National Guidelines for Community Based Early Warning Systems

Submitted to:

The Department of Disaster Management Affairs (DoDMA)
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By

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List of Abbreviations and Acronyms

CBDRM	Community-Based Disaster Risk Management
CBEWS	Community-Based Early Warning Systems
DCCMS	Department of Climate Change and Meteorological Services
DoDMA	Department of Disaster Management Affairs
DWR	Department of Water Resources
LGD	Lead Government Department (for CBEWS)
M-CLIMES	Modernised Climate Information and Early Warning Systems
NGO	Non-Governmental Organisation
PCVA	Participatory Capacity and Vulnerability Analysis.
UNISDR	United Nations International Strategy for Disaster Risk Reduction

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1. Foreword

1.1 Purpose and Use of these National Guidelines

These National Guidelines on community based early warning systems (CBEWS) have been developed to improve the effectiveness of CBEWS in Malawi by ensuring that all systems developed after their introduction conform to minimum standards and provide a high quality and consistent warning service for communities. The guidance and standards also provide a measure against which existing systems may be assessed in order to identify opportunities for continuous improvement.

To achieve this, the National Guidelines provide advice and direction for the establishment of new CBEWS in Malawi, setting out the five key elements that need to be addressed in any warning system in line with international guidance published by United Nations International Strategy for Disaster Reduction (UNISDR):

1. Risk Knowledge
2. Monitoring and Warning Service
3. Dissemination and Communication
4. Response Capabilities
5. Governance and Institutional

The National Guidelines break down each of these key warning system elements into their main components, providing practical guidance on issues for CBEWS designers and operators to consider and setting out the minimum actions required for the CBEWS to be considered satisfactory.

Whilst the National Guidelines are primarily intended to guide development of new CBEWS in Malawi, the principles, structures and minimum requirements set out can also be used for review of existing CBEWS, ensuring that communities can identify any gaps and work towards continuous improvement and development of their local systems. Annex 4 contains a checklist that can be used for assessment of existing systems developed prior to the introduction of these national guidelines.

A number of CBEWS established in Malawi are designed to provide warning of flood risk. Given the importance of flooding to CBEWS design in Malawi, additional background information on flood warning systems are set out in the annexes. However, the guidelines, governance strictures and minimum requirements for CBEWS apply to warning systems developed for any sudden onset hazard, or for CBEWS established to provide localised warnings for multiple hazards.

The National Guideline is intended for professional stakeholders and community leaders responsible for leading the development and implementation of CBEWS in Malawi. It provides an overview and appreciation of what is involved in establishing a CBEWS, but it is not intended as a technical manual for component elements, such as vulnerability assessments or flood modelling. The guidelines assume that suitably experienced and competent experts will provide specialist technical input and advice on CBEWS design and operation as required.

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2. Introduction

2.1 CBEWS Overview

There are many types and form of early warning systems, from national to community-based systems designed to provide warnings for slow or rapid onset events. The diversity of systems in operation, and the fact that each system comprises several separate but essential elements, can often lead to confusion and misunderstanding. This challenge was addressed by UNISDR through the production of a guidance document that sets out four essential elements that must be present in any early warning system if it is to be effective, spanning knowledge of hazards and vulnerabilities to preparedness and capacity to respond. To ensure these four elements are delivered effectively, they are supported by a fifth overarching element, covering the governance and institutional arrangements necessary to ensure that all parts of the system are effectively managed and sustainable.

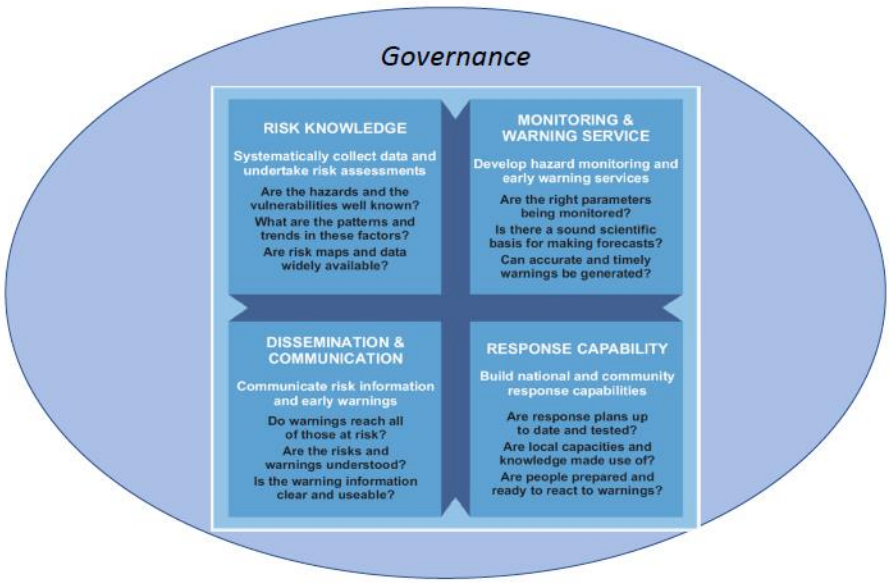

Fig 1: UNISDR – Early Warning Components

The UNISDR early warning guidance document includes both generic guidance and a "checklist" for development of early warning systems. Whilst the guidance and checklist are not specifically designed for CBEWS, they provide a robust structure for development of CBEWS. Therefore, these National Guidelines closely follow the general structure and approaches set out by UNISDR but have been amended and contextualised to suit the needs of CBEWS and communities in Malawi.

A key feature of the UNISDR early warning guidance and checklist is the identification of several interrelated steps and measures that form the key elements of any warning system. Once all of these elements have been considered and addressed, individuals and communities will have;

1. Knowledge about the hazards, vulnerabilities and risks they face.

2. Developed methods for monitoring those hazards and for providing an early warning alert once identified trigger points have been breached.
3. Developed communication and dissemination systems to ensure that once an alert is given, appropriate warnings reach all those at risk.
4. Developed local plans and capacities to respond to the warnings received.
5. Put in place robust and sustainable governance and institutional arrangements to ensure the systems are reliable, well managed, properly resourced and adequately maintained.

A Community-Based Early Warning System (CBEWS) is a specific category of early warning system where communities are active participants in the design, monitoring and management of the system, not just passive recipients of warnings. They are developed, managed and maintained with the full engagement of the community itself, empowering individuals and communities threatened by hazards to act in enough time and in an appropriate manner to reduce the possibility of personal injury, loss of life, damage to property, environment and loss of livelihood.

The purpose of a CBEWS is not limited to the monitoring of a hazard or issuing of an alert if one of the hazard parameters being monitored is breached. Early warnings need to be disseminated and communicated to the target community in order to drive early actions, enabling communities and individuals to better protect their families, assets and livelihood. Ultimately, the effectiveness of any early CBEWS is measured by the extent to which it empowers communities to prepare for, respond to, and recover from any disruptive event.

Delivery of an effective CBEWS depends on the contribution of a wide and diverse range of experts, including specialists that understand the specific hazard being monitored, those that understand community vulnerability and risk, disaster risk managers and planners, and of course, community experts who best know the local circumstances and conditions. All of these experts have a vital contribution to make in CBEWS design and delivery. The challenge is to bring together all of the necessary expertise and evidence necessary to deliver a safe, effective and sustainable CBEWS.

CBEWS forms part of a wider "people-centred" Community-Based Disaster Risk Management (CBDRM) approach that seeks ways to help communities use local resources and capacities effectively to better prepare for, respond to, and recover from disasters by adopting a range of measures to reduce their vulnerability to hazards.

CBEWS and CBDRM have common features and objectives in that they both seek to actively engage at risk communities in the identification, analysis, implementation, monitoring and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities.

Equal community participation / involvement	Reduced vulnerability focused DRM activities	Disasters are linked to development
The community is the key actor as well as the main beneficiary of short and long term DRM. The community directly participates in the entire process of DRM from situational analysis to planning to implementation local level risk reduction measures. Responsibility for change rests with those living in the local community.	Recognises different risk perceptions of different people. Revolves around reducing vulnerable conditions and the root causes of vulnerability through increasing a community's capacities, resources, and coping strategies. Within the community, priority attention is given to the conditions of the most vulnerable and to their mobilization.	CBDRM is multi diciplinary and multi sectoral linking DRM with poverty reduction and socio-economic goals. Disasters are viewed as unmanaged development risks and can become unresolved problems of the development process. CBDRM should lead to improvements in the quality of life of the poor and of the natural environment.

Fig2: Main Characteristics of Community based Disaster Risk Management adapted from World Bank 2008 (Yodmani 2001;9-10)

Although they are focussed at the community level, CBEWS do not operate in isolation and their effectiveness can be improved through linkages to the national warning systems and the CBEWS established in other local communities. For example, formal linkages between separate CBEWS' established in different parts of the same river catchment can ensure that upstream communities provide their downstream colleagues with advanced warning that a river is rising and that their own warning system may need to be activated or monitored more frequently. This ensures that downstream communities receive timely early warning information from their upstream colleagues, potentially before their own local gauging system has started to react to rising river levels.

In addition to CBEWS linking with each other at the local level, effective two-way communication and interaction between CBEWS and the operators of national warning services can improve the quality and reliability of warnings delivered. Data gathered at a local level for the CBEWS, for example, local river or rainfall data, will provide valuable input for the national warning systems upon which national warning service providers rely. In turn, national warning services can provide valuable information to pre-alert local community members responsible for monitoring CBEWS equipment or gauges so that they may be checked more regularly at times of high risk, for example, when heavy rains are predicted.

Most CBEWS in Malawi are established to respond to "rapid onset" emergencies, primarily flooding. However, there is no reason why the same approaches and methodologies should not be applied equally for "slow onset" events, such as drought. Whilst the national and international agencies involved in risk knowledge and monitoring warning activities may differ for slow onset events, the community level structures for dissemination and communication of warnings, and for building up local response capacity, are the same.

District, Area and Village Civil Protection Committees provide vital entry points for all types of early warning system and community preparedness activity. To avoid duplication of effort at the local level, only one CBEWS should be established in any community. The same governance, communication and other structures may support warnings for a number of

different hazards or provide warnings for specific parts of the community only. Whilst different hazards may need different monitoring arrangements and response plans, the same basic governance and warning dissemination structures may be used harmonised, with plans harmonised through the District, Area and Village Civil Protection Committees.

2.2 CBEWS Governance Arrangements

Effective CBEWS can provide vital early warning to enable communities to take action to save life and property. Equally, poorly designed or ineffective CBEWS can present a risk to life and property. Potentially the risk to a community of a poorly designed CBEWS could be higher than if no system had been in place at all, as community members placing their trust in a badly designed system may ignore the indigenous warning signs they would otherwise have monitored, leading to a failure to take appropriate and timely action. Given the importance of CBEWS and the potential impact of badly designed systems, robust national structures are required for their governance and to ensure all systems in place are effective and safe.

These governance arrangements apply to all CBEWS regardless of the type of hazard for which warnings are to be given, or whether the systems are being implemented by communities, government or non-government organisations.

The Department of Disaster Management Affairs (DoDMA) has been appointed as the Lead Government Department (LGD) for CBEWS. Acting as LGD does not mean that DoDMA will work in isolation. They will liaise with other Government Departments, local government and others in order to carry out their role. The key duties for the LDG are to;

1. Maintain a register of all CBEWS in Malawi. Projects established to develop a CBEWS must register their intentions at project initiation stage.
2. Evaluating and giving approval for all CBEWS detailed design proposals. (*The LGD will either provide approval allowing the CBEWS to be delivered as proposed, or provide guidance on further actions or evidence required before such approval can be given.)*
3. Evaluating and validating CBEWS on completion and prior to the systems becoming operational. In doing so the LGD will liaise and work in collaboration with experts from other government departments as necessary, such as DWR.
4. Maintain a central data base of hazard and risk information submitted as part of the CBEWS design approval and verification process.
5. Undertaking periodic reviews of CBEWS, ensuring that they are being maintained effectively and continue to provide a safe and reliable warning for the public.
6. Put in place processes to enable the outcomes of CBEWS reviews to be shared widely, ensuring good practice and lessons learnt are communicated to all communities operating CBEWS as part of a continuous improvement process.

Whilst these governance arrangements apply primarily to CBEWS established after the introduction of national guidelines, they will also be applied retrospectively to systems established prior their introduction. Existing systems will be evaluated and entered onto the national register by the LGD, following the assessment guidance set out in Annex 4. This evaluation will include an initial, high level, safety assessment to ensure the system does not pose an immediate risk to communities. Once existing CBEWS have been evaluated and

entered onto the national register, they will be subject to the same review and reporting requirements as all other CBEWS.

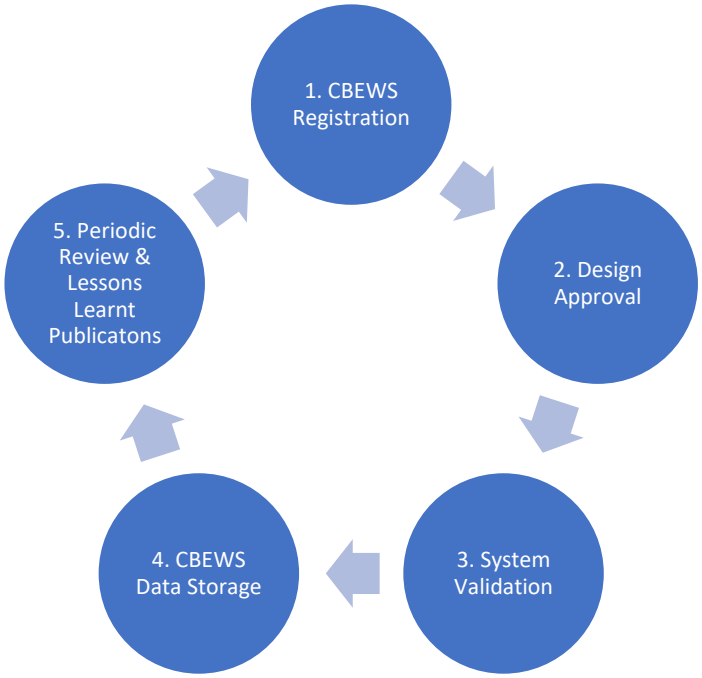

Fig 3: CBEWS Governance Cycle applied by LGD

If, during CBEWS design stage, a community, government or non-government body conclude that an alternate approach to that set out in these guidelines may be more appropriate in the specific circumstances, they can make a case to the LGD requesting a variation from these guidelines. In doing so, they will be required to provide robust data and reasons for that request.

