CLIMATE CHALLENGE PROGRAMME MALAWI

REPORT ON:

Indigenous Knowledge Early Warning Systems in Chikwawa, Zomba, Machinga and Balaka Districts, Malawi

Trócaire

SCIAF Uniting to end poverty Caritas Scotland

Scottish Government Riaghaltas na h-Alba gov.scot

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Abbreviations

ACPC	Area Civil Protection Committee
ADMARC	Agricultural Development and Marketing Corporation
CADECOM	Catholic Development Commission
CARD	Churches Action in Relief and Development
CCA	Climate change adaptation
CCPM	Climate Challenge Programme Malawi
CICOD	Centre for Integrated Community Development
CISONECC	Civil Society Network on Climate Change
COVID 19	Corona virus disease 2019
DAES	Department of Agricultural Extension Services
DRR	Disaster risk reduction
EWS	Early warning system
FAO	Food and Agriculture Organization
GoM	Government of Malawi
GVH	Group Village Head
IKEWS	Indigenous knowledge early warning system
KII	Key informant interview
LUANAR	Lilongwe University of Agriculture and Natural Resources
M-CLIMES	Saving Lives and Protecting Agriculture Based Livelihoods in Malawi: Scaling Up the Use of Modernized Climate Information and Early Warning Systems"
MRCS	Malawi Red Cross Society
MVAC	Malawi Vulnerability Assessment Committee
NASFAM	National Smallholder Farmers Association of Malawi
NGOs	Non-Governmental Organization
PICSA	Participatory Integrated Climate Services for Agriculture
PSP	Participatory scenario planning
SCIAF	Scottish Catholic International Aid Fund
TA	Traditional Authority
UNDP	United Nations Development Programme
VCPC	Village Civil Protection Committee
WFP	World Food Programme

Acknowledgements

This study was commissioned by Trócaire Malawi under the Climate Challenge Programme Malawi, which is implemented in the Balaka, Chikwawa, Machinga, and Zomba districts. The consultant would like to express profound gratitude to the Trócaire team for the support rendered during the process. Timely feedback and support provided by the Trócaire team is acknowledged. Data collection at district level would have been very difficult without the support of partner organisations in each of the districts: Centre for Integrated Community Development (CICOD) in Chikwawa, Catholic Development Commission (CADECOM) in Zomba, Churches Action in Relief and Development (CARD) and CADECOM in Machinga and Eagles Relief in Balaka. Officers from these partner organizations made arrangements for community-level interviews and accompanied the consultant to the field, including working over the weekend and during odd hours.

All pictures used in the report were captured by the consultant, except for Figure 7 (left, river gauges), which was captured by Maureen Msukwa from the Catholic Development Commission (CADECOM) in Zomba. All photos were captured with the consent of participants.

Executive Summary

Background

This study was commissioned by Trócaire under the Climate Challenge Programme, to document indigenous knowledge early warning systems (IKEWS) in seven traditional authorities in the Balaka, Chikwawa, Machinga, and Zomba districts. The scope of work covered six specific tasks, which were summarized into eight thematic areas at the inception phase: i) prevalent climate risks and adaptation practices in the communities (aligned to task 1 in scope of work); ii) existing scientific early warning systems in the communities (overall); iii) common IKEWS, as practiced by small-holder farmers (aligned to task 2); iv) effectiveness (application) of IKEWS to facilitate adaptation by farmers (aligned to task 3); v) trend in the use of IKEWS (aligned to task 4); vi) integration (synergies) of IKEWS and scientific EWS and approaches (aligned to task 6); vii) policy environment for IKEWS (aligned to task 6 - all); and viii) opportunities and threats in the use of IKEWS.

Methodology

Primary data was collected through mini group interviews, key informant interviews, and case studies at village level in the four districts with project participants, at district level with district key informants, and at national level with key informants from government, NGOs, academia, and development partners.

Results

Along the thematic areas, the results show that:

Regarding the **prevalent climate risks and adaptation practices in the communities**, communities in the study sites face similar climate risk, with floods and drought or dry spells being the major challenges faced. However, understanding the vulnerability and exposures require unravelling a series of interconnected issues that are at the centre of the risks the communities face. These include the socio-political ideologies and systems, limited access to social services, fragility of the local economy and environment and exposure to multiple hazards. Women, children, the elderly and person with disability tend to be more affected. Several efforts are underway from both government and non-state actors to contribute to resilience building.

There has been significant investment in the **existing scientific early warning systems,** which has led to recognizable advancements in how early warning information is generated, analysed and disseminated. The downscaling[1] of forecasts has also facilitated ease of access and usage of scientific early warning information. More people have trust in scientific early warning systems due to its enhanced accuracy and reliability. Most communities also have community-based early warning systems that are further aiding their preparedness to disaster and farming decisions.

In relation to **common IKEWS practiced by small-holder farmers**, there exist multiple indicators in the four districts. the study has identified a total of 241 IKEWS indicators practiced in the four districts. While some of these are similar, there are some that are unique to particular districts of communities. The majority of IKEWS are focused on rainfall onset, rainfall cessation, rainfall amount and rainfall intensity. These have been categorised as those associated with animals, those associated with plants, those associated with astrological elements and those associated with hydro-meteorological factors. There are variations in the **effectiveness of IKEWS to facilitate adaptation by farmers**. While some of these practices are assisting farmers in making their farming and other livelihood decisions, several factors have rendered most of them ineffective. They have become less accurate and reliable, which also closely relate to the **trend in the use of IKEWS**. A general reduction in the use of IKEWS was observed in all communities in the four district. Farmers are more dependent on scientific early warning information and hardly use IKEWS. In terms of **synergies between IKEWS and scientific EWS and approaches**, several approaches are being used or are potentially available to aid integration between the two. For instance, the participatory scenario planning

[1] Downscaling as used in this instance refers to the scientific process of taking the predictions or forecast made at a larger scale (such as national, regional or district level), to a local scale (such as by traditional authority area per district). Local-specific forecasts are made, instead of relying on the broader national or regional picture.

(PSP) approach is used in all the communities to ensure integration of scientific and IKEWS in aiding farmers to prepare for the farming season. The reliability of scientific early warning systems, climate change, limited documentation of IKEWS, environmental degradation and religion are some of the major **threats in the use of IKEWS** in the four districts.

However, the **policy environment for IKEWS** environment provides opportunities for integration and use of IKEWS in the country. National policies on climate change adaptation, disaster risk management, meteorology and agriculture all make specific mention of IKEWS, primarily focusing on integration.

Recommendations

The study makes recommendation at two levels: for Trocaire and its CCPM partners and for government authorities. For Trocaire and CCPM partners, the study makes the following recommendations:

i. *Undertake wider knowledge and best practices sharing through learning events.*

ii. *Promote IKEWS through existing innovative approaches, including PSP, PICA and farmer field schools.*

iii. *Trocaire and its partners should publicise the documented IKEWS and other findings and recommendations of the documentation process and report.*

iv. *Trocaire should engage more partners and hold learning events to publicise successes and lessons being learnt from its use of agro-ecological approaches to climate change adaptation.*

v. *Trocaire and its partners should make deliberate efforts to train and involve Civil Protection Committees and Natural Resources Management Committee at village and area level for documentation of IKEWS.*

vi. *Existing local structures should be mobilized and engaged to champion IKEWS.*

vii. *Trocaire and its partners should advocate for the documentation and dissemination of IKEWS by responsible government departments at district and national levels*

viii. *Integrated approaches to resilience building should be prioritised over those that focus on tackling single or visible and obvious vulnerability factors, guided by detailed participatory assessments of risks*

For government, the study makes the following recommendations:

i. *Integrate IKEWS into formal and informal education curriculum*

ii. *Government should lead in the implementation of its policy aspirations in relation to IKEWS*

iii. *Government should institutionalise IKEWS and identify sustainable ways of promoting IKEWS, including integration*

iv. *IKEWS should be a core component in the design and management of community-based early warning systems. IKEWS should be further strengthened in the existing National Guidelines on community-based early warning systems. Government should also ensure that the requirement for assessing existing IKEWS when designing CBEWS is enforced*

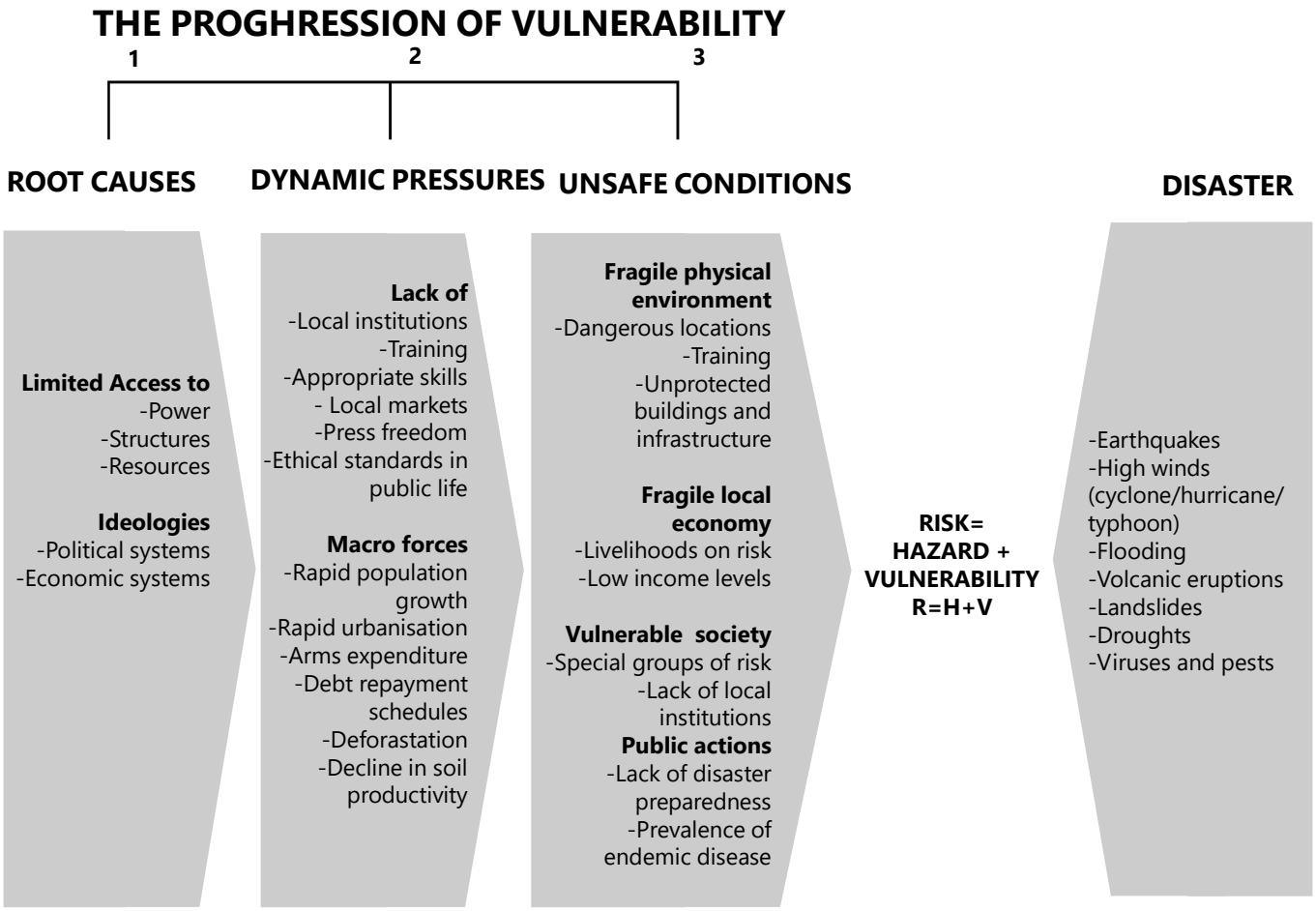
v. *Government should incorporate issues of IKEWS into the DRM regulations (DRM Operational Guidelines) and multi-hazard early warning system protocols, both of which are under development and being led by DoDMA*

vi. *The DRM regulations should clearly specify the government department, ministry or agency that has direct responsibility for IKEWS*

1. Introduction

1.1. Background to IKEWS, climate change and scientific early warning systems

The pressure and release model developed by Blaikie et al. (1994) and refined by Wisner et al. (2004) define the shocks and stresses that communities face as a culmination of two sources of pressure: the physical or biological hazard and the broader social context that creates vulnerability. The vulnerability progresses through three stages: root or underlying causes, dynamic pressures and unsafe conditions (Figure 1).



Source, Wisner et al. (2004), p. 51

Figure 1: The pressure and release model

What is critical is to demystify the trajectory through which people face the challenges, that vulnerability progresses through three stages: root or underlying causes, dynamic pressures, and unsafe conditions. While presenting different perspectives of vulnerability, the three stages are closely related. While focus on the hazard is important, the hazard should be considered as autonomous and would still occur even if the agent was not present (Arnall, 2015). Disasters and other climate change impacts are therefore tied to the presence of a vulnerable population and are triggered by the hazard. Vulnerability is rooted in the environmental, social, political, economic, and political systems within which people live. These systems, for instance, determine the resource allocation and distribution to the population and can create inequalities. They also reflect power relations within society, with those most vulnerable considered to be of lesser importance to those who hold power, thereby exacerbating their vulnerability.

Indigenous knowledge plays a pivotal role in disaster risk reduction and climate change adaptation, while also being an important enabler in agricultural production.

Most countries with successful disaster risk reduction practices employ indigenous knowledge early warning systems (IKEWS) in one way or another (Dube & Munsaka, 2018). Different terms have been used in reference to indigenous knowledge: local knowledge, indigenous technical knowledge, rural people's knowledge, people's science, insider knowledge, traditional environmental knowledge, tribal ecological wisdom, and folk knowledge (Nawrotzki & Kadatska, 2010). Indigenous knowledge is defined as a body of knowledge that exists within or is acquired by local people over a time through accumulation of experiences, relationships between society and nature, community practices and institutions, and is passed down from one generation to another. Scientific knowledge, on the other hand, is not local but global in nature (Mercer et al., 2010; Dube & Munsaka, 2018)

The majority of rural farmers in Sub-Saharan Africa and other low-income countries tend to use and rely heavily on IKEWS to guide their agricultural practices and prepare for disasters. As much as 92% and 83% of farmers in two separate studies in Tanzania, by Chang'a et al. (2010) and Mahoo et al. (2015), confirmed the use of IKEWS in their agricultural activities. A study in Tanzania (Mahoo et al., 2015) and another one in South Africa (Basdew et al., 2017) show that the majority of farmers believe that IKEWS is more reliable than scientific forecasts, with the majority also indicating that there is correlation in forecasts from IKEWS and scientific EWS.

However, IKEWS is not without shortfalls or criticism, as the literature highlights (Mercer et al., 2007; Chiroro et al., 2008; Chang'a et al., 2010; Masinde & Bagula, 2011; Mahoo et al., 2015; Basdew et al., 2017; Dube & Munsaka, 2018). The following are the most common issues

- absence of documented IKEWS;
- weak knowledge transfer mechanisms;
- high urbanisation rates;
- disappearance of key plant and animal species used for IKEWS;
- influence of science;
- increasing levels of literacy;
- lack of an organised system for collecting and disseminating IKEWS-based forecast;
- focus of IKEWS on daily than seasonal forecasts;
- being based on culture, hence relative to certain communities;
- lacking scientific validation; and
- lack of uniform terminology and benchmarks (such as quantity of rains) for some indicators (such as 'abundant mangoes or rainfall').

There is deliberate power interplay leading to marginalization, exploitation, and eventual suppression of IKEWS by scientists, particularly in contexts where scientific culture is predominant. Indeed, some studies (Mercer et al., 2010, 2007; Basdew et al., 2017; Dube & Munsaka, 2018) have shown that scientists and practitioners tend to undervalue IKEWS, considering it inferior to scientific knowledge, adding that it is devoid of scientific rigour through which meteorological forecasts undergo. This lack of trust is also common among ordinary community members (Dube & Munsaka, 2018). Furthermore, indigenous knowledge in general has been considered as rigid, non-documented, backward, and superstitious (Banda, 2008; Dube & Munsaka, 2018).

The need for parity and integration in aiding effective and sustainable DRR, CCA, and agriculture has been echoed by multiple scholars, deviating from the traditional dichotomies of indigenous vs scientific knowledge (Mercer et al., 2007; Basdew et al., 2017). Integration provides a more holistic approach for farmers to make decisions about their agricultural practices (Basdew et al., 2017). Achieving this requires understanding the ideological and methodological differences between IKEWS and scientific EWS. Also central to effective integration is sustained collaboration and interface between local institutions, the scientific community, and practitioners.

1.2. Objectives of the Study

The aim of this study was to document and assess IKEWS in use in the four districts and Traditional Authorities targeted by the CCPM and to explore linkages with scientific early warning systems.

In line with the terms of reference, the scope of work for this assignment involved six key interrelated tasks:

i. Identification and documentation of the climate risks prevalent, in seven Traditional Authorities targeted by the CCPM.

ii. Documentation of the IKEWS initiatives practiced by smallholder farmers in these areas and note the scientific research that shows the effectiveness or not of these approaches.

iii. Documentation of the effectiveness of these approaches in supporting smallholder farmers to adapt their behaviour to meet the challenges of climate change.

iv. Documentation of whether the use of IKEWS by smallholder farmers has been increasing or decreasing overtime. Note also the main reasons for either the increased or decreased use of these strategies.

v. Documentation of the threats to the use of IKEWS and actions required for their conservation.

vi. Evaluation and documentation of potential synergies for IKEWS with existing scientific climate approaches, and identify how IKEWSs can be aligned with current efforts which address the climatic challenges facing smallholder farmers.

1.3. Description of Study Sites

Chikwawa, Zomba, and Machinga were identified as among the priority districts to be implemented under the National Resilience Strategy (GOM, 2019), sharing common vulnerability factors. These include high population growth, food insecurity, floods, high illiteracy levels, and exposure to strong winds. Balaka shares the same challenges as the other three districts. Table 1 provides a summary of the number of people affected by food insecurity between 2008 and 2017 in the four districts, based on reports of the Malawi Vulnerability Assessment Committee (MVAC). These figures represent the population that required humanitarian food aid in each of the years. The table also shows the percentage of the affected people as an overall percentage of the district population.

Table 1: Number of food insecure population and percentage of food insecure people over total district population, 2008-2017

District	2008	%	2009	%	2010	%	2011	%	2012	%	2013	%	2014	%	2015	%	2016	%	2017	%
Balaka	27,091	9	55,332	17	23,362	7	11,256	3	208,501	58	95,647	26	29,186	8	196,551	50	333,943	82	83,294	20
Chikwawa	26,240	4	141,544	20	74,724	10	58,554	8	275,653	35	110,976	14	24,826	3	237,618	27	498,988	54	117,065	12
Machinga	22,761	4	0	0	20,120	3	0	0	20,556	3	114,234	15	36,625	5	113,914	14	456,225	53	91,913	10
Zomba	76,066	42	16,153	9	35,832	19	30,791	16	137,053	69	91,264	44	18,814	9	205,413	31	473,497	70	78,664	34

[2] TA's Nkaya and Matola in Balaka district; TA's Chapananga and Ngowe in Chikwawa district; TA's Liwonde and Nsanma in Machinga district and TA Mwambo in Zomba district.

2.0 Approach and Methodology

2.1 Primary Data Collection

The documentation largely relied on the collection of primary data at national level and in the four districts of Balaka, Chikwawa, Machinga, and Zomba. The following approaches were used in the collection of primary data:

2.1.1 Key Informant Interviews

In-depth key informant interviews (KIIs) were conducted with key players at national, district, and community levels to solicit detailed information related to climate risk, IKEWS, and general EWS. An open-ended interview guide was used for the KIIs. Each interview lasted between 30 and 45 minutes and was done face-to-face at community and for some of district level participants. All interviews at national level, and for the majority of district participants, were conducted by phone.

2.1.2 Case studies

Case studies were also collected to further illustrate IKEWS and adaptation measures practiced by the smallholder farmers in the target areas. The case studies have provided a more detailed picture of the findings at community level. Respondents for the case studies were identified through initial discussions

with the programme staff at district level and during interviews.

