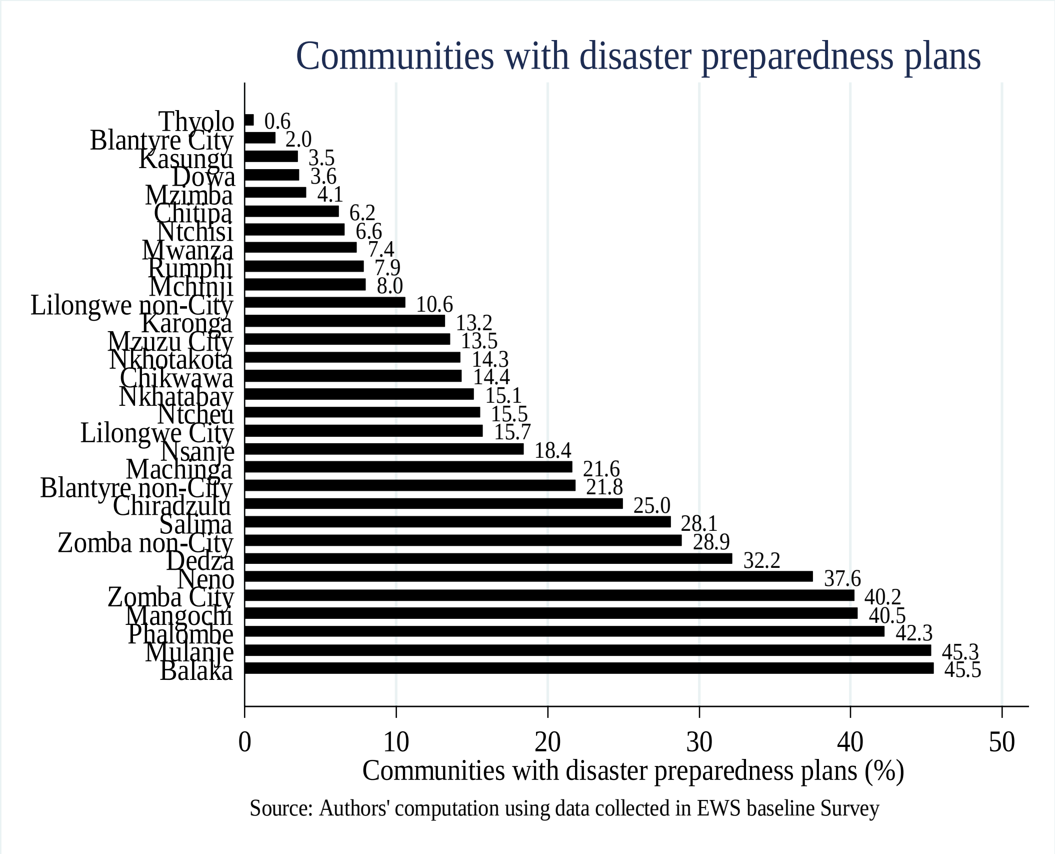


Figure 3.11: Awareness of availability of disaster preparedness plans and contingency plans by district

x. **Indicator D10: Extent of community involvement in preparation of disaster preparedness plans and contingency plans for weather-related natural hazards.**

Rationale

The justification for considering this indicator is similar to that given in indicators D2 and D3

National level

An interesting pattern emerges with respect to community involvement in preparation of disaster preparedness plans and contingency plans for weather-related natural hazards, where such plans exist. It was found that, on average, 89.95% of communities are involved.

Key finding: On average, 89.95% of communities are involved in preparation of disaster preparedness plans and contingency plans for weather-related natural hazards, where such plans exist.

This finding is interesting in the sense that unlike the low levels on the indicators for participation of communities in risk assessment, monitoring activities and communication and dissemination activities, for this indicator participation of communities is relatively high. While the availability of disaster preparedness plans is limited, where they are available, the process of formulating them is participatory.

Disaggregation by Hazard, Region and district

This pattern of high community participation is consistent across all dimensions of disaggregation; see Table 3.23 (by hazard type), Table 3.24 (by region) and Figure 3.12 below (by district).

Table 3.23: Community involvement in preparation of disaster preparedness plans and contingency plans by hazard type

Hazard	YES (%)	NO (%)	TOTAL (%)
Drought/erratic rains	88.82	11.18	100
Floods/Flash floods	92.5	7.5	100
Earthquakes/earth tremor	68.75	31.25	100
Storm surge/mwera winds	93.99	6.01	100
Hailstorm	76.32	23.68	100
Thunderstorm/lightening	77.42	22.58	100
Locust swarm	50	50	100
Other (specify)	92.75	7.25	100

Table 3.24: Community involvement in preparation of disaster preparedness plans and contingency plans by region

	YES (%)	NO (%)	DON'T KNOW (%)	TOTAL (%)
Northern region	71.22	16.55	12.23	100
Central region	89.93	7.66	2.41	100
Southern region	91.7	6.83	1.47	100

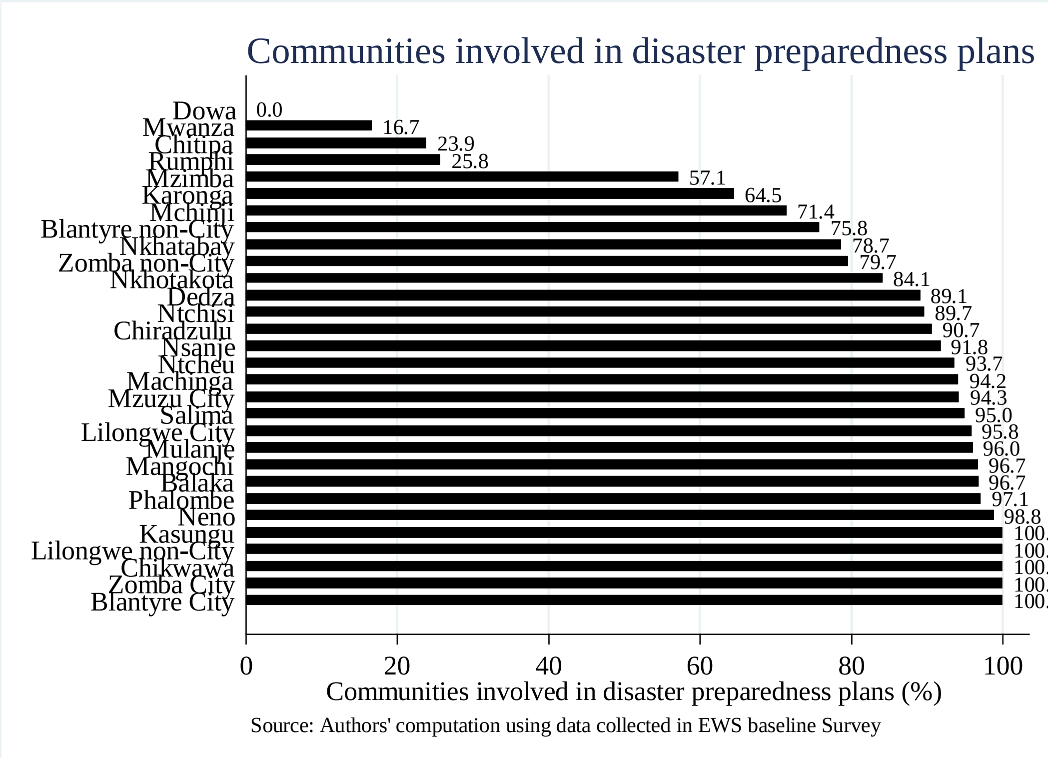


Figure 3.12: Community involvement in preparation of disaster preparedness plans and contingency plans by district.

Summary: *From the demand side, EWS in Malawi is strong in communication and dissemination. However, it is weak in risk knowledge, monitoring and warning service and response capacity.*

2. SUPPLY SIDE INDICATORS

Supply side indicators relate to the providers of the services provided by the Early warning system. These providers include such institutions various departments of government, NGOs and private sector players. The institutions targeted in this survey included DoDMA, DCCMS, DDROs, various radio stations and NGOs. On the supply side, we have developed the following set of ten indicators as outlined below. We organise these indicators around the main elements of the early warning system framework. For each indicator, we present results at national level. To gain more insights, we also present results after data were disaggregated. Disaggregation is done by region and weather-related natural hazard to help the Malawi Government get value of survey information for geographical targeting interventions. Unlike of the demand side, we do not perform analysis by district due to small sample size at district level. Further, when we disaggregate data by hazard, we do not report results for earthquakes/earth tremors because there was only one respondent who provided information for it and they are not weather related which was the focus of the survey on weather related hazards. Summary findings of these supply side indicators are presented in Box 3.2 below.

Box 3.2: Summary findings of supply side indicators

INDICATOR	DESCRIPTION	CURRENT PERFORMANCE (%)
S1	Coverage of hazard maps, vulnerability maps and risk assessments	80.20
S2	Extent of knowledge of national standards for the systematic collection, sharing and assessment of vulnerability data	67.51
S3	The proportion of gauging stations that are fully operational	7.3
S4A	The proportion of automatic weather stations that are fully operational	30.4
S4B	The proportion of conventional weather stations that are fully operational	100
S5	The proportion of automatic rainfall loggers that are fully operational	90.9
S6	awareness of existence of standard procedure for disseminating warnings	57.66
S7	Existence of feedback mechanism	51.75
S8	coverage of disaster preparedness and response plans	91.15
S9	Awareness of legislation or policy which provides a legal basis for implementing an early warning system.	60.85
S10	The proportion of VCPCs that are active	28.3

a. RISK KNOWLEDGE

i. Indicator S1: Coverage of hazard maps, vulnerability maps and risk assessments

Rationale:

The justification for considering this indicator is the same as that provided under indicator D1. However, while on the demand side (indicator D1) we were interested with the level of *awareness* among communities of availability risk assessments of hazard maps, vulnerability maps and risk assessments, this indicator on the supply side was aimed at establishing extent of *coverage* of hazard maps, vulnerability maps and risk assessments

National Level

One key element of risk knowledge from the supply side whether or not all geographical areas within national territory have risk assessments done. We established from this survey that coverage of hazard maps is at 67.42%, while that of vulnerability maps and risk assessments at 81.46% and 80.2% respectively.

Key finding: Current coverage of hazard maps is at 67.42%, while that of vulnerability maps and risk assessments at 81.46% and 80.2% respectively. These levels are generally good. However, there is need to increase these to 100%. It is also very unlikely that the risk assessments were comprehensive and standardised. This is because Malawi does not currently have a system for identifying, assessing, monitoring and mapping disaster risks (GoM, 2015). It is therefore necessary to put in place a system for risk assessment and mapping to ensure complete country coverage and ensure comprehensive and standardised risk assessments.

It is worth noting that this fairly optimistic picture on the supply side is not shared on the demand side, as discussed under indicator D1. Even though coverage levels are high as reported on the supply side, awareness levels on the demand side are relatively low as discussed under indicator D1. This shows a disconnection between supply and demand and could be investigated further through other studies. This is not surprising given that under indicator D2, it was established the community involvement in risk assessments is very limited. It is therefore very critical that the system for risk assessment and mapping ensures that that information relating to risk assessments seamlessly flows to the end users by encouraging community involvement.

Disaggregation by hazard and region

Results of coverage levels when disaggregated by hazard are shown in Table 3.25 below. It shows that the lowest coverage is for hailstorms at 75.86%, followed by floods and droughts at 78.26% and 78.79% respectively. Given that droughts and floods are the most dominants hazards in Malawi, there is need to upscale risk assessments on these hazards.

Table 3.25: Coverage of risk assessments by hazard type

	YES (%)	NO (%)	TOTAL (%)
Drought/erratic rains	78.79	21.21	100
Floods/flash floods	78.26	21.74	100
Storm surge/mwera winds	83.33	16.67	100
Hailstorm	75.86	24.14	100
Thunderstorm/lightening	100	0	100
Locust swarm	100	0	100
Other specify	100	0	100

Table 3.26: Coverage of risk assessments by region

	YES (%)	NO (%)	TOTAL (%)
Northern region	74.47	25.53	100
Central region	89.47	10.53	100
Southern region	77.78	22.22	100

Coverage of risk assessments by region is shown in table 3.26 above. The Central region is the most covered at 89.47% followed by the southern region at 77.78%. The northern region is the covered at 89.47%. It is surprising to note that Central region is the most covered yet from the demand side, has the lowest awareness of these risk assessment (D1). This may partly reflect that this region is the least people-centred region.

ii. Indicator S2: Extent of knowledge of national standards for the systematic collection and sharing of risk assessment data.

Rationale:
Collection, sharing and assessment of vulnerability data must be guided by national standards to ensure consistency of such data.

National Level

At the national level, an average of 67.51% of supply-side institutions is aware of national standards for the systematic collection and sharing of risk assessment data.

Key finding: On average, 67.51% of supply-side institutions are aware of national standards for the systematic collection and sharing of risk assessment data.

This finding shows some gaps in capacity of some institutions in the EWS chain. Even though not involved in generating vulnerability data, every institution must be aware of such standards and be able to use them in assessing such data. It is therefore imperative that effort be made to increase such awareness levels to 100%.

Disaggregation by hazard and region

By hazard, the lowest awareness levels are with respect to droughts, hailstorms, mwera winds and thunderstorms/lightening. This is shown Table 3.27 below.