In practice, communities, government or non-government organisations establishing a project to develop a new CBEWS will need to interact formally with the LGD at the following stages:

CBEWS Project Requirements	LGD Response
Register the intention to establish a CBEWS at project initiation stage with LGD	CBEWS project will be registered and the LGD will provide advice and guidance on request.
Submit detailed design proposals and supporting evidence for CBEWS to LGD for approval prior to implementation.	LGD will review the proposals paying particular attention to the proposals for community engagement, system design and long-term financial sustainability. Once satisfied, the LGD will provide formal Design Approval
Provide evidence to the LGD that the system has been delivered as set out in the approved design, has been tested, and is now ready to become operational. Evidence required will include copies of all supporting risk data and reports, and documentation relating to the system and community response plans put in place.	LGD will review the documentation provided, ensuring that the system has been implemented in line with the approved design and to an acceptable standard. On completion of the review, the LGD will provide validation that the system delivered is approved and may become operational.

On receipt of confirmation from the LGD that the system is approved, the system can be operationalised and formally handed over to the community. That handover should include all data, mapping and any other information necessary to enable the community to maintain the system in the future and to inform their future response plans.	LGD will maintain a database of key documents used in CBEWS design and delivery.
Once the CBEWS is Operational	**LGD Response**
Once the CBEWS is operational, it should be reviewed at a local level on an annual basis to ensure it continues to operate as expected, identify opportunities for improvement and to sensitise the community to the actions they should take when a warning is issued. The outcomes from this review should be copied to the LGD.	LGD will monitor annual reviews of CBEWS and archive all reports. In addition to ensuring that individual CBEWS are being regularly reviewed and remain safe for use, the LGD can look for any common lessons or issues and communicate these to all CBEWS operators accordingly. LGD may also chose to undertake external review of CBEWS on a periodic basis or to investigate any specific concerns reported.

Fig 4: Governance and Approval Process for CBEWS

3. Establishing a CBEWS

This section contains general guidance for the development of CBEWS followed by more detailed guidance on how each of the five key elements of a CBEWS can be addressed.

3.1 Considerations for Establishment of CBEWS

3.1.1 Project Initiation

Projects to develop and deliver CBEWS can be initiated by Communities, Government Departments or other partners, such as NGO's. Securing adequate finance for any CBEWS project is an essential part of any project and the many parties involved in both funding and delivery will have their own internal reporting and governance processes which must be observed. However, regardless of the funding or organisational structures required for design and delivery of a CBEWS, it should be remembered that the primary goal is to deliver an effective and sustainable warning system for communities at the end of a process, not simply deliver a "project" in line with a donor's exceptions, important as this is. In particular, for any warning system to be truly defined as a CBEWS, local communities and stakeholders must be engaged from the outset and must be at the heart of decision making. Equally, any system put in place should be financially sustainable and fit for purpose, not time limited to the duration of any project delivery programme.

Whilst it is possible to shortlist potential communities that might benefit from CBEWS from a high-level desk top risk review, the decision to initiate a project to establish a system must be

taken in consultation with the impacted community themselves. There have been examples in the past where donor funding has been obtained and systems developed without prior reference to the communities they are seeking to protect. This approach should be avoided, and early engagement of the community should be considered as an essential first step for any project.

Once a potential community and location for a CBEWS has been identified and a formal project for its delivery initiated, the project should be formally registered with the LGD. This early registration and communication will ensure that any existing data and information available at the national level, along with practical advice from LGD experts, can be made available to project delivery partners. Early registration of projects will also ensure that any potential duplications can be avoided at an early stage, or opportunities for partnership working or harmonisation of multiple CBEWS projects achieved.

The LGD can also advise on how project partners can best engage with other essential government stakeholders. For CBEWS, key Departments include DCCMS as the lead Government Department responsible for Meteorology and issuing national warning for flash flooding, and the Department for Water Resources as the primary agency responsible for issuing national riverine flood warnings. Other government departments may also have an important role, depending on the specific community to be protected and the types of hazard the CBEWS is designed to provide warnings for.

Action - Register Project to develop CBEWS with LGD as soon as a formal project is initiated.

3.1.2 Estimating and Understanding CBEWS Costs

Regardless of whether a CBEWS is to be delivered by Government, a non-government organisation, or local community, it is vital to understand all of the costs associated with its delivery and operation at the project initiation and design stage so that informed decisions can be made in respect of the systems design. Understanding the full cost implications of a system will also inform important discussions between all of the parties involved in the systems design and commissioning, and the communities that will be responsible for its long-term operation and maintenance.

The internationally accepted approach to estimating costs for operational systems such as CBEWS is termed "Whole Life Costing" (*or sometimes "lifetime costs"*). This may be defined as;

"The total cost of an asset over its whole life. It takes account of the initial capital cost, as well as operational, maintenance, repair, upgrade and eventual disposal costs".

Using this definition, it is possible for government, communities or any other organisation considering the establishment of CBEWS to clearly identify all potential costs at an early stage of project design, and to demonstrate that the technical solutions proposed are both appropriate and financially sustainable in the specific circumstances of the case.

Further guidance on whole life costing approaches for CBEWS are set out in annex 5. This guidance includes an illustrative checklist of cost drivers typically associated with CBEWS

and a summary table that can be completed to identify both the costs associated with initial design and delivery of a CBEWS and the ongoing operational costs. The two, when added together, represent the "whole life" costs of any proposed system.

3.1.3 Project Delivery

Project delivery must include the detailed steps set out at 3.2 - 3.7 below. These describe how each of the five key elements required to establish a CBEWS might be addressed. Each of these key elements are broken down into their major sub components, each of which is further broken down and a list of minimum actions required set out.

Action - Once detailed designs and proposals for CBEWS are complete, submit to LGD for Approval

Action - On project completion, submit reports, data and other evidence to LDG to confirm that the system has been delivered as set out in the approved design, has been tested, and is now ready to become operational.

3.2 Risk Knowledge

3.2.1 General Considerations

This section includes guidance on both the processes to evaluate and understand hazards, vulnerabilities and risks in a community, and the initial actions required to identify and engage stakeholders in the risk evaluation process.

Risks arise from both the hazards and the vulnerabilities that are present in a community, and understanding risk is the first step toward building effective CBEWS. Due to the frequent occurrence of disasters in the target areas, most community members are likely to be aware of the various hazards, vulnerabilities and risks they are exposed to. However, there is often a gap among community members in how to use their knowledge of disasters to inform local preparations and mitigation measures.

This element of the CBEWS process involves the engagement of a wide range of community members along with specialists from the District or National level in order to identify and then harmonise a range of hazard, vulnerability and risk information. This may come from indigenous knowledge and historical experience gathered from the community, along with data, validated hazard maps and other technical materials provided by National Agencies or commissined the CBEWS implementing partner.

Key tools required to support delivery of this element will include a Participatory Capacity and Vulnerability Analysis (PCVA) that captures all community level data and information, and reference to technical resources such as flood maps, social-economic data, demographic data, land use planning data, etc. Whilst the process may be led by a CBEWS implementing partner,

it is vital that local community members and Village and / or District Community Protection Committees are fully engaged as ultimately, they must agree and "own" the risk assessment.

A general overview of approaches to CBEWS risk assessment, especially for flood related hazards, is set out in Annex 1. Further information on effective stakeholder and community engagement is set out in Annex 2.

Although many CBEWS may utilise relatively "low technology" solutions for monitoring hazards, such as simple river gauges or manual rain gauges, the risk evaluation process cannot rely only on the communities lived experience. Therefore, a combination of PCVA and technical hazard and risk evaluation should be utilised wherever possible. This approach of using both community and technical risks knowledge in combination has a number of advantages, especially for CBEWS monitoring natural hazards, as reference to past disaster events in isolation may not be a good predictor of future risks. For example, climate change or changes to farming methods or land use upstream of a community mean their historic experience of flood disasters or drought may not be an accurate predictor of future risk?

It is recognised that some technical evaluations, such as production of flood risk maps, can be expensive. Before undertaking new hazard mapping or technical risk evaluation, a review of data that may already be available from Government Departments or development partners should be undertaken. Valuable sources of data and information may be available to inform your project, even where it has been gathered for another reason. For example, the Department for Water Resources may have catchment water level/ flood maps developed to inform infrastructure projects, such as dam design and hydroelectricity development. These flood maps may already be suitable to inform CBEWS risk evaluation and systems design or might provide a starting point for model downscaling that could save both time and costs for an individual CBEWS project. Advice may be sought from the LGD in relation to the availability of existing hazard and risk data or mapping. They, in turn, can refer your queries to experts in the most appropriate Government Department for advice and comment.

3.2.2 Risk Knowledge Sub Component 1 - Organisational Arrangements Established for the CBEWS

Delivery of this sub component requires actions to ensure that all appropriate stakeholders have been identified and engaged from the outset of the CBEWS process and appropriate structures and engagement plans put in place to ensure a comprehensive and participatory risk knowledge process.

Minimum Actions Required:

- Key national and local government departments, local and community partners, NGO's and others involved in hazard and vulnerability assessments need to be identified and roles clarified.
- Information in respect of the CBEWS, including the identification of all partners and stakeholders, should be communicated to the LGD as part of the project registration process.
- Relevant local leaders, stakeholders and community representatives must be identified, engaged and have confirmed their willingness to support the CBEWS process.

- Responsibility for coordinating PCVA must be clarified and arrangements for engaging communities in the process clearly established.
- Existing hazard, risk and vulnerability data for the community should be identified and obtained wherever possible. To ensure this information is suitable and sufficient, or to gather any missing data, the input of appropriate scientific and technical experts will be required.
- Processes must be established to engage local communities in the review and to update risk data both on completion of the initial evaluation and annually thereafter.

3.2.3 Risk Knowledge Sub Component 2. Natural Hazards Identified

This sub component requires review of the evaluation process to ensure it has considered both local knowledge and the latest risk modelling and mapping available to come to a robust consensus on key hazards.

Minimum Actions Required:

- Desk top review, stakeholder engagement and consultation has identified all potential data sources that may be used to inform the CBEWS design.
- Ensure that the characteristics of key natural hazards have been identified and prioritised so that a robust consensus can be agreed with all stakeholders.
- Ensure that finalised hazard evaluations and any hazard maps used for CBEWS design have included both community and technical input, and that they clearly identify the geographical areas and communities affected.

3.2.4 Risk Knowledge Sub Component 3. Participatory Capacity and Vulnerability Analysis (PCVA)

This sub component is intended to ensure that a PCVA been completed to a recognised standard / format and that it has considered all relevant factors. The assessment should be conducted by experienced and qualified specialists and with the full participation of other stakeholders including the communities themselves. Its outcome will be reviewed by the LGD as part of the detailed design approval process.

Minimum Actions Required:

- Community vulnerability assessments must be conducted in conjunction with local stakeholders for all relevant natural hazards.
- The PCVA should follow an internationally accepted process approved by a major development partner or NGO.
- Historical data sources, community level experience, and indigenous warning methods must be identified and recorded.
- Factors such as gender, disability, access to infrastructure, economic diversity and environmental sensitivities must be considered.

3.2.5 Risk Knowledge Sub Component 4. Risks Assessment

This sub component ensures that the impact and likelihood of natural hazards have been appropriately evaluated for different sections of the community.

Minimum Actions Required:

- The interaction of multiple hazards and vulnerabilities need to be assessed to determine the overall risks faced by various stakeholder groups within each community.
- Effective community consultation is essential to ensure that risk information is comprehensive and understood. It must include local historical and indigenous knowledge information as well as more technical and scientific evidence such as flood maps, soil maps, rainfall data and climate models.
- Any activities identified through the process that increase risks must be evaluated.
- The results of the risk knowledge process should be communicated to, and integrated into, District and Community level development and risk management plans and should be shared with any adjoining CBEWS.

3.2.6 Risk Knowledge Sub Component 5. Information Stored and Accessible

This sub component ensures that once the risk knowledge process is completed, the information and data that has been gathered is safely stored so that it can be regularly reviewed and updated, and is readily accessible to government or community organisations who need to use it.

Minimum Actions Required:

- Copies of all project hazard, vulnerability and risk data, along with any technical reports or data relating to system technologies, must be provided to the LGD as part of the final system validation submission.
- LGD will maintain a central database of key CBEWS information submitted so that it can be made available to communities or other central or local government bodies.
- A complete file of information should be provided for the group or body taking formal responsibility for the CBEWS post project implementation, for example, the District or Village Community Protection Committee. Where the committees do not have the facilities to store this data at a local level, they may request that the file is held by the local District DoDMA Officer, who can ensure the information is stored safely and made available locally to inform community plans or subsequent CBEWS reviews.
- A maintenance plan must be developed to ensure data is regularly reviewed and updated by the group or body taking formal responsibility for the CBEWS post project implementation.

3.3 Monitoring and Warning Systems

3.3.1 General Considerations

Having identified the hazards for which the community requires early warning, arrangements must be established to monitor those hazards. The system used for hazard monitoring needs to be appropriate for the circumstances and financially sustainable, ensuring that warnings are provided in sufficient time for effective actions to be taken by the community. At the systems design stage, if it is apparent that the hazard monitoring arrangements cannot provide sufficient lead time for the community to take effective actions, it will need to be reconsidered and redesigned.

Whatever measurement tool is used to monitor hazard parameters, a "trigger point" for the issuing of an alarm will need to be determined. The trigger point should be established based on a full understanding of risk, the likely impact of any event on a community, and the lead time required by the community to put their emergency plans into action. For example, a CBEWS monitoring flood risk may measure parameters such as rainfall or river levels. A trigger point needs to be set so that warnings can be issued, and actions taken, before flood waters enter properties in the community, or will cut off evacuation routes.

Once a trigger point has been breached, an alert must be raised so that the dissemination and communication element of the system can be activated. For automated warning systems, the systems alert will automatically trigger the linked dissemination systems such as evacuation sirens or SMS text messaging. At this point, the rest of the community response plan can be activated. For systems reliant on manual monitoring, such as manual river gauges, when an observer sees that a trigger point has been breached, or receives a message from an upstream community that their trigger point has been breached, they will enact the Village level communication and dissemination plan, which could include sharing of warning messages by loud hailer, drums, whistles, volunteers going from house to house, or any similar combination. More information on monitoring systems, and suggestions for monitoring levels, are provided in Annex 3.

3.3.2 Monitoring and Warning Service Sub Component 1 - Institutional Mechanisms Established

Roles and responsibilities for monitoring hazards and triggering an alarm as part of the CBEWS need to be made clear and robust arrangements put in place.