2.1.3 Mini Group Discussions/Interviews

In view of the COVID-19 pandemic and guidelines on safety and social distancing, the use of traditional focus groups was discarded. Instead, mini group interviews were conducted with a maximum of 5 participants. To ensure a more open discussion and also collect group-specific information, separate group interviews were conducted with female farmers (elderly), male farmers (elderly), female youth farmers, and male youth farmers. Deliberate efforts were made to include other vulnerable groups in the discussions, such as the disabled (see Figure 2). Each group interview lasted between 1 hour and 1 ½ hours. Consent was sought from participants to conduct the mini group discussions, as well as to use a voice recorder

Figure 2: Elderly male group discussions with a participants with disability

2.2 Sampling and sample sizes

The assignment was undertaken using qualitative approaches. Purposive sampling was used to identify participants. The districts, TAs and GVHs, where primary data was collected, were pre-determined as where the CCPM is being implemented. There are a total of seven TAs in the four districts, with two TAs in each district; except for Zomba where there is one TA.

In each TA, one GVH was targeted, except for Zomba where two GVHs were covered, reaching a total of 8 GVHs. Participants for the mini-group discussions and key informant interviews were purposively identified through the district project coordination teams and came from different villages. In each GVH selected, between 3 and 7 mini group discussions were done with different groups, with at least 8 covered in each district, with minimum participants of 40 per district.

At community level, in-depth key informant interviews were held in each TA with lead farmers who are direct project participants, extension workers, members of civil protection committee, and local leaders. A minimum of 8 community KII were conducted per district, with at least 4 per GVH. Further, a minimum of 6 KII were conducted in each district with district-level officers from government and NGOs, making a total of 29. At national level, 19 KII were conducted. Table 2 provides a summary of participants in the study for each district and TA covered, as well as at national level. In total, 61 key informants were interviewed at national, district, and community level, while 195 took part in the 39 mini group discussions, of which 100 were female and 95 were male. Participants for both mini groups and KII at community level were drawn from active direct project participants and other key informants from multiple villages within the GVH. At district and national levels, participants were purposively selected from key government ministries, departments and agencies, NGOs, academia, and development partners that have a prominent role in early warning systems, climate change, and disaster risk reduction.

Table 2: Number of participants covered under each category

District	TA	GVH	Key informant interviews	Mini group discussions		
				Male (youth and elderly)	Female (youth and elderly)	Total
Chikwawa	Ngowe	Khungubwe	4	2	2	**4**
	Chapananga	Lundu	4	2	2	**4**
	District		9			
	Sub-Total		**17**	**4**	**4**	
Zomba	Mwambo	Chaweza	4	2	2	**4**
	Mwambo	Magoli	4	1	2	**3**
	District		7			
	Sub-Total		**15**	**3**	**4**	
Machinga	Liwonde	Mangamba	4	4	4	**8**
	Nsanama	Mangulu	4	2	2	**4**
	District		6			
	Sub-Total		**14**	**6**	**6**	
Balaka	Nkaya	Phimbi	4	4	4	**8**
	Matola	Matola	4	2	2	**4**
	District		7			
	Sub-Total		**15**	**6**	**6**	
National Level			19			
Grand Total			**61**	**19**	**20**	**39**

Figure 3: The research team, assisted by community members and an officer from CICOD, crossing Mwanza River to GVH Lundu, TA Chapananga , Chikwawa

2.3 Data Collection Team, Quality Control and Assurance

The consultant was supported by six experienced Research Assistants during data collection and entry, who had a minimum qualification of a Bachelors' degree. Five of the research assistants were female, while one was male: of the five, four were based at the district level to ensure ease of data collection.

Data was collected in the four districts from 7th to 15th July, 2020 and at national level from 1st to 3rd July, 2020 and also in the course of local level data collection.

2.3.1 Quality Assurance

Several strategies were executed to ensure that data of the highest quality was consistently collected, primarily through:

i. Research assistant training;
ii. Direct supervision of data collection in the field by the consultant;
iii. Daily review meetings with research assistants at the end of each field day;
iv. Consultant's vetting of the notes and samples of recordings;
v. Debrief meeting with Trocaire Focal Point every two days.

These approaches ensured that challenges were noted and corrected in good time. There were no major challenges experienced, except for one instance where a recorder malfunctioned in one community. A mobile phone was used to record the interviews for the remaining respondents.

2.4 Data Analysis, Report Writing

The recorded data was transcribed and merged with field notes. The data was analysed using thematic and constant comparison analysis. The use of multiple categories of research participants to look at the same or very similar issues necessitates these analysis approaches for qualitative data. Codes were identified from the data sets, which were transformed into themes or patterns aligned to the thematic areas of the study that are based on the scope of work.

Throughout the report, key quotations have been used to illustrate key findings and themes coming out of the data. After completing the analysis, a report was drafted which also went through proofreading prior to submission.

2.5 Gender Consideration

As articulated in the methodology section, the documentation ensured participation of both men and women at all stages of the assignment. The research support team comprised one male and five female research assistants. Equal number of group discussions were planned for men and women, even though in the end there were more females than males. The identification of key informants considered gender balancing wherever feasible. The presentation of main findings documenting IKEWS have also been presented along gender categories.

2.6 Safeguards against Covid-19

To safeguard against Covid-19, the following measures were taken, which have also been shown in Figure 4:

i. the sitting arrangements during the discussions and interviews observed social distance, being at least one metre apart;

ii. washing of hands with soap for every participant and researcher prior to the initial briefing. The hand washing facilities were provided by the community;

iii. hand sanitizing for each researcher and participant within the mini group or individual interviews, provided by the consultant;

iv. restricting number of participants in the mini discussions to five;

v. covering faces with masks which were provided by the consultant (in Machinga, masks for one community were provided by Eagles Relief).

In several communities, participants requested for awareness on the use of masks and reasons for handwashing against use of hand sanitizers, which the consultant provided.

Figure 4: Research team conducting interviews while observing safety practices against COVID-19

3.0 Findings and Discussions

This section presents the main findings of the study. The findings are presented as a consolidation of views from different research participant groups at national, district, and community levels. The findings have been presented in line with the scope of work for the study and the ensuing thematic areas, presenting both a general picture across all districts, as well as district specific results.

3.1 Prevalent climate risks and adaptation practices in the communities

3.1.1 What is climate change

The level of understanding of climate change was quite advanced, in some instances. A young lady in TA Liwonde, Machinga, had this to say:

Due to the careless cutting down of trees, the carbon dioxide we breath out has no habitat so it goes into the atmosphere so together with other harmful gases they go and irritate the Ozone layer and the bring about CC effects life abnormal rainfall.

One community member in TA Mwambo in Zomba defined climate change in a very unique localized way, reflecting livelihoods:

This is a change in the maize produce regarding to how many bags of maize you would get in the past and how many bags we are getting right now. Same field you would get 10 bags but now it is only two or one bag.

The twin hazards of floods and drought or dry spells came out as the most predominant: the same communities that face floods also face dry spells or drought. In the majority of cases, it is a double edged sword; if they do not have floods, then their crops are ravaged by dry spells or drought. In either case, pest infestation is a lingering concern, affecting them on almost an annual basis; if both floods and dry spells are absent, and they have a seemingly good year with prospects of a bumper harvest, then fall armyworms and other pests are waiting to ravage their crops. As a result, if they manage to harvest, vendors flock to procure their produce at very cheap prices, whereby they are unable to make any reasonable returns

3.1.2 Evidence of climate change

Multiple factors were cited as evidence of climate change in the community, including increasing the frequency and magnitude of floods, dry spells, changes in intensity of rains, new varieties of crops pests, and loss of soil productivity. Change in rainfall onset and cessation was the most common factor mentioned: "Back then, rainy season was October and we would plant our seed in November or December but now it has changed, it rains less. Sometimes it rains in January and it stops in March or starts to rain in December and stop in February." (Female participant, GVH Magoli, TA Mwambo, Zomba)

3.1.3 Understanding community vulnerability

Floods, drought, pest infestations, food insecurity, and lack of portable water were cited as the most common challenges communities face in all the four districts. There was a constant linking of the challenges that communities face to climate change, even where they (the community) also had a part to play, or when it was not directly related to climate change. Livelihoods in the community are agro-based, which explains their sensitivity to the effects of climate change and climate variability. Reduction in yield creates a chain of effects on people's lives and livelihood.

Comparisons across different age groups and gender did not reveal major divergences, except for a few instances where the youth tended to mention elements peculiar to them such as lack of employment opportunities, lack of skills, failure to complete education due to inability to pay school fees, and an increasing number of youths engaging in prostitution to earn a living. Climate change was mentioned in every community as the major cause of the challenges they face.

Borrowing from Wisner and colleagues' (2004) pressure and release model, the shocks and stresses the majority of communities face in the four districts can be illustrated through a human ecological framework. Figure 5 uses a simplified illustration of the progression of vulnerability from the pressure and release model to show different factors that contribute to the challenges that communities in the four districts face:

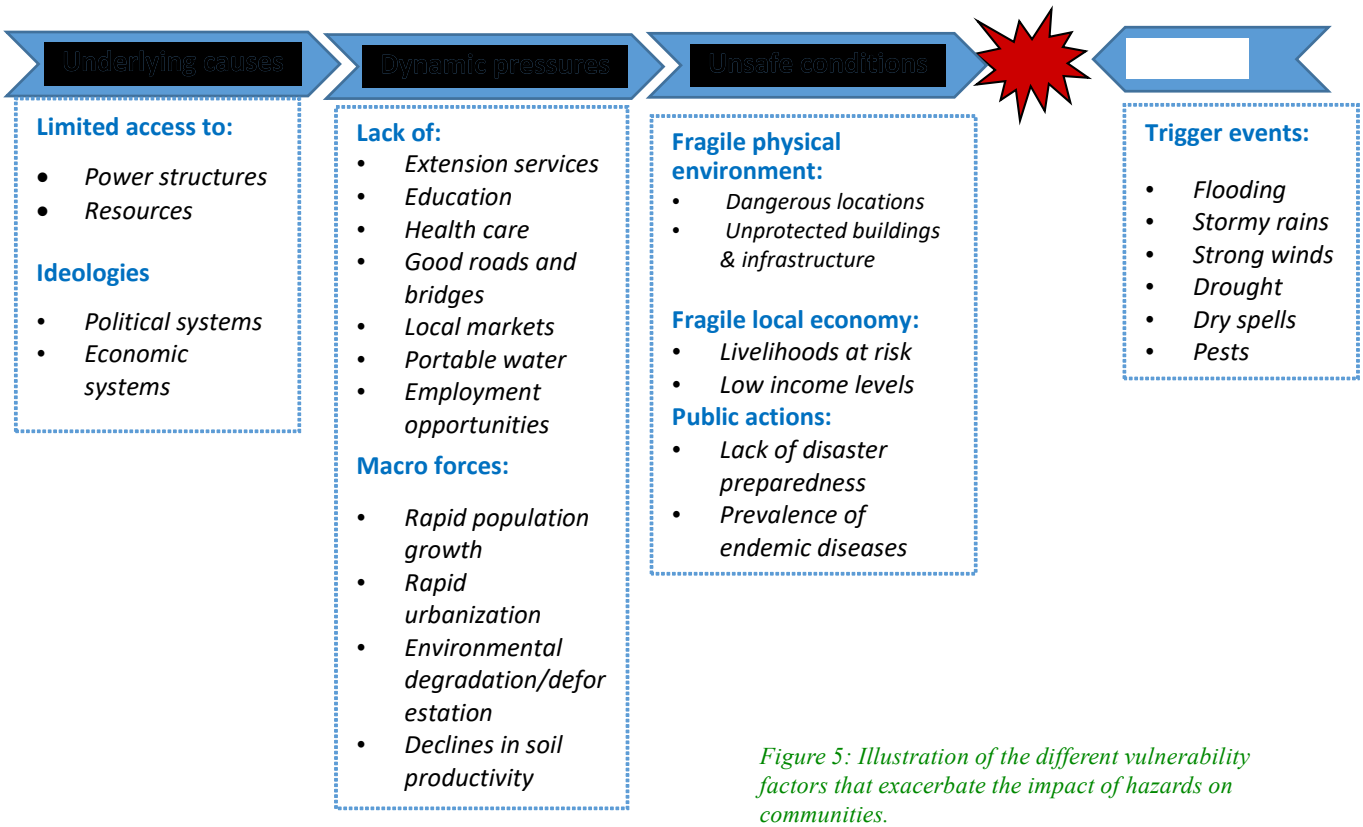


Figure 5: Illustration of the different vulnerability factors that exacerbate the impact of hazards on communities.

To illustrate the **vicious circle**: while most communities mention food insecurity or hunger as a major challenge, upon probing it is revealed that this is related to the following:

- poverty;
- cultivation without applying fertilizer;
- deforestation, which is related to lack of employment or business opportunities;
- access to markets, where farmers instead resort to selling to vendors at cheaper prices, meaning they do not earn enough for the next production and for family use; and
- rapid population growth leading to scarcity of land, as families have to sub-divide the same portion of land among members.

Food insecurity has further affected school attendance and development work in the communities, since, in the words of an elderly woman in TA Liwonde in Machinga, "...people don't want to work without food

in their tummies." Failure to attend school leads to high illiteracy levels, limits attainment of skills to get gainful employment, leading to early marriages, population growth, and adoption of maladaptive practices to survive such as cutting down trees for charcoal production but also clearing land for farming. Land degradation follows, increasing the risk of flooding and food insecurity, thus increasing levels of poverty that further exasperate the adoption of more maladaptive behaviours.

The link across multiple factors was well articulated in various interviews conducted:

Trees bring rainfall but because we cut down trees we are affected with dry spells. Whenever the rain comes, it comes with high velocity and because we don't have trees that can act as water break to reduce velocity we end up being affected by floods. Lack of job opportunities..., lack of access to markets for farm produce...., low yield and shortage of farmland has led to poverty. As a result, some people have resorted to engage themselves in sources of money that are destroying nature, for example, charcoal burning. (Elderly, male, TA Nkaya, Balaka)
Lack of access to clean water is another challenge that we are facing. Due to over population as well as increase in farm animals such as goats and cows, during the dry season we struggle a lot to access clean water because the same place that we get our water for drinking and other domestic purposes, is the same place that the animals also go and drink water, making the water unclean. So, due to this, women struggle a lot to access clean water mainly during the dry season. (Elderly, male, TA Ngowe, Chikwawa)

"We are being discriminated because of the poor leadership that we have because most of them want to include their relatives in most of the activities..... we are not given a chance on other activities but when it comes to community developments, we are asked to participate, So, this is why most of the youths do not take part in community developments." (Male youth group, TA Matola, Balaka)

Lack of cooperatives has made a lot of farmers to be selling their produce to vendors of which they don't make profits at all. Poor roads have made farmers to have difficulties in reaching the proper markets. (Elderly male group, TA...Machinga)

Poverty is due to lack of job opportunities since a lot of people depends on farming only. Hunger is caused by the low yield, we produce low yield because of lack of agriculture inputs, For example, a lot of people they use uncertified seeds because they cannot afford to buy the certified seeds so they just use the seeds from the previous season. Climate change has also contributed to production of low yields because sometimes we receive low rainfall which makes our crops not to grow well hence low yield.... We lack skills as the youth, this makes us not to have opportunities to work in different places. (Male youth group, TA Liwonde, Machinga)
People in power lack political will to develop their communities. (Youth male group, TA Mwambo, Zomba)

Mr. Austen Harry Chilumpha, from GVH Magoli TA Mwambo in Zomba, provided a further illustration of the complexity of the challenges people face in relation to human rights:

I feel like human rights have also contributed to some of the problems we are facing in our community, I was born here and I grew up here, In the past, we used to cultivate 12 yards away from the river both sides and whosoever tried to do the opposite was arrested. Nowadays, due to human rights this is no longer happening, Even our traditional leaders are failing to advise their own people on what to do. As such, there is siltation of rivers. All this is happening because everyone is saying that it is my right to do this or this is my parent's land and no one can tell me what to do with it. As a result, even with small amounts of rainfall, we are experiencing floods..... For example, the government constructed dykes but people are even damaging the dykes in the name of human rights. Had it been that the government makes sure that everyone who is doing this should be held accountable like how it used to be in the past, all this would not be happening.

Getting to the root causes of challenges

The use of the pressure and release model helps in unmasking root causes of challenges, which could centre on issues that could remain hidden due to the socio-political environment. What causes vulnerability may at times not be very obvious or could be engulfed in local political systems that covertly or overtly inhibit expression of issues. Consider the conversation below by men in TA Ngowe in Chikwawa district:

Respondent 4 (R4): *Another challenge is that Green Belt company took away our land which we used for farming and up to now we haven't been compensated.*

R1: *I feel like that is not a challenge to be presented here because the issue is in the hands of the TA.*

Later in the discussions....

R4: *Mr Water, there was also an issue of not being compensated by the Green Belt because of our land that was taken away. I just wanted to know if it's one of the challenges that we can present?*

R6: *The issue of our land being taken away by the Green Belt is also a challenge because those farmers whose land was taken away most of them don't have a piece of land where they can cultivate their crops. They are only benefiting partly because they were employed by the company.*

R3: *Just to add on, we were told that those who would like to give away his/her land will receive money but up to now we haven't received anything from the government. We cannot give away our land just like that without benefiting anything.*

R2: *In January we were told that we will be given 3 bags of maize and in March we will be given 3 bags of Maize and K30, 000. But we did not receive anything.*

3.1.4 Effects on women, children and other vulnerable groups

Further, while men are also affected, there was general consensus across communities and districts that women, the elderly, and children are the ones that are most affected by climate change effects, as demonstrated by the following responses:

> "*In the past when we want to buy maize at ADMARC, they used to say that this line is for old people, this is for women and this is for the youths but nowadays that is not happening.*" (Elderly man in TA Mwambo, Zomba)

> *In the past, water and firewood was found in nearby places whereby women would collect firewood and prepare meals on time. But as of now, women are having hard times to source firewood and water. If women go to fetch firewood and water, they take a lot of hours to come back home and prepare the food. As a result, men tend to be jealous because they feel like the women are having affairs with other men.* (Lead farmer, TA Nsanama, Machinga)

> *Women are the ones who are mostly affected than men because of their role of making sure that everything is in order as well as taking care of the children.* (Group discussion with elderly men, TA Ngowe, Chikwawa)

> *In times of hunger men leave their wives and children to search for food in different places. A lot of men end up marrying women where they have gone leaving their wives and children suffering. So, the ones that are affected much are women.* (Group discussion with elderly men, TA Matola, Balaka)

> *Children are also affected more especially during the rainy season. Most of them stop going to school because they cannot manage to cross rivers.* (Elderly men, TA Nsanama, Machinga)

> *Some men leave their families and marry other women that seem better off than themselves. Some women also engage in sex trade which later bring about HIV and AIDS. Women travel long distance to get essentials like water and firewood.* (Elderly women, TA Liwonde, Machinga)

> However, others felt both men and women are equally affected:
> *Men and women are affected equally because everyone has his or her own responsibilities. For example, it is us men who work had to provide for our families and it is women who are supposed to make sure that we have water. So, everyone is affected equally but the ones who are mostly affected are the children. (Group discussion with elderly men, TA Phimbi, Balaka)*

> *Yes, both parties are affected because men have to travel long distances looking for job opportunities while women are left alone to support the children, which leads to breakage of marriages.* (Female group, TA Mwambo, Zomba)

3.1.5 Dealing with the effects

On their own, communities are implementing various interventions to deal with the effects of climate change: prevention of deforestation and cultivation along river banks; planting of trees and vetiver grass; practicing family planning; applying manure to increase yield; practicing conservation agriculture; winter cropping using residue moisture and irrigation; venturing into the poultry business; planting of crops that do not require fertilizer such as sweet potatoes, groundnuts, rice and sorghum; and the development and enforcement of by-laws to curb malpractices.