Table 3.27: Awareness of national standards for the systematic collection and sharing of risk assessment data by hazard

	YES (%)	**NO (%)**	**TOTAL (%)**
Drought/erratic rains	65.08	34.92	100
Floods/flash floods	68.66	31.34	100
Storm surge/mwera winds	66.67	33.33	100
Hailstorm	65.52	34.48	100
Thunderstorm/lightening	66.67	33.33	100
Locust swarm	85.71	14.29	100
Other specify	100	0	100

By region, the lowest awareness levels are in the central region, followed by the southern region. This is shown Table 3.28 below.

Table 3.28: Awareness of national standards for the systematic collection and sharing of risk assessment data by region

	YES (%)	**NO (%)**	**TOTAL (%)**
Northern region	81.25	18.75	100
Central region	65.31	34.69	100

Southern region	62.38	37.62	100

b. MONITORING AND WARNING SERVICE

Rationale

Monitoring is probably the most important element. It involves monitoring parameters critical to occurrence of hazards and using model to issue warnings once thresholds have been reached. The importance of monitoring and warning service is underscored by both the HFA (priority area 2) and NDRMP (policy priority area 2). Sound monitoring requires well-functioning and fully operational equipment. This indicator sought to determine the extent to which the network of monitoring infrastructure is fully operational. The monitoring infrastructure of considered were Gauging Stations, Automatic Weather Stations (AWS), Conventional Weather Stations (CWS) and Automatic Rainfall Loggers (ARL).

The estimates in this section are based on the information provided by the DCCMS and the DWR.

STATUS OF GAUGING STATIONS NETWORK

Gauging stations (or stream/river gauges) are facilities which collect hydrological information such as stage (water height) and discharge (volume of water per unit time past a point) of water bodies. Such information is critical in flood prediction. Timely flood warnings and forecasts saves lives and aid disaster preparedness.

Indicator S3: The proportion of gauging stations that are fully operational

Table 3.29 below summarises status of gauging stations network for the 41 sites that were assessed under the Shire River Basin Management Programme (SRBMP). It shows that only three gauging stations (Monkey Bay, Liwonde and Matope gauging stations) are operational, representing 7.3%, while 38 gauging stations are out of service, requiring rehabilitation.

Table 3.29: Operational status of gauging stations network

	Number	Percent
Operational (Fully)	3	7.3
Out of service and requiring rehabilitation	38	92.7
TOTAL	41	100.0

Key finding: Only 7.3% of all Gauging Stations are fully operational

This results are not surprising. As noted in the SRBMP report (2015), many of the gauging stations are in a state of disrepair because they of lack of maintenance. Further, no water level recorders are working at any of the sites, with the exception of the gauging station of Shire River at Matope (1P2). Finally, apart from Monkey Bay, Liwonde and Matope gauging stations, there are no regular gauge readings being taken at any gauging stations due to the unavailability of gauge readers.

It is recommended, as in the SRBMP report, that this network of gauging station be rehabilitated into full functionality for better flood warnings and forecasts. The biggest problem has been funding but funding was to be made available under the SRBMP. It is recommended that such maintenance be expedited.

STATUS OF AUTOMATIC WEATHER STATION NETWORK

An Automatic Weather Stations (AWS) is a meteorological at which observations are made and transmitted automatically. AWS is emerging as a substitute to the conventional (traditional) weather station. It has an advantage as it can be installed at a very remotest place and still observe and transmit weather information. AWS measure such weather related parameters such as temperature, speed and direction wind, humidity and atmospheric pressure. The data gathered from AWS is useful for prediction of such hazards as floods, heavy storms, droughts among others.

Indicator S4A: The proportion of automatic weather stations that are fully operational

Table 3.30 below summarises status of AWS network across the country based on information provided by DCCMS. This information is shown in Appendix C. It shows that 30.2% is fully operational while 45.3% is operational with some faults which require attention. The faults relate to obsolete faulty communications module leading failure to download data. 24.5% of the AWS out of service.

Table 3.30: Operational status of automatic weather stations network

AWS	Number	Percent
Operational (Fully)	16	30.2
Operational but requiring maintenance	24	45.3
Out of service	13	24.5

TOTAL	53	100.0

Key finding: Only 30.2% of all AWS are fully operational

As noted in the SRBMP, most AWS are new and in good working conditions. According to DCCMS, rehabilitation of the stations which are either operational but require maintenance or completely out of service is going to be made available under the Green Climate Fund and SRBAM projects. It is recommended that such maintenance be expedited. Greater efforts need to be made on training of meteorological engineers to maintain these AWs. Further, some AWS still uses GSM mobile transmission technology which is expensive on data charges as it relies on mobile companies and they charge a lot for using mobile lines. So all these need to be upgraded and use GPRS technology which is cheaper.

STATUS OF CONVENTIONAL WEATHER STATIONS NETWORK

The present network of conventional weather stations comprises 22 full conventional weather stations, 21 subsidiary weather stations, strategically located in the eight ADDs. The network of full conventional weather stations is shown in Figure XX below while the list of all subsidiary station is provided in Appendix D.

Indicator S4B: The proportion of automatic weather stations that are fully operational

Table 3.31 below shows information on the operational status of Conventional weather stations network

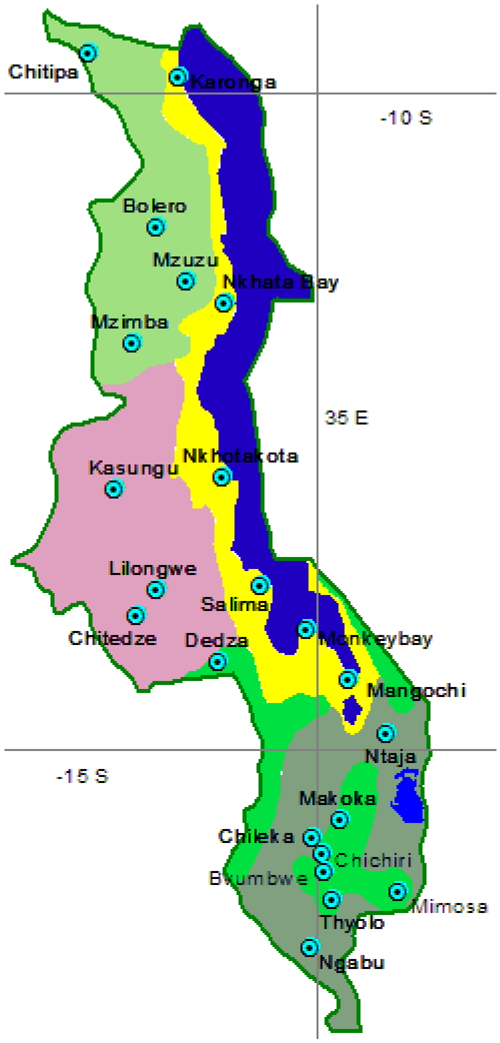
Table 3.31: Operational status of Conventional weather stations network

	Number	Percent
Operational (Fully equipped)	22	100
Operational but requiring maintenance	0	0
Out of service	0	0
TOTAL	22	100.0

Key finding: 100% of conventional weather stations are fully operational

This results follows maintenance works which took place on all conventional weather stations across the country. This has led to all stations being fully operation with all equipment required available and in good condition. This situation also applies to subsidiary stations which were maintained and re-equipped. All of them are fully operational. What is required is that these stations should be maintained regularly

Figure 3.13: Network of Conventional Weather Stations in Malawi



STATUS OF AUTOMATIC RAINFALL LOGGERS NETWORK

Automatic rainfall loggers (ARL) or automatic rain gauges (ARG) are instruments which collect hydrological information on intensity and duration of rainfall. This information, together with information collected from gauging stations, is critical in flood prediction. The ARL are emerging as a substitute to the conventional rain gauges.

Indicator S5: The proportion of automatic rainfall loggers that are fully operational

Table 3.31 below summarises status of ARL network for the 33 sites that were assessed under the Shire River Basin Management Programme (SRBMP).

Table 3.31: Operational status of automatic rainfall loggers network

	Number	Percent
Operational (Fully)	0	0
Operational but requiring licence subscription and/or maintenance	33	100.0
Out of service	0	0
TOTAL	33	100.0

Key finding: 0% of all ARLs are fully operational

As noted in the SRBMP, most ARL are new and in good working conditions. Almost all ARLs collect data. However, data from these loggers are not received by the DCCMS due expiry of transmitting licence. There is need to be pay for the license.

It is also important to note that there 400 volunteer rainfall recording stations across Malawi. Of these, 120 fully operational while 280 need replacement of measuring equipment. There is need for enhanced continuous training for all volunteer observers and good working relation with institutions and individual hosting the rainfall recording stations perhaps having revised MoUs and agreement with the institutions.

c. COMMUNICATION AND DISSEMINATION

iii. Indicator S6: awareness of existence of standard procedure for disseminating warnings

Rationale:
Warnings must be disseminated in a consistent manner to ensure that these warnings are easily available to end users. To this end there must be standard procedure for disseminating warnings and all institutions must be aware of and adhere to the same.

National Level

Nationally, an average of 57.66% of the institutions is aware of such standards.

Key finding: On average, only 57.66% of supply-side institutions are aware of national standards/procedures for disseminating warnings.

Disaggregation by hazard and region

Table 3.32 below shows the awareness of national standards/procedures for disseminating warnings by hazard. Table 3.33 show the same by region. By hazard, worst performance is for locust swarm, hailstorm and thunderstorm/lightening. Regionally, the northern region is the weakest.

Table 3.32: Awareness of national standards/procedures for disseminating warnings by hazard

	YES (%)	**NO (%)**	**TOTAL (%)**
Drought/erratic rains	60.29	39.71	100
Floods/flash floods	61.33	38.67	100
Storm surge/mwera winds	58.62	41.38	100
Hailstorm	48.48	51.52	100
Thunderstorm/lightening	50	50	100
Locust swarm	37.5	62.5	100
Other specify	50	50	100

Table 3.33: Awareness of national standards/procedures for disseminating warnings by region

	YES (%)	**NO (%)**	**TOTAL (%)**
Northern region	41.67	58.33	100
Central region	53.33	46.67	100
Southern region	69.23	30.77	100

iv. Indicator S7: Existence of feedback mechanism

Rationale:

Feedback mechanisms are important in any EWS because it provides a platform for the demand side and supply side to interface. This provides room for learning for the supply side.

National Level

On average 51.75% of the supply side institutions reported to have a feedback mechanism.

Key finding: On average, 51.75% of the supply side institutions have a feedback mechanism.

This result shows that only half of the supply side institutions have feedback. The other half therefore loses out on the opportunity of engaging the community and learning on how to improve on their service delivery. It is therefore important to institute a clear strategy to ensure that each institution in the EWS chain has a feedback mechanism.

Disaggregation by hazard and region

Existence of feedback mechanism is lowest for locust swarm followed by mwera winds and hailstorm. The full picture is shown in Table 3.34 by hazard and Table 3.35 by region.

Table 3.34: Existence of feedback mechanism by hazard

	YES (%)	NO (%)	TOTAL (%)
Drought/erratic rains	53.52	46.48	100
Floods/flash floods	55.26	44.74	100
Storm surge/mwera winds	43.33	56.67	100
Hailstorm	47.06	52.94	100
Thunderstorm/lightening	50	50	100
Locust swarm	37.5	62.5	100
Other specify	75	25	100

Table 3.35: Existence of feedback mechanism by region

	YES (%)	NO (%)	TOTAL (%)
Northern region	47.54	52.46	100

Central region	62.12	37.88	100
Southern region	46.67	53.33	100

d. RESPONSE CAPACITY

v. Indicator S8: coverage of disaster preparedness and response plans

Rationale:
Disaster preparedness and response plans are very critical in reducing loss and damage when a hazard occurs. For a EWS to be effective, all geographical areas must have these plans which are operational.

National level
On average, coverage of disaster preparedness and response plans is at 92.15%.

Key finding: On average, coverage of disaster preparedness and response plans is at 92.15%.

This result paints a very optimistic picture regarding coverage of disaster preparedness and response plans. However, on the demand side, awareness of the availability is very low. This reflects the fact that most of the disaster prepared plans are not operation. The most commonly cited reason for this was lack of funding. It is important to allocate funding to operationalisation of these plans. It is also important to set up emergency centres to facilitate such processes.

Disaggregation by hazard and region

The pattern of almost complete coverage is repeated when data is disaggregated by hazard (Table 3.36 below) and by region (Table 3.37 below).

Table 3.36: Coverage of disaster preparedness and response plans by hazard

	YES (%)	**NO (%)**	**TOTAL (%)**
Drought/erratic rains	90.48	9.52	100
Floods/flash floods	92.86	7.14	100

Storm surge/mwera winds	90.48	9.52	100
Hailstorm	96	4	100
Thunderstorm/lightening	66.67	33.33	100
Locust swarm	100	0	100
Other specify	100	0	100

Table 3.37: Coverage of disaster preparedness and response plans by region

	YES (%)	**NO (%)**	**TOTAL (%)**
Northern region	97.92	2.08	100
Central region	90	10	100
Southern region	90.43	9.57	100

CROSS CUTTING ISSUES

vi. Indicator S9: Awareness of legislation or policy which provides a legal basis for implementing an early warning system.

Rationale:

Any EWS is more effective if its operations are provided for and enforced by law or policy. The HFA's priority are 1 is that disaster risk reduction must a national and a local priority with a strong institutional basis for implementation. In Malawi, implementation of EWS is sanctioned by the NDRMP. In addition, there are further policies related to the implantation of EWS including Final Climate Change Policy, Final National Meteorological Policy. This indicator sought to establish the level of such policies among the institutions involved in EWS

National level

Supply side institutions must be aware of the existence of and provisions of such legislation or policy. In Malawi, an average of 60.85% of the supply side institutions is aware of the existence of and provisions of such legislation or policy.