Minimum Actions Required:

- Roles and responsibilities must be established and agreed by all partners, organizations or community members generating and issuing warnings forming part of the CBEWS.
- Community members and community protection partners should be aware of which organisations are responsible for initiating warnings.
- Arrangements must be in place at a community level to receive and react to advanced warning or hazard messages received from national warning systems. For example, a nationally issued severe rainfall alert may be given hours before rain actually starts to fall and rivers start to rise. On receipt of this warning at a local level, enhanced monitoring arrangements for rain or stream gauges may be put in place.
- Regardless of the method used, the monitoring and warning methodology should have an element of redundancy built in to take account of any changes in personal circumstances of individual community members responsible for key actions.
- Community stakeholders undertaking key tasks within the CBEWS should be trained appropriately and provided with such support as may be necessary to enable them to fulfil their function within the system.

3.3.3 Monitoring and Warning Service Sub Component 2. Monitoring Systems Developed

Reliable systems must be developed to monitor hazard parameters and appropriate "trigger points" for action identified. Once it has been established that these trigger points have been breached, the dissemination and communication element for the system can be initiated,

ensuring warnings are issued in time for effective community response plans to be put into action.

Minimum Actions Required:

- Measurement parameters and warning trigger points should be established and documented for each relevant hazard.
- Technical equipment selected must be suited to local conditions and circumstances and personnel / community members trained in its use and maintenance.
- Wherever possible, trigger points for action should be devised so that sufficient early warning is given to enable community level response plans to be delivered. For example, if the risk assessment and community response plan identify it will take at least 1 hour for community members to reach a safe shelter, a system with trigger points that provide only 30 minutes warning will have limited benefit.
- The community level arrangements established for monitoring hazards should be agreed with experts from relevant national authorities, dependant on the hazard being monitored.
- CBEWS monitoring arrangements should be designed so that they can be operated at all times. Automated systems can provide warnings 24 hours per day, seven days per week. However, it will not be practical or necessary for manual systems operated by community members to provide this level of monitoring. Manual monitoring arrangements and frequencies can be designed to suit all normal circumstances with arrangements to enhance them as necessary on receipt of information from national warning agencies or upstream communities warning of a higher likelihood the system will be triggered.
- Data and evidence demonstrating how the monitoring system has been developed and how trigger points for action have been established must be provided to the LGD as part of the evidence pack supplied for final system verification. The LGD will liaise with other Government Departments and experts as necessary to evaluate the technical information provided before giving final approval for the system to become operational.

3.3.4 Monitoring and Warning Service Sub Component 3. Links with National Agencies, Forecasting and Warning Systems Established

Systems need to be in place to ensure that the CBEWS has been informed by expertise provided by national experts from relevant agencies, such as DoDOMA, and that monitoring arrangements are formally linked with national forecasting and warning services where appropriate.

Minimum Actions Required:

- Arrangements must be in place to ensure there is effective communication between CBEWS and national warning system providers. E.g. mobile telephone or radios
- CBEWS linkages with national warning system providers should be routinely monitored and evaluated, including operational processes and warning performance.
- CBEWS response plans should include actions to be taken on receipt of warnings from national warning system providers. E.g. increase the frequency of monitoring of manual gauging equipment.

3.4 Dissemination and Communication

Dissemination and communication systems are often the weakest link in an otherwise sound CBEWS. They need to deliver warning messages to everyone in the affected locations and to alert local, district and national governmental agencies. To be successful, dissemination and communication messages need to be consistent, reliable and simple to understand for both authorities and the public.

The nature of risks for which CBEWS are designed, such as flood risk, mean there may be limited lead time provided by the system in which to take action. Therefore, any inefficiencies in the system resulting in a delay in communicating warnings to the entire community will significantly impact the ability of individuals to take effective actions to reduce their own risks, especially the most vulnerable.

Clear and easy to understand messages are critical to enable proper responses that will safeguard lives and livelihoods. Communication methods and systems must be pre-identified for both community level warnings and the sharing of warnings with "downstream" communities and government agencies. To ensure this process is robust, the use of multiple communication channels is necessary to ensure as many people as possible are warned, to avoid impacts from the failure of any one channel, and to reinforce the warning message.

Systems for dissemination and communication of warnings at the community level should be designed specifically to suit that individual community's needs. Most CBEWS will rely upon simple systems such as hand operated or automated sirens, megaphones, loudspeakers, bells, whistles, drums or flags. These simple systems can be very effective at the local level and their incorporation into local plans can give community members a direct and practical role in the operation of their own CBEWS.

The effectiveness of even very simple systems can be further improved through the incorporation of technology, such as mobile phones. For example, when appropriate trigger levels for a warning are observed in one part of a river system, mobile phones can be used to share that warning with downstream communities who will be impacted by the same event, or with government agencies so that they can enact their own plans and procedures. In highly developed communities, the extensive use of technologies such as automated SMS text messages, social media alerts and use of radio and TV will also prove effective. However, the practicality of these technologies for small and remote communities should be carefully considered before they are adopted for CBEWS in Malawi.

3.4.1 Dissemination and Communication Sub Component 1. Organisational and Decision-making Processes Institutionalised

This sub component ensures that the arrangements for dissemination of warnings are robust, that messages issued are clear, and that everyone involved is clear about their role and responsibilities.

Minimum Actions Required:

- Warnings generated and disseminated through CBEWS need to be efficient, timely, and in a format suited to local circumstances and community needs.
- Warning dissemination plans must be identified and agreed with stakeholders.
- Functions, roles and responsibilities of each community level actor in the warning dissemination process must be specified in local plans.
- CBEWS dissemination structures should be developed in such a way that the same basic structure could be extended to disseminate a range of warning messages at the community level, even if they are initially established for a single hazard, such as flooding. (*e.g. the community level warning dissemination system used for flooding could also be used to give warnings for windstorm or other "rapid-onset" events, even though the monitoring systems and relevant national government departments will differ for each hazard.*)
- Volunteer CBEWS network observers must be trained and empowered to receive and widely disseminate hazard warnings to remote households and communities.
- Robust arrangements must be established for communicating warning messages to the entire community with special attention given to those most at risk or especially vulnerable.
- Systems should be established at district and community levels to verify that warnings have reached the intended recipients.

3.4.2 Dissemination and Communication Sub Component 2. Effective Communication Structures and Equipment Installed

This sub component ensures that appropriate communication equipment in place, is robust, and supported by formal arrangements to ensure it is maintained as necessary.

Minimum Actions Required:

- Communication and dissemination structures in place must be tailored to the needs of individual communities *(e.g. mobile phone / SMS text messages or radio for those with access; or sirens, drums, warning flags or messenger runners for remote communities*).
- Warning communication protocols must be designed to ensure that warnings reach the entire population, including the most vulnerable, seasonal populations and remote locations.
- International organisations, National or District experts should be consulted to assist with identification and procurement of appropriate community-based equipment.
- Multiple communication mediums should be used for warning dissemination wherever possible to avoid the risk of any single points of failure (*e.g. mobile phone / SMS text or megaphone backed up by informal communication such as runners or drums).*
- Agreements should be developed to utilise private sector resources within the community where appropriate (*e.g. amateur radios, safety shelters*).
- Consistent dissemination and communication systems should be used for all hazards at the community level.
- Communication system should be two-way and interactive to allow for verification and confirmation that warnings have been received.

3.4.3 Dissemination and Communication Sub Component 3. Warning Messages Recognised and Understood

This sub component ensures that messages being disseminated are suitable for intended end users and that they will they initiate the required actions.

Minimum Actions Required:

- Early warning messages should be designed to inform recipients early actions, incorporating clear instructions for those who will need to act (*e.g. instructions for safe evacuation and shelter, or safeguarding livestock and pets).*
- Community level warning alerts and messages should be tailored to the specific needs of those at risk (*e.g. recognising diverse cultural, social, gender, linguistic and educational backgrounds*).
- Warning alerts and messages within the community should be geographically specific to ensure warnings are targeted to those at risk only.
- Community level warnings should be clearly recognisable and consistent over time and include follow-up actions when required.
- Mechanisms should be in place to inform the community when the threat has ended.
- CBEWS warning messages should be reviewed annually to study how people access and interpret messages. Lessons learnt should be incorporated into local plan revisions and communicated up to DoDMA who can consider any wider considerations and disseminate best practice examples and learning at a national level.

3.5 Response Capability

The primary purpose of a CBEWS is to ensure communities better understand the hazards and risks they face and that they receive sufficient early warning to take appropriate actions. Therefore, the community's response capability forms an integral part of the overall CBEWS. CBEWS response capabilities should include the full spectrum of disaster risk reduction activities so that communities and individuals can prepare for, respond to and recover from any disruptive event.

The starting point for the development of community response capabilities, is the production of Community and Household level Response Plans that identify actions to be taken in the event of an emergency. However, even the most detailed and technically advanced emergency plan will deliver little practical benefit if it is produced in isolation and without the input of community members. The engagement process that is established to develop local plans is as valuable as the final documentation produced, as the involvement of community members will both ensure that local knowledge and capabilities are fully incorporated into the plan and ensure more effective communication and understanding of the plan's contents.

The planning process must be participatory and inclusive of all community members. Once the plan is completed all community members should be informed about the types of warning they will receive and the response actions they must take, including knowledge about available escape routes, location of evacuation centres and simple steps to reduce damage and loss to their property. To assist in this process, plans should be exercised, reviewed and updated on a regular basis to ensure that they remain suitable and to remind people about the plan's contents and their own role and responsibilities during an event.

The individuals within communities at risk are usually the first responders and locally embedded Village Civil Protection Committees (VCPCs) will provide focus for the local response capacity. VCPCs and other local responders can also provide the focus for organisation and evaluation of local training and sensitisation events, ensuring that community members understand the CBEWS and know what to do in the event of an alert.

VCPCs are also equipped and trained in responding to rapid onset disasters and can act as soon as a warning is received or when a disaster takes place, offering search and rescue services, and providing first aid where needed. The teams will also coordinate the evacuation from the affected areas to designated shelters, as per village level contingency plans.

3.5.1 Response Capability Sub Component 1. Warnings Respected and Acted Upon

This sub component tests whether implementation of the CBEWS will result in Communities that better understand their risks and have sufficient confidence in the warnings issued to take immediate and appropriate action.

Minimum Actions Required:

- The CBEWS risk evaluation and engagement process should be designed to enhance the communities understanding of natural hazard risks and their involvement in developing local level response plans should be designed to ensure they understand what needs to be done in case of a warning and why.
- Local level strategies to build and then maintain credibility and trust in warnings need to be developed, so that individuals will take appropriate actions at the appropriate time.
- False alarms should be minimised to maintain trust in the warning system. However, in some circumstances, setting trigger levels so that a warning is only issued when an event is certain to occur could put lives at risk if that results in warnings being given when it is too late to take action.
- To ensure sufficient time for community response actions to be taken, some trigger points may need to be set at a level where warnings have to be issued with lower levels of certainty. (*for example, to allow time for evacuation in fast reaction flood catchments*). Where the systems design may be expected to generate unavoidable false alarms on occasion, the reasons for this need to be clearly understood by the community so that they can appreciate that an occasional false alarm does not mean the system is faulty.

3.5.2 Response Capability Sub Component 2. Disaster Preparedness and Response Plans Established

This sub component ensures that CBEWS process have robust plans at the community and individual level, and that they are practical and regularly practiced.

Minimum Actions Required:

- Disaster preparedness and response plans should be established at the community level, targeted to the individual needs of all community members, including the most vulnerable and those living in remote areas.

- Hazard and vulnerability maps and other local data collected as part of the CBEWS process should be utilised to develop community and individual / family level emergency preparedness and response plans.
- Up-to-date local emergency preparedness and response plans should be disseminated to the community and practiced.
- Previous disaster events and responses should be analysed at the community level, and lessons learnt incorporated into local disaster management plans.
- Strategies should be implemented to maintain preparedness for recurrent community wide hazard events.
- Regular community level sensitisation sessions should be held, along with tests and drills to test the effectiveness of the early warning dissemination processes and responses.

3.5.3 Response Capability Sub Component 3. Community Response Capacity Assessed and Strengthened

This sub component ensures that community members been sensitised and trained to respond appropriately, and that those responses been assessed.

Minimum Actions Required:

- Community's ability to respond effectively to early warnings should be assessed at project initiation stage and thereafter on an annual basis as a minimum.
- Response to previous disasters should be analysed and lessons learnt incorporated into response plans and future capacity building strategies.
- Community focused organisations should be engaged to assist with capacity building.
- Community and volunteer education and training programmes should be developed and implemented.
- Practical actions that can be taken by individuals and families should be clearly identified, communicated and tested. For example, knowledge about the nearest shelter and safe access routes during a flood.
- Arrangements must be put in place to ensure that CBEWS are subjected to system-wide tests and exercises involving community members, government and official partners at least once each year.

3.5.4 Response Capability Sub Component 4. Public Awareness and Education Enhanced

This sub component ensures that CBEWS plans include effective community risk awareness raising and education and can be evaluated to ensure they are effective.

Minimum Actions Required:

- Simple information on hazards, vulnerabilities, risks, and how to reduce disaster impacts should be disseminated to vulnerable communities and decision makers.
- Communities should be sensitised and educated on how CBEWS warnings will be disseminated, and what actions they should personally take in response to a warning or each level of alert.
- Community members should be trained to recognise when manual hazard monitoring equipment, such as a river gauge, is indicating that an alert is in place. They should also

be trained to recognise any other simple hydro-meteorological and geophysical hazard signals indicating the need for action.

- On-going public awareness and education should be built in to school or community curricula.
- Traditional communication media and methods should be utilised to improve public awareness.
- Public awareness and education campaigns should be tailored to the specific need of each audience (*e.g. children, emergency managers, farmers).*
- Public awareness strategies and programmes should be evaluated at least once per year and updated where required.

3.6 Cross Cutting Issues - Governance and Institutional

This element is designed to develop strong local policy frameworks that support the implementation and maintenance of effective CBEWS. Robust governance and institutional arrangements that place community members at the centre of all decision making are essential if a CBEWS is to be effective.

The whole life costs of a CBEWS should be identified and discussed between stakeholders at the project design stage so that ongoing costs for operation and maintenance of the system can be clarified and appropriate funding mechanisms considered.

3.6.1 Governance and Institutional Sub Component 1. Community Based Early Warning Systems recognised as a Long-Term Priority

This sub component ensures that the importance of CBEWS is recognised by key local decision makers.

Minimum Actions Required:

- Economic and social benefits of CBEWS must be highlighted to local leaders using practical methods such as case studies and cost-benefit analysis of previous disasters.
- Early warning role models or "champions" should be engaged within the Community Civil Protection Committee to advocate for CBEWS and promote its benefits.
- A multi-hazard framework and operational arrangements between Community and District level Civil Protection Committee's and key partners need to be established to maximise the benefits of CBEWS.
- CBEWS and its supporting action plans should be integrated into local social and economic planning.