Different actors are working with communities to aid them in their adaptation efforts. The role of government is primarily limited to the provision of extension services. In the majority of cases, the interventions mentioned are those implemented under the CCPM, with a few cases where NGOs such as Adventist Development and Relief Agency, Malawi Red Cross Society, Evangelical Association of Malawi, Goal Malawi and One Acre Fund provide additional support. In terms of focus, the majority are working on resilience building interventions. These are geared more towards agricultural productivity than humanitarian aid. It includes the following:

i. Promotion of drought and pest resilient crop varieties, including provision of seedlings: maize seeds, vegetable seeds, sweet potato vines, cassava cuttings and sorghum;

ii. Public education, awareness and promotion of climate smart agricultural practices, including agro-ecology, conservation agriculture, irrigation farming, production and use of compost manure;

iii. Promoting tree planting, including regeneration and free tree varieties;

iv. Planting of vertiver and other grass along the river banks to reduce flooding and soil degradation;

v. Promoting Village Saving Loans groups with focus on small scale business;

vi. Promoting family planning methods for households to manage population growth;

vii. Promoting community-based early warning systems through provision of equipment such as rain gauges, river gauges, megaphones, whistles and mobile phones;

viii. Promoting school feeding programmes to reduce school dropouts;

ix. Promoting home gardening, crop diversification and nutrition, and;

x. Promoting rearing resilient animals such as goats and ducks, including provision of livestock for pass-on schemes.

Are they effective?

The majority of these interventions benefit both men and women. However, there exist certain adaptation practices such as village banking groups that are predominantly patronised by women. Overall, the interventions are considered to be making a difference in reducing the vulnerability and exposure of the communities to the impacts of climate change and climate variability. Despite the challenges they face, without such interventions, they would have been worse off. The fact that most of them mention a lack of access to markets as a challenge, means they are able to harvest enough for their families and have surplus that they can sell.

The measures are very effective, so far there has been increased production due to irrigation and growing of drought tolerant crops. This has reduced hunger. (Mr. Darlington Magola, ACPC Chairperson, Matola, Balaka).

Very effective, we are able to sell our vegetables and use the income to support our households…. The planted trees will help in reducing the negative impacts of climate change. Some of the trees are fruit trees more food for us. (Youth women participants, TA Mwambo, Zomba)

Why are they failing?

A caveat should be provided regarding the preceding assertion on the selling of produce from a harvest. There were several cases mentioned where farmers sell part of their produce in a desperate attempt to earn income to meet other household needs. In several discussions, it was clear that the impact of the interventions was not substantial, with the following being cited as common reasons:

i. Different players are bringing different interventions, aligned to specific project objectives. Sustaining them once project funding ends remains a challenge. Most farmers tend to be active in the new practices being promoted when there is a project. However, once the project phases out, the farmers go back to their old ways. In TA Liwonde, for instance, this extends even to functionality of extension services, which are visible only when there is an active project:

"... we wish we had an extension worker close to our village for clarification because the one we have does not stay close and we been seeing her now more frequently with the incoming of CADECOM while in the past we could just see her in flashes." (Group discussion with male adults in TA Liwonde, Machinga).

Extension workers cited lack of financial resources and large catchment areas covered by an extension worker as some of the reasons affecting provision of extension services.

ii. Only few people benefit from the interventions, normally through farmers' clubs or groups, leaving out the majority of the community.

iii. The use of buckets or watering cans for irrigation and production of manure is considered cumbersome, covers only a small area and labour demanding.

iv. Interventions tend to only address one dimension of the problem, mostly the most visible ones. For instance, in the words of an agricultural extension worker in Machinga,

When the farmers are asked in groups what their problem s are, most of the time they portray hunger as the main challenge. But hunger is coming in as outcome of deforestation, leading to soil erosion which leads to low crop production.

v. There is reliance on handouts in form of food aid from government and non-state actors, which could be a disincentive to productivity. This is confirmed by records from the Malawi Vulnerability Assessment Committee and the Department of Disaster Management Affairs that reveal that (despite the investment in climate adaptation and resilience building) the four districts have faced food insecurity every year over the past ten years. Each has benefitted from food aid for each of these years, in addition to relief aid in response to floods, strong winds, and other disasters. However, as shown in the quote below from a group discussion among elderly men, generalizing this laxity across the whole community may be misleading:

> *Some people say that in Chikwawa and Nsanje we rely a lot on assistance but it is not true. We do a lot of farming but we have two problems; drought and floods. When the season has been normal without these two challenges we harvest a lot of produce for example sweet potatoes which is supplied to Blantyre. Just two weeks ago we were affected by floods such that most of our crops like tomatoes have been swept away with the water.*

i. There has been mushrooming of village loans and savings groups in all the communities. However, most indicated that these are often not sustained as most women fail to contribute shares to the groups as the small amount of money sourced by them is used to support the families.

ii. Large families mean the very same land that was used by one family has to be shared across the expanding family, hence reducing the cultivable land and produce. This has greatly contributed to farming along river bank, or even within river channels.

iii. While there are multiple pass-on schemes for livestock, lack of pasture and water affects productivity. In some communities, livestock varieties provided to them do not suit the climate of their area, hence most of them end up dying.

Measures of last resort?

Due to these challenges, some have resorted to practices that are essentially manifestations of maladaptation, which include:

i. Migration of men in search for employment, leaving families behind uncared for:

"*Men abandon their families for greener pasture in far places, women are left alone to take care of their families.*" **(Female youth participant, TA Nkaya, Balaka).**

ii. Prostitution to earn income to support family:

"*...men hardly manage their responsibilities as head of families, women resort to prostitution so that they provide for their families.*" **(Female participant, TA Matola, Balaka)**

iii. Clearing of vegetation along rivers:

"*Some men cut bamboos along the rivers to make mats to sell which also puts their lives at risk of being caught by crocodiles and exposes community to floods.*" **(Female youth participant, TA Ngowe, Chikwawa)**

iv. Cultivation along river banks or within river channels:

"*We do farm along the river banks to increase yields.*" **(Elderly female participant, TA Chapananga, Chikwawa)**

Figure 6: Cultivation of maize and other crops within the channel of Mwanza River, TA Chapananga in Chikwawa

v. Deforestation:

"Young people refuse to take part in farming activities instead they prefer going to the forest to cut down trees to source income and support themselves." (Lead Farmer, TA Nsanama, Machinga)

3.2 Existing scientific early warning systems in the communities

The Department of Climate Change and Meteorological Services (DCCMS) is responsible for the generation, analysis, and dissemination of weather forecasts in Malawi. It is also responsible for the issuance of flash flood warning, while the Department of Water Resources is mandated to monitor and issue riverine flood guidance and warnings. According to the Director of DCCMS, Jolam Nkhokwe, the country has witnessed substantial improvements in the generation and dissemination of early warning for agricultural and disaster purposes, which has led to the building of trust with the clients they serve. However, he acknowledges that more than 90% of this has been achieved through support from development partners, both local and international. The type of scientific information provided is in the form of seasonal forecasts, as well as fortnight, weekly, and daily weather updates.

It is apparent that the majority of farmers are using scientific early warning systems in their decisions. More than 90% of participants at community level indicated they use scientific early warning systems more than indigenous knowledge for their agricultural and other livelihood practices, including disaster preparedness. The accuracy and reliability has substantially improved, which has raised the bar regarding the level of trust on scientific early warning information across all levels and stakeholders. What has also enhanced this has been the steady improvements in the forecasts, particularly with the provision of downscaled seasonal forecasts that go up to the traditional authority area. However, over-reliance on

donor funding, for the downscaling of forecasts, raises sustainability issues in the event that no donor is willing to finance the process further. Moreover, downscaling has targeted only those districts and areas where the development partners and NGOs are implementing or supporting projects. A local meteorology scientist from the UN clarified some of the challenges with downscaling:

The scientific methodology to improve the coverage requires a lot of work in terms of modelling since modelling on a small scale is time consuming and requires a lot of data and most of the data that is available at small scale needs to be generated with a lot of expertise.

However, the forecasts are not without disappointments:
It is not most of the times that it (forecast) is accurate, which lets us down. For example, last year they passed on the information that we should plant our seeds with the early rainfall because it will stop for two weeks but it was contrary to what they said. The rains kept on falling and for the people who were just waiting they missed the timing and produced low yield. **(Male youth group, TA Liwonde, Machinga)**

As regards accuracy, an officer from the World Bank had this to say:
"the system is improving but there is still a lot of work to be done because the accuracy of the early warning system is depended on how dense the network is and how the system is operated with the people behind it but also on how the system is improved over time based on observation. So, I think we are yet to be there in terms of accuracy, but we are much better than 5 years or 10 years ago."

While some communities expect the forecast to come out exactly as stated, others demonstrated understanding the science of forecasting, as illustrated by a male youth participant in Balaka:
We mostly use the scientific ones because they are accurate…. We also know that if they predicted rainfall in the southern region even if we haven't received the predicted rainfall or dry spells in our area, somewhere within the southern region they must have received the rainfall.

3.2.1 Information dissemination

How does the information, then, trickle down to each of the end-users? Weather information is primarily accessed through radios, but farmers also get the information through extension workers, lead farmers, and communal gatherings, while others receive updates through their mobile phones, through platforms such as Esoko. A lead farmer in Ngowe TA in Chikwawa provided an example how early warning information is disseminated:

"Both VCPC members and lead farmers receive the information and act accordingly. For instance, we lead farmers we share the information with our fellow farmers while VCPC members call upon community members to a meeting where they share the information. Sometimes they use megaphones as well as phones when sharing the information. For example, if Laranje river is full to capacity we are being informed by our fellow friends who are living up land. Such kind of information has helped us to prevent some accidents which we have been experiencing in the past."

A few farmers are using radio listening clubs to gather and disseminate information:

Using radio listening clubs to adapt

Apart from that we also receive information through the radio. Just for example we have our own club known as Khungubwe club consisting of 10 people where we come conduct radio programs as well as receiving information through the radio on farming activities which in the end we conduct community campaigns or meetings where almost 15-50 people attend after seeking permission from our group village headman's, sharing the information we access at the club with others so that they should also have access to the information. For instance, we shared with the community on how they can manage army worms in their field by using fish (bonya) sauce.

(Vincent Khungubwe, VCPC Chairperson, Khungubwe, Chikwawa)

Not everyone receives the information, either due to lack of access to radios or not being able to participate in interface meetings where such information is disseminated. An officer from an UN agency pointed out that dissemination is part of the challenge, where she felt there should be different institutions responsible for the generation and dissemination of information. This can also be linked to challenges some communities cite, in understanding and interpreting the information:

*The message from the radio is not accurate because it is not communicated in a way that everyone should understand. For example, you (*the researcher) *are able to repeat the questions so that we understand but on radio they don't do that so if you haven't understood the information it means you have missed it.* (Elderly men group, TA Mwambo, Zomba)

Some stakeholders noted that, while DCCMS has streamlined the way they issue the information, as it does not go through the Principal Secretary and the Director issues the information, this is not the case with the Department of Water Resources (DWR). Here, there are delays, as the Principal Secretary has to approve the information before a warning is issued. However, DCCMS, DoDMA, and DWR indicated they are working together and have developed multi-hazard early warning protocols that will deal with some of the notable challenges.

3.2.2 Community-based early warning systems

There is a network of community-based early warning systems that have been set up in all the districts visited, predominantly with support from NGOs. These are in the form of river gauges, rain gauges, whistles, drums, megaphones, gumboots, and mobile phones, all of which have been set up for flood forecasting and warning. All existing community-based early warning systems are manual and are managed by Civil Protection Committees (CPCs), where CPC members have to physically go to the river to check on the water levels, which is posing challenges. Often, women are not able to actively involve themselves in such programmes, as at times the gauge readings are taken very early in the morning or even at night, posing challenges for married women. River gauges are calibrated after an assessment and surveying of the area, and are often colour-coded. A Green threshold means there is no danger in the area associated with the water levels, whereby no alert is issued; Amber or Yellow means there is danger in the area associated with the water levels, whereby a heightened risk alert is issued; and Red means there is extreme danger in the area associated with water levels, whereby an imminent risk alert is issued. Often, communities on the low-lying areas form a riverine alliance with others on the upland, who would also monitor water levels and weather conditions and alert those on the lower side when certain thresholds are reached. This assists those in low-lying areas with the level of effort they put into monitoring their river gauges. Communities are warned through word of mouth using megaphones, whistles, or drums. DoDMA developed National Guidelines on Community Based Early Warning Systems, which mention the need to consider IKEWS in designing community-based early warning systems. However, these have not been disseminated, nor is there a mechanism to enforce them. DoDMA also indicated it is currently in the process of setting up automated community-based early warning systems, which would also cover the Zomba district with support from the Green Climate Fund and UNDP through the M-CLIMES project, while Machinga would be covered through a World Bank funded project. These will use a similar approach to the manual systems, working through CPCs as focal points. They will also include manual river gauges so that warnings can still be issued in the event of automated river gauges malfunctioning.

Figure 7: Left: a network of river gauges on Phalombe River, TA Mwambo in Zomba.

GVH Mangulu, Machinga, displaying the rain gauge installed within his compound

The Department of Climate Change and Meteorological Services gave us rain gauges in 2018 for 3 different areas and we record the information and send it to the MET department through the Post Office once in a month and sometimes according to the rainfall pattern. We don't have the records because we send all the information to them.

GVH Mangulu, TA Nsanama, Machinga

Figure 8: An anti-hill observed in TA Nkaya in Balaka district, used to forecast rains

3.3 Common IKEWS practiced by small-holder farmers

This section presents findings of the documentation of indigenous knowledge early warning systems that are used in Balaka, Chikwawa, Machinga, and Zomba. Different scholars have provided different ways of categorizing indigenous knowledge, either based on the nature of indicator in terms of original, or by type of hazard or phenomenon the indicator predicts. However, for this study, these have been put into four categories: i) those associated with plants, ii) those associated with animals, iii) those associated with astrological elements (celestial bodies), and iv) those associated with hydro-meteorological events. In a few instances, other indicators associated with spiritual beings were also identified, though the general consensus was that these are no longer functional. The documentation has identified a total of 241 indicators (with district-level duplicates removed) that are practiced in the four study districts, with distribution illustrated in Figure 9.

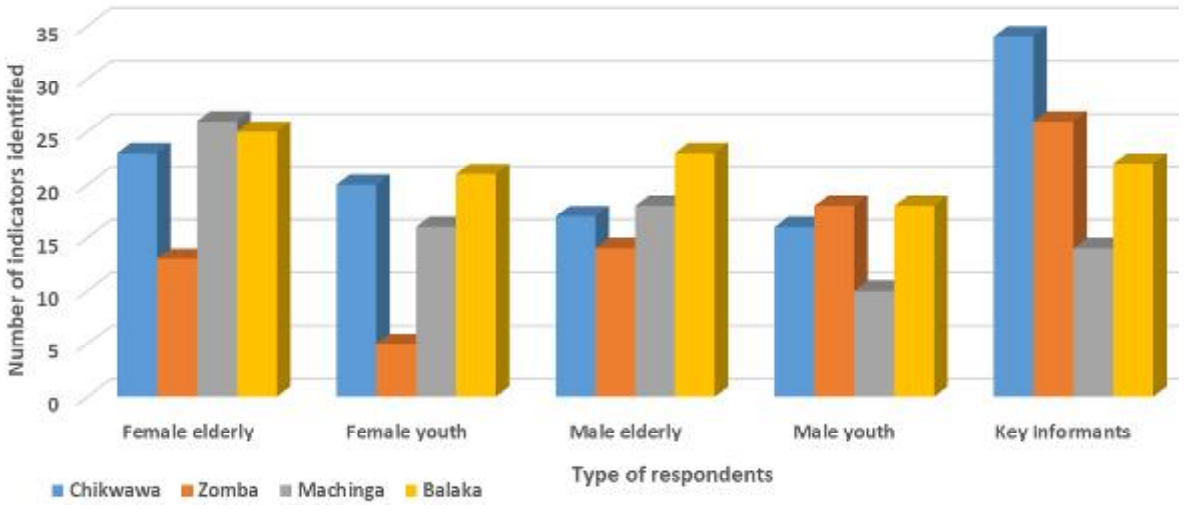


Figure 9: Distribution of indicators (with duplicates) against type of participants and district

The following can be noted from the findings:

i. **Overall number of indicators identified:** Without disregarding duplicates, a total of 379 indicators were identified at community level: Chikwawa has the largest number of indicators identified at 110, followed by Balaka, at 109, then Machinga, at 84, with Zomba having the least, at 76. Excluding duplicates within each district (same indicators being mentioned by more than one group or key informant), there are 241 indicators: Chikwawa has 66 indicators, Balaka has 68, Machinga has 53, while Zomba has 54.

ii. **Identification of indicators by sex and age:** Excluding duplicates, female elderly groups identified 87 indicators, followed by male elderly, at 72, while male and female youth groups had 62 each. The largest number came from community-level key informants at 96. Overall, female participants have cited more indicators than male participants, while the elderly have identified more indicators than the youth.

iii. **Indicators cutting across communities and districts:** One criticism against IKEWS has been the concern that they are location-specific and may not apply in other areas. While this remains true to some extent, as the majority of IKEWS identified are peculiar to districts and communities, such a generalisation is faulty. This study found multiple IKEWS that are used in different communities and are interpreted the same way in different communities and districts. For instance, excluding duplications across communities, there are 12 records related to fruiting and flowering of mangoes in the four districts. This was cited in almost every community, despite some differences in interpretation. The presence of swallows/swifts (nanzeze) was mentioned in all the four districts as an indicator of rainfall onset. Abundance of ants and behaviours of termites were the other indicators cited in most communities in all districts as predictors of the likely intensity of rainfall amounts during the rainy season.

iv. **Indicators peculiar to one community:** The study also found several IKEWS that are peculiar to one community or district. For instance, the Njeza plant that is used to predict rainfall onset was only mentioned in Zomba and it is located in the Lake Chirwa basin. These differences could be observed for the majority of birds, insects, and other animal species. There were also several indigenous tree species that were peculiar to localities: for instance, other than mangoes, mlambe (baobab), mkuyu (sycamore fig), nsangu (winter/camel thorn), nthundu (broom-cluster/cape fig) and mtondo (sunbird tree or wild mango), the majority of tree species mentioned as indicators for IKEWS were peculiar to communities and/or districts.

v. **Most frequently mentioned indicators:** A number of indicators were mentioned more frequently than others across communities. The majority of these are associated with rainfall onset or amounts. The most frequently mentioned IKEWS indicators across communities and districts were in relation to: mango trees, swallows, ants, frogs, butterflies, baobab, winds, moon, sun, stars, and cold or warm weather.

vi. **Indicators against the source:** Of the 241 indicators, the majority are those associated with animals (95, representing 39%), 70 are associated with plants (29%), 41 are associated with hydro-meteorology (17%), 29 are associated with astrology (12%) and the remaining 6 (2%) represent other unclassified categories (Figure 10). Similarly, in all the districts, animal-based indicators represent the highest number, followed by plant-based ones (Figure 11).