Key finding: In Malawi, an average of 60.85% of the supply side institutions is aware of the existence of and provisions of such legislation or policy.

This is not such a good state of affairs. Ideally all institutions involved in the EWS activities should be aware of these policies and their provisions. There is therefore need for conducting training of all institution in the EWS chain on the provisions of these policies and for sharing of information among the institutions involved

Disaggregation by hazard and region

When disaggregated by hazard, awareness level is lowest for thunderstorm/lightening and floods. This is shown in Table 3.38 below.

Table 3.38: Awareness of the existence of and provisions of legislation or policy for implementing EWS by hazard

	YES (%)	**NO (%)**	**TOTAL (%)**
Drought/erratic rains	60.66	39.34	100
Floods/flash floods	52.86	47.14	100
Storm surge/mwera winds	80.95	19.05	100
Hailstorm	64	36	100
Thunderstorm/lightening	33.33	66.67	100
Locust swarm	80	20	100
Other specify	66.67	33.33	100

Regionally, this awareness is lowest in the southern region. More information is provided in Table 3.39 below.

Table 3.39: Awareness of the existence of and provisions of legislation or policy for implementing EWS by region

	YES (%)	**NO (%)**	**TOTAL (%)**
Northern region	67.39	32.61	100
Central region	68.63	31.37	100
Southern region	53.76	46.24	100

Indicator S10: Proportion of VCPCs that are active

Rationale:

VCPCs are critical in enhancing community participation in all the four elements of the EWS. They can also be instrumental in bridging the gap between the demand side and the supply side of the EWS.

In Malawi, there are meant to be active VCPCs in all the disaster prone districts of Karonga, Rumphi, Nkhatabay, Nkhotakota, Salima, Dedza, Ntcheu, Balaka, Mangochi, Machinga, Zomba, Phalombe, Blantyre, Chikwawa and Nsanje. Appendix XX shows information relating to the number of VCPCs that active, dormant or yet to be established. For some districts (Blantyre, Nkhotakota, and Ntcheu) information was not available. For these district it was decided to regard VCPCs as not establish. The average number of VCPCs in TA or under an ACPC for those districts where information was available was used to approximate the number of VCPCs in the districts where there was no information. The average was 9 VCPCs per TA or ACPC.

Table XX computes the proportion of the expected total number of VCPCs that are active. The results show that 28.3% of the VCPCs are active, 41.3% are dormant and 30.4% are yet to be established.

Table XX: Proportion of VCPCs that are active

	Number	**Percent**
VCPCs active	401	28.3
VCPCs Dormant	585	41.3
VCPCs not established	431	30.4
	1417	**100**

Key finding: only 28.3% of all VCPCs are active

The result that that only 28.3% of all VCPCs are active partly explains the low levels of community participation as discussed under indicators (indicators D2, D3 and D8). It is important to strengthen the network of VCPCs by activating the dormant ones and establishing them where there are none. The dormancy of most VCPCs is due to lack of training the members. There must be deliberate effort to train these VCPCs. Where there are no VCPCs, they should be established as soon as possible.

C. WELFARE EFFECTS OF HAZARDS AND EFFECTIVENESS OF EWS

1. EFFECTS OF NATURAL HAZARDS ON WELFARE OF HOUSEHOLDS

National level

Objective 1 of the assignment was to estimate the impact of weather-related natural hazards on household's welfare. Our monetary measure of loss in welfare for a household includes the sum of the loss of assets, income, food production, food stock and food purchases (we called this total loss). For each hazard, we summed the loss on these categories. Our exploratory analysis of this variable (total loss) showed the presence missing values (coded as zero) and outliers [exceptionally small or large observations (numbers)] which could potentially bias our analysis. We therefore truncated our data at the 10th and 90th percentile in order to reduce that bias in our estimation.

Table 3.40 below presents the summary statistics of the losses suffered. The table shows that mean loss is MK154, 059.50 per household annual. Although the disasters occur with difference frequencies, we take the mean loss to be annual given the dominance of those hazards which have an annual frequency, including droughts and floods. However, given that the distribution of the variable in question is positively skewed as shown in Table 3.40 (skewedness = 1.1328) and Figure 3.13, the mean overstates the centre of the variable. A more conservative and reliable measure of central tendency given this skewness is the median. Table 3.38 therefore shows that the annual median loss is MK115, 000.00. This loss of MK115, 000.00 per year is a huge loss for the average household in Malawi. Our sample indicates an average annual household income of MK279, 933.90. This means that the conservative median loss of MK115, 000.00 represents a 41% loss of the realised income (MK279, 933.90) and 29% of all potential income (MK279, 933.90+ MK115, 000.00 = MK394, 933.90)

Table 3.40: Summary statistics of the losses suffered due to weather-related hazards at national level

Statistic	**Value**
Mean	MK154,059.50
Median	MK115,000.00
Standard deviation	123,035
Skewness	1.1328
Minimum	MK18,500.00
Maximum	MK525,000.00

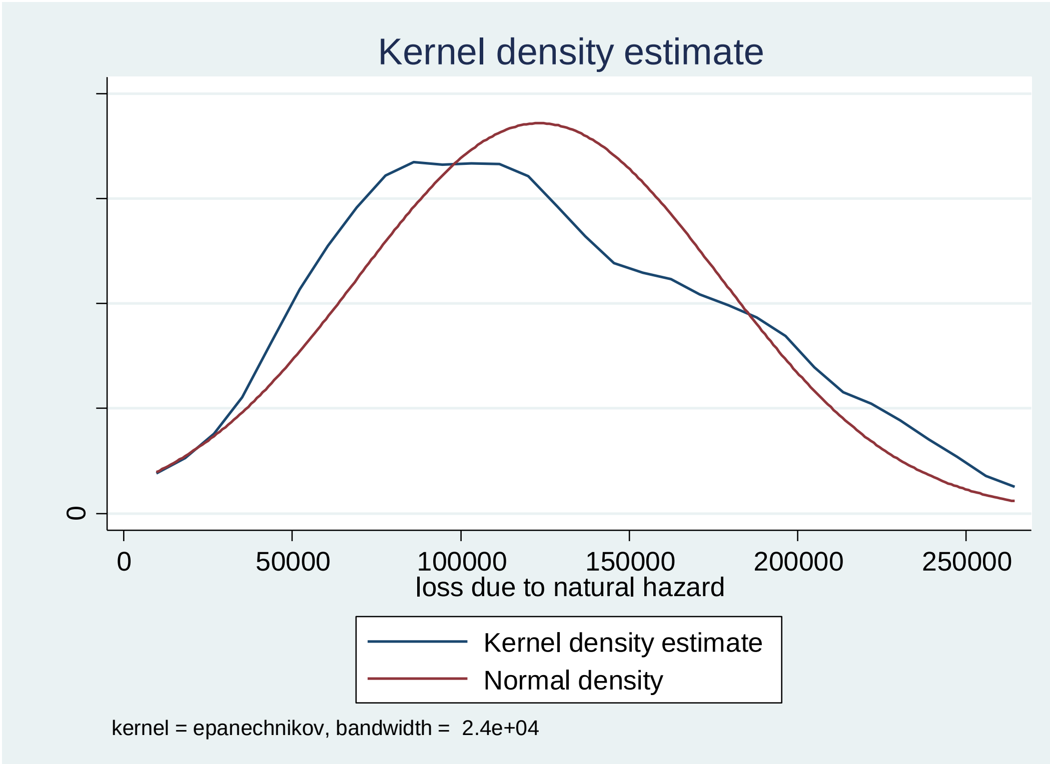


Figure 3.13: Distribution of losses suffered

Key finding: The annual median loss per household due to weather-related natural hazards is MK115, 000.00, representing a 41% loss of the realised income and 29% of all potential income.

This finding can be explained by the fact that most households (over 75% of the population) are agrarian and the most dominant weather-related natural hazards are droughts and floods. Therefore, the losses suffered for an average household relative to its annual income (realised or potential) is considerable. This is exacerbated by the fact that most households either do not receive warnings on time or that their response capacity is low given that a large share of the population does not have disaster preparedness plans.

This loss is posing a serious threat to household's welfare and therefore there is need to improve performance of the early warning system to improve the situation at household level.

Disaggregation by Hazard, region and District

Table 3.41 below shows the median loss associated with occurrence of weather-related natural hazards. The lowest average loss is associated with thunderstorm/lightening

(MK70, 000.00). Droughts and floods leads to a loss of MK122, 000.00 and MK103, 000.00 respectively. This means that drought is a more serious problem than floods.

Table 3.41: Median loss associated with occurrence of weather-related natural hazards by hazard type

	Median loss (MK)	**Mean loss (MK)**
Drought/erratic rains	122,000.00	160,829.30
Floods/Flash floods	103,000.00	135,334.40
Earthquakes/earth tremor	160,000.00	182, 523.90
Storm surge/mwera winds	118,000.00	164,323.20
Hailstorm	110,000.00	150,778.90
Thunderstorm/lightening	70,000.00	112,543.70
Locust swarm	212,000.00	214,551.70
Other (specify)	129,500.00	158,895.60

Table 3.42 below shows median losses suffered when data is disaggregated by region. Regionally, the highest loss is experienced in the central region (MK128,000.00) while the lowest loss is experienced in the Southern region (MK105,250.00). The fact that central region suffers the highest loss in not surprising given that it has consistently performed poorly on almost all the demand side indicators of the EWS as discussed earlier.

Table 3.42: Median loss associated with occurrence of weather-related natural hazards by region

	Median loss (MK)	**Mean loss (MK)**
Northern region	111,030.00	160,829.30
Central region	128,000.00	135,334.40
Southern region	105,250.00	182, 523.90

When the data is disaggregated by district Chikwakwa, Ntchisi, Zomba city, Dowa, Karonga, Nsanje, Chiradzulu and Chitipa have the highest loses with a median loss of above MK180,000.00. The median loss suffered by each is shown in Figure 3.14 below.

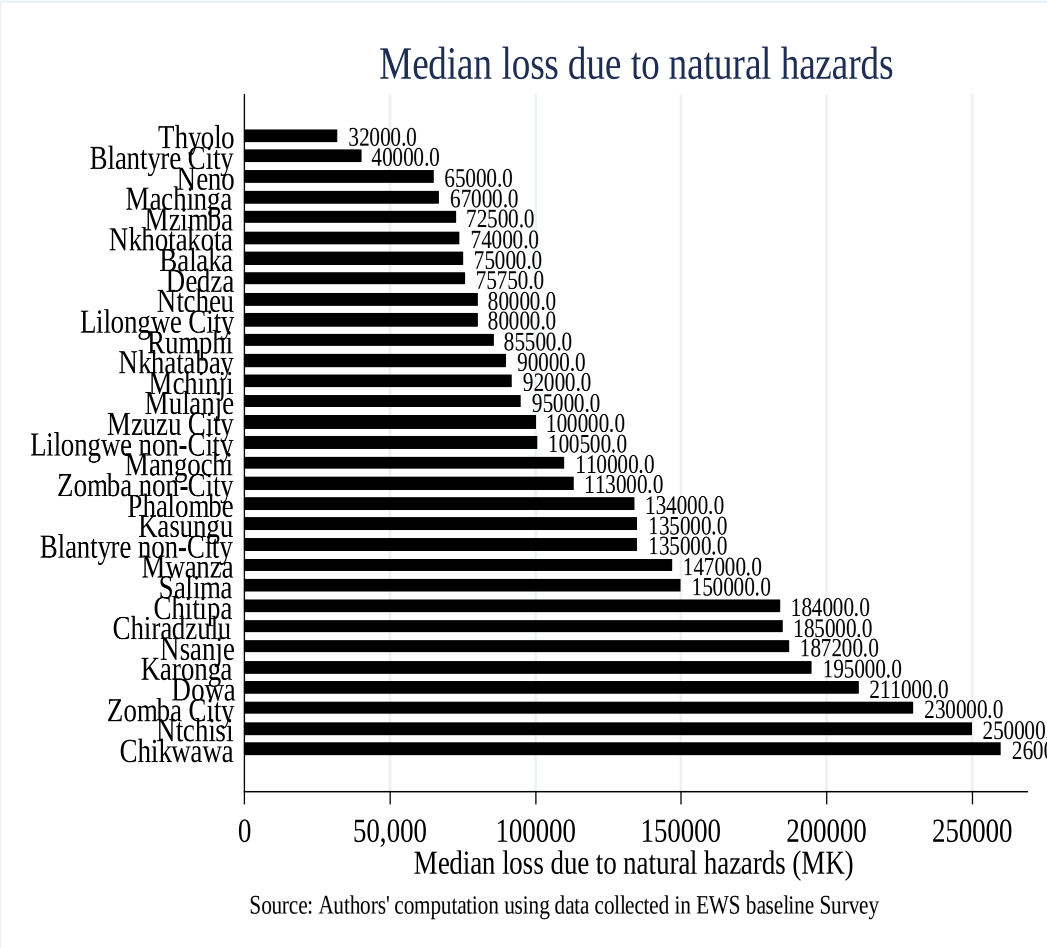


Figure 3.14: Median loss associated with occurrence of weather-related natural hazards by district.