3.6.2 Governance and Institutional Sub Component 2. Legal and Policy Frameworks to Support Early Warning Established and Strengthened

This sub component ensures that CBEWS been fully institutionalised at the local and national level.

Minimum Actions Required:

- All CBEWS must comply with these National Guidelines and follow the governance and system approval arrangements set out at Section 2.2.

- The LGD will ensure that all standards for design and operation of CBEWS across Malawi are consistent and that key lessons and best practice is widely shared.
- Governance arrangements for ownership and leadership of CBEWS should be clearly established, including responsibilities for management and maintenance of any assets, such as gauges, and for annual testing and exercising of plans. These arrangements will be evaluated by the LGD as part of the Detailed Design Approval process.
- Governance arrangements should set out clear roles and responsibilities for all organisations (*community, government and nongovernment*) at a local level, and all individual community members involved in operation and maintenance of CBEWS.
- Overall responsibility and authority for coordination of early warnings should be assigned to one committee or body at a local level, for example, a Village or District Community Protection Committee.
- Policies should be developed to encourage ongoing community participation beyond any initial project phase.
- Local decision making, and implementation of CBEWS should be supported within broader administrative and resource capabilities at the District level.
- CBEWS should be integrated into local disaster reduction and development policies.
- Local level monitoring and enforcement regimes should be put in place to support implementation of CBEWS policies.

3.6.3 Governance and Institutional Sub Component 3. Institutional Capacities Assessed and Enhanced

This sub component ensures that opportunities are taken to use the CBEWS process to enhance institutional and community capacities.

Minimum Actions Required:

- Capacities of all local organisations and institutions involved should be assessed as part of the CBEWS design process and capacity building plans and training programmes developed and resourced. The LGD will review this assessment as part of the CBEWS Design Approval process.
- The Non-governmental sector should be engaged and encouraged to contribute to capacity building wherever possible.

3.6.4 Governance and Institutional Sub Component 4. Financial Resources Secured

This sub component is designed to ensure that financial requirements to ensure the CBEWS is sustainable beyond any initial project stage have been identified and addressed.

Minimum Actions Required:

- The sustainability requirements and ongoing “whole life costs” for operation and maintenance of any CBEWS should be identified in any project proposal or development plan.
- Government or other funding mechanisms for CBEWS and should be developed and institutionalised.
- Any funding requirements essential for operation and maintenance of CBEWS, along with the authorities / organisations responsible for meeting those costs, should be

identified and arrangements put in place to ensure the funding is available when required.

- Access to funding at the national and international level to support CBEWS and resulting community action plans should be explored.
- Opportunities should be explored to ensure that CBEWS can be self-sustaining, e.g. by creating opportunities for local income generation to offset maintenance and other operational costs.
- Opportunities for public/private partnerships should be considered to assist with CBEWS development.
- All financial arrangements and sustainability issues relating to CBEWS will be evaluated by the LGD as part of the Detailed Design Approval process.

List of Annexes

1. Annex 1. Assessing Flood and Other Risks for CBEWS
2. Annex 2. Effective Engagement
3. Annex 3. Selection of Appropriate Monitoring and Warning Methods
4. Annex 4 Checklist for existing CBEWS in Malawi
5. Annex 5 Whole Life Costing for CBEWS

Annex 1. Assessing Flood and Other Risks for CBEWS

Risk Assessment Process – General Guidance
Assessments of risk within a particular community requires systematic collection and analysis of data. The assessment should consider the dynamic nature of hazards and vulnerabilities that arise from processes such as urbanisation, rural land-use change, environmental degradation and climate change.

Risks arise from the combination of hazards, exposure, and vulnerabilities at a location. All of these components need to be identified and assessed as part of the CBEWS process. This National Guidance is not intended to provide a detailed guide to risk assessment processes, but the following overview is intended to provide context for the process.

In the context of CBEWS risk assessment, the key components may be defined as follows;

Hazard: *The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision and environmental resources.*

Exposure: *People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses or disruption.*

Vulnerability: *The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.*

Risk; *The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs, and that may require external support for recovery.*

Fig 5. Risk Assessment Components: World Bank Publication - Understanding Risk

Understanding Flood Risk

In Malawi, the key hazard for which CBEWS is established is flooding. Whilst flood impacted communities may have a long history of dealing with floods, and have excellent community level information that should be used to inform any assessment, it should also be recognised that with climate change, development pressures and changes in farming practice, historic data and community recollections in relation to flooding may not be a reliable indicator of future flood risks that a CBEWS must respond to.

Wherever possible, the best flood risk evaluation for a CBEWS will be both the rich indigenous knowledge and experience held by community members and specialist technical input from flood experts. The resulting risk assessments and maps produced in partnership with the community and informed by the best available scientific and technical data will be more robust than any assessment using only data source. Robust assessments understood and accepted by local communities will help to motivate people, prioritise early warning system needs and guide preparations for disaster prevention and responses.

Communities can provide good information about historic flood events, and working with community members through the PCVA process, the primary sources of flooding, the extent and nature of the flood in terms of depth, speed of flow and area that was covered by floodwater, can be mapped. Community knowledge can also provide invaluable information about the key impacts of previous floods at the community level. The PCVA engagement process can also be used to help identify and record any local or indigenous warning signs that have traditionally been used to warn of impending floods.

Further context and data relating to flood risk can be provided through a technical flood risk assessment. This is a specialised technical discipline combining various elements of Meteorology and Hydrology along with an understanding of the physical environment. In simple terms, hydrological modelling as part of a flood risk assessment is used to understand

the ways that water enters and leaves a community. To do so it typically asks questions such as:

- *How much rainfall?*
- *How much and how quickly does it get in to the rivers?*
- *Water levels on the rivers, lakes and other conditions (wind and wave propagating speed)?*
- *How much water is in a dam or behind a levee?*

Essentially – the amount of water can determine the extent of flooding?

Hydraulic modelling than determines:

- *Where does the water go?*
- *How deep will it be?*
- *How fast will it flow?*

Essentially – where does it flood and what is the impact?

With this greater understanding of the potential for flooding in a community, typical questions to be answered include:

Under what conditions will the flooding occur?

- *How much rainfall?*
- *Water state of large lakes (wind and wave conditions)?*
- *Previous conditions - is the rain falling on very dry land, or waterlogged land due to recent rainfall?*

Where can it happen?

- *Topography?*
- *Drainage network – condition/blockages, etc.?*
- *What's upstream?*

How frequently can it occur?

- *Principally related to frequency of extreme weather.*
- *Based on historic events –*
- *Frequency can be very difficult to predict – can change unexpectedly, especially with climate change.*

To undertake a technical assessment of hydro-metrological risk a systematic, standardised collection and analysis of data is required and there are a number of tools and models available to assist in this process. Most systems rely on a computer model's ability to overlay physical characteristics of a community onto detailed digital elevation terrane maps, along with a range of other hydraulic and metrological data and information such as;

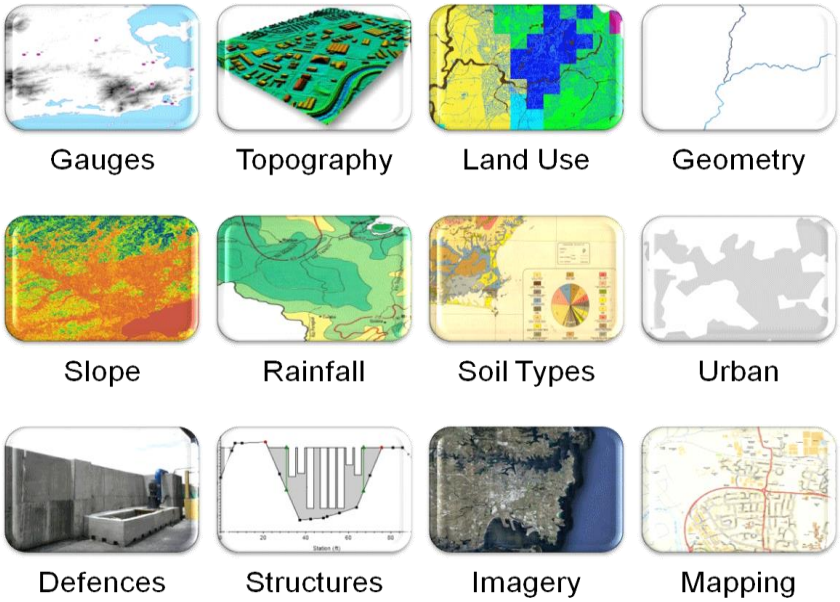

Fig 6: typical components evaluated within a computer flood model

The challenge with technical flood mapping is access to high quality data. It is recognised that "perfect" data sets can be either very difficult or very expensive to obtain. This may be a particular challenge for designing a CBEWS. However, so long as reasonably accurate topographical maps are available, most systems have an ability to address some of the data gaps elsewhere, either by downscaling national or regional data that is available or applying generic factors from very similar environments.

Theme	Purpose	Methods	Indicators	Coverage/Users	Impact	Challenges
Meteorology (drought, floods, thunderstorms, and so on)	Weather and climate forecasting	Weather prediction models, satellite data, and global circulation	Average rainfall, average temperature, and climate forecasts	National and regional levels; commercial and subsistence producers	Inform planting and harvest dates, off-farm activities, and disaster (scenario) preparedness plans	Resource constraints, weak observation network, downscaling forecasts to high resolution, and dissemination language not tailored to users
Hydrology (water)	Hydrological information and information on dam capacities	Collection of river flow and dam levels	Annual rainfall pattern, dam monthly capacity, and water supply	National and regional levels; commercial and subsistence producers	Inform warning on energy production and water management	Resource constraints, weak observation network, and weak transboundary agreements

Fig 7: Common Methods for Generating Risk Information for an Early Warning System. World bank

A major advantage of technical flood modelling over use of local knowledge, is that it is possible to test the model against different scenarios that take account of devolvement and climate change. For example, even if the technical model and local experience produced a very similar flood outline for a community, how might that be changed over the next 25 years if current climate change assumptions prove correct? What would be the impact of further development, deforestation or changes to farming practice in upstream communities be? It is not suggested that every CBEWS must test against multiple scenarios, but known or anticipated changes should be considered and included to "future proof" the CBEWS.

The type and cost of flood mapping and modelling varies considerably depending on the scale and detail included. The higher the model's complexity and resolution, the more expensive it will be to produce. Ultimately, the scale, resolution and cost for flood modelling will be driven

by the purpose the models are expected to be put to. For CBEWS, even relatively low-resolution / low-cost modelling approaches can provide invaluable information when linked with local knowledge

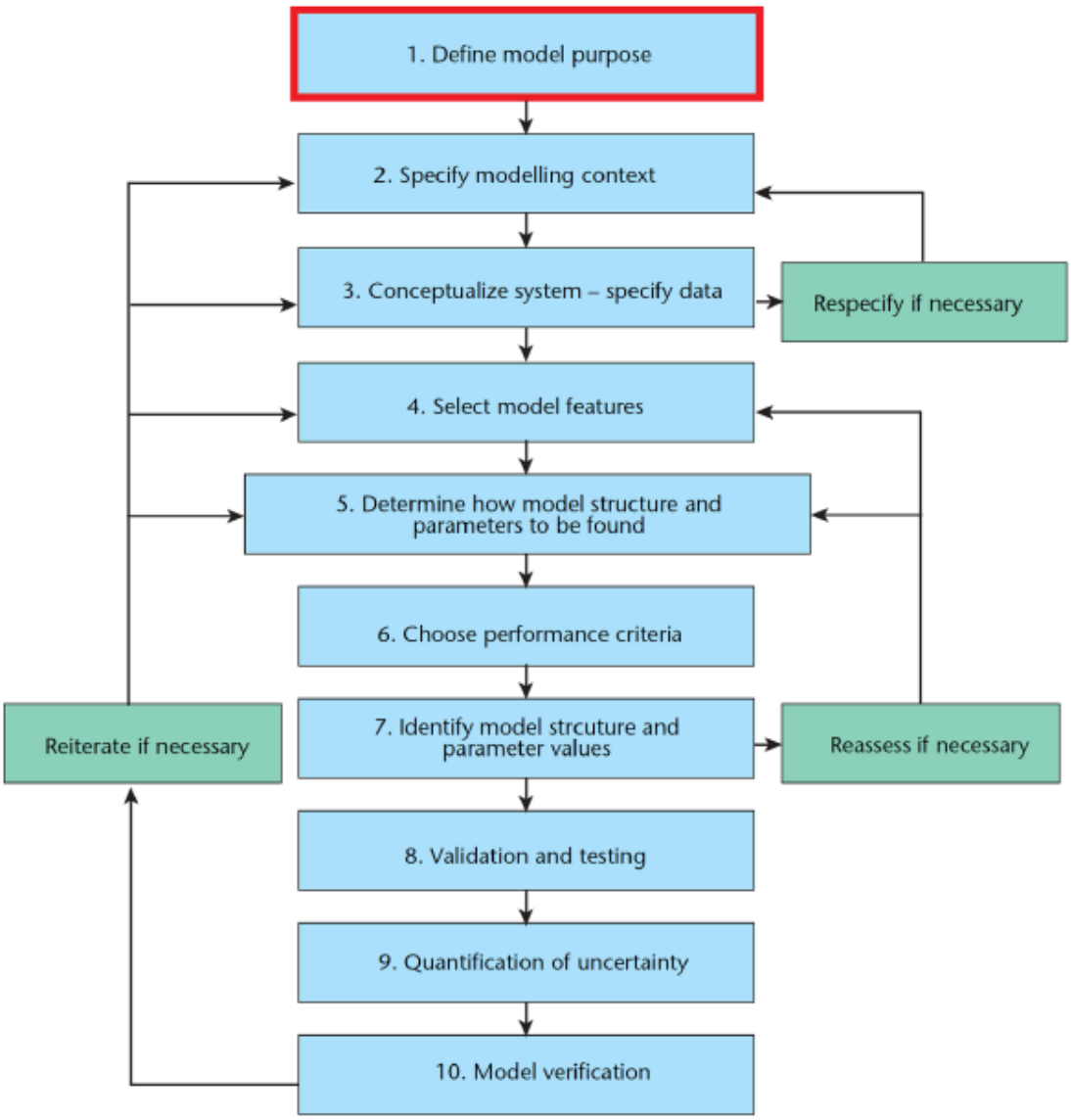

Fig 8: Process for developing a flood forecasting model - WMO / Global Water Partnership

It should be noted that technologies in this area are developing and changing quickly, and that relatively inexpensive access to satellite digital terrane mapping has greatly reduced the costs for production of flood models, especially for projects such as CBEWS, where the granularity of the mapping is less critical than it may be for protection of critical national infrastructure.