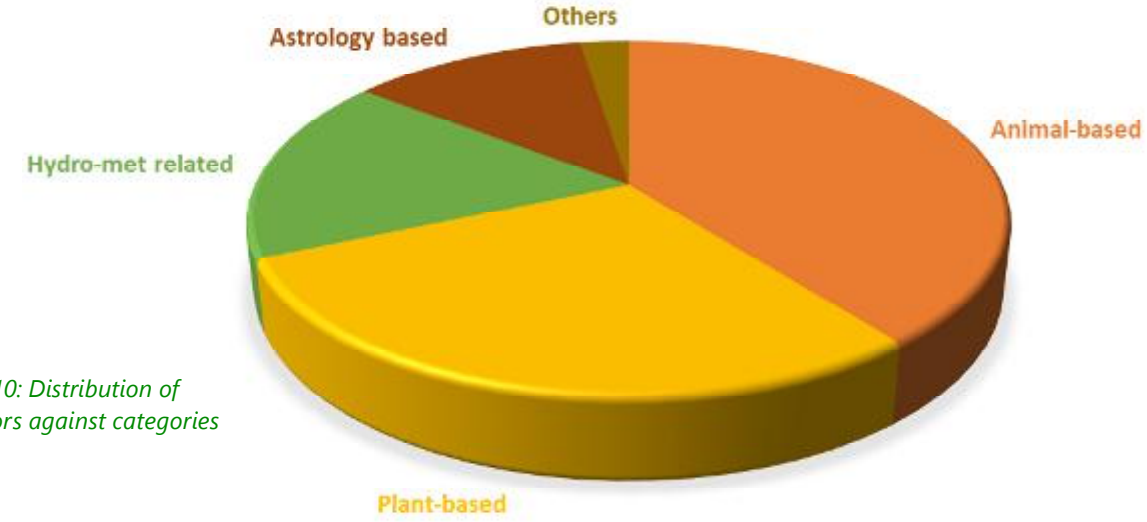


Figure 10: Distribution of indicators against categories

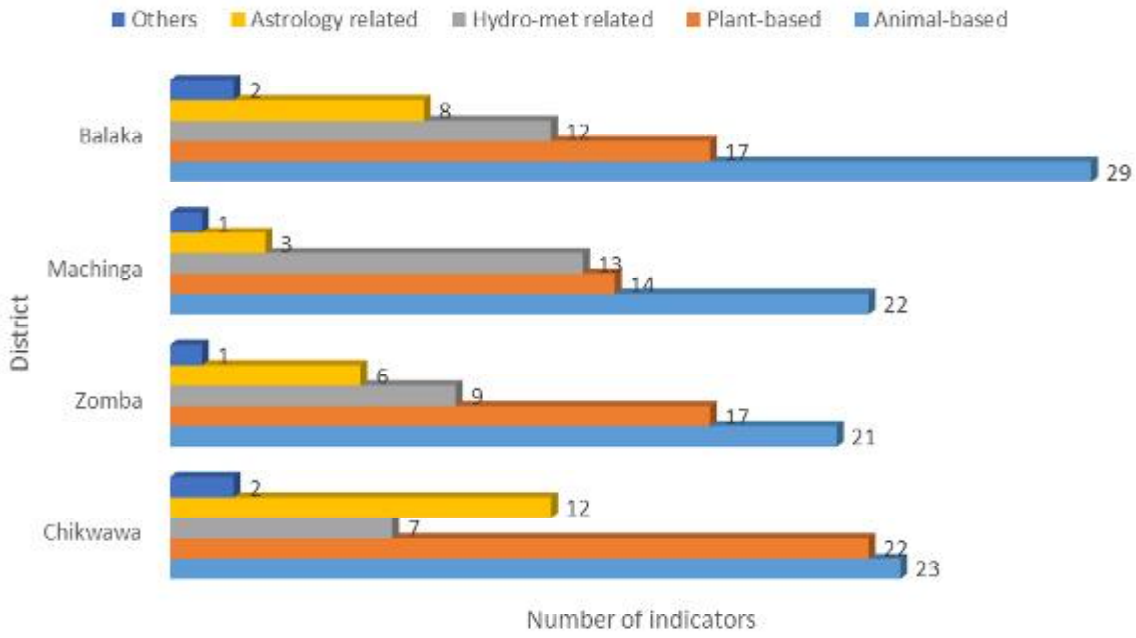


Figure 11: Distribution of indicators against categories for each district

vii. Contradictions in interpretation of IKEWS indicators: There are also a few instances where the same indicator is interpreted differently from one community to the next, or within the same community. For instance, within the same area in Zomba, Machinga, and Balaka abundance of mangoes mean good harvest to some and bad harvest to others (in Balaka, the disagreement was also noted within the same group discussion). Indeed, an abundant flowering of mangoes can mean good harvest to some, bad harvest to others, and onset of rains to others. When probed, each would argue that this is what he/she has been told and/or what he/she has also observed. Similarly, the sound of tsokonombwe can mean the onset of rains for some and the cessation of rains for others.

Figure 12: Signs of good rains or a bad year? A defoliated baobab tree standing in the middle of two mango trees with abundance of flowers, both used to forecast good or bad rains, TA Mwambo, Zomba

viii. **Unknown indicators:** In several instances, respondents could only remember the sound or behaviour of a particular indicator, such as the sound or appearance of birds or flowering or leafing of an unknown tree, without remembering its name. These indicators have been omitted from the list as they fail to represent a definite entity.

ix. **Variations on indicators:** It was noted that the type of indicator varies depending on level of exposure to hazards and the extent to which the community upholds its cultural values and practices. Those at higher risk and with closer ties to cultural values tend to have more indicators.

x. **Agricultural use of indicators:** The majority of the indicators are related to agricultural production, predicting onset and cessation of rains, dry spells or drought and heavy rains (which is also associated with flooding)

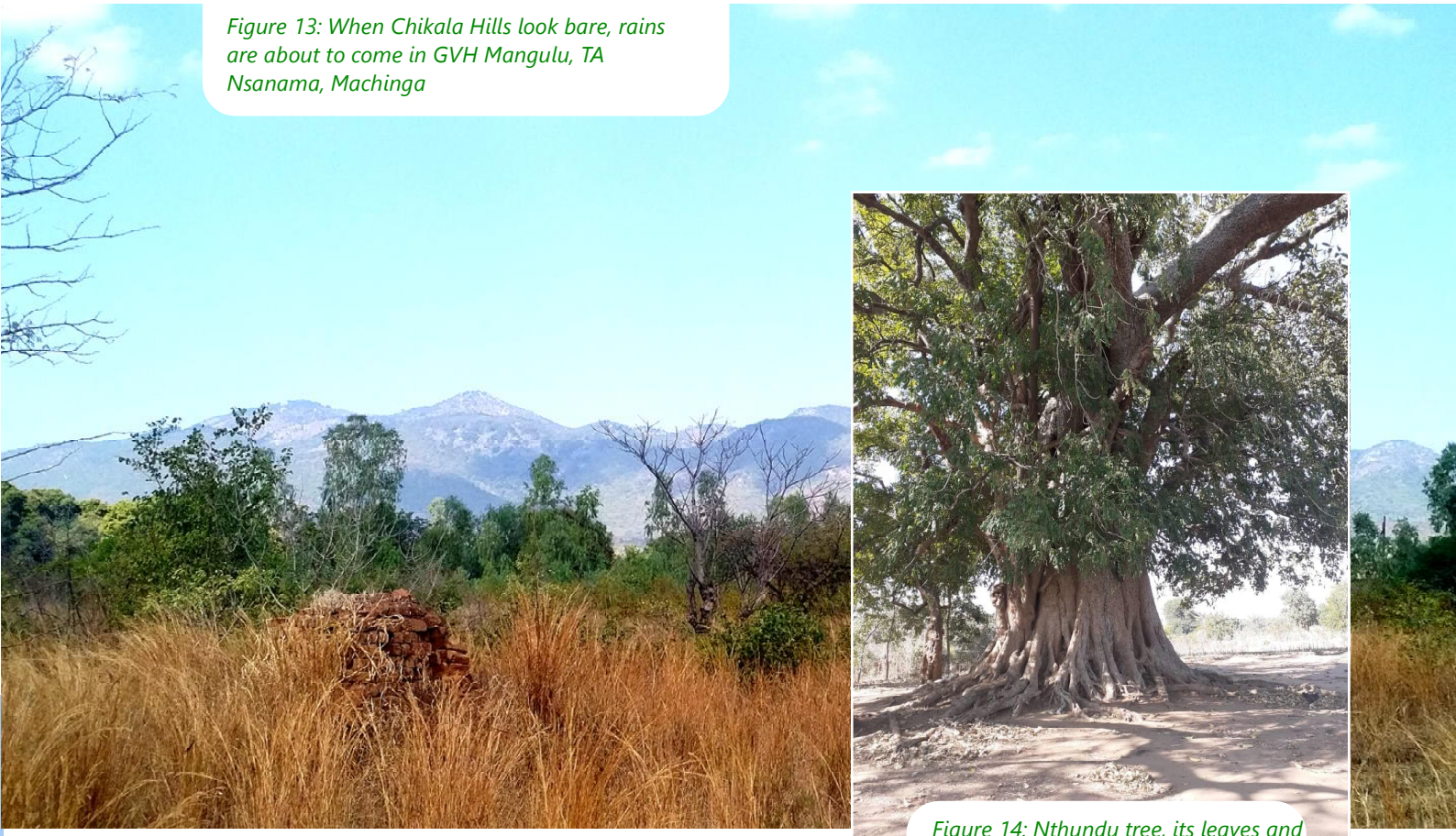


Figure 13: When Chikala Hills look bare, rains are about to come in GVH Mangulu, TA Nsanama, Machinga

Figure 14: Nthundu tree, its leaves and fruits used to forecast rainfall

xi. **Indicators used for hazard prediction:** In terms of hazards, of the 109 indicators that can be directly associated with hazards across the four districts, the majority predict floods (57, representing 52%), followed by drought or dry spells (48, representing 44%), with very few used for prediction of strong winds (2, representing 2%), pest infestations (1, representing 1%), and disease outbreaks (1, representing 1%). However, indicators used to predict flooding could also predict a bumper harvest, as they are both indications of heavy rainfall, which can also be interpreted by communities as meaning that there will be good rainfall for the community. Machinga has the least number of IKEWS used for hazard forecasting, at 10, with Zomba having 21, Balaka having 30, and Chikwawa having the highest, at 48. The majority of hazard-related IKEWS for Machinga and Balaka relate to drought, while for Zomba and Chikwawa flooding has the majority of indicators. There are very few indicators that were directly associated with flooding, most of which are associated with migration or just movement of aquatic animals such as frogs and hippo to higher ground. Table 3 provides a summary of the hazards and the number of indicators forewarning of these hazard events across the four districts.

Table 3: IKEWS used for hazard purposes across the four districts

District	Hazard	Number of IKEWS indicators
Chikwawa	Floods	30
	Dry spells or drought	18
	Pest outbreak	0
	Disease outbreak	0
	Strong winds	0
	Total for Chikwawa	
Zomba	Floods	11
	Dry spells or drought	8
	Pest outbreak	0
	Disease outbreak	1
	Strong winds	1
	Total for Zomba	
Machinga	Floods	3
	Dry spells or drought	7
	Pest outbreak	0
	Disease outbreak	0
	Strong winds	0
	Total for Machinga	
Balaka	Floods	13
	Dry spells or drought	15
	Pest outbreak	1
	Disease outbreak	0
	Strong winds	1
	Total for Balaka	
	Total for all 4 districts	**109**

Detailed description of IKEWS indicators for the four districts are presented below: Table 4 for Chikwawa, Table 5 for Zomba, Table 6 for Machinga, and Table 7 for Balaka. These cover all indicators identified in each district, excluding duplications. Annex II-V, at the end of this report, provides disaggregated IKEWS indicators across the four districts, with duplicates; Annex I provides a glossary of the key local IKEWS indicators, with scientific and English equivalents.

Chikwawa

Table 4: IKEWS indicators and interpretation for Chikwawa district

IKEWS Indicator	Interpretation
Animal-based	
Abundant presence of ants	Heavy rainfall that may lead to floods
Owls hooting all night	Heavy rainfall
Sighting of *khaka* bird	Dry spell
Presence of monkeys/*apusi*	Dry spell
Cackling of *mbaichuche* birds	Heavy rainfall.
Presence of *zam'dambo* insects	Heavy rainfall
Bellowing or coming out of hippopotamus	Heavy rainfall which will lead to flooding and the water will reach the exact same place the hippos reached
Flying of *nanzeze*	Heavy rainfall
Presence of frogs	Heavy rainfall
Presence of millipedes	Rainfall
The sound of *Gokomola/Nkwazi*.	Heavy rainfall
High manifestation of mosquitoes	Heavy rainfall
When *mavabingu* bites	It will rain within 2-3 hours
Presence of *mthusi*	Rainfall will come soon
Presence of butterflies	Risk of having army worms
Nkhululu forms a small anti hill	Heavy rainfall
Cows running around	Heavy rainfall
Coming of *kam'dambo* from the dambo area	Heavy rainfall
Hissing and whining of a python	Presence of spirits
Hissing of a python	Heavy rainfall
When bovwi closes its pit	Heavy rainfall
When *mwadonta* birds build their nest facing the west	Heavy rainfall
Cackling of *mphama* bird	Heavy rainfall
Plant-based	
Abundant flowering of *nkunkhu* trees	Heavy rainfall which may lead to flooding
Abundant flowering of *nyenja* trees	Heavy rainfall which may lead to flooding
Abundant fruiting or flowering of mango trees	Low yield

IKEWS Indicator	Interpretation
Abundant fruiting of *mtowe* trees	Heavy rains which may lead to flooding
Abundant fruiting of *kachere* trees	Heavy rains which may lead to flooding
Abundant fruiting of baobab trees	Low yield
Abundant fruiting of *matondo* trees	Low yield
Abundant fruiting of *masau* trees	Low yield
Shading of flowers by *mlusa* trees	Heavy rainfall.
Abundant flowering of *nkotamo* tree	Drought
Shading off of leavings of *matondo* tree	Heavy rainfall
Nkotamu tree produces red flowers	Rainfall onset
Abundant flowering of *mtondo* trees	Good rains
Abundant fruits from *nkolobwe* trees	Bumper harvest
Chikasu shrub placed in a clay pot and when it starts sprouting	Rainfall onset
Sprouting of buds on *njale* trees	Rainfall onset
Njale tree regenerates shoots	Heavy rains
Nkanda wa atsikana a type of tree when it produces red fruits	Low yield
Shading of leaves from *mvunguti* tree	Heavy rains
Abundant *bwemba* fruits	Low yield
Phingu tree regenerates shoots	Heavy rains
Abundant *kholongo* fruits	Low yield
Mbalu winds from the north going towards south	Good rain
First rains with hail storms	Low yield
Frequent occurrence of lightning and thunder	Rainfall
Cold weather during summer	Dry spells
Whirlwinds	Dry spell
Mbalu winds	Rainfall onset
Lightning and thunder	Rainfall
Astrology based	
Stars seen in the northern hemisphere (Nthondowa)	Dry spell
Stars seen on the southern hemisphere (Nthanda)	Heavy rainfall
Appearance of morning star/Nthanda	Normal rainfall

A bright shining star from the East	Heavy rainfall + bumper harvest
When stars are in a line	Heavy rainfall
Ring around the moon	Good rain
Eclipse of the sun	Low yield
Sunny days for a week during rainy season	Heavy rainfall
When the moon appears in half	Drought
When the moon appears in full	Bumper harvest
Eclipse of the sun	Dry spell
Ring around the moon	Heavy rainfall + adequate harvest
Others	
Offering of spiritual sacrifice	To receive rainfall
Nsanza Mvula outbreak of skin rashes	Heavy rainfall

Zomba

Table 5: IKEWS indicators and interpretation for Zomba district

Indicator	Interpretation
Animal-based	
Singing of maditi birds	Rainfall onset
Flying of nanzeze	Rainfall onset
Flying of Nanzeze	High rainfall intensity
Akakowa birds from north going towards the south	Good rainfall
Presence of frogs	Rainfall onset
Presence of crows	Rainfall cessation
Abundant presence of ants	Heavy rainfall leading to flooding
Abundant presence of ants	Rainfall onset
Abundant presence of ants	Good rains
Presence of frogs	Rainfall onset
Presence of gontham'kutu (flying ants)	Rainfall onset
When nkhululu forms an anti hill and leaves it open	Rainy season is not near
Chipping sound of nkoka bird	Rainfall onset
The appearance of Madulira (ucheche/njuzi)	Onset of rainy season
When tsokonombwe makes a lot of noise	End of rainfall season
When nkuta bird is singing regularly	Onset of rainfall season
When katawa bird builds a nest facing upwards	Inadequate rainfall
Nankako birds singing	Rainfall onset
Presence of frogs	Rainfall onset
Abundant presence of butterflies	Bumper harvest
Presence of Chankoko birds	Rainfall season is near
Sound from white frogs	Rainy season is near
Plant-based	
Flowering of mango trees	Rainfall/growing season
Abundance presence of mango fruits	Low yield
Abundance production of mango flowers and fruits	Good rainfall
Flowering of Chalima trees	Rainfall onset
Flowering of nsangu trees	Rainfall onset
Production of buds by nkuyu tree	Rainy season onset
Production of buds by nsangu tree	Rainy season onset
Production of buds by baobab tree	Rainy season onset
Production of buds by m'bawa tree	Rainy season onset

When rain comes but Tsanya trees have not produced buds	We don't have to plant our crops
New leaves/ budding of flowers on trees	Rainy season onset
When mitwana starts producing new leaves	Rainy season onset
When mkwera nyani starts producing new leaves	Rainy season onset
When mijombo starts producing new leaves	Rainy season onset
Hydro-met related	
Frequent occurrence of whirl winds	Onset occurrence
Extreme hot temperatures	Rainfall onset
Presence of fog	Rainfall onset
Extremely hot temperatures	Rainfall season is near
Cold weather until September/October	Late rainfall
No dew during the cold season	No rains/late rainfall
Whirl wind	Rainfall onset
Dark clouds and thunder Rainfall onset	
Rise in temperature in month of November	More rainfall
Lightning	Onset of rainfall season
Smell of wet soil	Onset of rainfall
Extremely hot temperatures	Rainfall season is near
Cold weather until September/ October	No rains/late rains
Astrology based	
Ring around moon (nkhokwe ya mwezi)	Bumper yield
The smell produced by the sun when it is bright	Onset of rainy season is near
Eclipse of the moon	Dry spells
Others	
Offering of sacrifice	To receive rains

Machinga

Table 6: IKEWS indicators and interpretation for Machinga district

Indicator	Interpretation
Animal-based	
Singing of *maditi birds*	Rainfall onset
Flying of *nanzeze*	Rainfall onset
Flying of Nanzeze	High rainfall intensity
Akakowa birds from north going towards the south	Good rainfall
Presence of frogs	Rainfall onset
Presence of crows	Rainfall cessation
Abundant presence of ants	Heavy rainfall leading to flooding
Abundant presence of ants	Rainfall onset
Abundant presence of ants	Good rains
Presence of frogs	Rainfall onset
Presence of *gontham'kutu* (flying ants)	Rainfall onset
When *nkhululu* forms an anti hill and leaves it open	Rainy season is not near
Chipping sound of *nkoka* bird	Rainfall onset
The appearance of *Madulira* (*ucheche/njuzi*)	Onset of rainy season
When *tsokonombwe* makes a lot of noise	End of rainfall season
When *nkuta bird* is singing regularly	Onset of rainfall season
When *katawa bird* builds a nest facing upwards	Inadequate rainfall
Nankako birds singing	Rainfall onset
Presence of frogs	Rainfall onset
Abundant presence of butterflies	Bumper harvest
Presence of *Chankoko birds*	Rainfall season is near
Sound from white frogs	Rainy season is near
Plant-based	
Flowering of mango trees	Rainfall/growing season
Abundance presence of mango fruits	Low yield
Abundance production of mango flowers and fruits	Good rainfall
Flowering of *Chalima* trees	Rainfall onset
Flowering of *nsangu* trees	Rainfall onset
Production of buds by *nkuyu* tree	Rainy season onset
Production of buds by *nsangu* tree	Rainy season onset
Production of buds by baobab tree	Rainy season onset

Production of buds by *m'bawa* tree	Rainy season onset
When rain comes but *Tsanya* trees have not produced buds	We don't have to plant our crops
New leaves/ budding of flowers on trees	Rainy season onset
When *mitwana* starts producing new leaves	Rainy season onset
When *mkwera nyani* starts producing new leaves	Rainy season onset
When *mijombo* starts producing new leaves	Rainy season onset
Hydro-met related	
Frequent occurrence of whirl winds	Onset occurrence
Extreme hot temperatures	Rainfall onset
Presence of fog	Rainfall onset
Extremely hot temperatures	Rainfall season is near
Cold weather until September/October	Late rainfall
No dew during the cold season	No rains/late rainfall
Whirl wind	Rainfall onset
Dark clouds and thunder	Rainfall onset
Rise in temperature in month of November	More rainfall
Lightning	Onset of rainfall season
Smell of wet soil	Onset of rainfall
Extremely hot temperatures	Rainfall season is near
Cold weather until September/ October	No rains/late rains
Astrology based	
Ring around moon (nkhokwe ya mwezi)	Bumper yield
The smell produced by the sun when it is bright	Onset of rainy season is near
Eclipse of the moon	Dry spells
Others	
Offering of sacrifice	To receive rains