2. EFFECTIVENESS OF THE EWS IN DISASTER RISK REDUCTION

Objective 2 required that an assessment be done of the effectiveness of EWS in Malawi. The primary role of any EWS is to reduce disaster risk. That is, any EWS aims at minimising damage and loss when a weather-related natural hazard occurs. Consequently, if an EWS is effective those households (or communities) who receive warnings should suffer lower loss than those which did not. We therefore tested the effectiveness of the early warning system by comparing the average losses suffered by those households (or communities) who received warnings (designated group 1) against those of households (or communities) which did not (designated group 2).

We used the t-test under the equi-variance assumption of the losses suffered by the two groups. The null hypothesis was that there is no difference in the average loss suffered by the two groups. That is, $H_0 : \text{diff} = \text{mean(group 1)} - \text{mean(group 2)} = 0$. Since we expect that average losses suffered by those households (or communities) who received warnings should be lower than those households (or communities) which did not, the null hypothesis was tested against the alternative hypothesis that the difference in average losses is negative. Table 3.43 presents the results of the test.

Table 3.43: Two sample t-test for equality of losses suffered

Group1	**Group 2**	**p-value**		
		H1: diff!=0	**H1: diff>0**	**H1: diff<0**
YES(159721.8)[1]	**NO(150010)**	0.067	0.030	0.997

Note: [1]Means in parentheses.

Since p-values under that alternative hypothesis that the difference is negative (**H1: diff<0)** is greater than the conventional 5 % level of significance (0.997>0.05), then we fail to reject that null hypothesis. That is, there is no statistical difference in the average losses suffered by those households (or communities) who received warnings in that they should suffer lower loss than those households (or communities) which did not. This provides evidence that the current or prevailing EWS in Malawi is ineffective in reducing disaster risk.

Key finding: The EWS in Malawi is ineffective in reducing disaster risk.

This finding can be explained by several factors. First, the existing EWS are not people centred (indicators D2, D3 and D9). Secondly, levels of risk knowledge are low. Coverage of risk assessments is incomplete geographically and across hazards (indicator S1). Awareness of the same by households and communities is even lower (indicator D1). Further, there is low response capacity due to incomplete coverage of disaster preparedness and contingency plans and lack of resources where such plans exist.

D. MODELLING DEMAND FOR EWS

Objective 4 of the assignment required the modelling of demand for EWS in the face of climate. In essence, this objective required that we establish determinants of demand for EWS. The question we sought to answer is: *what causes households to require more services offered by the EWS?* We were particularly interested in the demand to receive warnings. Ideally, we should have been interested in what drives the amount of warnings received, which is necessarily a continuous variable. However nature of services within the EWS context, and way data was collected, measuring the amount of warning services received was impossible. Consequently, in the present study, we were interested in what drives the probability of demanding more warning services. We therefore used probability (discrete response) regression model of the probit and logistic type instead of the conventional linear regression models. Our primary model was the probit model.

The dependent variable in our probit model is a categorical variable; precisely, binary dependent variables taking a value of 1 if a household receive a warning a warning and zero otherwise. We are interested in the factors which would increase the probability of household's desire to receive warnings. This outcome variable (whether or a household received a warning) can be thought of as a result of an underlying unobservable latent function. Denoting the observable outcome by y and the unobservable latent variable by y^*, the probit model can be written as in (1).

$$P_r\left(y=1 \mid \vec{x}\right)=\Phi\left(\vec{x}\beta\right) \qquad (1)$$

Where $\vec{x}$ is a vector of independent variables, β is a vector of parameters to be estimated, Φ is the cumulative density function of the standard normal distribution. Equation (1) says that we are interested in modelling the probability that a household will receive warnings (the outcome variable takes a value of 1), given a specified set of explanatory variables under the normality assumption.

The observability criterion of y is given by (2).

$$y* = \vec{x}\beta + \vec{e}, \qquad y = 1\bullet\left(y^* > \theta\right) \qquad (2)$$

Where $\vec{e}$ is a vector of disturbances (error terms) which follows a normal distribution and $1\bullet(\ )$ is an indicator function which shows us that the observable variable y is one when the condition in the parenthesis is met (the latent variable exceeds the threshold θ which usually is normalised to zero). Therefore, the observability criterion in equation (2) is the underlying latent function which determines whether or not the observable outcome takes a value of 1 (a household receive warnings). What we then seek to model using the probit model is the probability that the observable outcome takes a value of 1 (a household receive warnings).

The vector $\vec{x}$ contains socioeconomic variables and EWS-based variables. These variables, their definitions and their apriori expected signs (direction of influence) are shown in Table 3.44 below.

Table 3.44: Definition of variables included in regression models and their expected signs

Variable	**Definition**	**Expected sign**
Socio-economic variables		
Male	Dummy: 1 if respondent is male, 0 if female	+
No education	Dummy: 1 if respondent has no education, 0 otherwise	+
Primary education	Dummy: 1 if respondent has primary education, 0 otherwise	+
Secondary education	Dummy: 1 if respondent has secondary education, 0 otherwise	+
Tertiary education	Dummy: 1 if respondent has tertiary education, 0 otherwise	+
Log of Income per capita	Weather-related natural log of income per person in the household	–
Northern region	Dummy: 1 if respondent resides in the Northern region, 0 otherwise	+
Central region	Dummy: 1 if respondent resides in the Central region, 0 otherwise	-
South region	Dummy: 1 if respondent resides in the Southern region, 0 otherwise	+
EWS-based variables		
Radio	Dummy: 1 if warnings are communicated to respondents via radio, 0 otherwise	+
Messenger	Dummy: 1 if warnings are communicated to respondents via messenger runner, 0 otherwise	+
Log of total loss	Weather-related natural log of annual loss per household due to weather-related natural hazards	+

Warning received timely	Dummy: 1 if warnings are received by respondents in time, 0 otherwise	+
Warning understood	Dummy: 1 if warnings are understood by respondents, 0 otherwise	+
Warning trusted	Dummy: 1 if warnings are trusted by respondents, 0 otherwise	+
Preparedness plan present	Dummy: 1 if a respondent's area has a disaster preparedness plan, 0 otherwise	+
VCPC	Dummy: 1 if a respondent's area has a Village Civil Protection Committee, 0 otherwise	+

The results of the probit model are shown in Table 3.45 below. Following the statistical convention for the probit model, we report the marginal effects and not the coefficients. For binary independent variables, the marginal effects measure the change in the predicted probability as that independent variable change from 0 to 1. For a continuous variable, the marginal effects report the instantaneous rate of change in the predicted probability. For purposes of comparison with respect to direction of influence and statistical significance we also report odds ratios obtained from a logistic regression. The odds ratio show the ratio of the probability of success (a household receiving warnings) to the probability of failure (a household not receiving warnings).

Table 3.45: Regression results from Probit Model and Logistic Model

	Probit Model		**Logistic Model**	
	Marginal effect	**Std. error**	**Odds ratio**	**Std. error**
Male	0.070	(0.066)	0.267	(0.391)
No education	-0.007	(0.066)	0.047	(0.413)
Primary education	-0.021	(0.072)	-0.052	(0.427)
Secondary education	-0.080	(0.298)	-0.707	(2.353)
Central region	0.023	(0.105)	-0.019	(0.653)
Southern region	0.010	(0.102)	-0.089	(0.618)
Log of Income per capita	0.021	(0.018)	0.124	(0.107)
Radio	0.289***	(0.083)	1.720***	(0.462)
Log of total loss	0.050*	(0.027)	0.265	(0.169)
Warning received timely	0.341***	(0.085)	1.992***	(0.486)
Warning understood	0.890***	(0.081)	4.110***	(0.424)
Warning trusted	0.051	(0.079)	0.331	(0.501)
Preparedness plan present	0.152	(0.104)	0.893	(0.625)

VCPC	-0.033	(0.079)	-0.194	(0.473)
_cons	-4.240***	(0.992)	-8.088***	(2.294)
Pseudo r-squared	0.80		0.80	
chi2	545.48		304.63	
p-value	0.000		0.000	

Notes: Robust standard errors in parentheses; * means significant at 10%, ** significant at 5%, *** at 1%

Source: Authors' computation based on data collected from national EWS survey.

The results show that the model provides a good fit of the data, able to explain 80% of the changes in the probability of demanding warning services. The joint hypothesis that all coefficients are simultaneously equal to zero was resoundingly rejected with a p-value for the chi-square statistic at 0.000. Therefore, we can confidently adopt the model as reflecting a reliable process generation for the demand of EWS services.

The results also show that all the socio-economic variables are statistically insignificant. For instance, the probability of demanding warnings is no different between males and females. Neither does it change with levels of education or income per capita. Similarly, there is no difference in the probability of demanding warnings across regions. We therefore find no evidence that demand for EWS is driven by socioeconomic factors.

These findings are confirmed by the logistic regression. The odd ratios for all the socio-economic variables are insignificant. This implies that the odd ratio is statistically 1. That is there no difference in the probability of demanding EWS services and the probability of not demanding the same.

However, the probability of demanding warning services increases as the log of total loss due to hazards increases. Specifically, a one percentage point increase in the log of total loss increases the probability to demand early warnings by 5%. This result is intuitive. Since the log of total loss is the proxy for disaster risk (threat of negative effect caused by a weather-related natural hazard), the higher the risk of loss the higher is the incentive to demand early warnings in to order avoid or at least minimise the actual loss.

The demand for warnings is higher when communicated via radio than the other channels. Specifically, the probability of demanding early warnings is 28.9% higher when communicated through radio than all other media channels. This is probably because other media channels like television and newspapers are not accessible to a significant proportion of the population. There is therefore need to increase allocation of time for communication of forecast and warnings through radios. ***Further, weather related forecasts and warnings communication component must be strengthened among community radios.***

The logistic regression confirms this result. The odds ratio is 1.72 and is statistically significant. This means that warnings communicated through radio are almost twice more likely to be demanded than warnings communicated through other channel.

Furthermore, people are likely to demand warnings if the warnings can be supplied with adequate lead time. Specifically, the demand for timely warnings is 34.1% higher than late warnings. Again, this result is intuitive. The use of warning is to minimise damage or loss. Action to be taken to reduce such loss or damage requires time. Therefore people value warnings which give them enough time to react. ***There is therefore need to improve speed with which warnings are transmitted along the EWS chain from point of warning-generation to the end user.***

The logistic regression confirms this result. The odds ratio is 1.992 and is statistically significant. This means that warnings communicated with adequate lead time are almost twice more likely to be demanded than warning communicated late.

Additionally, the probability of demanding warnings is higher if the respondent can understand the content of the warnings. From our results, this probability is 89% higher for warnings that recipients can easily understand compared to those warnings they don't understand. This means that the literacy and needs of the recipient must be understood so that warnings are tailor made and so easily understood across the spectrum of end users.

One surprising result pertains to the trust recipients have in the warnings. The results show that the marginal effects are insignificant, meaning that whether or not the messages are trustworthy does not matter in terms of demand for warning service. This result may likely be because most households are risk-averse. That is, they have a safety-first attitude in the sense that they would rather act once they receive message whether or not it may be a false.

Presence of disaster preparedness plan doesn't matter for the demand of EWS. This means that people are equally likely to demand warning services whether or not there are those plans in place. This is not surprising since rational households would not wait until the plans for them are made in order to demand more warning services. They would still demand the warning services and do whatever is within their means to reduce the loss associated with hazards. However, this may mean higher cost of coping up.

VCPC, a proxy for community participation, is also found to be insignificant. That is, households will demand more warnings regardless of whether or not they are involved in the EWS processes. This is so because rational households would not wait until they are involved in the EWS processes for them to demand more warning services.

Summary: Demand for EWS services is not driven by socio-economic factors but factors inherent to EWS itself. This demand increases as extent disaster risk (measured by total loss) increases and the warnings are disseminated by radio, are supplied to the recipient timely and in an easily understandable format. These are the important aspects which households pay attention to when deciding whether or not to demand warning services. They are therefore the most critical aspects which must be improved for the EWS to be more useful to the end users.

The NDRMP states that an early warning system can be considered people-centred if individuals, communities and organisations that are threatened by hazards participate in the generation of early warning information and have access to timely and meaningful early warning information that enables them to act timely and appropriately. These results serve to show that a people centred approach to EWS is core to ensuring that EWS is relevant to, and therefore, demanded by households and communities.

E. COST-BENEFIT ANALYSIS OF ADAPTATION STRATEGIES

Objective 3 required that a cost benefit analysis be conducted for various adaptation strategies. We did not attempt a cost benefit analysis for several reasons. Firstly, the data requirements for a reliable coast benefits are beyond what can be achieved by a survey (household or institutional) of this nature. A lifetime of an adaptation strategy must be defined and cash inflows and outflows rigorously worked out of this life and properly discounted. This requirement goes beyond what this survey could realistically achieve. Secondly, cost-benefit analysis within the EWS context is contentious. This is because some costs and benefits cannot be quantified. One key benefit which can never be quantified is lives saved (or loss of life averted). As Rogers and Tsirkunov (2010) note, not counting the value of lives saved implicitly puts a zero value on life and therefore benefits are underestimated. Therefore any cost-benefit analysis within EWS context is suspect.

CHAPTER FOUR

CONCLUSION AND RECOMMENDATIONS

This chapter summarises the discussion of the previous chapter (chapter 3), singling out the key recommendations based on the results obtained therein.