It is suggested that the starting point for CBEWS technical flood mapping and modelling in Malawi is to make contact with the Department for Water Resources. They already have maps and models covering some of the most flood prone communities in Malawi and may be able to assist a CBEWS project without the need for further mapping. Even where flood maps do not

exist, the Department for Water Resources can offer technical advice on how the mapping process may best be approached. Similarly, if new flood models are required, the Department of Climate Change and Meteorological Services (DCCMS) may be able to provide valuable rainfall and other climate data to inform a mapping process.

Regardless of where the mapping and other technical information comes from, typical products resulting from a technical flood evaluation include flood maps showing the predicted extent of a flood based on estimates of an anticipated event specified for system design purposes. Rather than assuming a "worst credible" flood event for an area, most flood inundation maps are based on a more realistic event scenario that may be anticipated to occur, for example, on a 1 in 10, 1 in 50 or 1 in 100-year scenario.

The resulting flood maps can show the impact of flooding on a community in terms of the area covered by water, water depth and likely speed / power of flow. The maps and other information can be used both to help communicate risks to local community members, and to evaluate risk reduction and response options, such as identification of safe shelters or evacuation routes.

Fig 9: Typical examples of a flood inundation map

Once developed, flood maps can be an excellent general engagement tool for local stakeholders, political leaders and decision makers. This engagement can test out the predicted extent of flood water in a significant event against peoples past experiences. The maps can also be used to inform response actions, such as identification of most at risk homes and individuals, at risk infrastructure, identification of safe shelter areas for people and livestock, and identification of safe evacuation routes.

An understanding of the extent of any potential flood, its causes and likely speed of development, can also help in setting trigger points for various alert levels within the warning system. For example, a system may need to trigger a "take immediate action" message before flood waters cut off safe routes for evacuation, even if this trigger occurs before properties in the community have actually become flooded.

Further potential sources of official data and information to inform any CBEWS risk evaluation include:

Department of Climate Change and Meteorological Services (DCCMS)
The Department of Climate Change and Meteorological Services (DCCMS) under the Ministry of Natural Resources, Energy, and Mining is responsible for matters related to climate change and meteorological services such as climate and weather. DCCMS cooperates with other government agencies through their provision of weather forecasts, climate predictions, data-sharing, and technical advice on climate related matters. In particular, DCCMS regularly coraborates with the Department of Disaster Management Affairs, Department of Water Resources Affairs, and the Environment Affairs Department, through the provision of weather forecasts and meteorological-hazard early warning information

Department of Water Resources Management and Development (DWRMD)
The Department of Water Resources Management and Development (DWRMD) under the Ministry of Agriculture, Irrigation and Water Development is responsible for water resources planning, policy development and trans-boundary water resources management. It is also responsible for flood forecasting and early warning.

Department of Disaster Management Affairs (DoDMA)
The Department of Disaster Management Affairs (DoDMA) was established in 1992 by the Preparedness and Relief (DPR) Act of 1991 with the mandate of coordinating and directing Disaster Risk Management (DRM) programs in the country in order to improve and safeguard the quality of life of the people of Malawi, especially those vulnerable to, and affected by disasters.

Sothern Africa Development Community - Climate Services Centre (CSC)
The CSC provides operational regional services in monitoring and predicting extremes in climate condition, through the development and dissemination of meteorological, environmental and hydro-meteorological products aimed to improving disaster risk management in the region. A key activity of the SADC CSC is the organisation of the Southern

Africa Regional Climate Outlook Forum, a process that provides seasonal climate prediction for the sub-region.

WMO Regional Specialized Meteorological Centre (RSMC) Pretoria

The WMO Regional Specialized Meteorological Centre (RSMC), hosted by the SAWS in Pretoria runs the Severe Weather Forecasting Demonstration Project (SWFDP). Like similar RSMCs, it interprets information received from global centres, and prepares daily guidance products (1-5 day) for distribution to 16 countries, which includes all SADC Member States and the Comoros.

Further Reading may be found at:

https://www.fema.gov/risk-map-flood-risk-products
https://www.unisdr.org/we/inform/publications/57457
http://documents.worldbank.org/curated/en/395541467991908801/Methods-in-flood-hazard-and-risk-assessment

Annex 2. Effective Engagement

Effective engagement and contribution of local stakeholders is a prerequisite for establishment of any CBEWS, and this commences at project inception and initial work to identify community risks.

This leads to greater local ownership and understanding of community level risks and the warning system established to reduce them. Effective engagement also ensures that warnings are understood and can be acted upon by all members of the community, especially the most vulnerable. Full community engagement and local ownership of CBEWS also ensures the long-term sustainability of any system.

International experience confirms that the most successful CBEWS projects will be those that have effectively engaged local stakeholders. Examples of good CBEWS engagement practices include:

1. Involvement of community members, especially the vulnerable groups, at all stages of the CBEWS process and in development of each key element, from understanding risk, monitoring the systems, receiving and disseminating the warning messages, responding to the warning and contributing to long term governance and maintenance of the systems and plans.
2. Inclusion of measures based on the needs of everyone in the community including the most vulnerable segments of the community.
3. Meaningful participation of the community in the decision-making process when establishing Early Warning Systems and in the long-term governance and management arrangements to ensure that once developed, it is sustainable, owned and directed locally by community members.
4. Engagement with local community members to ensure that their local knowledge is incorporated into any system and that their local capacity to respond to a situation is fully recognised and enhanced.

A key priority for engagement activities is to facilitate inclusion of community knowledge into the more formal risk assessment process. A number of well-established methodologies have been developed to assist in this process, including participatory capacity and vulnerability analysis (PCVA). As its name suggests, PCVA has its roots in two proven social development methodologies.

First, it stems from capacity and vulnerability analysis methodology. This has long enabled programmes to be designed in accordance with a community's capacities as well as its vulnerabilities. It recognises that vulnerable people have capacities to cope with adversity and can take steps to improve their lives, however difficult their situation may be.

Second, it recognises that enabling communities to genuinely participate in programme design, planning, and management leads to increased ownership, accountability and impact, and is the best way to bring about change. PCVA draws on a wide range of participatory learning and

action techniques and tools that are designed to channel participants' ideas and efforts into a structured process of analysis, learning, and action planning, with the overall aim of reducing a community's disaster risk.

The participatory nature of the process supports men and women to act as agents of their own development who, with the right resources and support, can solve their own problems. It promotes the participation of women in particular as risk analysts and decision makers when it comes to prioritising what a community can do to reduce its disaster risk.

Carrying out a PCVA as part of the CBEWS process should be regarded as an investment with communities. Once the CBEWS is established, the PCVA process can be repeated regularly to help assess implementation of the system and enable any changes to be made in light of changing risks or lessons learned.

The main stakeholders in the CBEWS process are the community members themselves. But it must be remembered that communities are not homogeneous; there are significant differences based on gender, age, socio-economic status, religious or political affiliations, as well as individual and collective interests. Securing buy-in from a wide range of stakeholders is the key not only to a successful PCVA process, but an effective action plan to reduce disaster risks identified through the CBEWS. As well as members of the community, other stakeholders in the local area are likely to include:

- National and Local Government departments and institutions,
- United Nations (UN) bodies,
- International non-government organisations (NGOs),
- Local NGOs or community-based organisations,
- Religious groups or institutions,
- Private companies.

The best way to identify stakeholders is to visit the community, meet with its leaders, identify the other actors involved, and begin a working relationship with them. This approach will also provide valuable information about the community in terms of what happens on a day-to-day basis that can better inform "risk knowledge" evaluation activities.

During initial visits and discussions, it should be emphasised that any risk reduction action plan resulting from the CBEWS process needs to be owned and led by the community. Whilst projects to establish CBEWS may have the support of a team or organisation, they will require other forms of support from, and co-ordination with, the stakeholders involved.

Annex 3: Selection of Appropriate Monitoring and Warning Methods

General monitoring and Warning Approaches

The monitoring and warning component of a CBEWS must be designed to suit the specific circumstances of the community being protected, there is no single approach or solution that can be applied in every circumstance. However, given the nature of hazards, risks and communities, most CBEWS in Malawi will include a flood component reliant on staff gauges, rain gauges or metrological forecasting methods, either in isolation or in combination.

Traditional approaches to river or catchment-based flood warning include a manual or automated river gauge located upstream of the at-risk community. With an understanding of the likely impact on downstream communities of various levels observed higher up the river system or catchment, appropriate trigger points can be identified for the CBEWS.

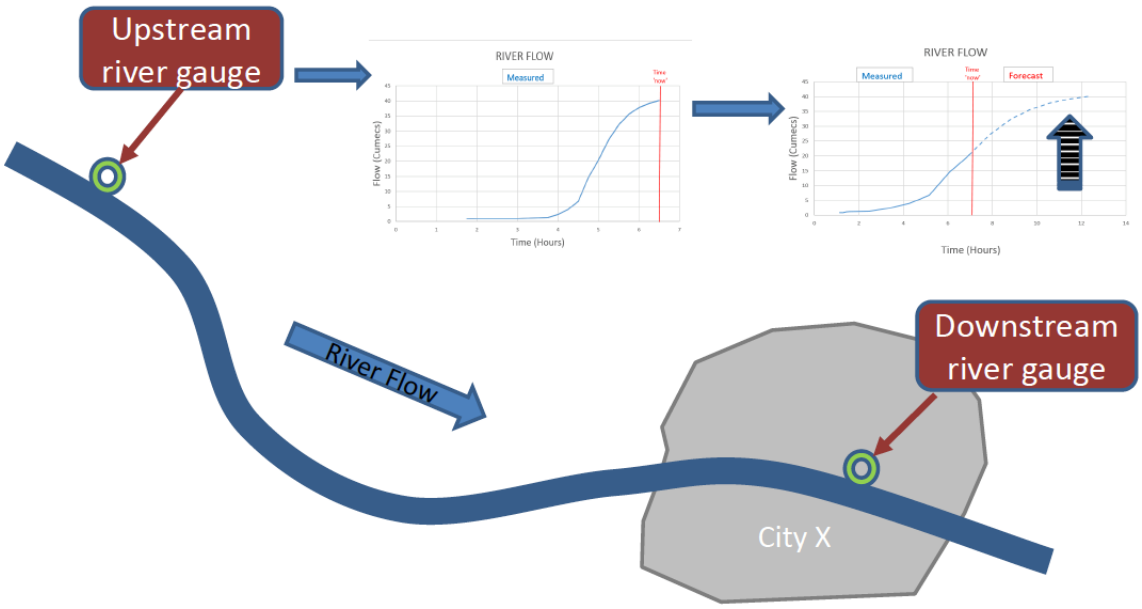

Fig 10: Schematic for simple flood monitoring system

As these traditional methods can only react to water once it has already entered the river or catchment, warning times for downstream communities may be very short. To address this, additional characteristics such as rainfall can be monitored and incorporated into an extended monitoring and warning system. With an understanding of the amount of rainfall likely to result in a rise in river or catchment water levels, and systems in place to monitor both rainfall and river levels, the CBEWS will be able to issue more timely warnings.

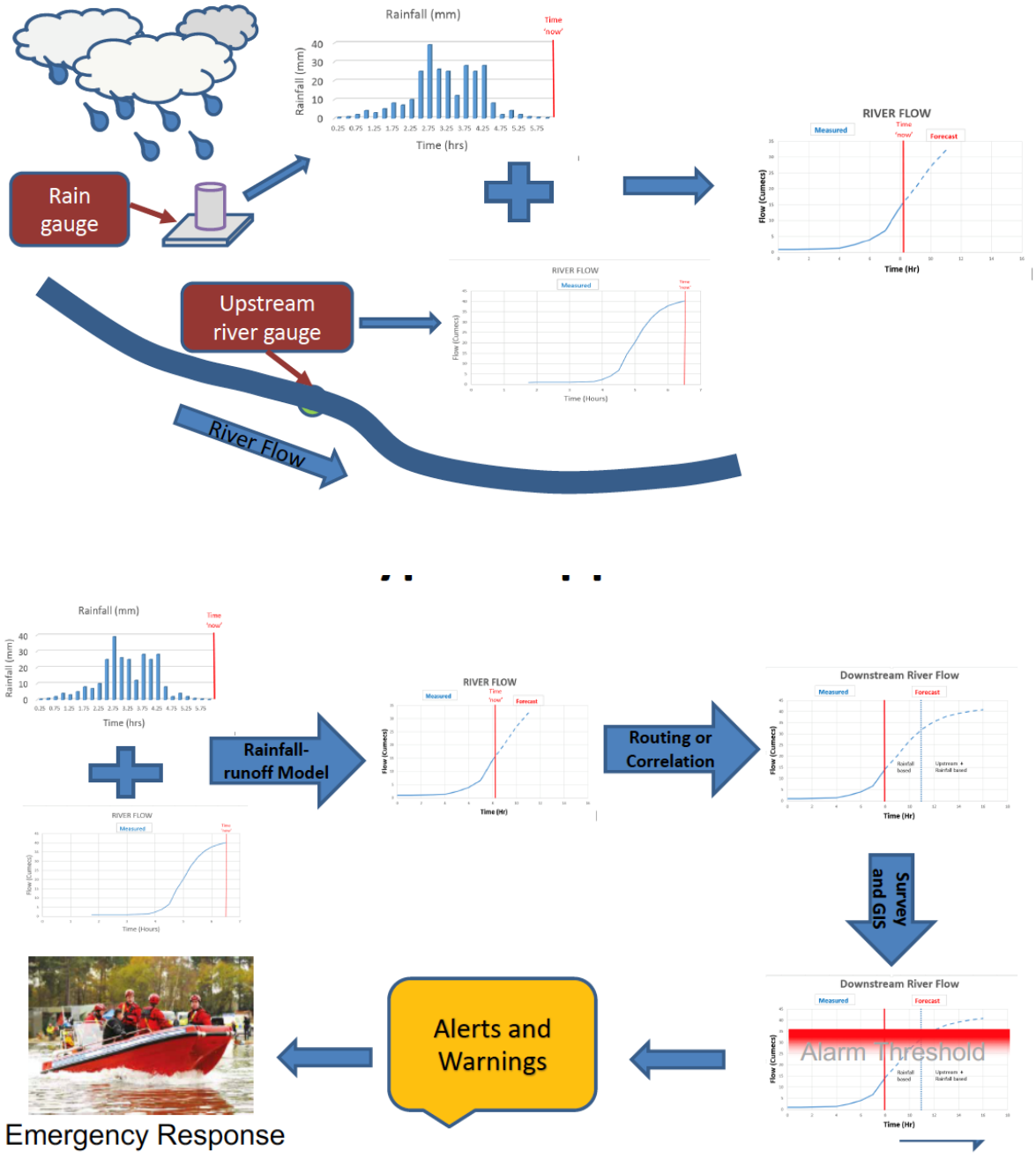

Fig 11: Schematic for extended flood monitoring system

New technologies have resulted in rapid development of monitoring and warning systems for flooding. Key developments include;

- Computing technology - *enabling multiple and complex data to be analysed in "real time".*
- Modelling capability - multiple *factors can be modelled to give a much more accurate estimate of flood likelihood and impacts*

- Improvements in Weather Radar - *Improved weather radar can identify the likelihood of rainfall more accurately than before and can estimate the volumes of water falling on a catchment even before ground based rain gauges have started to register the rain falling.*
- Understanding of flood mechanisms - *Improved understanding of flood mechanisms and understanding of "whole catchment" reactions to water has improved predictive capabilities.*

The monitoring and warning systems used in the most sophisticated flood warning systems may be inappropriate or unaffordable for CBEWS. However, as technologies improve and costs fall, they may feature in CBEWS in the future? The basic components for an integrated and automated early warning system are described below for information.