Balaka

Table 7: IKEWS indicators and interpretation for Balaka district

Indicator	Interpretation
Animal-based	
Flying of *nanzeze*	Probability of having rainfall on that day
Increase in number of *amulunguzi/ Christmas insects*	Heavy rainfall
Mthutira ants collecting grass/foodstuff	Rainy season is near
The sound of *tsokonombwe*	Onset of rainy season is near
Mouse making a lot of noise	End of rainfall season
Sound of *nkhulawe bird*	Onset of rainfall
If *alolo/bololo* are not coming out of their dens	Drought leading to low yield
When termites are gathering foodstuffs	Low yield
Presence of butterflies	Absence of army worms
Presence of butterflies	Signifies fall army worms
Presence of butterflies	Heavy rains which may lead to flooding
Abundant presence of ants	Heavy rainfall
When *nthusi insects* carries its food/grass	Onset of rainy season is near
When a mouse known as *chitute/dungu* starts collecting food	Onset of rainy season is near
Chirping of *mwiyo bird*	Rainfall onset
Direction where *atombolombo insects* are coming from	Rainfall will come from that direction
Plenty grasshoppers	Bumper harvest
Plenty grass hoppers	Little rainfall
Abundance of crickets	More rainfall
Frogs moving from the river to the land	Floods
When an underground spider makes a web without a hole	Dry spells
When an underground spider makes a web with an opening	Good rains
Killing a python and throwing it in the water	Heavy rainfall
If a termite/ant called *nthuka* eats a broom that was left outside overnight	Heavy rains
If a termite/ant called *nthuka* doesn't eat a broom that was left outside overnight	Dry spells
Presence of *nyenje*	Rainfall onset
Nkhululu forms a small anti hill	High yields
Nkhwazi (eagle) sighting	End of rainfall season

Nthuta birds carrying food to its nests	Good yields
Plant-based	
Early mango flowering	Early rainfall season onset
Plenty mango	Bad rainfall pattern/Low yield
Regeneration of *Msangu* tree leaves	Rainfall season onset
Good productivity of fruits	Low yield
When *nfula* tree starts producing leaves	Onset of rainy season is near
When *nsangu* produces leaves	Ceasation of rainfall season
Good flowering of *Ntondo* trees	Adequate rains/good rains
When *mlambe* (baobab) tree produces buds and new leaves	Onset of rainy season is near
When baobab tree doesn't produce	Dry spells
When *Nthundu* tree produces buds and new leaves	Onset of rainy season is near
Nthundu tree late shedding of leaves	Heavy rainfall
When *mkuyu (fig)* tree produces buds and new leaves	Onset of rainy season is near
Leafing of fig trees	More rainfall
When *chimanaga cha pusi* is flowering	Rainfall onset
Mango tree flowering one side	Dry spells
When *tsanya* trees lose all leaves and the new ones start to grow	Rainfall onset and good rains
Mango tree flowering abundantly	Heavy/good rainfall
Hydro-met related	
Dark cloud that looks like a mountain	Prolonged dry spells
Frequent occurrence of whirl winds	Heavy rains with strong winds
Direction of whirl wind	Direction of rainfall
Prolonged cold weather up to September or October	Late onset of rainy season
When the wind is blowing from the north to the south	Probability of drought
Winds blowing from north to south showing very high temperatures and extreme heat	Rainfall
Collision of wind	Rainfall onset
Extremely hot temperatures	Heavy rainfall
Mwera winds	Dry spells
Whirl winds	Dry spells
Mangoni winds	Dry spells
Mwera winds (may- September)	Good rains

Astrology based	
Few stars shinning	Heavy rains
Moon surrounded by a big ring like a nkhokwe/granary	Bumper harvest, good rains
When the moon is at the centre	Good and timely rains
When the sun is shining too much producing a lot of heat from October- December	Rainfall onset
When the moon is not showing up during rainy season.	Heavy rainfall
An image like a barn on the sun	Bumper harvest
Ring around the sun	Dry spells
Rainbow	Rainfall cessation
Others	
Smell of wet soil	Rainfall is about to start
Offering prayers to *bimbi* (the rain god)	To receive rainfall

3.4 Effectiveness of IKEWS to facilitate adaptation by farmers

The effectiveness of IKEWS was assessed by looking at perceptions of farmers and other stakeholders regarding the extent to which IKEWS are helping them to adapt to climate change and climate variability, particularly in terms of reliability, accuracy, and timeliness of the information deduced from IKEWS. This was also assessed by checking the level of use or dependence on IKEWS in farming, disaster preparedness, and other livelihood decisions.

The general consensus from all level of participants at community level was that, where they are present, IKEWS are very effective in facilitating farming decisions and general adaptation. As highlighted by an elderly man in Balaka: "Indigenous knowledge is reliable that's why we have been using it since we were young." In most cases, people observe IKEWS before they receive scientific information and, thus, may already have made their farming decisions by the time they receive the scientific information. In the majority of cases, the information is accurate and reliable. This is further confirmed by the number of indicators that participants were able to identify, including those that no longer exist in the communities. However, there appeared to be no consensus on the effectiveness of IKEWS for participants at district and national level. Some viewed the knowledge as archaic and inhibiting the proper utilization of scientific early warning information, affecting agricultural production, or putting people at risk of disasters. Others considered it more effective, having survived the test of time and being more easily accessible to them, compared to scientific information. One reason commonly cited as to why IKEWS is more effective is the fact that scientific forecast tends to mostly generalize a larger geographical vicinity, while IKEWS is local and applies only to the area where the indicators are being observed.

There was evidence that most farmers have just developed knowledge on the IKEWS, but the level of usage is limited, despite several assertions to the contrary. Even among groups of elderly people in their 70's, they kept referring to IKEWS as being the knowledge of their forefathers, while discussions with youths often made reference to them as custodians. Regarding age and gender distribution in terms of usage, IKEWS is mostly used by the elderly, with no difference between men and women: "These are mostly used by older people than us the youth. A lot of youth don't have time to be following IKEWS. All they know is to listen to the radio and from the phones." (Youth men participant, TA Liwonde, Machinga).

The notion of accuracy remains a contentious issue, both for scientific and IKEWS, as forecasts are based on probabilities and events may not occur exactly as forecasted. Community members emphasize caution when taking either the IKEWS or scientific forecast at face value. In the words of Vincent Khungubwe, a VCPC Chairperson in Chikwawa, "some of the plants may produce more flowers due to the amount of water that the plant is up-taking, so we should not only conclude that we are going to have heavy rains."

3.5 Trend in the use of IKEWS

It is clear from the discussion with farmers and other stakeholders that the trend in the use of IKEWS is substantially decreasing. Apart from usage, the level of knowledge and understanding of IKEWS has also been dwindling in all four districts in this report. Several reasons were provided for this, most of which closely relate to the major threats or weaknesses of IKEWS, as provided in section 3.6:

i. As discussed in section 3.2, there is significant advancement in scientific early warning systems in the country, in terms of accuracy, reliability, timeliness and geographical reach. In the word of Mr. Louis Solomon from Goal Malawi: "*Honestly it's decreasing and it's because most people don't trust these due to availability of scientific knowledge*."

ii. Related to this is the issue of perception and how others would view those who follow IKEWS, which is considered archaic. In some instances, those believing in IKEWS are linked to witchcraft. There is a trend to think modern and act modern and those using IKEWS may be considered not to be moving with the changes of time. "*We don't use them because a lot of young people says that's a primitive way of thinking,*" stated an elderly male participant in TA Chapananga, Chikwawa.

iii. The majority of farmers are being advised to do away with traditional farming practices, such as use of local varieties, cultivation without fertilizer, ridge making, among others. Most of the approaches being adopted to adapt to the changing climate are modern and have close relation with scientific early warning systems

iv. The majority of farmers are considering themselves to be the current generation and feel IKEWS is for their forefathers who used it when there was no or limited scientific EWS. During discussions with several elderly men and women, they kept on ascribing IKEWS to their parents or ancestors.

v. Due to environmental degradation some of the IKEWS are no longer in existence in the communities. Deforestation has meant that most tree species that were closer to the community are no longer there; animals that used the forest as their habitat have either migrated or been overhunted: *"For example in that graveyard we had a python that was signifying us rainfall through its unusual sound but as of now it is no longer there*." (GVH Lundu, TA Chapananga, Chikwawa). Majority of rivers have also lost their vegetative cover and most are no longer perennial, which has led to loss of aquatic life, some of which were IKEWS indicators.

vi. The other challenge with IKEWS is that, unlike scientific information, there is no update on the weather as the season progress since most indicators cover specific timeframes of the agricultural calendar such as rainfall onset, rainfall cessation, rainfall amount. This brings in challenges of reliability as IKEWS are not considered as an information source that can be consistently used by the farmers throughout the season.

vii. Climate change has made a number of IKEWS no longer effective as IKEWS was mainly linked to a normal climate but with climate change, most issues cannot be relied upon to come as anticipated. "*Due to climate change most of the times when we predict the outcome is different from what we were expecting so a lot of people are not using them including the farmers*." (Men youth group, TA Matola, Balaka)

viii. Climate change has also led to changes in temperature and created an environment not conducive for the survival of some of the indicators

ix. Unlike scientific knowledge, IKEWS cannot warn people about threats that they face due to events occurring in other communities. For instance, flooding in districts like Chikwawa is linked to heavy rains in neighbouring upland districts. Meteorological forecast can warn them about heavy rains in the other areas and they can prepare accordingly. However, IKEWS is not disseminated the same way and there is no sharing of information across communities and may not be helpful under such circumstances.

x. The decline in usage is also due to failure to correctly predict the weather or season, which is linked to a multiplicity of factors.
I see the number of people using IKEWS declining because it is not giving us what we expect. For example, even if it happens that there a lot of ants in that year, still we don't get normal rains. (Mixed men group, TA Chapananga, Chikwawa)

xi. The government extension service and NGOs tend to promote scientific methods as compared to IKEWS. As such, most farmers are adopting the practices being advocated by these players. GVH Mangulu of Machinga attested to this, while commending Trocaire's documentation of IKEWS:
We are mostly using the scientific ones because it is the one which is mostly being encouraged by the government and different organizations. So, we are also using the scientific one so that we should all be on the same page. But what you are doing is a very commendable work, because it is like you are bringing back the dead information so that it should continue existing.

xii. Religion and an increase in literacy has also, in a way, contributed to the abandonment of some traditional practices being used. In all the communities, it was revealed that they used to rely on spirits when they had drought or dry spells. Sacrifices would be made to their ancestral spirits and rains would start falling. With the advent and spread of Christianity and other religions, the practice is frowned upon now, leaving many not to follow it in fear of public condemnation. In the few instances where it was still being practiced, things have often turned out differently, where regardless of sacrifices offered, no rains would come, leading to community ridicule for those involved.

Snippets on use of trend on use and reliability of spiritual sacrifices to seek rainfall blessings

We believe that the spirit that were helping us are disappointed. In the past, we could go for spiritual sacrifice of which now we stopped and this has made the spirits to be mad at us. In the past, pythons could hiss and whine in the villages which was a sign that the spirits are around us. We also believe that spirits were disappointed because of cutting down of trees. The good place for spirits to live is in the shade of trees so with deforestation the spirits got mad and the spirits don't give us whatever they used to.

(Mixed men group, TA Chapanga, Chikwawa)

Yes, some of the IKEWS are no longer used, for example our parents used to meet and conduct Spiritual sacrifices during the rainy season and we hear that they used to come back home wet but nowadays it is no longer happening. This other year our headmen went for spiritual sacrifice but the rains did not come. So, they just stopped and people laughed about it so the leaders just stopped doing it. But in the past the rains used to come just after the sacrifice but, not nowadays.

(Adult men group, TA Ngowe, Chikwawa)

3.6 Threats to the use of IKEWS

The preceding section identified some of the major reasons why there is a decrease in the level of adoption and use of IKEWS by smallholder farmers in the four districts. The majority of these factors support findings from studies within Malawi and other countries. This section presents some of the major threats to the use of IKEWS among smallholder farmers in the four districts, but most of the findings would also apply in other areas. Some of these threats have been presented in the previous section as factors inhibiting adoption and use of IKEWS by smallholder farmers. The threats, which also reveal weaknesses of IKEWS, have been grouped into nine broad categories:

i. Those associated with science and scientific ways of generation and dissemination of climate information services

The advancement in scientific forecasting and warning at national level has made such information more reliable and increased the level of trust in the scientific knowledge. This is a major threat to IKEWS as the two, despite efforts on integration, are commonly seen as rival forms of knowledge, where the scientific one aims to improve on and discourage use of traditional knowledge systems. There is also consistency and learning over time with scientific knowledge, unlike IKEWS, which has been considered as static.

> *On the weaknesses it's the same to do with scientific knowledge because the robustness of scientific knowledge is that you will actually get the results, then you repeat and somebody else gets the results and repeats again and then you improve upon. Indigenous knowledge is like static and that's the major weakness* **(Professor Chiotha, Chancellor College and LEAD)**

> **In the words of an elderly man during group discussions in TA Ngowe in Chikwawa:**
> *The other threat is that people are now relying on scientific knowledge such that even if someone says that with what is happening we are going to receive this kind of rainfall, people will doubt that person and sometimes mock him/her. With that kind of behaviour, people just chose to be quiet. Sometimes one of the old people may say that this is what will happen depending on the indicators he has seen but the young generation may as well mock him that it is old age that is making him to think in that way, so to avoid the insults they just remain silent.*

ii. Those that deal with the threat posed by climate change

> *We don't know any more whether the behaviours will still be the same for certain indicators as the climate is changing. For example, for the ants maybe in those days they were coming out due to soil moisture, and the time we are expecting that there will be soil moisture, it may happen that it's not there may be for 3 months it means the ants will not come out. So, what are we going to say? I think it will give us wrong information in terms of what we wanted to predict* **(Julius Ng'oma, National Coordinator, Civil Society Network on Climate Change)**

iii. Those that deal with modernity, including religion

In most communities, past behaviours that ensured IKEWS is passed on from generation to generation have dwindled. The practice of sitting with grandparents in the evening, listening to stories on IKEWS and other events is now gone. Children and youths are relying more on technology.

> *Indigenous knowledge is mainly used by the old generation because this generation is copying the western culture which they are using and they no longer listen to us the elderly.* (Elderly men group discussion, TA Mwambo, Zomba)

iv. Those that focus on environmental degradation resulting from human activities

Destruction of habitat for animals and deforestation makes it difficult to find most of the tree and animal species that provided the warnings. In most cases, for one to make the observations, they would have to walk long distances to find the trees or animals.

Compared to scientific information which can be easily accessed through radios or extension workers, the interest in the use of IKEWS is being threatened.

For example, we used to have these types of birds known as Ng'ombeng'ombe in Chichewa. When we hear the sound of these birds, we knew that it will rain within 2 days. But because of deforestation, the birds have gone so far away so much that we no longer hear them. **(Mr. Bonjesi, lead farmer, TA Ngowe, Chikwawa)**

However, in some instances, it was indicated that tree species that are critical for IKEWS are being preserved and protected by the community. In the words of a participant in a group discussion:

That is why we are still having those trees because they are still preserved by us no matter what no one can cut down those trees.

Planting of trees was also mentioned as one of the strategies being employed to conserve IKEWS. However, planting more trees in itself may not automatically mean sustaining IKEWS. For instance, even where planting of trees is to be propagated, what will happen if the varieties being promoted are genetically different from the traditional ones? Would they still be relied upon for IKEWS? How will animals migrate back to such habitats if they are reclaimed?

v. Those that deal with practices advocated by government and non-governmental organizations

Some NGOs and government departments working on climate change adaptation, agriculture, and disaster risk management are promoting new ways of doing things, mainly in response to the threat posed by climate change and climate variability. New varieties of crops and livestock, new ways of cultivation, new ways of pest management, and new tree varieties are all being promoted that tend to discourage the use of traditional ways of dealing with everyday challenges. These new ways also mean the behaviour of plants and animals may not be the same as demonstrated previously in reaction to weather or climatic conditions.

In the words of Mr. Geoffrey Chirombo from DAES: "*NGOs and other farmers bring in hybrid or improved varieties of mango trees. So, you can't deduce from such varieties; you can see that's a threat.*"

The case of Mr. Waterbag further illustrates this:
My name is Bonest Waterbag, I mostly use the scientific one because I tried to use both systems but I saw that I was benefiting more when I use the scientific one than the IKEWS. I was doing the comparison at once, planting maize using indigenous knowledge on another field and scientific on the other. Then I was advised by CICOD volunteers that I should try planting tomatoes using our local knowledge where we just plant anyhow, and on the other side I should plant using stakes and then I should compare which one will give me more produce. As of now, that is what I have done. So, as for me I think the scientific one has more benefits because I once did the comparison. (Bonest Waterbag, tomato farmer, TA Ngowe, Chikwawa district)

vi. Those that deal with transmission approach, including documentation and dissemination of IKEWS

One of the commonly cited threat to the use and sustainability of IKEWS is lack of documentation, since the information is passed on from generation to generation by word of mouth.

> *The other weakness is the dissemination part, people may have the knowledge but they may not have the mechanism to share the knowledge unless you ask them. So, this affects even the usage part because the very few people who have that knowledge do not have the platform to share that knowledge.* **(Frank Masankha, NASFAM)**

> *The other reason is like we don't have a proper system to say this is our village can we sit down and discuss early warning signs and predictions on things like rainfall so that all the people in the area are aware.* ***(*Mercy Chirambo, CADECOM National Secretariat*)***

However, documentation of IKEWS has been done in part for Malawi. The author came across at least four publications that have documented IKEWS in Malawi, with primary focus on Chikwawa and Nsanje districts. So, what could be the real problem? Awareness? Dissemination of results? Utilization of findings? Sheer lack of interest to further pursue the issues as it defeats the scientific knowledge, which is at the centre of most proposals submitted for funding?

One challenge noted was that, while there has been some documentation of IKEWS in the country, all the documentation done has been at institutional level, tied to a project. Findings have not been disseminated and are often done just as a constituent of a project. This also speaks to the level of awareness, as the common challenge cited by national and district-level actors is lack of documentation, when there is evidence of this having been done. People can only use IKEWS if they are aware and they have confidence in the indicators: both elements are under threat in the four districts. Even on fora where people share weather information, such as the *Weather Chaser Group*, there are hardly any updates or discussions on IKEWS.

vii. Those that deal with the intrinsic nature of IKEWS in terms of reliability and accuracy of the indicators

The accuracy and reliability of IKEWS has been questioned at all levels and discussed before. Where farmers do not have faith and confidence in the indicators, they will opt out and rely more on those they can trust.

> **According to GVH Khungubwe in TA Ngowe in Chikwawa:**
> *These IKEWS do not inform us when exactly will be the occurrence of what we are predicting, while the scientific one is capable of informing us about the occurrence, for example the exact month which the rainfall will start as well as when it will stop or the type of drought we are going to experience.*

viii. Those that deal with contradictions or inconsistencies in interpretation of the indicators

Contradictions and inconsistencies in the indicators from one area to another or within the same community make it difficult to decide what the indicator is really forecasting. Such contradictions even exist within one community. A common case is the mango tree, where some use flowering while other use fruiting to warn on rainfall or food insecurity or good harvest. In Zomba, abundant flowering of mango trees means a bumper yield in one area, in another instance in the same area abundant flowering of mango means rainfall onset, while abundant presence of mango fruits means drought in another. In Machinga, the abundant presence of ants means a) rainfall onset, b) heavy rains leading to flooding, and c) good rains. Flying of nanzeze bird can mean onset of rains or heavy rainfall. The presence of butterflies in Balaka can indicate that a fall army worm attack is imminent or mean that there will be no fall army worms in the season, t can also mean heavy rains that may cause flooding. Some have associated this with migration of people from one area to another who end up taking IKEWS indicators they used to observe in their original areas and applying them in another area where they may not work in the same manner.

ix. Those that focus on institutional processes and coordination

The Department of Climate Change and Meteorological Services is responsible for the generation and issuance of early warnings related to climate and weather. "Who is responsible for indigenous knowledge? This remains a major challenge with this type of knowledge," said Mr. Jolam Nkhokwe, Director of Climate Change and Meteorological Services. Right now, there is no discussion on how the issue of IKEWS knowledge can be used by different government departments and ministries. As a result, there has been a lot of promotion of IKEWS without proper coordination.