Recommendation 1: Creation of a strategy for community participation

From the analysis of the indicators, there is clear disconnect between the demand side and supply, with the demand side performing badly across all elements of the EWS chain. This is in part due to the fact that community participation is very limited. All indicators of community participation were low (indicators D2, D3, D8 and S10), with the exception of disaster preparedness plans element. Clearly, the existing EWS structures are not people-centred. The NDRMP states that an early warning system can be considered people-centred if individuals, communities and organisations that are threatened by hazards participate in the generation of early warning information and have access to timely and meaningful early warning information that enables them to act timely and appropriately.

A people-centred is recognised to improve the effectiveness of EWS in disaster risk reduction. Therefore, lack of a people-centred approach hampers the effectiveness of the EWS. Thus the ineffectiveness of the EWS in disaster risk reduction observed in the previous chapter is partly explained by this lack of a people-centred approach.

A further advantage of this strategy is that it will also increase demand for EWS. Results from modelling demand for EWS show that a people centred approach to EWS is core to ensuring that EWS is relevant to, and therefore demanded by, households and communities. This means a people centred approach makes the EWS relevant to the end users. This strategy should include strengthening of the VCPC network

Recommendation 2: Establishment of a system for identifying, assessing, monitoring and mapping disaster risk

Risk knowledge is a precondition for effective disaster risk reduction. Risk knowledge requires risk assessments in which the nature of natural hazards is analysed together with vulnerability of communities. Analysis of nature of natural hazards includes such things as patterns, frequency and intensity of natural hazards while analysis of a community's vulnerability involves such things as exposure to natural hazards, extent of fragility and lack of resilience. From such analysis, risk that each community faces is known.

Currently, this process of identifying, assessing and mapping risks has been fragmented and not standardised across institutions. As a result, coverage of risk assessments and maps is not complete (indicator S1) and awareness of the same is even lower (indicator D1). There is therefore need to set up a system for identifying, assessing and mapping risks to ensure that risk assessment is comprehensive and standardised. Further, such a system must be designed such that it encourages community participation and/or ensure that information relating to risk assessments seamlessly flows to the end users.

Recommendation 3: Strengthening monitoring capacity

Monitoring of key parameters associated with occurrence of natural hazards is very critical if lives are to be saved and property losses minimised. Both the HFA and NDRM make a case for a vibrant and well-function monitoring network. However, indicators S3, S4 and S5 show that that there are some gaps and weakness in the monitoring capacity of the responsible institutions. It is therefore recommended that strategies be put in place and funding be made available to strengthen the existing monitoring network

Recommendation 4: Increase coverage of the population have access to forecasts and warnings

A key requirement for an effective EWS is that households and communities that are threatened by hazards have access to timely and meaningful early warning information that enables them to act timely and appropriately. However, in Malawi the proportion which receives warning is only 42.74% (indicator D4). This means that a large share of the population does not have such access. This has serious implications on the effectiveness of the EWS. There is therefore need to increase coverage of the population have access to forecasts and warnings. For those who have access to warnings, radio is the most commonly used media channel. For those who do not get the warning the most important factor is “not owning” a radio. Some responded reported having a radio but not being able to power. These things should be considered in order to increase coverage.

Recommendation 5: Strengthening of response capacity.

As recognised in the NDRMP, strengthening preparedness capacity is key to ensuring rapid and effective response. Effective disaster response and recovery is dependent on stakeholders and communities being in a state of preparedness to deal with different types of disasters which the country is prone to. Response capacity is currently weak. Coverage is not complete geographically and across hazards (indicator S5). Awareness of existence of preparedness plans by communities is very low (indicator D9). Where preparedness plans exist, they are not operational mostly due to lack of resources. There therefore is need to strengthen the response capacity by instituting mandatory response plans for each hazards with complete geographical coverage. Funds should be made available to ensure that the plans are always operational. Emergency response centres should be set up to facilitate such operationalisation

Recommendation 6: Strengthening the human and financial capacity of the institutions across all elements of EWS

A common reason why most institutions are not delivering is due to lack of funding. This was the commonly cited reason for not performing risk assessment activities and preparedness plans. It was also critical reason why most institutions involved in monitoring parameters associated with natural hazards use outdated equipment and fail to maintain faulty equipment.

Recommendation 7: Establishment of Comprehensive and integrated Early Warning System

An effective EWS is one which is not only people centred but also integrated. An integrated EWS is one which employs a multi-hazard approach. This ensures that the EWS is comprehensive and the synergies are harnessed across the hazards involved. The existing EWS structures are fragmented and not coordinated. This is evidenced, for example, by the differences in degrees of coverage of risk assessments and preparedness plans. There is need to develop and strengthen an integrated EWS.

APPENDICES

APPENDIX A: HOUSEHOLD QUESTIONNAIRE

DEPARTMENT OF DISASTER MANAGEMENT AFFAIRS

BASELINE SURVEY ON

EARLY WARNING SYSTEMS IN MALAWI

HHLD ID |__|__|__|__|

1. **District** |_ _||_ _||_ _|
2. **Traditional Authority** |_ _||_ _|
3. **Enumeration Area** |_ _||_ _||_ _|
4. **Household Identification** |_ _||_ _||_ _|
5. **Supervisor** |_ _||_ _||_ _|
6. **Name of Household Head** ________________________________

INTRODUCTION

START TIME: RECORD THE TIME THAT YOU START THIS INTERVIEW: |__|__|: |__|__|

CONVEY THE FOLLOWING INFORMATION TO THE HOUSEHOLD TO BE INTERVIEWED

"Good [MORNING/AFTERNOON/EVENING]. My name is [NAME] and I am working for **e-CRG Consulting** doing research on behalf of **Department of Disaster Management Affairs**. Climate change is increasing the frequency and intensity of weather-related natural hazards (e.g. floods, droughts, mwera winds, earthquakes etc). We are interested in finding out how people in different place get warnings of natural hazards and how their livelihoods are affected by natural disasters. Your household has been selected at random to participate in this survey. The Department of Disaster Management Affairs will only use this data for statistical purposes and no one will find out what you personally have said."

Interviewer note: Read the following only if respondent asks about the length of the interview: "The interview takes about 30 minutes on average to complete, but it varies from person to person."

"I would like to begin by asking you some questions about you and the members of your household. Please note, by members of your household I mean those who eat from the same pot. By household head I mean the main financial decision maker in the household. Let's start with the head of household and then list all other household members in age order, starting with the oldest first."

Contents

SECTION A: HOUSEHOLD DEMOGRAPHIC INFORMATION

Interviewer note: List all members of the household

ROSTER NUMBER	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11
	Q: What are the names of all persons who are members of this household?	Q: Is [NAME IN A01] male or female? A: *CODES* Male …1 Female …2	Q: What is the relationship of [NAME IN A01] to the head of the household? *A: CODES* Head…………………1 Spouse/partner…....2 Child…………….....3 Grandchild………...4 Parent……………...5 Sibling……………..6 Brother/sister-in-law 7 Niece/nephew……..8 Other relative...........9 Domestic help........10 Other (specify)........11	Q: How old was [NAME IN A01]at his/her last birthday?	Q: What is this person's marital status? Married monogamous..1 Married polygamous….2 Informal union………..3 **>> Go to A06** Divorced...........4 Separate..........5 Widowed..........6 Never married...........7 **>> Go to A07**	Q: Copy roster number of spouse if A5 = 1, 2, or 3	Q: Can [NAME IN A01] read and write in English, Chichewa or Tumbuka? *A: CODES* Yes….1 No......2	Q: What is the highest level of schooling that [NAME IN A01] has completed? *A: CODES* Some or no primary.................1 Primary (St.1-5).......2 Primary (St.6-8).......3 Secondary (1-2)......4 Secondary (3-4)......5 Tertiary (college or university)............6 Other (specify)…..7	Q: How would you describe [NAME IN A01] <u>main</u> status in the last four weeks? A: CODES Employed, formal sector.........1 Employed, informal sector......2 Self-employed, including own farm, unpaid family worker..3 Looking for work......................4 Waiting for busy season… .....5 Studying…..............................6 Retired…...............................7 Sick/disabled…......................8 Housewife/house-work/caring for household member…….9 Other…..................................10	ASK OF HH HEAD ONLY Q: What is the monthly income of the household?	ASK OF HH HEAD ONLY Q: What language do you speak at home? USE CODES BELOW
	NAME			YEARS		R. NO.					
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

A12 *INTERVIEWER:* Write roster number of person who provided this information: **|__|__|**

CHEWA…..1	TUMBUKA….4	NGONI……….7	TONGA….10	SUKWA……………….13
NYANJA….2	NKHONDE…5	SENA………..8	LAMBYA…11	ENGLISH…………….14
YAO………3	LOMWE…….6	NYAKYUSA…9	SENGA…..12	OTHER (SPECIFY)….15

SECTION B: LIVELIHOODS- AGRICULTURE

Interviewer note: The respondent should be household head. In the event that the head is not available, interview the spouse.

B01	B02	B03	B04		B05	B06		B07			B08			B09
Q: Did you or anyone in the household plant any crop in the last (2015/ 2016) cropping season? *A: CODES* YES…1 NO….2 >> Next section **ENUMERATOR:** DO NOT LIST TEA, COFFEE OR ANY FRUITS. FIRST ASK THE HOUSEHOLD TO LIST ALL TYPES OF CROPS PLANTED DURING THE 2015/2016 RAINY SEASON. ONCE LISTING IS COMPLETED, GO THROUGH THE ENTIRE SECTION FOR EACH CROP, ONE CROP AT A TIME.	CROP CODE Maize…………...1 Tobacco……….2 Rice…………….3 Sweet potato…...4 Irish potato…....5 Sorghum……....6 Beans………….7 Soybeans……...8 Pigeon peas…..9 Peas……………10 Cotton………..11 Sunflower……...12 Tomato...….....13 Onion…………14 Paprika………..15 Cabbabe……..16 Tanaposi……..17 Groundnuts….18 Other (specify).19	Q: Was [CROP NAME] grown on the same plot with other crops? *A: CODES* YES…1 NO…..2	Q: What was the area planted during the 2015/2016 rainy season? CODES FOR UNIT Acre……………….1 Hectare…………..2 Square metre……..3 Other (specify)……4		Q: Was the area harvested less than area planted or were there any losses of [CROP] before harvest? *A: CODES* YES…1 NO…..2>>B07	Q: Why was the area harvested less than area planted? READ ANSWERS LIST UP TO 2 REASONS Drought……………….1 Dry spell…………..2 EFFECTS OF: Floods…….………...3 Strong winds…….…..4 Locust………………..5 Animals………..……..6 Crop theft……….…...7 Diseases….…..……..8 Lack of hired labor.…..9 Other (Specify)……….10		Q: How much [CROP] did you harvest during the 2015/2016 rainy season? FOR ALL APPLICABLE CROPS, MAKE SURE TO ASK WHETHER THE REPORTED VALUE IS SHELLED OR UNSHELLED. If B5 is NO…..2>>B09			Q: How much [CROP] would you harvest in a normal rainy season? FOR ALL APPLICABLE CROPS, MAKE SURE TO ASK WHETHER THE REPORTED VALUE IS SHELLED OR UNSHELLED.			Q: Did you sell any of the harvested [CROP] during the 2015/2016 rainy season? *A: CODES* YES…1 NO…..2>>B11
			Area	Unit		1st	2nd	Quantity	Unit	S/U	Quantity	Unit	S/U	

TO ACCOMPANY INFORMATION COLLECTED ON "QUANTITY", WITH THE EXCEPTION OF LAND AREA:
CODES FOR UNIT:
KILOGRAM......1 PAIL (SMALL)…..4 NO. 12 PLATE….7 BALE........................10 NKHOKWE…..13
50 KG BAG.....2 70 kg BAG PAIL (LARGE)…..5 BUNCH............... 8 BASKET (*DENGU*)..11
90 KG BAG.....3 NO. 10 PLATE….6 PIECE..................9 OX-CART.................12

CODE FOR S/U:

S: SHELLED....1 U: UNSHELLED….2 NOT APPLICABLE...3

	B10			B11		B12	
Crop code	Q: How much [CROP] did you sell in the 2015/2016 rainy season?			Q: What was the price per unit of [CROP]?		Q: If you were to sell [CROP], what would be the price per unit?	
	Quantity	Unit	S/U	Price	Unit	Price	Unit

TO ACCOMPANY INFORMATION COLLECTED ON "QUANTITY", WITH THE EXCEPTION OF LAND AREA:

<u>CODES FOR UNIT:</u>

KILOGRAM......1	PAIL (SMALL)…..4	NO. 12 PLATE….7	BALE........................10	OTHER (SPECIFY)…..13
50 KG BAG.....2	PAIL (LARGE)…..5	BUNCH............... 8	BASKET (*DENGU*)..11	
90 KG BAG.....3	NO. 10 PLATE….6	PIECE..................9	OX-CART.................12	

<u>CODE FOR S/U:</u>

S: SHELLED....1 U: UNSHELLED….2 NOT APPLICABLE...3

END OF SECTION B

SECTION C: LIVELIHOODS-FISHERIES

Interviewer note: the respondent should be household head. In the event that the head is not available, interview the spouse.