Fully automated systems provide constant river / catchment monitoring with sensors and gauges at multiple points providing live water level and flow data via a telemetry system back to a central control point. Weather radar information also provides live data in respect of rainfall, monitoring both rainfall volumes and location across the area being monitored.

At the control point, all data is fed into a grid based 2d flood model for the area. This can compare multiple factors and trigger points for the alarm system. When any one of the multiple trigger points is breached, an alert can be issued to the warning communication and dissemination system. A feature of this live modelling warning system, is that it can constantly compare and adjust predictions provided by the model against actual values measured on the ground, reducing false alarms and enabling model verification and validation.

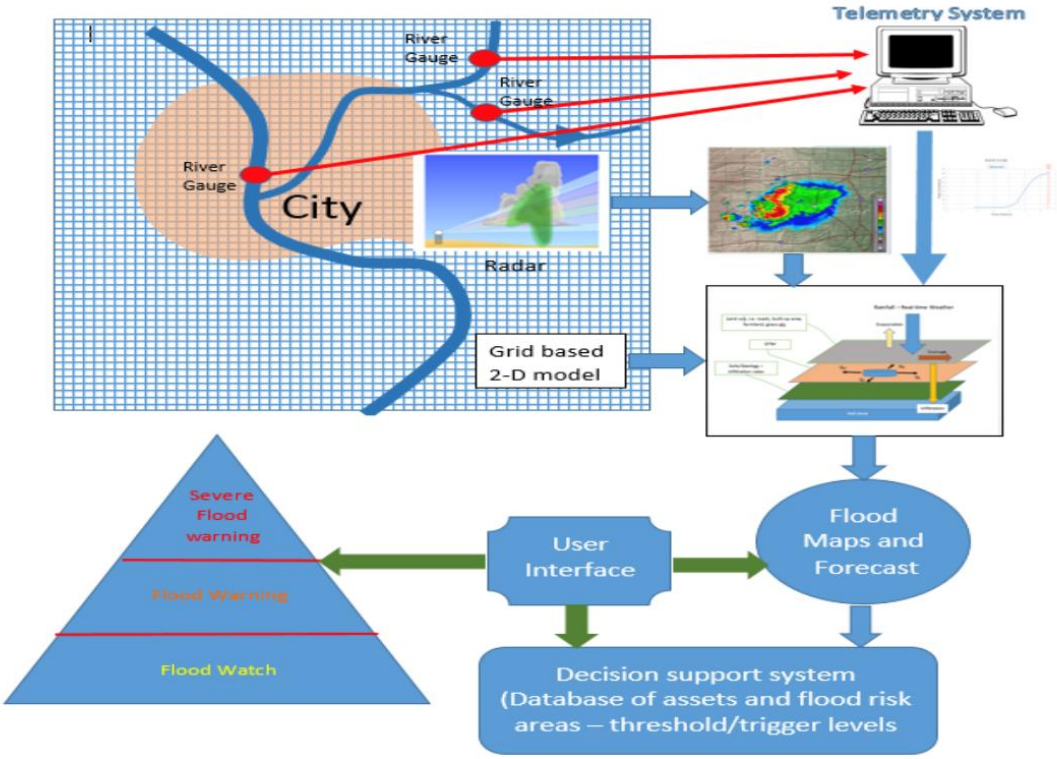

Fig 12: Schematic for advanced flood monitoring system

Selecting the most appropriate methods for CBEWS in Malawi

Any of the simple, extended or advanced monitoring and warning systems outened above may be suitable for CBEWS in Malawi. However, it is unlikely that advanced systems will be necessary or affordable in most circumstances. The only exception may be where an advanced system for monitoring and warning is implemented at the catchment scale providing alert signals for multiple communities and CBEWS. In these instances, efficiencies of scale may allow a comprehensive system to be put in place for similar costs to multiple individual projects each using automatic monitoring systems.

The key issue in selecting the most appropriate approach, will be an understanding of risks to the community and an understanding of the warning time required to enact a communities response plans. In most instances, a simple approach will provide sufficient lead time to enable the community to take effective actions, such as evacuation to a lace of safety or protection of property and livestock. Warning time provided by simple systems can be improved further by linking upstream and downstream communities, so that downstream communities receive a warning even before their own local river gauges have reached a danger threshold.

For upstream or highland communities, with little opportunity to extend the warning time they will receive from gauges higher up the catchment, an extended system may offer some benefits. By measuring rainfall, trigger points for action may be monitored even before a river catchment has fully reacted to the rain that has fallen.

Both the simple and extended systems can benefit from incorporation of meteorological and hydrological forecasting information from the national warning systems. Linkages between the local and national systems should be incorporated into every CBEWS project. Even the simplest manual flood warning system can be enhanced if community members can receive pre-warning of heavy rains from national agencies.

Whatever systems are used to inform a CBEWS, they must provide continuous monitoring of the hazard parameters and precursors so that once trigger points are breached an alert can be given to initiate the communication and dissemination element of the system. Although most CBEWS in Malawi relate to flood risks, warning services for different hazards should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks.

Manual or Automated Systems?

The costs to develop, operate, and maintain CBEWS will vary greatly depending on the monitoring systems selected. One major cost factor is whether to use manual or automatic monitoring sensors and gages.

Manual gages are relatively inexpensive to purchase and maintain, but labour intensive to operate. By contrast, automatic gages are more expensive to buy and maintain, but do not

require any labour to monitor or report data. Automatic gages offer several advantages over manual gages, including:

- Ability to provide information from places and at times when people are unavailable
- Ability to report information almost instantaneously
- Ability to communicate during severe weather, when other communications channels may become unavailable
- Uniform standards for data collection and reporting

Because of these advantages, automatic systems present an ideal solution and are preferred by most operators of national warning systems or to protect high value infrastructure.

However, the costs for automated systems in Malawi, both initial capital purchase price and real world "whole life costs", present a barrier to CBEWS expansion. Whilst automated systems may present the best solution where costs are not an issue, manual systems operated by community members can provide very valuable systems for communities that would otherwise be unprotected.

To provide a guideline on the comparative costs for manual and automated gauging equipment, an automated water level radar alone would cost in the region of US$6,000. A simple staff gauge to monitor river levels would cost in the region of US$600. It should be noted that even where an automated gauge or sensor is used to monitor a hazard parameter, it is not an automated early warning system without the inclusion of technologies to monitor parameters and issue an alert signal once one of the trigger points for the warning system has been breached. The actual costs for a single automated CBEWS delivering a simple warning system based on a single gauge or sensor being monitored by a computer-controlled monitoring station may therefore be in excess of US$100,000 with a significant ongoing annual cost for operating and maintaining the system. A manual solution for delivery of the same simple warning system based on a single gauge would cost less than US$1,000 with minimal ongoing maintenance requirements

For this reason, simple manual staff gauges are the main monitoring device within many CBEWS in Malawi, with each system having a number of gauges installed along river systems both upstream and downstream of the community or risk area being protected. The location for upstream gauges can best be identified with reference to hydraulic models in order to identify the ideal position that will provide sufficient warning (lead) time for the communities downstream and provide correlation between observed water levels at the upstream location and predicted extent of flooding and water depth in the protected area.

Downstream gauges can also be located close to the communities that are to be protected. The main purpose of these gauges will be to provide immediate warning information to the communities in these areas, supplemented by the information from gauges upstream. Intermediate gauges may be placed between the upstream and downstream locations to provide further warnings in that immediate location as required.

a) 

b) 

Fi 13: Examples of Staff Gauges- (a) Colour coded gauge, (b) sequential gauge set in river bank (NIRAS Report on CBEWS 2018)

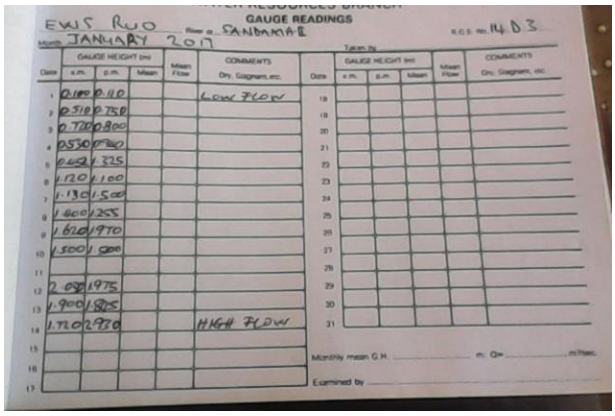

Fig14: Example of a simple Staff Gauge and Gauge Reading Book - Malawi Red Cross

Rain gauges can be a valuable addition to CBEWS. Relationships between precipitation and river levels affecting a community at risk should have been identified during the "risk knowledge" stage of the CBEWS process. Using that information, rainfall-depth thresholds can be established and the information from rain gauges can be used operationally for early warning purposes as part of an extended warning system.

The use of rain gauges has some advantages over water level devices (*both staff gauges and water level radar sensors*). In the first place, the rainfall is a more direct measurement than water level, and it can provide warning with a higher lead time than water level monitor devices. Also, while water level monitors are close to the river and may be damaged during floods (*especially staff gauges*), rain gauges are in most cases safe from the impact of flooding providing they are located outside of the floodplain.

Existing and available meteorological forecasting information from the DCCMS can also be incorporated into CBEWS schemes. Many communities are already making use of the meteorological information received, although it is acknowledged that the information is not localised, and the warnings given usually apply to several districts.

Monitoring Levels

Constant monitoring of hazards is essential in order to generate accurate warnings in a timely fashion. National level warnings could potentially involve inputs and data provided by various monitoring agencies at the Global, Regional and National level, and various levels of sophistication including 24 hours a day predicting and forecasting systems combining satellite data, weather radar and water measurement technologies and then combining them within a computer model that will issue a range of predicted outcomes with varying degrees of certainty. However, as monitoring and warning systems for most CBEWS reside within the community, most rely on local and relatively simple systems and equipment.

CBEWS generally provide different levels of warning depending on the level of confidence that an event will impact the community, or the anticipated severity of the event. For the sake of simplicity and the avoidance of confusion, the common convention used internationally is for community-based signals to have a situation "normal" level and no more than three levels of warning or alert.

Many community-based systems adopt a simple colour coding approach to these signal levels, with each colour depicting a different level of alert and triggering different actions within the community. Once a community is sensitised to the warning system, these different colour codes can be easily understood, require little or no literacy and can be enacted quickly using entirely local resources. The same codes / levels can also be incorporated into plans of the various government and non-government organisations involved in risk reduction. For example:

Green Status – **Alert levels not reached**: No significant hazard expected. At this level, the monitoring network does not predict any impending event, or following an alert, a green status signals that the water levels have returned to normal (*although other types of risk may have arisen as a result of the flood which will be identified and addressed in the community plan).*

Yellow Status - Be Aware: The concept behind yellow alert is to notify community members that a developing situation is being monitored. In case of a yellow alert, community members should ensure that everyone, including the most vulnerable, is aware of the situation and can take early preventative action as set out in their community or household level safety plan.

Orange Status - Be Prepared: Orange status means that weather / river conditions have now reached the level where significant impact is expected. Arrangements for enhanced monitoring of the situation should be put in place at the community level as the conditions may change or worsen quickly, leading to disruption;

Note *In many simple systems, a single stage alert is used incorporating both yellow and orange in a single level.*

Red Status - Take Action: The issue of red level warnings should be limited to situations where serious flood conditions are expected imminently. Community members in receipt of a red warning should take immediate action to protect themselves and/or their property, for example, by moving their families and livestock out of the danger zone temporarily or taking any other actions as identified in the community or household plan.

To ensure adequate waring time can be given to enable community plans to be safely enacted, it is important to set an appropriate trigger point for each of the above alerts.

The key determining factor impacting the warning time that a monitoring system can provide will be its monitoring method and sophistication. The most sophisticated systems using metrological forecasting systems can provide alerts to the potential of an event a number of days before the event occurs, but with lower levels of accuracy. Sophisticated systems would generally combine this advanced warning with more detailed monitoring of parameters such as weather radar and modelling to issue a warning with a high degree of accuracy. At the other extreme, simple manual monitoring systems can provide a high degree of accuracy in their warnings, as by the time their local gauges have registered an event is already underway, but the lead time for warning may be very short.

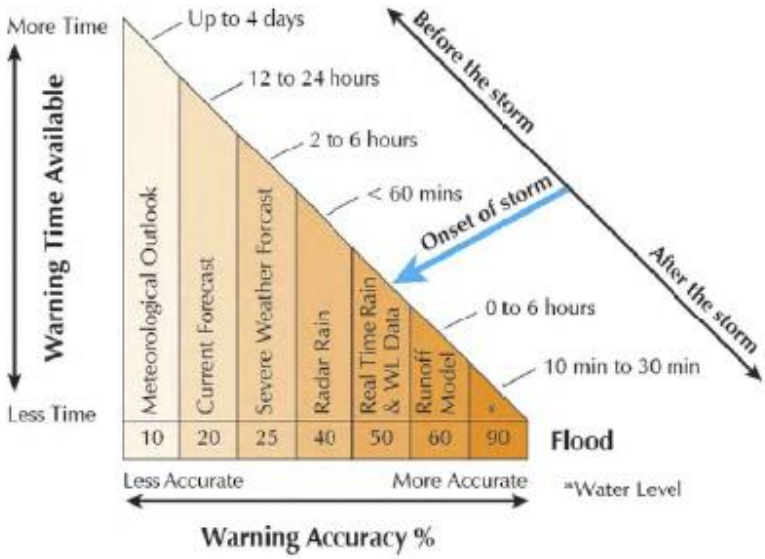

Fig 15: Trade off between warning time and flood forecast accuracy (Wright 2001)

In design of a CBEWS and in setting appropriate trigger points, there can be a temptation to avoid issuing the most serious level of alert until the anticipated event is a certainty, in order to minimise false alarms. Whist this might be entirely appropriate in some circumstances, in others, it could mean that by the time action is initiated, it is already too late for effective response actions to be safely taken. For example, if the emergency plan identifies that a school will take at least 30 minutes to evacuate to a place of safety, the trigger point for a "Red" alert should be set so that at least 30 minutes warning is delivered.