3.7 Synergies between IKEWS and scientific EWS and approaches

Different opportunities exist for the integration of scientific and indigenous knowledge early warning systems. There is also evidence that the synergies between the two sources of knowledge are being recognized and efforts are being made to integrate them. Discussions with different groups of stakeholders also revealed multiple ways through which farmers are integrating scientific and IKEWS in their farming and other adaptation decisions and practices. While physical evidence is not available, majority of respondents indicated that scientific knowledge and IKEWS, in as far as it concerns early warnings, tend to agree. Often, the signs seen by the communities would at time agree with the forecast provided by the Department of Climate Change and Meteorological Services.

> "*The synergies are there, when we predict about rainfall it happens that what we predicted and what the scientific information is saying they are the same. For example, they predicted that we are going to experience el nino and with what we also predicted using our local knowledge it was the same*." **(Elderly men, TA Mwambo, Zomba)**
>
> Some agriculture extension workers also pay closer attention to both IKEWS and scientific knowledge indicators in deciding what course of advisories to provide to farmers: "*We make comparison on the use of both methods and then see if the combined results are the best or individual results should be used.*" **(Agriculture Extension worker, TA Matola, Balaka). Mr. McNed Sankhulani, an AEDO in Chikwawa, gave a most recent example on how they integrate the two sources of information:**
>
> *For example, in the previous year, many farmers used indicators like ants, wind as well in which they were saying that when wind is blowing from south to north it indicates that there will be inadequate rainfall in that particular year, scientific information also predicted that we will experience dry spells in February. Both information helped us in planning our activities such as crop mulching and planting early maturity varieties. So, what I can say is that half of the local knowledge used is accurate so when we integrate the two, we are able to know the outcome*
> However, the majority of direct integration is project-driven: "*But the challenge is that the integration is mainly project based, so if there are no projects it means you are not able to integrate through these mechanisms like PICSA*." **(George Mwinawina, Malawi Red Cross Society).**
>
> **According to a meteorological scientist from one of the UN agencies:** "*the problem is that we have not reached a point where we can bring these two together and see the relevance*." Even convincing a donor to support IKEWS on its own may be a tall order. An officer from one of the development partners had this to add:
> *Even when requesting for support, you can't go to a donor to say we need support because people are seeing ants in this area and we should support them to prepare for heavy rains. No donor will give you funds for this. To some extent, we don't value them and we need to start finding ways how we can integrate these in our programmes.*

However, several opportunities were noted during the documentation in the four districts that either provides potential for integration or are already integrating the two, some of which are being championed through the CCPM, including:

i. The adoption of participatory scenario planning, which provides a clear example of an approach that directly engages with scientific and indigenous sources of climate and weather information:

I think the PSP was received well, this is why partners like TROCAIRE are mainstreaming this into their programs such that each and every program that we have worked with them since 2016 until now there is always an element of having PSP in their programs. (Julius Ng'oma, National Coordinator, Civil Society Network on Climate Change)

However, in the areas where the CCPM is being implemented, what has largely been done is to train lead farmers on the approach and it will be applied during the 2020/2021 farming season.

An expert's perspective on PSP: Professor Sosten Chiotha, Chancellor College and Lead

First, what is PSP in general from the literature?

Participatory Scenario Planning (PSP) is an approach that recognizes the uncertainty associated with short and long-term climate information products and brings together practitioners and communities in the interpretation of seasonal forecast within their local context that also integrates local knowledge and practices and past seasonal experiences. According to Ambani and Percy (2017), the approach is based on 7 principles:

1. Involve all relevant stakeholders;
2. Conduct PSP workshops as soon as seasonal forecasts are available;
3. Multi-stakeholder interaction, dialogue and co-production of information with scientists, com munities and other stakeholders;
4. Communication, understanding and interpreting climate probabilities and uncertainty;
5. Apply user experiences and results from previous seasons;
6. Advisories should be presented as options, rather than instructions;
7. Communication of advisories should be inclusive, reaching all genders and groups.

How the integration is done

Actually, Mr Nkhokwe (DCCMS Director) was right because on the PSP we engaged DCCMS to try and test PSP with our communities and we tested it in the communities of Mpyupu as we go to Lake Chilwa. It was very effective, the communities participated very well, basically going through what are the signals to use such as when will the rains come as well as long term forecasting. They had to provide that information and we engaged them for the long term forecast in terms of how the season was going to be and all that. Of course that's how we knew that some of the indigenous knowledge is location specific and some are common in so many areas. The location specific one was to do with this plant called Matchedza found in Lake Chilwa. When the small seeds from that particular plant starts flying in the air, they know that within the next 3-4 weeks it will rain. We also asked them what if the rains will come late and they replied that if that's the case then the seeds of that plant also starts to fly very late. For example, if they start flying in November then onset will be December, if they start September then onset will be in October.

This means there is indigenous knowledge on the onset and there is also indigenous knowledge on how the season is going to be like. On how the season is going to be like they use the behaviour of ants, birds but also what plants displays in terms of new leaves, flowering and fruiting, so there are a lot indicators which they use for both short term and long term forecast. Having agreed that this season will be like this, then DCCMS presented the seasonal forecast downscaled to Zomba and tried to explain that there is a similarity here and there is a difference here so going forward how are you going to prepare the forecast using both your indicators and our forecast. So, they were able to come up with a plan of action which was formed both by the indigenous knowledge and the scientific forecast. The approach was not to replace theirs but simply to provide them with an ideal set of information to help them come up with a better decision as well as when they are following, they should validate the scientific forecast as well as their indigenous knowledge. The following year we had to go back and check on how it went on like.

Challenges with PSP?

Unfortunately, there is no investment to continue with the same community for a long time, so we did that project with them just for that period. Of course, DCCMS has also run this in other communities but usually you don't do with the same communities. So, I think that's where our problem is, focusing on specific projects. I think we need to institutionalize it and run with the community for about 10 years so that it should be able to provide good information, so in relation to PSP.

Lisa Kamunde *from Komiha 1 village, GVH Magoli, TA Mwambo is one of the lead farmers that has been trained on the PSP approach by CADECOM. After the training, she went ahead to sensitize other farmers on the approach and other climate resilient practices. She has applied the knowledge in her farming practices, where she integrates both IKEWS and scientific knowledge. She strongly feels the approach will go a long way in improving their planning processes for agricultural. She says this year (2020) she has noted that the scientific forecast provided has been different from the outcome, while the indigenous knowledge indicators they observed have come out correct.*

ii. Another innovative approach that was commonly cited as being used is the Participatory Integrated Climate Services for Agriculture (PICSA). This is an approach that considers the variability in climate and weather across areas and brings extension workers, farmers, and other players together to analyse, using participatory decision-making tools, the weather forecast and historical information and then explore the crop, livestock, and livelihood options that they can adopt for a particular farming season. However, unlike PSP where IKEWS is an integral part, for PICSA,

> "*unless if you bring in that discussion deliberately in the component part, the indigenous doesn't come out clearly. So, when we are discussing you need to probe the farmers, unlike the PSP where it deliberately has the indigenous knowledge where you need to ask the farmers*" **(Frank Masankha, NASFAM).**

Geoffrey Chirombo, Agricultural Communications Officer for the Department of Agriculture Extension Services agrees with his NASFAM counterpart:

"The opportunity exists but it's not like a written rule where there is a certain section where we should be discussing about indigenous knowledge. But it's like those who developed PICSA as an approach encourages everyone to integrate issues according to what they believe in.

PICSA as well can be used in indigenous knowledge in order to have farmers understand what the scientific knowledge is trying to tell them so it can be adopted as well but it's something which is part of the steps of PICSA but I have seen that most of the facilitators they use indigenous knowledge in order to bring farmers on the same level so that farmers can be able to understand what the scientific knowledge is trying to tell them."

iii. Capitalizing the farmer field school approach, which is already utilizing multiple approaches to ensure agricultural productivity, where IKEWS could also be taken on board.

The opportunities with the farmer field school in the words of an Agriculture Extension Development Officer (AEDO), Bonwell Simbi, TA Mwambo, Zomba

What is the farmer field school?

Farmer field school is a program where farmers choose a certain type of crop which they would like to learn from, they plant this type of crop in different field with different farming activities then they learn from both field from the planting period up to the harvesting period and later on they compare which crops and from which field have done better and with what farming practices. From there they make concrete decisions on the farming practices they should follow. They also learn issues of climate change and farming activities they can practice in order to still benefit from their farming such as irrigation farming. Apart from meeting time to time due to farming school activities they also have a savings and loans group where they save and access loans so that they also deal with issues of financial challenges. All these programs are also helping them because we are able to see a positive change from 3 years ago when these activities started. But again farmers have also realized that even if they encounter challenges like floods, they can still use other methods of farming such as irrigation.

How does it link with early warning systems?

The Ministry of Agriculture and some other organizations have been proving extension workers with scientific early warning information as well as updates on weather forecast. Through WFP we also have a program known as PICSA where extension workers are supported on how best they can supply climate change or weather forecast information to their farmers. Through different farming groups that are already there such as the field schools we are able to easily supply the information to the farmers. Since the weather forecast has been downscaled, we are also able to provide the information according to the concerned area and farmers are able to prepare accordingly. Some of the organizations that are supporting this program includes Malawi Red Cross, CADECOM, and FAO.

We started using PICSA from 2016. Using this program, we are working with farmers in their groups but there are also some farmers that are not in groups so we also follow them and supply them information such as downscaled weather information so that all farmers should get prepared. For example, last season showed in January we will have heavy rainfall, we informed farmers and they were all prepared for the situation. The time we received the rainfall it led to flooding but because farmers were prepared most of them did not lose their properties.

How does IKEWS come in?

The indigenous knowledge is there but since my EPA is much bigger so it depends with the area because IK is specific. For example, during different meetings with the farmers, they are able to tell us their indigenous systems that they use but for us extension workers we can't know much of the IK of that area compared to owners of the community. What most of us extension workers do is encouraging the community members to keep on using the IK.

However, there are some threats

Each and every season we are supposed to be given a downscaled forecast. This has been happening with the support from WFP and MET department and this is the forecast that we were giving the farmers. So, the challenge is we don't know if MET will be able to supply us this information for free.

The other thing is that we have only managed to use this approach with a few farmers meaning to say there are still a lot of farmers we haven't reached because it is not only a matter of giving them the forecast but also teach them on climate issues such as climate change hence we are supposed to have necessities so that we can be able to teach these farmers. The government on its own cannot manage to do so, so unless if we can be using other communication platforms like WhatsApp may be sustainability can be there.

iv. Integrating IKEWS within the community based early warning systems (CBEWS)that have been set up across communities in all the four districts. Since the CBEWS' provide warning based on the local observable context, it relates closely with IKEWS in this instance and could be easily integrated into the whole system. For instance, observance of indicators that forecast heavy rains like ants could be a stimuli for closer observance of the river gauge readings or checking closely with communities in upland as part of the riverine alliances for flood forecasting and warning.

v. Downscaling of scientific weather forecast to the TA level also provides a way of confirming or verifying the IKEWS being observed as communities can use the downscaled information to check if what is being forecasted and what they are observing are tallying.

vi. Radio listening clubs and radio programmes financed by NGOs and government provide an opportunity to integrate IKEWS within the programmes. This currently is not being done as the focus tends to be on scientific knowledge:
One thing that we also don't emphasize very much is our Radio Programs, when we have got the radio programs we focus very much on the scientific and we don't discuss much on the indigenous but that can also be a good way of trying to start a discussion in the communities (George Mwinawiwa, MRCS)

vii. Trend towards movement to climate smart agriculture, where some of the practices, such as agro-ecology, manure making, are what farmers used to do previously before proliferation of fertilizer use.

iii. During interactions with farmers when disseminating scientific weather forecast, NGOs and government officers also probe on IKEWS being observed and how these relate to the scientific information. According to Frank Masankha, Farms Services Officer for the National Smallholder Farmers Association of Malawi (NASFAM):

When we are doing some examinations with the farmers we are able to provide the information on what the focus will provide and we ask them what indigenous information they have from their areas so that it should be combined with what we have so people come up with a lot of information.

The following provides some of the sentiments raised by farmers in terms of the synergies they see between the two and how they are bringing them together in their decisions:

> *Some indigenous knowledge give same predictions as the scientific methods so at times we use them both mainly to do with the time the rains will start.* **(Female lead farmer, TA Mwambo, Zomba)**

MINISTRY OF FORESTRY AND NATURAL RESOURCES

DEPARTMENT OF CLIMATE CHANGE AND METEOROLOGICAL SERVICES

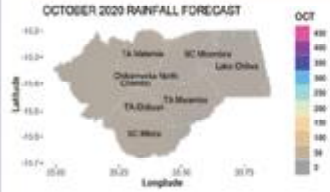
ZOMBA DISTRICT DOWNSCALED SEASONAL FORECAST, 2020-2021

OVERVIEW OF 2020/2021 RAINFALL SEASON

The 2020-2021 rainfall season for Malawi is expected to be influenced by La Nina conditions which are projected to prevail until early 2021. La Nina is the unusual cooling of ocean waters over eastern-central equatorial Pacific Ocean.

Expect normal to above-normal total rainfall amounts in Zomba district during the rainfall season from October 2020 to April 2021.

October 2020



Expect rains to be accompanied by strong winds and lightning in the month of October with the rains being below 50mm.

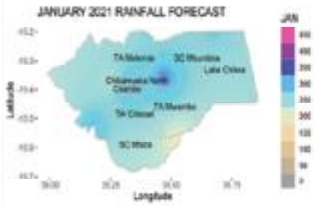
November 2020

Most areas are expected to receive rainfall between 100 and 150mm in the month of November . Most areas are expected to experience onset toward the end of this month.. Expect the rains to be accompanied by strong winds and lightning

December 2020

Most places are expected to receive more rainfall in December between 150 and 250mm. Areas around Chikamveka and Chambo are expected to receive more rains that the rest of the district.

January 2021



Rainfall ranging from 150 to 350 mm is expected in the month of January . There is a chance of dry spell of about two week in this month in few areas

February 2021

Most areas are expected to receive rainfall between 150 to 250mm in February and areas around Chikamveka and north of TA Malemia may receive even more rains than the rest of the district. There is a chance of dry spell of about two week in this month in some areas

March 2021

Areas around Chikamveka are expected to receive more rainfall than other places in the district in the month of February. Most areas are expected to receive rainfall around 100 to 150mm.

April 2021

The month of April is expected to mark the end of the rainfall season as most areas are expected to receive rainfall below 50mm in the month of April .

Zomba District is expected to experience rainfall onset from the last week of November to the second week of December 2020.
There is a high chance of dry spells occurring during the season in January and February. Rainfall cessation is expected from the last week of March to the second week of April 2021. the 2020/2021 rainfall season is expected to last 120 to 160 days.

ZOMBA AGRICULTURE			
MONTH	NORMAL RANGE		FORECAST
OCT	3.7	29.2	23.3
NOV	64.4	101.7	93.2
DEC	197.8	289.6	294.2
JAN	231.4	362.9	316.4
FEB	181.1	290.7	222.2
MAR	124.1	221.8	136.6
APR	27.7	66	43.7

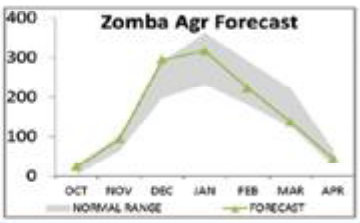


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Figure 15: Downscaled seasonal forecast for Zomba for 2020/2021 season: **Source: DCCMS**

Before receiving scientific information, it happens that we have already started seeing some local indicators on how that season will be like and as soon as we receive the scientific information we now integrate. If the local indicators signified drought and then scientific information is saying that rainfall will start in December, we now integrate the two information when planning our farm activities such as planting with the first rains as well as choosing crops that mature early. In general, we use both systems in our agricultural activities because we believe both systems complement each other. **(Mr. Bonjesi, lead famrer, Khungubwe GVH, TA Ngowe, Chikwawa)**

However, others feel there are no synergies. **In the words of GVH Lundu in TA Chapananga in Chikwawa:**
Most of the times the outcomes are different, most of the times we see that the scientific information that we received has come to pass. ***It's like these scientists own the rain****. For example, last year (*2019*) we were informed on the exact month when the rainfall will start and when it will stop so we were advised to plant our crops earlier and it really happened the same way they predicted. The indigenous systems are no longer working because of climate change.*

The distinct nature of the two approaches may also partly explain why integration has been a challenge in some instances: "*the synergies exists, but the difference is that with science we are informed on when exactly it will rain for instance while with IKEWS we don't know the exact date when it will occur….with IKEWS we don't know the amount of whatever we are predicting for example rainfall amount that we will receive in that but with scientific information we know the amount.*" **(Youth men, TA Matola, Balaka)**

3.8 Policy environment for IKEWS

The policy framework, for adaptation to climate change, disaster risk management, and agriculture, seeks to consider indigenous knowledge, focusing on documentation and integration of IKEWS with scientific knowledge. The study analysed a number of policy and other government instruments and identified four policies that make specific mention of indigenous knowledge, either directly in the policy document or within their implementation, monitoring, and evaluation strategies. Indigenous knowledge has also been mentioned in the National Adaptation Programme of Action.

- National Meteorological Policy, 2019, Policy Priority Area 4, strategy number c): *Identify and document indigenous weather and climate indicators and knowledge*

- National Disaster Risk Management Policy, 2015 (Implementation, monitoring and evaluation strategy), policy priority area 4, strategy number 1: *Develop and implement a national DRM communication strategy that engages the media, takes into account indigenous knowledge and reaches all stakeholders*

- National Agriculture Policy, 2016, policy priority area 3.1.2, strategy number 11: *Integrate indigenous knowledge with scientific research for agriculture.*

- National Climate Change Management Policy, 2016 (Implementation, monitoring and evaluation strategy), Policy priority area 4, objective 4, strategy 1: *Promote access to research grants for centers of excellence to undertake research in climate change adaptation and mitigation, including indigenous knowledge.*

- Malawi National Adaptation Programmes of Action, 2015, priority 1, activity number 4: *Integrate indigenous knowledge into the scientific climate and weather forecasting and any related information*

While several policies mention integration or promotion of IKEWS, the extent to which this has been actualized is wanting. Almost all stakeholders interviewed at national, district, and community level felt there was no

policy that considered IKEWS, either through ignorance of the policy or just through a lack of general awareness. The following conflicting statements demonstrate the different levels of awareness on the national policies and practice on the ground, regarding IKEWS:

> "*Even looking at the national Meteorology policy there is nothing on indigenous knowledge and nothing of integration of the indigenous knowledge and the scientific.*" **(An officer from one of the development partners at national level)**
>
> *"I don't see that there is adequate policy instruments that can support the use of indigenous knowledge but there is some effort from individuals, and maybe I need to check again with the sectors but I see there is little appreciation of the indigenous knowledge. Most of the policies they would like to support the scientific knowledge.*" (an officer with one of the development partners at national level) *DCCMS always talk about indigenous in their meetings and they always encourage the partners to talk about indigenous early warning systems but in terms of documentation I haven't seen any policy*. **(An officer with the Malawi Red Cross Society)**
>
> *As a department, we have been promoting the use of indigenous knowledge in our activities when dissemination forecasts. You see that the National Meteorological Policy has issues of indigenous knowledge included and we have been promoting PSP in our activities as part of translating the policy stipulations.* **(Jolam Nkhokwe, Director, DCCMS)**
>
> *Actually the government is discouraging the use of IKEWS. There is nothing they are doing against IKEWS threat*. **(A lead farmer from TA Nkaya, Balaka)**
>
> *Based on experience in DRR, the IKEWS is rarely used in decision making processes*. **(a central government officer working in DRR)**
>
> *Government is now promoting integration of the two so the knowledge of indigenous knowledge early warning systems is not lost among farmers*. **(An agriculture extension worker in TA Matola, Balaka)**
>
> *"The government through extension workers are telling the farmers not to completely ignore the tradition ways but should continue to practice them.*" **(An Area Civil Protection Committee Chairperson in TA Matola, Balaka)**

A few of the policy stipulations on IKEWS have been translated into other national tools and instruments. The adoption of practices such as PSP could be an indicator of actualizing the aspirations of these policy instruments. While no national tool or framework has been developed that specifically focuses on IKEWS, there are several other national instruments that have sections on IKEWS. These include the National Climate Change Adaptation Training Manual, which has a whole module on IKEWS; the National Disaster Risk Management Communication Strategy, which make specific mention of IKEWS, including some examples that were documented during the development of the strategy; and the National Disaster Risk Management Handbook which has documented several district-specific IKEWS. The NAPA also make specific mention to the use of PSP for climate and weather information for preparedness purposes.