C01	C02	C03	C04								C05	
Q: Did anyone in this household get involved in fishing, fish processing? [This could be full or part time.] *A: CODES* YES…1 NO…2 >> Next section	Q: Please list up to five main species of fish that you or any member of your household have landed as a fisher during the last HIGH fishing season. CODES FOR FISH SPECIES: MAKAKANI….1 MAKUMBA…..2 MLAMBA……3 MATEMBA…..4 NKUNGA……5 CHAMBO……6 NYESI…….7 NCHENI……8 USIPA…….9 UTAKA……10 OTHER (SPECIFY)..11 AGGREGATED.12	Q: How many weeks have you or any member of your household landed [FISH SPECIES] during the last HIGH season?	Q: How much [FISH SPECIES] did you, other members of your household and/or any hired fishers **catch** on average per week during the last HIGH fishing season? What was the price per unit of packaging? RECORD QUANTITY FOR UP TO TWO DIFFERENT TYPES OF PROCESSING.								**ENUMERATOR:** FOR EACH SPECIES, MULTIPLY THE AMOUNT LANDED / WEEK (QUESTION 4) BY THE TOTAL NUMBER OF WEEKS OF FISHING (QUESTION 3).	
		NO. OF WEEKS	**PROCESSING TYPE # 1**				**PROCESSING TYPE # 2**				**PROCESSING TYPE # 1**	**PROCESSIN G TYPE # 2**
			Landed quantity	Form of packaging	Form of processing	Price (MK) per unit	Landed quantity	Form of packaging	Form of proces sing	Price (MK) per unit		

<u>CODES FOR FISH PACKAGING</u>:
PIECE ………1
DOZEN/BUNDLE…2
KILOGRAM…….3
5 KG BAG…….4
10 KG BAG……5
25 KG BAG……6
SMALL BASKET…7
LARGE BASKET…8
OTHER(SPECIFY)……9

<u>CODES FOR PROCESSING:</u>
FRESH……1
SUN-DRIED..2
SMOKED…..3
ICED…….4
OTHER (SPECIFY)..5

C06	C07		C08	
Q: Was the catch of [SPECIES] for last season lower than normal catch in a regular year? *A: CODES* YES…1 NO….2 >> Section D	Q: What would be the catch of [SPECIES] in a regular year? <u>CODES FOR FISH PACKAGING</u>: PIECE ....1 DOZEN/BUNDLE...2 KILOGRAM.......3 5 KG BAG.......4 10 KG BAG......5 25 KG BAG......6 SMALL BASKET...7 LARGE BASKET...8		Q: Why was the catch last season lower than normal catch? *A: CODES* Mwera winds…1 Low water levels..2 Siltation…….3 Water pollution…4 Lack of fishing equipment…5 Other (specify)..6	
	Landed quantity	Unit	1st	2nd

SECTION D: NATURAL HAZARDS

D01		D02	D03	D04					D05				
Q: In the past three years, did you experience any weather-related natural hazards? *A: CODES* YES…1 NO…..2	**ENUMERATOR:** FIRST ASK THE HOUSEHOLD TO LIST ALL WEATHER-RELATED NATURAL HAZARDS ONCE LISTING IS COMPLETED, GO THROUGH THE ENTIRE SECTION FOR THE THREE MOST SIGNIFICANT, ONE HAZARD AT A TIME.	Q: Hazard code USE CODES PROVIDED BELOW	Q: In which year did the hazard occur? IF THE HAZARD OCCURRED MORE THAN ONCE, RECORD THE YEAR FOR MOST RECENT OCCURENCE	Q: As a result of the [HAZARD], did your […] READ RESPONSES FOR EACH COLUMN *A: CODES* Increase ………..1 Decrease……….2 Did not change…3>>D07					Q: What was the estimated value of the [INCREASE/ DECREASE] in […] ? READ RESPONSES FOR EACH COLUMN				
				Assets	income	Food production	Food stock	Food purchases	Assets	Income	Food production	Food stock	Food purchases

CODES FOR NATURAL HAZARDS

Drought/erratic rains…………………..…1	Hailstorm…………………..…5
Floods/Flashfloods……..………………..2	Thunderstorm/lightening…6
Earthquakes/earthtremors……………..3	Locust swarm…………..….7
Storm surge/ mwera winds…………...4	Other (specify)……………8

	D06			D07	D08		D09		D10		D11	D12	
Hazard code	Q: What did your household do in response to this [HAZARD] to try to regain your former welfare level? FOR EACH HAZARD, LIST UP TO 3 ANSWERS BY ORDER OF IMPORTANCE. IF THE HAZARD HAPPENED MORE THAN ONCE DURING THE LAST THREE YEAR, ASK ABOUT THE MOST RECENT INCIDENT. USE CODES BELOW.			Q: Did you receive any kind of warning of this [HAZARD]? *A: CODES* YES…1 NO…..2>>D14	Q: why did you not receive any warning? *A: CODES* Don't have radio…1 Don't have television..2 Cant afford to buy a Newspaper……….3 Messenger runner did not deliver message..4 Didn't know media used for communicating the warning……………5 Other (specify)…….6		Q: Through which communication channel did you get the warning? *A: CODES* Radio………....1 Television........2 Internet……….3 Newspaper.….4 Messenger runner………..5 SMS…………..6 Mobile App…. 7 Other (specify)……..8		Q: In what language did you get the warning? USE LANGUAGE CODES IN SECTION A		Q: Did you understand the warning? *A: CODES* YES…1>>D13 NO…..2	Q: Why did you not understand the warnings? *A: CODES* communicated not in my language…1 language used is technical………..2 Not familiar with warnings signals used……………3 Warnings communicated inconsistently…4 Other (specify)…5	
	1st	2nd	3rd		1st	2nd	1st	2nd	1st	2nd		1st	2nd

RELIED ON OWN-SAVINGS……1
RECEIVED UNCONDITIONAL HELP FROM RELATIVES/FRIENDS……2
RECEIVED UNCONDITIONAL HELP FROM GOVERNMENT……3
RECEIVED UNCONDITIONAL HELP FROM NGO/RELIGIOUS INSTITUTION……4
CHANGED EATING PATTERNS (RELIED ON LESS PREFERRED FOOD OPTIONS, REDUCED THE PROPORTION OR NUMBER OF MEALS PER DAY, OR HOUSEHOLD MEMBERS SKIPPED DAYS OF EATING, ETC.) ……5
EMPLOYED HOUSEHOLD MEMBERS TOOK ON MORE EMPLOYMENT……6
ADULT HOUSEHOLD MEMBERS WHO WERE PREVIOUSLY NOT WORKING HAD TO FIND WORK……7
HOUSEHOLD MEMBERS MIGRATED……8
REDUCED EXPENDITURES ON HEALTH AND/OR EDUCATION……9
OBTAINED CREDIT……10
SOLD AGRICULTURAL ASSETS.11
SOLD DURABLE ASSETS……12
SOLD LAND/BUILDING……13
SOLD CROP STOCK……14
SOLD LIVESTOCK……15

INTENSIFY FISHING……16
SENT CHILDREN TO LIVE ELSEWHERE……17
ENGAGED IN SPIRITUAL EFFORTS -PRAYER, SACRIFICES, DIVINER CONSULTATIONS……18
DID NOT DO ANYTHING……19

D13	D14	D15		D16	D17	D18	D19		D20
Q: Did you get the warning in good time to take appropriate action when [HAZARD IN D01] occurred? *A: CODES* YES…1>>D15 NO…..2	Q: Why did you not get the warning in good time to take appropriate action when [HAZARD IN D01] occurred? *A: CODES* The messenger runner was late..2	Q: What action did you take when [HAZARD IN D01] occurred? *A: CODES* Moved to uplands…1 Diversified crops grown…….2 Did not go fishing…3 Nothing…..4 Other (specify)..5		Q: Did the action you took reduce loss when [HAZARD IN D01] occurred? *A: CODES* YES…1 NO…..2	Q: Are you regularly updated on [HAZARD]? *A: CODES* Always…1 Most times…2 Sometimes..3 Never…..4	Q: How regularly do you get this information? *A: CODES* Daily….1 Weekly….2 Monthly…3	Q: How do you get information on [HAZARD]? *A: CODES* Radio………....1 Television........2 Internet……….3 Newspaper.….4 Messenger runner…………5 SMS………….6 Mobile App…. 7 Other (specify)……...8		Q: Do you trust the messages/ do you find the messages useful? *A: CODES* YES...1 NO….2
		1st	2nd				1st	2nd	

END OF SECTION D

SECTION E: EARLY WARNING SYSTEM

E01	E02	E03	E04	E05	E06	E07	E08		E09
ENUMERATOR: COPY DOWN THE HAZARDS FROM D02 GO THROUGH THE ENTIRE SECTION FOR THE FOUR MOST SIGNIFICANT, ONE HAZARD AT A TIME	Q: Are there hazard maps for [HAZARD IN A01] for your community? *A: CODES* YES……….1 NO………..2 DON'T KNOW…..3	Q: Is there an integrated hazard map for all [HAZARDS IN E01] in your community? *A: CODES* YES…………1 NO………….2 DON'T KNOW..3	Q: In the past three years, has there been a vulnerability assessment of your community for [HAZARD IN E01]? *A: CODES* YES………..1 NO..2>>E06 DON'T KNOW..3	Q: Are there vulnerability maps of your community for [HAZARD IN E01]? *A: CODES* YES……1 NO………..2 DON'T KNOW…….3	Q: In the past three years, has there been a risk assessment of your community for [HAZARD IN E01]? *A: CODES* YES……1 NO………..2 DON'T KNOW…3	Q: Is your community involved in the risk assessment for [HAZARD IN E01]? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Which factors increase the risk of your community for [HAZARD IN E01]? *A: CODES* Farming in river banks….1 Late planting……………..2 Use of less drought-resistant varieties……….3 Lack of crop diversification…………….4 Settling close river………5 Substandard dwelling places……………………..6 Urbanisation………………7 Deforestation………………8 Lack lightening protectors……………..….9 Other (specify)…………10		Q: Is your community involved in monitoring [HAZARD IN E01]? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5
							1st	2nd	

	E10		E11	E12		E13		E14	E15	E16	E17	
Hazard code	Q: what tools do you use to monitor [HAZARD IN E01]? Weather stations Automatic………..1.1 Manual…………..1.2 Hydrological stations……2 River gauges…….3 Rainfall logging stations..4 Satellite…………. 5 Radar …………….6 Agro-meteorological stations…………..7 Weather buoy…. 8 Lightening sensors.. 9 Other (specify)….10		Q: Before a [HAZARD IN E01] occurs, do you get warnings? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4>>E18 Don't know…5	Q: Through which media do you get warnings on [HAZARD]? *A: CODES* Radio…....1 Television........2 Internet……….3 Newspaper.….4 Messenger runner…………5 SMS…………..6 Mobile App…. 7 Other (specify)……..8		Q: In what language do you get warnings on [HAZARD]? USE CODES IN A11		Q: Do you understand warnings for [HAZARD]? *A: CODES* YES...1>>E16 NO….2	Q: Why do you not understand the warnings for [HAZARD]? *A: CODES* communicated not in my language…1 language used is technical………..2 Not familiar with warnings signals used……………3 Warnings communicated inconsistently…4 Other (specify)…5	Q: Do you trust the warnings for [HAZARD]? *A: CODES* YES...1>>E18 NO….2	Q: Why do you not trust the warnings? LIST UP TO TWO RESPONSES *A: CODES* Predictions usually not accurate...............1 Warnings not differentiated from forecasts…………..2 Indigenous knowledge not incorporated ….3 Low public awareness of warning signals…4 Don't know…….5 Other (specify)…..6	
	1st	2nd		1st	2nd	1st	2nd				1st	2nd

E18	E19	E20		E21	E22	E23	E24	E25
Q: Do you use indigenous knowledge in predicting hazards? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Do you get warnings in time to take appropriate action? *A: CODES* YES…..1 NO……2	Q: Approximately how much time you are given between getting the warning and the hazard occurring? CODES FOR UNITS Minute……….1 Hours……..2 Days…..3 Weeks…..4 Months….5		Q: What communication channels you think is the most timely? *A: CODES* Radio………...1 Television........2 Internet……….3 Newspaper.….4 Messenger runner…………5 SMS…………..6 Mobile App…. 7 Other (specify)……...8	Q: Which media or channel would you prefer to receive the warnings? *A: CODES* AM Radio………...1 Television........2 Internet……….3 Newspaper.….4 Messenger runner…………5 SMS…………..6 Mobile App…. 7 Other (specify)……...8	Q: When you get a warning of [HAZARD INE01] at actions do/would you take? *A: CODES* Moved to uplands…1 Diversified crops grown…….2 Did not go fishing…3 Other (specify)..4	Q: are you notified when a disaster has ended? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Which media or channel would you prefer to receive the notification? *A: CODES* Radio………...1 Television........2 Internet……….3 Newspaper.….4 Messenger runner…………5 SMS…………..6 Mobile App…. 7 Other (specify)……...8
		Time	Unit					

	E26	E27	E28	E29		E30	E31
Hazard code	Q: Is there a disaster preparedness and response plan for [HAZARD IN E01] in your area? *A: CODES* YES…………1 NO…………...2>>E28 DON'T KNOW…3	Q: Was you community involved in preparing the disaster preparedness and response plan for [HAZARD IN E01]? *A: CODES* YES…………1 NO…………...2 DON'T KNOW…3	Q: do you have Civil protection committee? *A: CODES* YES…………1 NO……..2>>E30 DON'T KNOW…3	Q: What is the role of the civil protection committee? *A: CODES* Monitoring of weather-related parameters..1 Dissemination of warnings…..2 Identifying beneficiaries ….3 Plan distribution of relief items…4 Holding duty bearers accountable…5 Don't know…………………..6 Other (specify)……………..7		Q: Is your community involved in communication of warnings? *A: CODES* YES…………1 NO…………...2 DON'T KNOW…3	Q: Is your community involved in disaster risk management? *A: CODES* YES…………1 NO…………...2 DON'T KNOW…3
				1st	2nd		

END OF SECTION E

Thank person for their help and close interview.