Annex 4. Checklist for Existing CBEWS in Malawi

This checklist is intended to provide a consistent methodology for assessment of Community Based Early Warning Systems (CBEWS) in Malawi that have been developed prior to the introduction of National CBEWS Guidelines.

The Checklist is designed in three parts;

Section 1 Asks for background information about the CBEWS, how it was developed and by whom, and a description of its key features.
Section 2 Sets out a high-level structure to evaluate the systems current safety and operational effectiveness
Section 3 Contains an overall assessment checklist for the CBEWS based on the National Guideline Document.

Section 1 & 2 of the checklist are intended to assist in the national registration process for existing CBEWS, and to identify any immediate safety critical issues so that they may be prioritised by the Lead Government Department for CBEWS and remedial actions considered as a matter of urgency.

The overall assessment checklist set out in section 3 is intended for evaluation of systems that have been assessed as operating safely, looking to identify non-critical gaps or opportunities for ongoing system development and continuous improvement. This overall checklist follows the same structure as National Guidelines, recognising that all early warning systems, require five key elements to be in place and working effectively;

1. Risk Knowledge
2. Monitoring and Warning Service
3. Dissemination and Communication
4. Response Capabilities
5. Governance and Institutional

Although a pragmatic approach should be taken to review of CBEWS established prior to national guidelines being adopted, all CBEWS in Malawi should be encouraged to work toward addressing each of the five key elements as set out in the National Guideline document, including the minimum actions required in relation to each sub component that relate to systems in operation. Where opportunities for improvement are identified using the checklist in section 3, these should be discussed with local stakeholders responsible for governance of the CBEWS and a risk prioritised improvement plan agreed.

All review forms, once completed, should be returned to …….

Section 1: CBEWS Overview

1. CBEWS and Reviewer Identification

Identification of the CBEWS	Identification of the Reviewer
Name of the System / Project:	Name:
Area / Community Covered by CBEWS:	Title / Position:
Lead Organisation / Entity:	Email / Contact Details:
CBEWS Contact Name / Details:	Date of Review:

2. General CBEWS Background Information

Question	Response
1. What hazards does the system provide warnings for?	
2. What monitoring systems are used to measure hazard parameters? (*River gauges, rain gauges etc*)	
3. How are those systems monitored and by whom?	
4. How are warnings disseminated? (*Loud hailers, drums etc*)	
5. What arrangements have been made to ensure warnings reach the most vulnerable members of the community?	

3. Understanding the CBEWS Governance and Operational Arrangements.

Question	Response
1. When did the CBEWS become operational?	
2. Which organisation led the CBEWS Project and which partners were involved in its funding or delivery?	
3. How long did it take from Project Inception to CBEWS becoming Fully Operational?	
4. What was the Budget for establishment of the CBEWS?	
5. What are the ongoing / year on year, costs of maintaining your CBEWS?	
6. What processes were used to identify key hazards, risks and vulnerabilities in order to design the CBEWS?	
7. How was indigenous knowledge integrated into the CBEWS design?	
8. How is the CBEWS linked with National Early Warning Systems?	
9. What actions do community members take in response to warnings received?	
10. How has CBEWS been incorporated into community-based resilience building?	
11. What arrangements are in place for coordinating committees/teams at the community level?	
12. What, if any, financial or sustainability challenges have been identified that may threaten the long-term viability of the CBEWS?	

Section 2 - CBEWS Safety Assessment

The reviewer is required to consider the safety critical features of the CBEWS set out below and form a judgement in respect of the systems overall suitability to operate. The key determining factor is whether the community is safer with the system in place, even if there are a number of areas that require improvement, or if the system should be shut down until such time as improvements are made.

Issue	Yes	No (comment)
Are local governance arrangements working effectively and volunteers fully engaged?		
Is the system being adequately monitored by volunteers?		
Has the hazard monitoring equipment in place been maintained and is it functioning effectively?		
Does the trigger point for initiating a warning provide sufficient warning time to enable local plans to be enacted?		
Are the warning dissemination arrangements adequate, is any provided equipment fully maintained and working?		
Has the system been operated for a real event since it was put in place and did it adequately protect the community?		
Are there effective community response plans in place?		
Any other issues identified that could have a serious impact on the systems safety or reliability?		
	Satisfactory	**Not Satisfactory**
Overall Assessment		

If the overall assessment is satisfactory, continue onto the full review set out in section 3. If the overall assessment is unsatisfactory and significant safety concerns are identified, refer immediately to the Lead Government Department for consideration of further actions.

Section 3 - Overall CBEWS Assessment

Key Element 1: RISK KNOWLEDGE

Key question in relation to this element: *Has the CBEWS been designed on the basis of a robust assessment of hazards, vulnerabilities and risks and has this evaluation been used to inform CBEWS design and operation?*

Risk Knowledge Sub Component 1 - Organisational Arrangements Established for the CBEWS

Question: Were all of the appropriate stakeholders identified and engaged from the outset of the CBEWS process and are the necessary structures and engagement plans in place to ensure that the system can be operated and maintained effectively?

Issues to consider?

- Do CBEWS documents and plans identify roles and responsibilities of key government agencies, local and community partners, NGO's and others involved in CBEWS operation and review?
- Have key local leaders, stakeholders and community representatives been identified and engaged, and have they confirmed their support the CBEWS process?
- Was the data, mapping and any reports used to underpin CBEWS design shared with the community or local committees on project completion?
- Are processes in place to ensure local communities are engaged in the review and to updating of risk data annually?

Risk Knowledge Sub Component 2. Natural Hazards Identified

Question: Has the risk evaluation considered both local knowledge and the latest risk modelling and mapping available to come to a robust consensus on key hazards, and is the evaluation up to date?

Issues to consider?

- Are the characteristics of key hazards identified, prioritised at a community level?
- Was a technical hazard and risk review completed and were its outcomes in line with community level evidence and experience?
- Are hazard maps available to the community showing the geographical areas at risk and key features, such as evacuation routes and safe shelters?

Risk Knowledge Sub Component 3. Participatory Capacity and Vulnerability Analysis (PCVA)

Question: Was a PCVA completed by a competent body to a recognised standard / format? Is it up to date and has it considered all relevant factors?

Issues to consider?

- Where community vulnerability assessments conducted with local stakeholders for all relevant natural hazards and are those evaluations available to the community to inform their risk reduction and response planning activities?
- Where factors such as gender, disability, access to infrastructure, economic diversity and environmental sensitivities considered.

Risk Knowledge Sub Component 4. Risks Assessed

Question: Has the impact and likelihood of natural hazards been evaluated for different sections of the community?

Issues to consider?

- Has the interaction of hazards and vulnerabilities been assessed to determine the risks faced by various stakeholder groups within each community?
- Was technical data and input, such as flood maps, evaluated alongside PCVA evidence to ensure overall assessment is robust and takes account of climate change and other factors. Is that technical data available to the community to inform their risk reduction and response planning activities?
- Was a community consultation conducted to ensure risk information is comprehensive and includes local historical and indigenous knowledge information as well as more technical and scientific evidence such as flood maps, models and climate change predictions?
- Where any activities that increase risks identified and evaluated as part of the risk assessment process?
- Have the results of risk assessment been shared with all local and District level stakeholders and incorporated into risk management plans?

Risk Knowledge Sub Component 5. Information Stored and Accessible

Question: Since the risk knowledge process was completed, has the information and data been regularly reviewed, updated, and revised risk assessment data made readily accessible to those who need it?

Issues to consider?

- Arrangements made for a central 'library' to store all disaster and natural hazard risk information gathered during this exercise. This may include a mixture of hard and soft copies at a local or District level. The key issue is that the information is secure and community stakeholders can access it effectively.
- Has a review or maintenance plan been developed to keep data current and updated?

Checklist Score for Key Element 1 - Risk Knowledge

Sub Component	Fully Addressed	Partly Addressed	Significant Gaps
1. Organisational Arrangements Established for the CBEWS are in place			
2. Natural Hazards Identified			
3. Community Vulnerability Analysed			
4. Risks Assessed			
5. Information Stored and Accessible			
Overall evaluation of this element (1 - 3 as below)			

1 = Fully satisfactory
2 = Satisfactory but some opportunities for improvement
3 = Significant gaps and urgent improvement required.

Key Element 2: MONITORING AND WARNING SERVICE

Key question in relation to this element: *Has an effective hazard monitoring and warning service been established and is there a sound scientific and technological basis for the warning trigger points put in place?*

Monitoring and Warning Service Sub Component 1 - Institutional Mechanisms Established

Question: Have roles and responsibilities for monitoring hazards and triggering an alarm as part of the CBEWS been made clear and are robust arrangements in place to ensure effective warnings are given?

Issues to Consider?

- Have roles and responsibilities been established and agreed for all partners, organisations or community members generating and issuing warnings forming part of the CBEWS?
- Are all community members and warning system partners aware of which organizations are responsible for initiating warnings?
- Do local plans set out protocols for communicating and disseminating warning messages, including standardisation of the language, terminology and communication methods to be used?
- Are arrangements in place to share warning messages with neighbouring CBEWS and community protection partners at the District and National level.
- Are arrangements in place to receive and react to warning or hazard messages received from national warning systems?
- Is the CBEWS subjected to system-wide tests and exercises involving community members, government and official partners at least once each year?
- Are systems in place to verify that warnings have reached the intended recipients?
- Do the CBEWS arrangements in place provide a reliable warning service and do they have an element of redundancy built in to take account of any changes in the availability or personal circumstances of individual community members responsible for key actions?

Monitoring and Warning Service Sub Component 2. Monitoring Systems Developed

Question: Have appropriate monitoring systems and “trigger points” been established for the warning system so that reliable warnings can be issued at the right time?

Issues to Consider?

- Have measurement parameters and warning thresholds been established and documented for each relevant hazard?
- Do the trigger points for a warning provide sufficient time to enable community level response plans to be delivered?
- Have the community level arrangements for monitoring been agreed with experts from relevant authorities?
- Is the technical equipment provided suited to local conditions and circumstances, and have personnel / community members been trained in its use and maintenance?

Monitoring and Warning Service Sub Component 3. Forecasting and Warning Systems Established

Question: Has the forecasting and warning system been robustly established?

Issues to Consider?

- Have the CBEWS warning and action thresholds been reviewed by National or District level experts to ensure that warning generation is suitable and sufficient?
- Have community stakeholders undertaking key tasks within the CBEWS been trained appropriately and provided with such support as may be necessary to enable them to fulfil their function within the system?
- Are community level systems robust and resilient and have any single points of failure been identified and addressed?
- Has the CBEWS been routinely monitored and evaluated, including operational processes and warning performance?

Checklist Score for Key Element 2 Monitoring and Warning Service

Sub Component	Fully Addressed	Partly Addressed	Significant Gaps
1. Institutional Mechanisms Established			
2. Monitoring Systems Developed			
3. Forecasting and Warning Systems Established			
Overall Score for this Element (1 - 3 as below)			

1 = Fully satisfactory

2 = Satisfactory but some opportunities for improvement
3 = Significant gaps and urgent improvement required.

Key Element 3: DISSEMINATION AND COMMUNICATION

Key question in relation to this element: *Have robust community level communication and dissemination systems been put in place, and do they ensure people are warned in advance of impending hazard so that they can enact their local response plans?*

Dissemination and Communication Sub Component 1. Organizational and Decision-making Processes Institutionalised

Question: Are the arrangements for dissemination of warnings robust and is everyone involved clear about their role and responsibilities?

Issues to Consider?

- Have warning dissemination plans been identified and agreed with stakeholders?
- Have functions, roles and responsibilities of each community level actor in the warning dissemination process been specified in local plans?
- Are arrangements in place to ensure CBEWS and national warning systems are linked, consistent and facilitate two-way information exchange between local CBEWS and government departments?
- Have the CBEWS dissemination structures been developed in such a way that the same basic structure could be extended to disseminate a range of warning messages at the community level in the future, even if they are initially established for a single hazard, such as flooding?
- Have volunteers supporting the CBEWS been trained and empowered to receive and widely disseminate hazard warnings to remote households and communities?
-

Dissemination and Communication Sub Component 2**. Effective Communication Structures and Equipment Installed**

Question: Is appropriate communication equipment in place, robust, and supported by formal arrangements to ensure it is maintained?

Issues to Consider?

- Are the communication and dissemination structures in place robust and tailored to the needs of individual communities?
- Do warning communication protocols ensure that warnings reach the entire population, including the most vulnerable, seasonal populations and remote locations?

- Are multiple communication mediums used?
- Are arrangements in place to ensure verification and confirmation that warnings have been received?
- Are community level maintenance and back up arrangements in place to ensure resilience of the overall system?

Dissemination and Communication Sub Component 3. Warning Messages Recognised and Understood

Question: Are the messages being disseminated suitable for intended end users and will they initiate the required actions?

Issues to Consider?

- Do the early warning messages in place incorporate clear instructions for those who will need to act (*e.g. instructions for safe evacuation and shelter, or safeguarding livestock and pets)?*
- Are community level warning alerts and messages tailored to the specific needs of those at risk (*e.g. recognising diverse cultural, social, gender, linguistic and educational backgrounds*)?
- Are mechanisms in place to inform the community when the threat has ended?
- Have the CBEWS warning messages been reviewed annually or after an event to study how people access and interpret messages?

Checklist Score for Key Element 3 Dissemination and Communication

Sub Component	Fully Addressed	Partly Addressed	Significant Gaps
1. Organizational and Decision-making Processes Institutionalised			
2. Effective Communication Structures and Equipment Installed			
3. Warning Messages Recognised and Understood			
Overall Score for this Element (1 - 3 as below)			

1 = Fully satisfactory
2 = Satisfactory but some opportunities for improvement
3 = Significant gaps and urgent improvement required.

Key Element 4: RESPONSE CAPABILITY

Key question in relation to this element: *Has the CBEWS process strengthened the ability of communities to respond to natural disasters through enhanced understanding of the hazards, vulnerabilities and risks they face, and have they put in place effective disaster preparedness arrangements as a result?*

Response Capability Sub Component 1. Warnings Respected and Acted Upon

Question: Has implementation of the CBEWS resulted in Communities that better understand their risks and have sufficient confidence in the warnings issued to plan for, then take, immediate and appropriate action?