4.0 Conclusion and Recommendations

Indigenous knowledge early warning systems (IKEWS) has been observed as an important way of adapting to the effects of climate change and climate variability. However, although it provides multiple opportunities, it also faces multiple challenges. This study was commissioned by Trócaire to document indigenous knowledge early warning systems being used by smallholder farmers in two TAs each in Chikwawa, Machinga, and Balaka, and one TA in Zomba. The process involved direct interaction with multiple respondents in eight GVHs, in addition to research participants at national and district levels. The report has, identified the major climate risks that are faced in these communities, documented the IKEWS being practiced in the areas, assessed the effectiveness of the IKEWS in aiding adaptation of smallholder farmers to climate change and climate variability, identified synergies between IKEWS and scientific knowledge sources, and documented the trend in the use of IKEWS and the threats to IKEWS usage. In addition, while not a direct component of the scope of the work, the inception report notes the need to review where the issue of IKEWS sits within existing policies and to look at how IKEWS fits within the broader early warning systems within the country.

The recommendations that follow are made based on the findings presented in this report and have been divided into two: those that target Trócaire and its programme partners, and those that target national and local government stakeholders. The implementation of these recommendations will require working with multiple stakeholders at community, district, and national level, including NGOs, development partners, government ministries, departments and agencies, academia, media, local authorities, and farmers and other community members. The majority of the recommendations are targeted at Trócaire and its programme partners, but for some of the final recommended actions they may require the involved of government partners. While government may be required to take some action, the report recommends that Trócaire and its partners play an advocacy role and bring awareness to the government-focused recommendations in order to ensure they are implemented and/or followed up.

4.1 Recommendations for Trocaire and CCPM Partners

i. Undertake wider knowledge and best practices sharing through learning events. The number of projects and organizations focusing on early warning system in Malawi is high, and more are being added. Trócaire stands at an advantage, as it works with communities through partner organizations, which accords it convening powers to ensure IKEWS is integrated in all the programmes it implements. Evidence from the four districts, along with interviews with other national players, shows that this is already being done where, for instance, all programmes have integrated PSP as part of their programming. This should, not only be up-scaled, but the knowledge generated and experience should be shared with the broader constituency across the country.

ii. Promote IKEWS through existing innovative approaches, including PSP, PICA and farmer field schools. PSP has come out as an important vehicle to promote IKEWS use and adoption at community level. Even NGOs and government departments not directly working with Trócaire are adopting the approach. However, interactions with extension workers revealed that they relate more with the PICSA approach than PSP; possibly because it is being driven by DAES. The following are recommended:

a. Continue engaging umbrella organization such CISONECC with which Trocaire already closely works with. Trocaire should further engage other umbrella organizations in relevant fields, including the Civil Society Agriculture Network on the approach.

b. Undertake wider training of extension workers to institutionalise the PSP approach, use it as a vehicle to integrate IKEWS in their day-to-day interactions with farmers.

c. Initiate national dialogue on IKEWS and PSP, particularly to share experiences from the field on how it is adding adaptation.

d. Explore how IKEWS can be integrated into the farmer field school approach that is being promoted in all the communities where CCPM is being implemented

e. Engage partners leading the PICSA, mainly the World Food Programme, the Department of Agriculture Extension Services, NASFAM and the MCLIMES project to explore how the approach can be integrated into CCPM and also used as a vehicle to integrate IKEWS

f. The PICSA approach should further be interrogated to identify entry points for integration of scientific and indigenous information;

iii. Trocaire and its partners should publicise the documented IKEWS and other findings and recommendations of the documentation process and report. Work promoting integration of IKEWS and scientific information has been underway at the community level. The extent to which this has been publicized is limited. Similarly, documentation of IKEWS has been commissioned by multiple NGOs. The results have often remained within the parties that commissioned the studies. One issue cited by key informants at national and sub-national levels, as well as existing literature, is the lack of documentation of IKEWS. This is not entirely correct. The problem has been that such results have remained with the parent institutions, in some cases not even disseminated to the districts or communities where the studies were undertaken. There is, therefore, a need to properly disseminate findings of such documentation. Several approaches are recommended to disseminate the findings of this current study:

a. Sharing the reports with the academia, government ministries and departments, local authorities, NGOs and libraries;

b. Disseminating the findings through special interaction with the media in form of radio or television programmes, with emphasis on community-based media houses. Other than just dissemination of reports, deliberate efforts could be made to have programmes that show evidence of integration if IKEWS and scientific information;

c. Production of brochures, leaflets, posters and other information, education and communication products that can be distributed in the communities of concern in local language. Such materials should be area-specific and should go beyond just publicizing this report but can also be an innovative way of disseminating IKEWS, where the indicators are documented on leaflets annually and disseminated to community members;

d. Engaging extension workers as vehicles to disseminate the documented IKEWS, including actively i nvolving them in training and awareness exercises;

e. Holding café or workshops to share and discuss documented IKEWS. This could, for instance, bring together all partners that have done the documentation before;

f. Publication of the report online, that can also be linked to other national-level websites, for instance that of the Department of Climate Change and Meteorological Services, Ministry of Agriculture, Department of Disaster Management Affairs, Department of Environmental Affairs and CISONECC;

iv. Trocaire should engage more partners and hold learning events to publicise successes and lessons being learnt from its use of agro-ecological approaches to climate change adaptation. One of the major threats to IKEWS is environmental degradation, resulting from deforestation, particularly. Trócaire is promoting an agro-ecological approach to adaptation, which includes promoting regeneration of indigenous tree varieties within agricultural zones, which is assisting in bringing back some of the IKEWS indicators that have been lost. This should go hand in hand with practices that are preventing deforestation, including through facilitating the formation of bye laws and setting up structures to enforce these. Engagement of officials from government's forestry department is crucial, in ensuring sustainability of the approach. The land department and traditional leaders should also be engaged to ensure adequate land is available, as challenges with land were observed as challenges in this report.

v. Trócaire and its partners should make deliberate efforts to train and involve Civil Protection Committees and Natural Resources Management Committee at village and area level for documentation of IKEWS. IKEWS is passed on from generation to generation by word of mouth. In most communities, there exist structures that coordinate disaster risk management or agricultural activities.

These could be encouraged to locally document IKEWS and disseminate them available to community members;

vi. Existing local structures should be mobilized and engaged to champion IKEWS. At community level, mechanisms should be established for the identification and dissemination of IKEWS to the whole community. For instance, existing youth groups in the communities could champion the course, considering that youths are mostly considered anti-IKEWS;

vii. Trócaire and its partners should advocate for the documentation and dissemination of IKEWS by responsible government departments at district and national levels.

viii. Integrated approaches to resilience building should be prioritised over those that focus on tackling single or visible and obvious vulnerability factors, guided by detailed participatory assessments of risks. There is some disconnect between interventions being implemented by NGOs and government entities on the ground and the vulnerabilities that are exposing them to the risks. Most tend to focus on the easy-to-do elements and most visible elements. Perhaps, it is easier to get funding for riverbank afforestation than building strong governance institutions within the communities. However, disjointed implementation of interventions that do not consider the broader vulnerability picture will continue yielding limited results. There is need for dialogue and proper planning to ensure a more comprehensive approach to vulnerability reduction, climate change adaptation, and disaster risk reduction. Different programmes implementing human rights, governance, health, agriculture, education, transport, and provision of other social services should be linked to the resilience projects being implemented, to ensure a holistic approach to dealing with vulnerabilities. Proper understanding of the local context is also key at the design stage of interventions to avoid wholesale transfer of technologies and practices that have worked in one country or community. The use of approaches such as participatory vulnerability and capacity assessment (PVCA) that also integrates elements of the pressure and release model, as was done under the CCPM, are important. However, in most PVCAs, only a few issues are prioritised and supported. The rest of the issues identified, even when not financed, should be integrated in the programmes or form part of advocacy issues with government. However, although promoting agricultural production is good, if farmers are not able to sell their cotton due to absence of ADMARC, as was noted in Chikwawa, or they cannot reach markets due to bad roads, such investments would be fruitless.

4.2 Recommendations for government

ix. Integrate IKEWS into formal and informal education curriculum. Farmers interact closely with extension workers, who go through the formal education system. However, while scientific early warning systems are part of the curricula, issues of IKEWS are not tackled. Opportunities exist within local academic institutions that are offering relevant courses where IKEWS issues can be integrated. Apart from agriculture-related courses offered at LUANAR, the Malawi University of Science and Technology has undergraduate programmes in climate and meteorology, as well as disaster risk management, where IKEWS could be integrated. This will ensure that the crop of graduates that go on to interact with farmers and local communities are knowledgeable enough on IKEWS. Here, Trócaire can advocate directly with the academic institutions, or through parent ministries.

x. Government should lead in the implementation of its policy aspirations in relation to IKEWS. This report has presented a number of policy instruments that are promoting IKEWS. However, not much can be seen on the ground from government in actualising these. There have even been claims that government is discouraging the use of IKEWS and promoting only scientific information. Advocacy with the key government departments and ministries at national and district level is a first step in ensuring adoption. The advantage is that there is a starting point, from within existing policy frameworks and other instruments. Those interviewed from government were keen to promote the use of IKEWS. Thus, the focus should not be to promote IKEWS over scientific knowledge, as such an approach would be an exercise in futility. Thus, effort should be placed on the synergies that exist between the two and how they can be integrated in practice, such as is advanced through PSP.

xi. Government should institutionalise IKEWS and identify sustainable ways of promoting IKEWS, including integration. The current practice of relying on NGOs or support from development partners is likely to face challenges in the future when funding is not available. In part, this requires institutionalization at district and extension planning area levels so that such aspects are considered as part of their routine work. There are already fears that some extension workers are active because of the activities of NGOs and other UN agencies. There are also fears as to whether the downscaled weather forecasts will still be available if the current donors phase out their funding. When district councils start, for instance, including approaches such as PSP in their annual budgets, this will signal institutionalization and guarantee sustainability.

xii. IKEWS should be a core component in the design and management of community-based early warning systems. IKEWS should be further strengthened in the existing National Guidelines on community-based early warning systems. Government should also ensure that the requirement for assessing existing IKEWS when designing CBEWS is enforced. Most communities in the four districts have set up community-based early warning systems. These are established within the communities and managed by the community. Where community representatives take the responsibility of generation, interpretation, and dissemination of early warning information, they could easily integrate IKEWS. A starting point could be the documentation of IKEWS within the community and then these could feed into the setup of the CBEWS. So, if there are indigenous indicators of heavy rains, this could motivate those managing the CBEWS to be closely monitoring manual river gauges in anticipation of flooding.

xiii. Government should incorporate issues of IKEWS into the DRM regulations (DRM Operational Guidelines) and multi-hazard early warning system protocols, both of which are under development and being led by DoDMA;

xiv. The DRM regulations should clearly specify the government department, ministry or agency that has direct responsibility for IKEWS. Lack of a government entity with an IKEWS mandate could be one of the challenges affecting direction on IKEWS, particularly work on integration. Presently, each government department works on the issues in isolation, with no forum for knowledge sharing and proper coordination. Trócaire should initiate dialogue to identify the most suitable entity for IKEWS. With the focus on early warning systems, most of which are weather or climate related, the DCCMS would be best placed to lead.

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Annex I: Glossary of IKEWS terms[3]

Birds/Insects/Animals	Scientific Name	English Name
Akakowa	*Bubulcus ibis*	Cattle egret
Alolo/Bololo	*Gryllotalpa africanus*	Mole cricket
Amulunguzi	*Unknown*	Christmas insects
Atombolombo	*Philonomon luminans*	Orange dragonfly
Bovwi	*Unknown*	Unknown
Chitute/Dungu	*Unknown*	Unknown
Gokomola/ Nkwazi	*Haliaeetus vocifer*	African fish eagle
Gontham'kutu	*Pseudocanthotermes militaris*	Winged inedible termite
Kam'dambo/Zam'dambo/Chadambo	*Heteracris attentuatu*	Green stripped grasshopper
Katawa	*Scopus umbretta*	Hamerkop
Khaka	*Unknown*	Unknown
Lumbe	*Caprimulgus fossii*	Fiery-necked nightjar
Maditi	*Unknown*	Unknown
Madulira	*Unknown*	Type of ants
Mavabingu	*Unknown*	Unknown
Mbaichuche	*Unknown*	Unknown
Mbalure	*Unknown*	Unknown
Mbawala	*Unknown*	Unknown
Mbilu	*Unknown*	Unknown
Mphama	*Sarkidiornis melanotos*	Knob-billed duck
Mthusi/Nthusi	*Hodotermes mossambicus*	Harvester termite
Mwadonta	*Unknown*	Unknown
Mwimba	*Unknown*	Vulture
Mwiyo	*Laniarius aethiopicus/ Dryocopus cubla*	Tropical or Ethiopian Boubou/ Southern puffback
Nachidwi	*Unknown*	Type of frog
Namadidi	*Unknown*	Unknown
Nang'omba	*Bycanistes bucinator*	Trumpeter Hornbill
Nanzeze	*Unknown*	Swift/swallows
Njeza	*Unknown*	Unknown
Njuzi	*Leptailurus serval*	Serval cat
Nkhulawe	*Unknown*	Unknown
Nkhululu	*Brachytrypes membranaceus*	Giant cricket
Nkhwazi	*Haliaeetus vocifer*	African fish eagle
Nkoka/Nankako/Chankoko/Mkoka	*Clamator jacobinus*	Jacobin cuckoo

[3] The scientific and English names for the IKEWS indicators were identified through extensive online search, including from published text books and journal articles. The consultant acknowledges support from Henry Utila of the Forestry Research Institute of Malawi who reviewed and provided additional names for tree species. While efforts have been made to ensure accuracy of the information provided, the consultant takes responsibility for all errors and omissions.

Nkuta	*Centropus supercilious*	Burchell's Coucal
Nthuka	*Unknown*	Type of termite
Nthumbu	*Anomma nigricans*	Red driver ant
Nthusi	*Hodotermes mossambicus*	Harvester termite
Nthuta	*Unknown*	Unknown
Nyenje	*Platypleura brevis*	Cicada
Tchete/Chete	*Unknown*	Lesser African Weaver
Tsokonombwe	*Lobosceliana Naploscelis*	Toad grasshopper
Ucheche	*Unknown*	Type of termite
Zam'dambo	*Heteracris attentuatu*	Green stripped grasshopper

Plants/Trees	*Scientific Name*	English Name
Bwemba	*Tamarindus indica*	Tamarind
Chalima	*Entada abyssinica*	Splinter bean
Chikasu	*Costus spectabilis*	Yellow trumpet
Chilusa	Lannea schweinfurthii	False Marula
Chimanaga cha pusi	*Unknown*	Unknown
Chitimbe	Bauhinia thonningii	Camel's Foot
Kachere	*Ficus natalensis*	Common wild fig
Kholongo	*Unknown*	Unknown
M'bawa	*Khaya nyasica*	Mahogany
Mangansanja	*Unknown*	Unknown
Masau	*Ziziphus mauritiana*	Indian Jujube
Matondo	*Cordyla africana*	wild mango
Mfula	*Sclerocarya birrea*	Marula
Mjombo/Mijombo	*Brachystegia boehmii*	Prince of Wales' feathers
Mkanda wa atsikana	*Abrus precatorius*	Jequirity bean/Rosary pea
Mkwera nyani	*Sterculia quinqueloba*	Egyptian plane tree
Mlambe	*Adansonia digitata*	Baobab
Mlusa/Mulusa	*Pouzolzia hypoleuca*	Unknown
Msangu/Nsangu	*Faidherbia albida*	Winter/camel Thorn
Mthundu/Nthundu	Ficus capensis	Fig Tree
Mtondo/Matondo.Ntondo	*Cordyla african*	Sunbird Tree/ Wild Mango
Mtowe/Ntowa	*Senna petersiana*	Monkey pod /Eared senna
Mtwana	*Brachystegia bussei*	Unknown
Mvunguti	*Kigelia africana*	Sausage Tree
Nankuye	*Ficus sycomorus*	Sycomore Fig
Njale	*Sterculia appendiculata*	Tall sterculia
Njeza/Matchedza	*Maerua angolensis*	Bead-bean
Nkolobwe	*Unknown*	Unknown
Nkotamo/Nkotamu	*Combretum microphyllum*	Burningbush/flamecreeper
Nkunkhu	*Acacia galpinii*	Monkey Thorn
Nkuyu/Mkuyu	*Ficus sycomorus*	Sycomore Fig
Nthundu	*Ficus Capensis*	Broom-cluster/cape fig
Nyenja	*Unknown*	Unknown
Pakasa	Lonchocarpus capassa	Raintree
Phingu	*Dalbergia melanoxylon*	Zebrawood
Sukachuma	*Antidesma venosum*	Tassel berry
Tsanya	*Colophospermum mopane*	Butterfly Tree/Turpentine
Tsanya	*Colophospermum mopane*	Butterfly Tree/Turpentine

Annex II: Chikwawa complete List of IKEWS by district and community

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
		Indicator	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
Chikwawa TA: NGOWE	**Associated with *animals***	Abundant presence of ants	Heavy rainfall that may lead to floods	Cackling of Mbaichuche birds	Heavy rainfall. ,	The sound of Gokomola/ Nkwazi.	The sound of Gokomola/ Nkwazi.			Abundant presence of ants	Heavy rainfall
		Owls hooting all night	Heavy rainfall	Presence of Zam'dambo insects	Heavy rainfall	Abundant presence of ants	Abundant presence of ants			Butterflies	Risk of having army worms
		Sighting of Khaka bird	Dry spell	Bellowing or coming out of hippopotamus	Heavy rainfall which will lead to flooding and the water will reach the exact same place the hippos reached	High manifestation of mosquitoes	High manifestation of mosquitoes			Bellowing or coming out of hippopotamus	Heavy rainfall which will lead to flooding and the water will reach the exact same place the hippos reached
		Presence of monkeys/apusi	Dry spell	Flying of Nanzeze	Heavy rainfall	When Mavabingu bites	When Mavabingu bites			Cackling of Mbaichuche birds	Heavy rainfall –
		Presence of large animals in the village	Dry spell	Sighting of Khaka bird	Drought	Presence of Mthusi	Presence of Mthusi			Nkhululu forms a small anti hill	Heavy rainfall
				Presence of frogs	Heavy rainfall					Cows running around	Heavy rainfall
										Coming of kam'dambo from the Dambo area	Heavy rainfall

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
		Indicator	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
	Associated with plants	5		7		5		0		7	
		Abundant flowering of Nkunkhu trees	Heavy rainfall which may lead to flooding	Abundant fruiting of Mango trees	Hunger	Abundant fruits of Nyenja trees	Heavy rainfall in that particular year			Abundant fruiting of Mango trees	Hunger
		Abundant flowering of Nyenja trees	Heavy rainfall which may lead to flooding	Abundant fruiting of Baobab trees	Hunger	Abundant flowering of Nkotamo tree	Drought			When Matondo tree shades off its leaves	Heavy rainfall
		Abundant fruiting of Mango trees	Hunger	Abundant fruiting of Matondo trees	Hunger	Abundant flowering of Nkunkhu	Adequate rainfall/ bumper harvest			Nkotamu tree produces red flowers	Rainfall onset
		Abundant bearing of mtowe fruits	Heavy rains which may lead to flooding	fruiting of Masau trees	Hunger					Abundant flowering of Nkunkhu tree	Heavy rainfall
		Abundant bearing of kachere fruits	Heavy rains which may lead to flooding	Abundant flowering of Nkunkhu (Acaica galpini) tree	Heavy rainfall					Abundant production of Nyenja fruits	Heavy rainfall
		Abundant bearing of kachere fruits	Heavy rains which may lead to flooding	Abundant flowering of Nkunkhu (Acaica galpini) tree	Heavy rainfall					Abundant production of Nyenja fruits	Heavy rainfall
				Shading of flowers by Mlusa trees	Heavy rainfall					Abundant fruiting of Matondo trees	Dry spell