APPENDIX B: INSTITUTIONAL QUESTIONNAIRE

Department of Disaster Management Affairs

INSTN ID |__|__|__|__|

BASELINE SURVEY ON

EARLY WARNING SYSTEMS IN MALAWI

1. **District code** |_ _||_ _||_ _|
2. **Institution Identification** |_ _||_ _||_ _|
3. **Position of interviewee** ______________________________

INTRODUCTION

CONVEY THE FOLLOWING INFORMATION TO THE HOUSEHOLD TO BE INTERVIEWED (Include in App Help Menu)

"Good [MORNING/AFTERNOON/EVENING]. My name is [NAME] and I am working for **e-CRG Consulting** doing research on behalf of **Department of Disaster Management Affairs**. Climate change is increasing the frequency and intensity of weather-related natural hazards (e.g. floods, droughts, mwera winds, earthquakes etc). We are interested in finding out how people in different place get warnings of natural hazards and how their livelihoods are affected by natural disasters. Your institution has been selected at random to participate in this survey. The Department of Disaster Management Affairs will only use this data for statistical purposes and no one will find out what you personally have said."

Interviewer note: Read the following only if respondent asks about the length of the interview: "The interview takes about 30 minutes on average to complete, but it varies from person to person."

Contents

SECTION A: RISK KNOWLEDGE

A01	A02		A03	A04	A05	A06	A07	A08	A09
Q: What are the most frequent natural hazards in this area? A: LIST UP TO 4 HAZARDS Drought/erratic rains………….1 Floods/flash floods…………..2 Earthquakes/earthtremors…..3 Storm surge/Mwera winds…..4 Hailstorm……………………..5 Thunderstorm/lightening……..6 Locust swarm………………...7 Other (specify)………………8 INSTR-to-ENUMERATOR: FIRST ASK THE RESPONDENT TO LIST ALL WEATHER-RELATED NATURAL HAZARDS ONCE LISTING IS COMPLETED, GO THROUGH THE ENTIRE SECTION FOR THE FOUR MOST SIGNIFICANT, ONE HAZARD AT A TIME.	Q: With what frequency does [HAZARD IN A01] occur in this area? A: CODES FOR UNITS Week………..1 Month……….2 Quarterly……3 Semi-annual….4 Year…………5 Biannual……6 Other (specify)…7		Q: Are there hazard maps for [HAZARD IN A01] for this area? *A: CODES* YES……1>>A 05 NO………..2 DON'T KNOW……3	Q: Why are there no hazard maps for [HAZARD IN A01] for this area? *A: CODES* Lack of funding…1 Lack of expertise…2 lack of legal or policy basis……..3 Corruption…4 other (specify)….5	Q: Is there an integrated hazard map for all [HAZARDS IN A01] in this area? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: In the past three years, has there been a vulnerability assessment of communities for [HAZARD IN A01]? *A: CODES* YES…1>>A08 NO…..2 DON'T KNOW..3	Q: Why has there been no vulnerability assessment of communities for [HAZARD IN A01] for this area? *A: CODES* Lack of funding…1 Lack of expertise…2 lack of legal or policy basis……..3 other (specify)….4	Q: Are there vulnerability maps of communities for [HAZARD IN A01]? *A: CODES* YES……1 NO…………..2 DON'T KNOW……….3	Q: In the past three years, has there been a risk assessment of communities for [HAZARD IN A01]? *A: CODES* YES……1>>A11 NO……………..2 DON'T KNOW…3
	Frequency	Unit							

A10	A11	A12	A13	A14	A15	A16	A17	A18	A19
Q: Why has there been no vulnerability assessment of communities for [HAZARD IN A01] for this area? *A: CODES* Lack of funding…1 Lack of expertise…2 lack of legal or policy basis……..3 Corruption…4 other (specify)….5	Q: Were communities involved in local hazard and vulnerability assessment for [HAZARD IN A01]? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: Which factors increase the risk of communities for [HAZARD IN A01]? *A: CODES* Farming in river banks….1 Late planting……………..2 Use of less drought-resistant varieties……….3 Lack of crop diversification…………….4 Settling close river………5 Substandard dwelling places……………………..6 Urbanisation..................….7 Deforestation.................….8 Lack lightening protectors………………..….9 Other (specify)…………10	Q: How is the information on Hazards, vulnerabilities and risk associated with [HAZARD IN A01] stored? *A: CODES* Website…….1 Library……2 Other (specify)….3	Q: Is the information on [HAZARD IN A01] accessible? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: What is the estimated percentage of the population that has access to hazard maps for [HAZARD]? RECORD ANSWERS ON A SCALE FROM 0 TO 100	Q: Is there a national organisation coordinating hazard identification, vulnerability and risk assessment [HAZARD IN A01]? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: Is there legislation or government policy for the preparation of hazard and vulnerability maps [HAZARD IN A01]? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: Are there national standards for the systematic collection, sharing and assessment of vulnerability data[HAZARD IN A01]? *A: CODES* YES…1 NO…..2>>A20 DON'T KNOW..3	Q: Are these standards [HAZARD IN A01] within international standards? *A: CODES* YES…1 NO…..2 DON'T KNOW..3

SECTION B: MONITORING AND WARNING SERVICES

B01	B02	B03			B04			B05			B06		B07	B08		
ENUMERATOR: COPY DOWN THE HAZARDS FROM A01 GO THROUGH THE ENTIRE SECTION FOR THE FOUR MOST SIGNIFICANT, ONE HAZARD AT A TIME	Q: Is your institution involved in monitoring [HAZARD]? *A: CODES* YES…1 NO…..2>> SECTION C	Q: What equipment do you use to monitor [HAZARD]? *A: CODES* Weather stations Automatic………..1.1 Manual…………..1.2 Hydrological stations……2 River gauges…………….3 Rainfall logging stations..4 Satellite…………………. 5 Radar ………………..….6 Agro-meteorological stations…………………..7 Weather buoy………… 8 Lightening sensors…… 9 Other (specify)………..10			Q: How many [EQUIPMENT IN B03] do you have to monitor [HAZARD IN B01]? *A: CODES*			Q: How many [EQUIPMENT IN B03] are non-functional? *A: CODES* If zero >>B07			ASK OF THE NON-FUNCTIONAL EQUIPMENT Q: For how long has [EQUIPMENT IN B03] been non-functional? *A: CODES* CODES FOR UNITS Week………..1 Month……….2 Year………..3 Other (specify)…4		Q: What prediction models do you use? *A: CODES* Land surface model…..1 Hydrological model Flood……….2.1 Drought…….2.2 Weather model…....3 Climate model….......4 Other (specify)……..5	Q: What parameters in [MODEL IN B07] do you monitor? *A: CODES* Precipitation………1 Temperature……..2 Soil moisture……..3 Wind speed……..4 Wave height…….5 Amount of rainfall..6 Other (specify)……7		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	Time	Unit		1st	2nd	3rd

B09			B10			B11						B12	B13	B14	B15		
Q: At what intervals is data on [PARAMETER] collected? *A: CODES* Hourly…………1 Daily………….2 Weekly……….3 Monthly……..4 Quarterly…….5 Other (specify)…6			Q: How is the information on [PARAMETER] stored/archived? *A: CODES* Website…….1 Library……2 Other (specify)….3			Q: What is the threshold value of [PAREMETER] to issue a warning? *A: CODES FOR UNITS* Millimetres……1 Height………..2 Speed ………3 Degrees Celsius…4 Other (specify)….5						Q: Is your institutions responsible for issuing warnings for [HAZARD]? *A: CODES* YES……1 NO……2 DON'T KNOW…3	Q: Is there only one institution responsible for issuing warnings for [HAZARD]? *A: CODES* YES……1>>B15 NO……2 DON'T KNOW…3	Q: Is there coordination among institutions responsible for issuing warnings? *A: CODES* Always….…1 Most times...2 Seldom……3 Never………4	Q: is the threshold value of [PAREMETER] to issue a warning in accordance with international standards? *A: CODES* YES……1 NO……2 DON'T KNOW…3		
1st	2nd	3rd	1st	2nd	3rd	1st		2nd		3rd							
						Value	Unit	Value	Unit	Value	Unit				1st	2nd	3rd

B16			B17		
Q: Do you access information on [PARAMETER] from a neighbouring territory or an international source? *A: CODES* YES……1 NO……2>>C01 DON'T KNOW…3			Q: At what intervals do you access information on [PARAMETER] from a neighbouring territory or an international source? *A: CODES* Hourly…………1 Daily………….2 Weekly……….3 Monthly……..4 Quarterly…….5 Other (specify)…6		
1st	2nd	3rd	1st	2nd	3rd

END OF SECTION B

SECTION C: DISSEMINATION AND COMMUNICATION

C01	C02		C03	C04		C05		C06		C07	C08	C09
ENUMERATOR: COPY DOWN THE HAZARDS FROM A01 GO THROUGH THE ENTIRE SECTION FOR THE FOUR MOST SIGNIFICANT, ONE HAZARD AT A TIME	Q: What media is used to disseminate the warnings for [HAZARD IN C01]? RECORD UP TO TWO RESPONSES *A: CODES* Radio…………..1 Television........2 Newspaper..…3 Message runner…………4 SMS…………..5 Mobile App…. 6 Other (specify)……...7		Q: Through which form of media do most people access warning messages for [HAZARD IN C01]? *A: CODES* Radio…………..1 Television........2 Internet……….3 Newspaper..…4 Messenger runner…………5 SMS…………..6 Mobile App…. 7 Other (specify)……...8	Q: In what language are the warnings [HAZARD IN C01] disseminated? *A: CODES* English….1 Chichewa….2 Tumbuka…3 Yao….4 Other (specify)….5		Q: How much time does it take for the warnings to reach the intended recipients? *A: CODES FOR UNITS* Minutes…1 Hours……2 Days…….3 Weeks…….4 Months….5		Q: How much lead time are the communities given to respond to warning? *A: CODES FOR UNITS* Minutes…..1 Hours……2 Days……….3 Weeks…….4 Months…..5		Q: Are the warnings understood by the intended recipients? *A: CODES* Always…1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Is there any feedback mechanism when the warnings reach the intended recipients? *A: CODES* YES…1 NO…..2>>C10 DON'T KNOW..3	Q: What are the feedback mechanism when the warning reaches the intended recipients? *A: CODES* Radio…………..1 Local meeting.......2 Internet……….3 Telephone …..4 Messenger runner…………5 SMS…………..6 Mobile App…. 7 Other (specify)...8
	1st	2nd		1st	2nd	Time	Unit	Time	Unit			

C01	C10					C11	C12	C13	C14	C15	C16
Hazard code	Are the following differences in characteristics of those at risk taken into account when disseminating warnings for [HAZARD IN C01]? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5					Q: Are warnings for [HAZARD IN C01] geographically-specific to those at risk? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: Is the warning dissemination chain for [HAZARD IN C01] enforced by government policy or legislation? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: Are there clear roles and responsibilities for each actor in the warning system for [HAZARD IN C01]? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: Is there a standard procedure for disseminating warnings for all hazards? *A: CODES* YES…1 NO…..2 DON'T KNOW..3	Q: Are communities involved in warning dissemination for [HAZARD IN C01]? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Are the communities informed when a threat has ended? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5
	Cultural diversity	Gender	Language	Educa tion	Special needs						

SECTION D: RESPONSE CAPACITY

D01	D02	D03		D04		D05	D06	D07	D08
ENUMERATOR: COPY DOWN THE HAZARDS FROM A01 GO THROUGH THE ENTIRE SECTION FOR THE FOUR MOST SIGNIFICANT, ONE HAZARD AT A TIME	Q: Are warnings for [HAZARD IN D01] respected? *A: CODES* Always……1>>D05 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Why are warnings for [HAZARD IN D01] are not respected? LIST UP TO TWO RESPONSES *A: CODES* Predictions usually not accurate..............1 Warnings not differentiated from forecasts…………..2 Indigenous knowledge not incorporated ….3 Low public awareness of warning signals…4 Don't know…….5 Other (specify)….6		Q: What is being done to ensure warnings for [HAZARD IN D01] are respected? LIST UP TO TWO RESPONSES *A: CODES* Improving Predictions accuracy..............1 Differentiating warnings not from forecasts…………..2 Incorporating Indigenous knowledge ….3 Raising public awareness of warning signals…4 Nothing………….5 Don't know………6 Other (specify)….7		Q: Are there disaster preparedness and response plans for [HAZARD IN D01]? *A: CODES* YES…………1>>D07 NO……………2 DON'T KNOW…..3	Q: Why are there no disaster preparedness and response plans for [HAZARD IN D01]? *A: CODES* Lack of funding…1 Lack of expertise…2 lack of legal or policy basis……..3 other (specify)….4	Q: Are hazard and vulnerability maps used in developing disaster preparedness and response plans for [HAZARD IN D01]? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Are the communities at risk involved the formulation and implementation of disaster preparedness and response plans for [HAZARD IN D01]? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5
		1st	2nd	1st	2nd				