Issues to Consider?

- Did the CBEWS risk evaluation and engagement process enhance the communities understanding of the hazard, vulnerabilities and risks they face?
- Did the CBEWS risk evaluation and engagement process lead to development of local level response plans that set out what needs to be done in case of a warning and by whom?
- Have local actions been taken to build and then maintain credibility and trust in warnings so that individuals will take appropriate actions at the appropriate time?
- Have false alarms been minimised as far as is possible to maintain trust in the warning system?

Response Capability Sub Component 2. Disaster Preparedness and Response Plans Established

Question: Has the CBEWS process resulted in development of robust plans at the community and individual level, are they practical and practiced?

Issues to Consider?

- Are robust disaster preparedness and response plans established at the community level, and are they targeted to the individual needs of all community members, including the most vulnerable and those living in remote areas?
- Are up to date hazard and vulnerability maps available to those responsible for development of community and individual / family level emergency preparedness and response plans?

- Are regular community level sensitisation sessions held, along with drills to test the effectiveness of the early warning dissemination processes and responses at least once a year?

Response Capability Sub Component 3. Community Response Capacity Assessed and Strengthened

Question: Have community members been sensitised and trained to respond appropriately, and have those responses been assessed?

Issues to Consider?

- Has the community's ability to respond effectively to early warnings been assessed?
- Have responses to previous disasters been analysed and lessons learnt incorporated into plans and capacity building strategies?
- Have all community-focused organisations been engaged to assist with capacity building?
- Have community and volunteer education and training programmes been developed and implemented?
- Have practical actions that can be taken by individuals and families been clearly identified, communicated and tested. For example, knowledge about the nearest shelter and safe access routes during a flood?

Response Capability Sub Component 4. Public Awareness and Education Enhanced

Question: Has the CBEWS included effective community risk awareness raising and education, has it been effective?

Issues to Consider?

- Has simple information on hazards, vulnerabilities, risks, and how to reduce disaster impacts been disseminated to vulnerable communities and decision-makers?
- Has the community been educated on how CBEWS warnings will be disseminated, what actions are required in response to each level of alert and how to respond to different types of warning message?
- Have any public awareness and education campaigns been tailored to the specific need of each audience (*e.g. children, emergency managers, farmers, etc.)*
- Have public awareness strategies and programmes evaluated at least once per year and updated where required?

Checklist Score for Key Element 4 Response Capability

Sub Component	Fully Addressed	Partly Addressed	Significant Gaps
1. Warnings Respected and Acted Upon			
2. Disaster Preparedness and Response Plans Established			
3. Community Response Capacity Assessed and Strengthened			
4. Public Awareness and Education Enhanced			
Overall Score for this Element (1 - 3 as below)			

1 = Fully satisfactory
2 = Satisfactory but some opportunities for improvement
3 = Significant gaps and urgent improvement required.

Key Element 5: GOVERNANCE AND INSTITUTIONAL

Key question in relation to this element: *Are robust local policy and planning arrangements in place that will support the operation and maintenance of CBEWS?*

Governance and Institutional Sub Component 1. Community Based Early Warning System recognised as a Long-Term Priority

Question: Is the importance of CBEWS recognised by the local community, local leaders and key local decision makers?

Issues to Consider?

- Have the economic and social benefits of CBEWS been highlighted to local leaders using practical methods such as a case studies and cost-benefit analysis of previous disasters?
- Have early warning role models or "champions" been engaged within the community to advocate CBEWS and promote its benefits?
- Has a multi-hazard framework and operational plan been established to maximise the benefits of CBEWS?
- Have CBEWS and its supporting action plans been recognised and integrated into local social and economic planning?

Governance and Institutional Sub Component 2. Legal and Policy Frameworks to Support Early Warning Established and Strengthened

Question: Has CBEWS been fully embedded at the local level?

Issues to Consider?

- Do local plans and policies provide a robust basis for operation and maintenance of CBEWS.
- Do the governance arrangements for ownership and leadership of CBEWS clearly establish responsibilities for management and maintenance of any assets, such as gauges, and for annual testing and exercising of plans?
- Do the governance arrangements set out clear roles and responsibilities for all organisations (*government and nongovernment*) at a national and local level, and all community members involved in operating or maintaining CBEWS?

- Has overall responsibility and authority for coordination of early warning assigned to one agency or body at a local level, such as the Village Community Protection Committee?
- Are the local CBEWS arrangements supported within broader administrative and resource capabilities at the District level?
- Have the relationships and partnerships between all organisations involved in CBEWS been institutionalised and are effective coordination mechanisms in place?
- Has the CBEWS and associated response plans been fully integrated into local disaster reduction and development policies?

Governance and Institutional Sub Component 3. Institutional Capacities Assessed and Enhanced

Question: Have opportunities been taken to use the CBEWS process to enhance institutional and community capacities?

Issues to Consider?

- Have the capacities of all local organisations and institutions involved in supporting CBEWS and its associated action plans been assessed and have capacity building plans and training programmes been developed and resourced?
- Have all non-government sector partners been engaged and encouraged to contribute to capacity building?
- Have all community members been sensitised in relation to CBEWS so that they understand their own personal role in implementing and supporting local risk reduction plans?
- Are there effective local / District level monitoring systems in place to ensure the CBEWS is being managed and delivered effectively?

Governance and Institutional Sub Component 4. Financial Resources Secured

Question: Have financial resources been identified to ensure the CBEWS is sustainable beyond any initial project stage?

Issues to Consider?

- Were "whole life costs" and sustainability requirements for the CBEWS recognised and addressed in the CBEWS project or development plan?
- Have any funding requirements essential for maintenance of CBEWS, along with the responsible authorities / organisations responsible for meeting those costs, been identified and are arrangements in place to ensure the funding is available when required?
- Has access to funding at the national and international level for the maintenance and future development of the CBEWS been explored?
- Have any opportunities for public/private partnerships to assist with CBEWS maintenance been explored?

Checklist Score for Key Element 5 Governance and Institutional

Sub Component	Fully Addressed	Partly Addressed	Significant Gaps
1. Community Based Early Warning System recognised as a Long-Term Priority			
2. Legal and Policy Frameworks to Support Early Warning Established and Strengthened			
3. Institutional Capacities Assessed and Enhanced			
4. Financial Resources Secured			
Total Score for this Element (1 - 3 as below)			

1 = Fully satisfactory
2 = Satisfactory but some opportunities for improvement
3 = Significant gaps and urgent improvement required.

Summary Score

Key Element	Overall Score
1 **Risk Knowledge**	

2 **Monitoring and Warning Service**	
3. **Dissemination and Communication**	
4 **Response Capability**	

Annex 5 Whole Life Costing for CBEWS

If it is to be effective and sustainable, the costs of establishment and operation of a CBEWS need to be understood at the project initiation and design stage. This will allow the most appropriate warning system components to be selected and ongoing operational costs to be identified.

The internationally accepted approach to estimating costs for operational systems such as CBEWS is termed "Whole Life Costing" (*or sometimes "lifetime costs"*). This may be defined as;

"the total cost of an asset over its whole life. It takes account of the initial capital cost, as well as operational, maintenance, repair, upgrade and eventual disposal costs".

Using this definition, it is possible for government or any other organisation considering the establishment of CBEWS to clearly identify all potential costs and to demonstrate that the technical solutions proposed are both appropriate and financially sustainable in the specific circumstances of the case.

The following checklist is not intended to be comprehensive but provides an illustration of some key activities that can drive costs associated with CBEWS. Each of the items listed below may drive a cost that needs to be identified and considered.

Item	Description	Frequency	Comment
Project Initiation	Initial actions to identify potential sites for CBEWS and obtaining necessary permissions and funding	One-off	
Project mobilisation	Recruitment of project staff and establishment of reporting and management arrangements.	One-off	
Establish Community level Organisational Arrangements.	Key CBEWS stakeholders engaged, sensitised and all associated governance structures put in place	One-off	
Hazards Identified	Hazard, analysis undertaken, including evaluation of both technical and community level data and production of hazard maps.	One-off, with periodic reviews	The initial analysis can be reviewed as part of the annual CBEWS review process to ensure it remains relevant.
Vulnerabilities Identified	Participatory Capacity and Vulnerability Analysis conducted	One-off, with periodic reviews	The initial analysis can be reviewed as part of the annual CBEWS review process to ensure it remains relevant.
Risks Assessed	All of the hazard and vulnerability data is brought together, and risks quantified. This information provides the input for warning	One-off, with periodic reviews	The initial analysis can be reviewed as part of the annual CBEWS review process to ensure it remains relevant.

	system design and community plans.		
Information Stored and Accessible	Measures taken to ensure that all data and information used in the process is secured, passed to the Lead Government Department for review, and can be made available for the communities' use.	One-off	This may require arrangements for paper-based storage at Village or District level, and / or, provision of electronic storage facilities.
Monitoring and Warning Service	Institutional mechanisms agreed with local stakeholders and structures and arrangements established	One-off	
Monitoring Systems Designed and Developed	Identification of appropriate hazard monitoring system (*manual or automated gauges etc*), locations selected for monitoring equipment and establishment of appropriate trigger points for the warning system taking account of both risk assessments and the needs of community response plans	One-off	This element is linked with the hazard and risk process set out above. Selection of appropriate monitoring equipment, such as river gauges and decisions about their siting need to be informed by appropriate technical data and mapping as well as community knowledge.
Procurement and deployment of monitoring systems	Includes all costs for equipment purchase and its installation / initial calibration	One-off	
Operational Costs for Monitoring Systems	Operational costs include any planned maintenance required to ensure the systems remain functional for their full anticipated life.	Ongoing for the whole life of the system	For planning purposes, systems may be presumed to have a life cycle of 10 years, unless directed otherwise by suppliers of major equipment items.
Links with national forecasting and warning systems developed	May include costs for items such as airtime for mobile telephones used by the community and for community sensitisation to ensure they understand national warnings.	Ongoing for the whole life of the system	It is assumed there are no national costs, as national warning services are already being provided
Effective Communication and dissemination structures and Equipment	Includes selection and procurement of equipment and any technical training required by community members to use it or undertake routine local maintenance.	One-off	
Operational costs for Communication and dissemination Equipment	Costs associated with the operation and ongoing maintenance of any provided equipment, airtime for mobile telephones, replacement batteries for loudhailers etc.	Ongoing for the whole life of the system	
Community review of systems and ongoing sensitisation	CBEWS warning messages and dissemination systems should be reviewed annually to study how people access and interpret messages	Annual review	
Response Capability Evaluated	Community responses to CBEWS warning messages should be evaluated at design stage and	Initial evaluation	

	reviewed annually to ensure they are effective and understood.	followed by Annual review	
Disaster Preparedness and Response Plans Established	Initial work to establish community response plans and then costs for annual review and testing process to ensure they remain relevant.	One-off, with periodic reviews	
Community Response Capacity Assessed and Strengthened	Initial assessment of communities' capacity to respond followed by annual review.	One-off, with periodic reviews	
Public Awareness and Education Enhanced	Initial and ongoing engagement and sensitisation for the community.	Ongoing for the whole life of the system	
CBEWS recognised as a local priority, supported by key stakeholders	Activities to train and sensitise key stakeholders at the Village and District level, and then refresh them periodically or train new post holders.	One-off activities with periodic refresh	
Institutional Capacities Assessed and Enhanced	Activities to ensure that all relevant institutions and organisations recognise their role in the CBEWS or associated response plans.	One-off activities with periodic refresh	
Financial Resources Secured	Whole life costing exercise needs to be completed and understood by those responsible for CBEWS, including requirements for periodic reviews, training and maintenance of any equipment.	One-off, with periodic reviews	
Process for replacing equipment as required throughout the design life of the system	The whole life costing process should identify, at the outset, the anticipated life of any provided technical equipment, such as river or rainfall gauges, mobile telephones and any other essential equipment.	Initial one-off process with action to replace components as determined by the service life policy set by equipment manufacturers.	It is suggested that the design life of a CBEWS should be set at a minimum of 10 years. Within that period, most major items of technical equipment may be expected to perform satisfactorily, subject to required routine maintenance. However, the manufacturers of some items may advise a shorter operational life for specific items.

Fig 16: Illustrative CBEWS Whole Life Costing Checklist

Although not exhaustive, the above list should assist those planning a CBEWS to consider the potential costs involved in delivery of various component elements of a CBEWS. Once they have done so, it may be useful to consolidate the various costs identified so that an estimate of whole life costs can then be made as follows;

Item	Initial Costs	Ongoing / Whole Life Cost
Project Overhead Costs		
CBEWS Governance & Management		
Risk Analysis		

Monitoring Systems		
Dissemination & Communication Systems		
Response Plans, Training & Sensitisation		
Periodic Review and Updating		
Total / Whole Life Costs		

Fig 17: Consolidated CBEWS Whole Life Costing Estimate

The whole rationale behind CBEWS is that once implemented, the community will take ownership and responsibility for the systems and associated equipment. By undertaking the process set out above, the costs being met by a project implementation partner and the responsibilities and costs potentially being passed onto local communities can be estimated.

Where the ongoing liability for maintaining a CBEWS is minimal and involves little more than occasional re-painting of warning markers and topping up of air time credit for a mobile telephone, passing all responsibilities to a local community on completion of an initial project phase may be entirely reasonable. However, with the introduction of upstream and downstream monitoring systems that require regular mobile telephone calls, and as more sophisticated and automated hazard monitoring systems are introduced, communities may have no means to meet the costs involved in maintaining the system post project implementation. For example, equipment such as water level radars may require frequent recalibration or adjustment to take account of changing river conditions and silting up, and annual servicing and testing to ensure they are working correctly.

Carrying out a whole life costing exercise in itself will not resolve all of the funding and sustainability challenges facing CBEWS. However, identifying all of the "real world" costs associated with the operation of CBEWS, not just its initial "purchase price", will provide transparency about costs and inform important discussions between Government, funders and communities about the systems sustainability.

It is appreciated that many donor funds are time limited and have to be spent within defined periods. Depending on the procurement process used to purchase CBEWS equipment, it may be possible to capitalise the ongoing maintenance and other system costs for the anticipated life of the equipment, so that a donor can fund a systems maintenance for an identified period "up front" as part of the purchase price or with a one-off payment from its grant programme. This would mean that the donor has no ongoing cost liabilities beyond the project period, and they would have the benefit of being assured that the system they have funded would remain operational for at least the anticipated design life of the equipment they have supplied.