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
		Indicator	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		5		6		3		0		6	
	Associated with hydro-meteorological	Mbalu winds from the north going towards south	Good rain	Hot temperatures	Heavy rainfall	Hot temperatures in winter	Heavy rainfall			Hot temperature	Heavy rainfall
				Cold temperature	Little rainfall						
		Abundant fruiting of Mango trees	Hunger	First rains with hail storms	Hunger					Frequent occurrence of lightning and thunder	Rainfall
										Cold weather during summer	Dry spells
										Whirlwinds/ strong winds	Dry spell
										Mbalu winds	Rainfall onset
		1		3		1		0		5	
	Associated with astrology	Stars seen in the northern hemisphere (Nthondowa)	Dry spell	Eclipse of the sun	Hunger	Appearance of morning star/ Nthanda	Normal rainfall			When the moon appears in half	Drought
		Stars seen on the southern hemisphere (Nthanda)	Heavy rainfall	Sunny days for a week during rainy season	Heavy rainfall					When the moon appears in full	Bumper harvest
		Ring around the moon	Good rain							Eclipse of the sun	Dry spell
										A bright shining star from the East	Heavy rainfall + bumper harvest

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
		Indicator	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		3		2		1		0		4	
	others in addition to these	Offering of spiritual sacrifice	To receive rainfall	Nsanza Mvula - Skin rashes	Heavy rainfall					Offering of sacrifice	To receive rainfall
				Spiritual sacrifice offerings	To receive rainfall						
		1		2		0		0		1	
Chikwawa, TA Chapananga	**Associated with animals**	Abundant presence of ants	Rainfall			Abundant presence of ants	Rainfall	Abundant presence of ants	Heavy raifall	Abundant presence of ants	Heavy raifall
		Nkhululu forming small ant hills	Heavy rainfall			Nkhululu forms a small anti hill	Heavy Rainfall	Nkhululu forming small ant hills	Heavy raifall	Nkhululu forms a small anti hill	Heavy rainfall
								When bovwi closes its pit	Heavy raifall	Hissing of a python	Heavy rainfall
		Hissing and whining of a python	Presence of spirits					Hissing of a python	Heavy rainfall	Cackling of mphama bird	Heavy rainfall
								When Mwadonta birds build their nest facing the west	Heavy rainfall		

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
		Indicator	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		3		0		2		5		4	
	Associated with plants	Abundant flowering of Mtondo trees	Good rains			Sprouting of buds on Njale trees	Onset of rainy season	Abundant flowering of mango trees	No rains and hunger	When kholongo and bwemba tress bear a lot of fruits	hunger
		Abundant fruits from Nkolobwe trees	Bumper harvets			Abundant flowering of Mtondo	Good rainfall	Abundant fruits from masau tree	Hunger		
		Chikasu shrub placed in a clay pot and when it starts sprouting	Rainy season is near			Abundant Nkolobwe fruits	Bumper yields	Nkanda wa atsikana a type of tree with red fruits	Hunger		
		Sprouting of buds on Njale trees	Rainfall onset			Chikasu shrub placed in a clay pot and when it starts sprouting	Onset of rainy season is near	Njale tree regenerates shoots	Heavy rains		–
								Shading of leaves from mvunguti tree	Heavy rains		
								Abundant bwemba fruits	Hunger		
								Phingu tree regenerates shoots	Heavy rains		
		4		0		4		7		1	
Associated with hydro-meteorological								Hot temperatures	Rainfall	Hot temperature	Heavy rainfall

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
		Indicator	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
								Lightning and thunder	Rainfall	Cold temperature	Little rainfall
		4		0		0		2		2	
	Associated with astrology							Ring around the moon	Heavy rains and adequate yield	Ring around the moon	Heavy rainfall + adequate harvest
										Nthanda (star) when it shines from the east	Heavy rainfall
										When stars are in a line	Heavy rainfall
		0		0		0		1		3	
	others in addition to these	Offering sacrifice to the spirits	To receive rainfall			Offering sacrifice to the spirits	To receive rainfall	Offering sacrifices to the spirits	To receive rains	Offering sacrifice to the spirits	To receive rainfall
		1		0		1		1		1	
		23	0	20	0	17	0	16	0	34	

Annex III: Zomba complete List of IKEWS by district and community

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
Zomba TA Mwambo	**Associated with animals**	Abundant presence of ants	Good rainfall	Flying of Nanzeze	Heavy rainfall	Crying of mbilu animals	Heavy rainfall	Abundant presence of ants	Rainfall onset	Abundant presence of ants (madulira and nthumbu)	Heavy rainfall
		Abundant presence of Nang'omba Birds	Good rainfall			Crying of namadidi animals	Heavy rainfall				
		Abundant presence of red butterflies	Good rainfall			Flying of Nanzeze	Heavy rainfall leading to floods	Chirping of Nkoka bird	Rainfall onset		
		Frogs (Nachidwi) they shade their skin	Good rainfall			Coming out of lumbe bird	Heavy rainfall	Flying of Nanzeze	Rainfall onset		
		Abundant presence of Nanzeze Birds	Good rainfall			When an eagle removes its eggs/ chick	Rainfall onset	When Madulira animal fills up its hole with grass	Rainfall onset		
							When Madulira animal fills up its hole with grass	Rainfall onset		Chete's (bird) nest direction for example when its on the north	Rainfall will come from the south
							Sound of Nang'omba bird	Rainfall onset		When mbalure bird is singing regulary	Onset of rainy season
										Abundant presence of ants	Rainy season
										Butterflies moving from uplands going down wards	Good rains

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
										Abundant presence of mwimba birds	Rainy season
										Mbawala birds singing	Heavy rainfall and floods
										Presence of Njeza	Heavy rainfall
		5		1		7		5		8	
	Associated with plants	Bloosoming of chitimbe trees	Good rainfall	When mangansanja loses all its leaves	Bad trainfall	Abundance presence of mango fruits	Drought/ dry spells	Abundance presence of mango fruits and flowers	Good rainfall	Leafing of Chilusa trees.	Onset of rainy season
		Bloosoming of mthundu trees	Good rainfall	When mangansanja keeps some of its leaves	drought	Abundance Flowering of Sukachuma trees	Heavy rainfall			Leafing of baobab trees	Onset of rainy season
		Bloosoming of mlambe trees	Good rainfall							Leafing of nankuye trees	Onset of rainy season
		Bloosoming of chilusa trees	Good rainfall							Leafing of nthundu trees	Onset of rainy season
		Bloosoming of pakasa trees	Good rainfall							Abundant flowering of mango tree	Rainy season is about to start
		Abundance flowering of mango trees	Bumper yield/ good rainfall							Presence of Njeza flowers in the sky	Rainfall onset
										Mango trees having more fruits	Hunger
										Fruits of nthundu falling prematurery	Hunger

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		6		2		2		1		8	
	Associated with hydro-meteorological	Winds from different directions	Bad rainfall	When the water is moving too fast	Floods	If Hail storm takes a shape of maize	Maize bumper harvest			Increase in temperature in the month of November	Rainy season is about to start.
		Cold weather during summer	Dry spells	When you stand on the ant hill	You can tell that the air signifies rainfall	Abundance Flowering of Sukachuma trees	Heavy rainfall			Heavy/Whirl winds blowing from north	Heavy rainfall
										More clouds in month of November	Disasters such as storms
										Lightening	Little rainfall in that particular year.
		2		2		1		0		5	
	Associated with astrology					Small ring around the moon	Drought/ hunger			Moon with big ring	More harvest
						Big ring around the moon	Bumper harvest			Moon with a small ring	Hunger/ shortage of food
						Bending of the moon	People will be free from diseases			More stars in the month of November	More yield
						Round moon	People will suffer from a lot of diseases			Absence of moon during rainy season	Heavy rainfall

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		0		0		4		0		4	
	others in addition to these									Smell of mpoto air	Onset of rainy season
		13	0	5	0	14	0	6	0	26	

Annex IV: Machinga complete List of IKEWS by district and community

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
Machinga, TA Liwonde	**Associated with animals**	Singing of maditi birds	Rainfall onset	Abundant presence of ants	Heavy rainfall leading to flooding	Abundant presence of ants	Heavy rainfall	Abundant presence of ants	Rainfall onset	When nkuta bird is singing regulary	Onset of rainfall season
		Flying of Nanzeze	Rainfall onset	Flying of Nanzeze	High rainfall intensity	Chirping of birds (unknown)	Rainfall onset	Chipping sound of nkoka bird	Rainfall onset	Abundant presence of ants	Floods
		Akakowa birds from north going towards the south	Good rainfall	Presence of frogs	Rainfall onset	When Nkhululu forms an anti hill and leaves it open	Rainy season is not near	Flying of Nanzeze	Rainfall onset	When katawa bird builds a nest facing upwards	Inadequate rainfall
		Presence of frogs	Rainfall onset	Presence of gonthankhutu (flying ants)	Rainfall onset			The appearance of Madulira (ucheche/ njuzi)	Onset of rainy season		
		Presence of crows	Rainfall cessation	Birds (unknown) producing sound	Rainfall is near			When tsokonombwe makes a lot of noise	End of rainfall season		
		5		5		3		6		3	
	Associated with plants	Flowering of mango trees	Flowering of mango trees	Rainfall/ growing season		Abundance production of mango flowers and fruits	Good rainfall	Abundant production of mango fruits and flowers	Good rainfall	Abundant flowering of mango trees	More rains
						Production of buds by nkuyu tree	Rainy season onset				
		Abundance presence of mango fruits	Hunger	Plenty mango fruits	hunger	Production of buds by nsangu tree	Rainy season onset				

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		Indicator	Interpretation	Indicator	Interpretation	Indicator	Interpretation	Indicator	Interpretation	Indicator	Interpretation
		Flowering of Chalima trees	Rainfall onset			Production of buds by baobab tree	Rainy season onset				
		Flowering of nsangu trees	Rainfall onset			Production of buds by baobab tree	Rainy season onset				
		Flowering of nsangu trees	Rainfall onset			Production of buds by m'bawa tree	Rainy season onset				
						When rain comes but Tsanya trees have not produced buds (chizimalupsya)	We don't have to plant our crops				
		4		2		6		1		1	
	Associated with hydro-meteorological	Whirl wind, wind from all directions	Rainfall onset	Extremely hot temperatures	Rainfall season is near	Dark clouds and thunder	Rainfall onset	Hot weather during the rainy season	Dry spells	Increase of temperature in month of November	More rainfall
		Extreme hot temperatures	Rainfall onset	Cold weather until September/ october	Late rainfall					Lightning	Onset of rainfall season
		Fog	Rainfall onset	No dew during the cold season	No rains/late rainfall					Smell of wet soil	Onset of rainfall
				Whirl wind	Rainfall onset						

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		3		4		1		1		3	
	Associated with astrology	Ring around moon (nkhokwe ya mwezi)	Bumper yield	Ring around moon (nkhokwe ya mwezi)	Bumper yield						
		Moon surrounded by a ring	Bumper harvest								
		The smell produced by the sun when its bright	Onset of rainy season is neart								
		3		1		0		0		0	
	Others in addition to these	Offering of sacrifice	To receive rains								
		1		0		0		0		0	–
	Associated with animals	Abundant presence of ants	Rainfall onset	Extremely hot temperatures	Rainfall season is near	Dark clouds and thunder	Rainfall onset	Hot weather during the rainy season	Dry spells	Increase of temperature in month of November	More rainfall
		Nankako birds singing	Rainfall onset	Abundant presence of ants	Rainy season is near					Abundant presence of ants	Onset of rainfall
		Presence of frogs	Rainfall onset	Cold weather until September/ october	Late rainfall					Sound from white frogs	Rainy season is near
		3		3		2		1		3	
	Associated with plants	Flowering of mango trees	Rainfall onset/ growing season/bumper yields	When leaves fall off and new leaves start to sprout	Rainy season is near	When mitwana starts producing new leaves	Rainy season onset			Abundance flowering of mango trees	Bumper harvest

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		Plenty mango fruits	Hunger			When mkwera nyani starts producing new leaves	Rainy season onset				
		New leaves/ budding of flowers on trees	Rainy season onset			When mijombo starts producing new leaves	Rainy season onset				
		3		1		3		0		1	
	Associated with hydro-meteorological	Extremely hot temperatures	Rainfall season is near			Frequent occurrence of whirl winds	Onset occurrence	Hot weather during the rainy season	Dry spells	Whirl wind	Rainfall onset
		Cold weather until September/ October	No rains/ late rains			Increase in temperature	rainfall			Hot temperature	Rainfall season onset
		Whirl wind	Rainfall onset			Lightning	Rainfall			Lightning strikes	Onset of rainy season
		3		0		3		1		3	
	Associated with astrology	Eclipse of the moon	Dry spells								
	Others in addition to these	1		0		0		0		0	
		26	0	16	0	18	0	10	0	0	14

Annex V: Balaka complete List of IKEWS by district and community

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
Balaka TA Matola	**Associated with animals**	Abundance of ants	Heavy rainfall leading floods	Flying of nanzeze	Probability of having rainfall on that day	When Mthutira ants collects tiny grass	Rainy season is near	Flying of nanzeze	Adequate rainfall	If alolo are not coming outside of their carves	Drought leading to hunger
		Flying of nanzeze birds	Rainfall onset	Flying of Nanzeze	High rainfall intensity	Chirping of birds (unknown)	Rainfall onset	Chipping sound of nkoka bird	Rainfall onset	Abundant presence of ants	Floods
		Akakowa birds from north going towards the south	Rainfall onset	Increase in number of amulunguzi/ Christmas insects	Heavy rainfall	Tsokonombwe's sound	Onset of rainy season is near	Nkhulawe bird	Onset of rainfall	When termites are gathering some food	Hunger
		When an underground spider makes a web without a hole	Dry spells			Flying of nanzeze	Rainfall onset	Mouse known as tsokonombwe	End of rainfall season	Nanzeze birds	Good rains
		When an underground spider makes a web with an opening	Good rains							Nthuta birds carrying food to its nests	Good yields
		When we kill a snake (python) and throw it in the water	Heavy rainfall			Crying of Nthengu	Rainfall season is near			Abundant flowering of mango trees	More rains
		If a termite/ ant called nthuka eats a broom that was left outside overnight	Heavy rains								

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
		If a termite/ant called nthuka doesn't eat a broom that was left outside overnight	Dry spells								
	Associated with plants	7		3		4		3		4	
		Mango tree flowering one side	Dry spells	Early mango flowering	Early rainfall season onset					Plenty mango	Bad rainfall pattern/ hunger
				Good regeneration of misangwi leaves	Timely rains					Early flowering of mango trees	Early rainfall season onset
		When baobab tree doesn't produce	Dry spells								
	Associated with hydro-meteorological	2		2		0		0		2	
		Extremely hot temperatures	Heavy rainfall	Dark cloud that looks like a mountain	Prolonged dry spells	Frequent occurrence of whirl winds	Heavy rains with strong winds	Prolonged cold weather up to September or October	Late onset of rainy season	When the wind is blowing from the north to the south	Probability of drought
		Whirl wind	Strong stormy rains	Some winds	Probability of drought	Direction of whirl wind	Direction of rainfall			Mwera winds (may-September)	Good rains
		Mwera winds	Dry spells								
	Associated with astrology	2		2		0		0		2	
		Rainbow	Rainfall cessation	Few stars shinning	Heavy rains	Moon surrounded by a ring like a nkhokwe/ granary	Bumper harvest			A moon surrounded by a ring like nkhokwe	Bumper harvest

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
										When the moon is being observed as being at the centre	Good and timely rains
		1		2		2				2	
	Others in addition to these	Mango tree flowering one side				Spiritual sacrifice	To receive rainfall				
Balaka TA Nkaya				0		2		0		0	
		Abundance of ants	Heavy rainfall leading too floods	Presence of butterflies	Heavy rains which may lead to flooding	Abundant presence of ants	Heavy rainfall	Abundant presence of ants	Heavy rainfall	Abundant presence of ants	More rain/ heavy rainfall/ floods
		Flying of Nanzeze birds	Rainfall onset	Flying of Nanzeze birds	Rainfall onset	When nthusi insects carries its food	Onset of rainy season is near	Nthusi collecting grass	Onset of rainy season is near	Plenty grass hoppers	Little rainfall
		Presence of nyenje	Rainfall onset	Presence of butterflies	Signifies fall army worms	When a mouse known as chitute/ dungu starts collecting food	Onset of rainy season is near	Plenty grasshoppers	Bumper harvest	More crickets	More rainfall
		Nkhululu forms a small anti hill	High yields	Nkhwazi (eagle) sighting	End of rainfall season						
						Flying of nanzeze	Onset of rainfall	Flying of nanzeze	More rains	Frogs moving from the river to the land	Floods
						Chirping of mwiyo bird	Rainfall onset				

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
Balaka TA Nkaya						Direction where atombolombo insects are coming from	Rainfall will come from that direction				
	Associated with plants	4		4		6		3		4	
		When Tsanya trees lose all leaves and the new ones start to grow	Rainfall onset and good rains	Regeneration of Msangu tree leaves	Rainfall season onset	Flowering of mango trees	Rainy season is near/ growing season	When nsangu produces leaves	Ceasation of rainfall season	Leafing of fig trees	More rainfall
		Mthundu tree takes time to lose its leaves	Good rains	Good productivity of fruits	hunger	When nfula tree starts producing leaves	Onset of rainy season is near	Good flowering of mango trees	Adequate rains/good rains	Plenty mango trees	hunger
		Mthundu tree takes time to lose its leaves Presence of nyenje	Rainfall onset	Presence of butterflies	Signifies fall army worms	When a mouse known as chitute/ dungu starts collecting food	Onset of rainy season is near			More crickets	More rainfall
		Nkhululu forms a small anti hill	High yields	Nkhwazi (eagle) sighting	End of rainfall season						
						Flying of nanzeze	Onset of rainfall	Flying of nanzeze	More rains	Frogs moving from the river to the land	Floods
		Plenty mango fruits	Hunger					Good flowering of Ntondo trees	Adequate rains/good rains		

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
				Mango tree flowering abundantly	Heavy/good rainfall	When mkuyu tree starts producing leaves	Onset of rainy season is near	When Mlambe tree, produces buds and new leaves	Onset of rainy season is near		
				Nthundu tree-late shedding of leaves	Heavy rainfall			When Nthundu tree produces buds and new leaves	Onset of rainy season is near	When chimanaga cha pusi is flowering	Rainfall onset
								When Mkuyu tree produces buds and new leaves	Onset of rainy season is near	Failing of nthundu leaves	Rainfall onset
	Associated with hydro-meteorological	3		4		3		6		4	
				Winds blowing from the north to the south showing very high temperatures and extreme heat	Rainfall	Dark cloud	Rainfall onset	Low temperature from October-December	Late onset of rainfall	Hot temperature	Rainfall onset
		Extremely hot temperatures	Heavy rainfall	Mangoni winds	Dry spells	Collision of wind	Rainfall onset				
		Whirl winds	Dry spells	Clouds	Rainfall						
		Cold temperature	Dry spells	Cold temperatures	Dry spells	Flying of nanzeze					

		Female Elderly		Female Youth		Male Elderly		Male Youth		Key Informants	
District		**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**	**Indicator**	**Interpretation**
	Associated with astrology	3		4		2		1		1	
		Ring around the moon	Good rains			When the sun is shining too much producing a lot of heat from October-December	Rainfall onset	When a moon is surrounded by small dots of clouds	Bumper harvest	Moon surrounded by a big ring	Bumper harvest
		Ring around the sun	Dry spells			When moon is surrounded by a ring	Bumper yields	When the moon is not showing up during rainy season.	Heavy rainfall	An image like a barn on the sun	Bumper harvest
	others in addition to these	3		0		2		2		2	
								Smell of wet soil	Rainfall is about to start	Offering prayers to bimbi the rain god	To receive rainfall
								Asking for rains from bimbi/ mlosi	To receive rainfall		
				0		0		2		1	
		25	0	21	0	23	0	18	0	22	2

Designed by Peter Gwazayani