	D09	D10	D11	D12		D13	D14	
Hazard code	Q: Are the disaster preparedness and response plans for [HAZARD IN D01] disseminated to communities at risk? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Are the disaster preparedness and response plans for [HAZARD IN D01] empowered by law? *A: CODES* YES……………1 NO………………..2 DON'T KNOW…….3	Q: Are communities able to respond to early warnings? *A: CODES* Always……1>>D13 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Q: Why are communities not able to respond to early warnings? RECORD UP TO TWO RESPONSES *A: CODES* Communities not educated on how to respond…….1 Low awareness of disaster risk…2 Warnings not respected…………..3 Lack of policy or legislation……4 Lack of response plans……..5 Lack of response practice drills…6 Other(specify)………………7		Q: Are there any measures to strengthen the response capacity of communities? *A: CODES* YES………………1 NO……….2>>E01 DON'T KNOW…...3	Q: What measures are being taken to strengthen the response capacity of communities? RECORD UP TO TWO RESPONSES *A: CODES* Educating communities on how to respond…….1 Raising awareness of disaster risk…2 Increasing credibility of warnings…………..3 developing policy or legislation……4 Developing response plans……..5 Enhancing response practice drills…6 Other(specify)………………7 Nothing……………………..8	
				1st	2nd		1st	2nd

END OF SECTION D

SECTION E: CROSS CUTTING ISSUES

E01	E02	E03	E04	E05	E06	E07		E08	E09
	Is there legislation or policy which provides a legal basis for implementing an early warning system for [HAZARD IN E01]? *A: CODES* YES………1>>E04 NO……………..2 DON'T KNOW….3	Are there clear roles for organisations in the early warning system for [HAZARD IN E01]? *A: CODES* Always……1 Most times….2 Sometimes….3 Never ……..4 Don't know…5	Is there an organisation responsible for coordinating the early warning system for [HAZARD IN E01]? *A: CODES* YES………1 NO……………..2 DON'T KNOW….3	Is disaster risk management for [HAZARD IN E01] decentralised? *A: CODES* YES………1 NO……………..2 DON'T KNOW….3	Are communities involved in disaster risk management for [HAZARD IN E01]? *A: CODES* Always……1>>E08 Most times….2 Sometimes….3 Never ……..4 Don't know…5	What is being done to encourage community participation in disaster risk management for [HAZARD IN E01]? *A: CODES* Civic education…1 Awareness campaign…2 Strengthening feedback mechanism…3 Improving governance…4 Capacity building among communities……….5 Policy formulation aimed at enhancing participation..6 Other(specify)…………7		Are all organisations involved in the early warning system for [HAZARD IN E01] capable of performing their roles? *A: CODES* Always……1>>End interview Most times….2 Sometimes….3 Never ……..4 Don't know…5	Why are some organisations involved in the early warning system for [HAZARD IN E01] not capable to performing? *A: CODES* Lack of funding…1 Lack of expertise…2 lack of legal or policy basis……..3 Corruption…4 other (specify)….5
						1st	2nd		

END OF SECTION E

Thank person for their help and close interview.

APPENDIX C: STATUS OF AWS NETWORK IN DCCMS

INDEX	STATION NAME	DISTRICT	TYPE	MANUFACTURER	YEAR OF PURCHASE	SOURCE OF FUNDS	STATUS	REMARKS
1	KIA	Lilongwe	GSM enabled	Casella Measurement, UK	2006	Govt Of Malawi	Operational but old and in need of replacement	Upgrade being planned under Shire River Basin Management Programme
2	Chileka	Blantyre	GSM enabled	Casella Measurement, UK	2006	Govt Of Malawi	Operational but old and in need of replacement	Upgrade being planned under Shire River Basin Management Programme
3	Mzuzu Airport	Mzimba	GSM enabled	Casella Measurement, UK	2009	Govt Of Malawi	Unserviceable due to faulty communications module power supply	Upgrade being planned under Shire River Basin Management Programme
4	Karonga Airport	Karonga	GSM enabled	Casella Measurement, UK	2009	Govt Of Malawi	Unserviceable due to faulty communications module power supply	Upgrade being planned under Shire River Basin Management Programme
5	Tembwe	Mchinji	GSM enabled	Casella Measurement, UK	2007	World Bank	Unserviceable due to obsolete faulty data logger	Upgrade being planned under Shire River Basin Management Programme
6	Balaka	Balaka	GSM enabled	Casella Measurement, UK	2007	World Bank	Unserviceable due to obsolete faulty data logger	Upgrade being planned under Shire River Basin Management Programme

7	Thyolo	Thyolo	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
8	Nkhotakota	Nkhotakota	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
9	Bolero	Rumphi	GSM Enabled	Casella Measurement, UK	2010	World Bank	Unserviceable due to obsolete faulty data logger	Upgrade being planned under Shire River Basin Management Programme
10	Likoma	Likoma	GSM Enabled	Casella Measurement, UK	2010	World Bank	Unserviceable due to obsolete faulty data logger	Upgrade being planned under Shire River Basin Management Programme
11	Ntchisi	Ntchisi	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
10	Makoka	Zomba	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but	Upgrade being planned

							no data download due to obsolete faulty communications module	under Shire River Basin Management Programme
12	Ntaja Met	Machinga	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
13	Chichiri	Blantyre	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
14	Mimosa	Mulanje	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
15	Bvumbwe	Thyolo	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme

16	Ngabu	Chikhwawa	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
17	Salima	Salima	GSM Enabled	Casella Measurement, UK	2010	World Bank	Unserviceable due to faulty data logger and damaged power supply	Upgrade being planned under Shire River Basin Management Programme
18	Nkhata Bay	Nkhata Bay	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
19	Mzimba	Mzimba	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
20	Chitipa	Chitipa	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
21	Chitedze	Lilongwe	GSM Enabled	Casella Measurement, UK	2010	World Bank	Operational but no data download due to obsolete faulty	Upgrade being planned under Shire River Basin Management Programme

							communications module	
22	Monkey Bay	Mangochi	GSM Enabled	Casella Measurement, UK	2011	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
23	Vinthukutu	Karonga	GSM Enabled	Casella Measurement, UK	2011	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
24	Namwera	Mangochi	GSM Enabled	Casella Measurement, UK	2011	World Bank	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
26	Mwanza	Mwanza	GSM Enabled	Casella Measurement, UK	2008	DFID	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
27	Naminjiwa	Phalombe	GSM Enabled	Casella Measurement, UK	2008	DFID	Unserviceable due to faulty logger and obsolete faulty	Upgrade being planned under Shire River Basin Management

							communications modules	Programme
28	Mangochi	Mangochi	GSM Enabled	Casella Measurement, UK	2008	DFID	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
29	Dedza Rtc	Dedza	GSM Enabled	Casella Measurement, UK	2008	DFID	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
30	Kasungu	Kasungu	GSM Enabled	Casella Measurement, UK	2008	DFID	Unserviceable due to faulty logger and obsolete faulty communications modules	Upgrade being planned under Shire River Basin Management Programme
31	Zomba Rtc	Zomba	GSM Enabled	Casella Measurement, UK	2012	WFP/AAP	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
32	Nsanje	Nsanje	GSM Enabled	Casella Measurement, UK	2012	WFP/AAP	Unserviceable	Upgrade being planned

							due to faulty power supply and obsolete faulty communications module	under Shire River Basin Management Programme
33	Kaporo	Karonga	GSM Enabled	Casella Measurement, UK	2012	WFP/AAP	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
34	Chikhwawa	Chikhwawa	GSM Enabled	Casella Measurement, UK	2012	WFP/AAP	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
35	Mulanje Agric	Mulanje	GSM Enabled	Casella Measurement, UK	2012	WFP/AAP	Operational but no data download due to obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
36	Kaluluma	Kasungu	GSM Enabled	Casella Measurement, UK	2012	WFP/AAP	Unserviceable due to faulty power supply and obsolete faulty communications	Upgrade being planned under Shire River Basin Management Programme

							module	
37	Chitala	Salima	GSM Enabled	Casella Measurement, UK	2012	WFP/AAP	Unserviceable due to faulty power supply and obsolete faulty communications module	Upgrade being planned under Shire River Basin Management Programme
38	Neno	Neno	GPRS enabled	Adcon Telemetry, Austria	2014	UNDP/SLM	Operational	
39	Ntcheu	Ntcheu	GPRS enabled	Adcon Telemetry, Austria	2011	COMESA/COMRAP	Operational	
40	Dowa	Dowa	GPRS enabled	Adcon Telemetry, Austria	2011	COMESA/COMRAP	Operational	
41	Mkanda	Mchinji	GPRS enabled	Adcon Telemetry, Austria	2011	COMESA/COMRAP	Operational	
42	Ntakataka	Dedza	GPRS enabled	Adcon Telemetry, Austria	2011	COMESA/COMRAP	Unserviceable due to damaged power source	To be relocated to a more secure location and upgraded under Shire River Basin Management Programme
43	Ntchenachena	Rumphi	GPRS enabled	Adcon Telemetry, Austria	2011	COMESA/COMRAP	Operational	
44	Njolomole	Ntcheu	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
45	Kamuzu Dam II	Lilongwe	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
46	Mayani	Dedza	GPRS	Campbell Scientific	2015	EWS	Operational	

			enabled	Africa, South Africa				
47	Mwimba	Kasungu	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
48	Mvera	Dowa	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
49	Mbawa	Mzimba	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
50	Chintheche	Nkhata Bay	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
51	Chelinda	Rumphi	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
52	Meru	Chitipa	GPRS enabled	Campbell Scientific Africa, South Africa	2015	EWS	Operational	
53	Capital Hill	Lilongwe	GPRS enabled	CIMEL France	2015	SADC	Operational	

APPENDIX D: LIST OF SUBSIDIARY WEATHER STATIONS

List of Subsidiary Stations (all are fully operational have this table as annex	
1) Chelinda 2) Kaperekezi 3) Vinthukutu Agric 4) Ntchena-chena Agric 5) Lunyangwa Agric 6) Mzuzu University 7) Chikangawa 8) Emfeni Agric 9) Dwangwa 10) Lifuwu Agric 11) Chitala Agric	12) Ntchisi Agric 13) Natural Resources College 14) Neno Agric 15) Chancellor College 16) Mikonga 17) Chipale 18) Alumenda 19) Kasinthula Agric 20) Nchalo 21) Nsanje Agric

APPENDIX E: STATUS OF VCPCs

District	TA/ACPC	Number of VCPCs active	Number of VCPCs dormant	VCPCs not established
Nkhatabay	Timbiri	4		
	Fukamalaza	4		
	Mankhambira		7	
	Mnyaluwanga		2	
	Fukamapiri			3
	Zilakoma			1
	Malengamzoma			3
	Malanda			3
	Mkumbira			4
	Boghoyo			1
	Mkondowe			1
Nsanje	Mbenje	2	2	
	Ndamera		11	
	Ngabu	1	6	
	Tengani	8	8	
	Malemia		5	
	Mlolo	5	9	
	Makoko		3	
Zomba	Mwambo	3	5	6
	Chikowi		7	7
	Kumtumanji		4	3
	Nkangula			7
	Ngwelero			4
	Nkumbira		2	
	Malemia		4	2
	Mlumbe	2	4	
	Nkapita	4	3	
	Mbiza	6		
Dedza	Kachere	2	25	
	Chilikumwendo			18
	Kamenyagwaza		4	
	Chauma		9	
	Kachindamoto		18	
	Tambala		19	
	Kasumbu		4	15
	Kaphuka		54	

Salima	ALL	32	35	49
Phalombe	Kaduya	9		
	Nkhulambe	4		
	Nazombe	3	2	2
	Jenala	8		1
	Chiwalo	8		
	Mkhumba	7	2	
Mangochi	Chimwala	9		
	Nankumba	9		
	Chowe		9	
	Bwananyambi		9	
	Jalasi		9	
	Makanjira		9	
	Mpondasi		9	
	Katuli		9	
	Mtonda			9
	Chilipa			9
Chikwawa	Ngabu	5	19	5
	Chapananga		9	2
	Makhuwira	6	7	
	Kasisi	3	2	
	Katunga	2	3	
	Maseya		5	
	Lundu		4	
	Mlilima	2		
Karonga	Mwakaboko	4	1	
	Mwirang'ombe	3		
	Wasambo	4	1	
	Kilupula	1	2	
	Kyungu	6	4	
Balaka	Msamala	18		9
	Chanthunya	17		15
	Nkaya	22		7
	Sawali	15		
	Kachenga	12		8
	Kalembo	7		18

	Amidu	32		
	Matola	4		8
	Phalula	7		
	Toleza	2		4
Rumphi	Bolero	10	13	
	Bumba	2	3	
	Mwazisi	2	16	
	Katowo	8		
	Henga	7		
	Mzokoto	8		
	Jalawe			
	Chozoli		22	
	Zolokera		16	
	Mphompha		14	
	Phoka		60	
Machinga	Ngokwe	11		
	Chikweo	7		
	Mchinguza	6		
	Nkoola	11		
	Nyambi	10		
	Kapoloma	5		
	Kawinga	12		
	Liwonde		13	
	Nsanama		4	
	Mposa		9	
	Mlomba		31	
	Chiwalo		3	
	Chamba		7	
	Sitola		4	
	Nkula		5	
Nkhotakota	Kafuzila			9
	Mphonde			9
	Kanyenda			9
	Malengachanzi			9
	Mwadzama			9
	Mwansambo			9
Blantyre	Kapeni			9
	Chigalu			9

	Kuntaja			9
	Kunthembwe			9
	Lundu			9
	Machinjiri			9
	Makata			9
	Somba			9
Ntcheu	Champiti			9
	Chakhumbira			9
	Goodson Ganya			9
	Kwataine			9
	Makwangwala			9
	Masasa			9
	Mpando			9
	Njolomole			9
	Phambala			9
		401	585	431

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