THE ROLES OF STATE AND NON-STATE ACTORS IN EARLY WARNING AND EARLY ACTION

CAPACITY GAPS AND COLLABORATION

REAP Risk-informed Early Action Partnership

CONTENTS

Acknowledgments

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Practical ACTION

Met Office

Acronyms

ADA	Adaptation Consortium
AI	Artificial Intelligence
AMHEWAS	Africa Multi-Hazard Early Warning and Early Action System
CAP	Common Alerting Protocol
CBO	Community-Based Organisation
CCSMKE	Christian Community Services Mount Kenya East
CDEMA	Caribbean Disaster Emergency Management Agency
CIEETS	Interchurch Center for Social and Theological Studies (Nicaragua)
CIS	Climate Information Services
CREWS	Climate Risk and Early Warning Systems
CSO	Civil Society Organisation
DFID	Department for International Development (UK)
DREF	Disaster Response Emergency Fund
EWEA	Early warning and early action
EWI	Early Warning Initiatives
EWS	Early Warning Systems
FAO	Food and Agriculture Organization
FCAS	Fragile and Conflict-affected States
GEAG	Gorakhpur Environmental Action Group
GHACOF	Greater Horn of Africa Climate Outlook Forum
HFP	Humanitarian Futures Programme
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	Intergovernmental Panel on Climate Change
ICT	Information and communication technologies
IIED	International Institute for Environment and Development
IMD	Indian Institute of Meteorology
INETER	Nicaragua Institute for Territorial Studies
INSMET	Meteorology Institute (Cuba)
ITU	International Telecommunication Union
KMD	Kenya Meteorological Department
LDC	Least Developed Countries
LGBTQ+	Lesbian, gay, bi, trans and any other gender identity or sexual orientation
MEAL	Monitoring, evaluation, accountability, and learning
MHEWS	Multi-hazard Early Warning Systems
NDUAT	Narendra Deva University of Agriculture and Technology
NGO	Non-governmental organisation
NMHS	National Meteorology and Hydrology Service
NDMA	National Disaster Management Agency
PVCA	Participatory vulnerability and capacity assessment
PWS	Public weather services

RCCC	Red Cross and Red Crescent Climate Centre
REAP	Risk Informed Early Action Partnership
RIMES	Regional Integrated Multi-Hazard Early Warning System for Africa and Asia
RSF	Rapid Support Forces
SAF	Sudanese Armed Forces
SIDS	Small Island Developing States
SOFF	Systematic Observations Financing Facility
SOP	Standard Operating Procedures
SMS	Short Message/Messaging Service
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction (formerly UNISDR)
UNHCR	United Nations High Commissioner for Refugees
WFP	World Food Programme
WISER	Weather and Climate Information Services programme (UK Government fund)
WG	Working Group
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

In early warning and early action (EWEA), the active participation of non-state actors is imperative to the design and dissemination of effective warnings and in ensuring that life-saving preparedness measures are actioned when alerts are issued. Regrettably, there is often a lack of collaboration between state and non-state actors in the development and coordination of early action plans for extreme weather and climate-related events. This document provides an overview of the state and non-state actors involved in building effective, people-centred, inclusive and resilient early warning systems (EWS) at the local, national, and international levels (as depicted in Figure 1). It also outlines their specific roles and contributions across the four key areas of the early warning system value chain (as illustrated in Figure 2).

Additionally, this document encompasses eight essential recommendations (R1-R8) aimed at international organisations, national governments and other actors involved in developing and providing early warnings and/or early action to improve the willingness and efficacy of EWEA actors to collaborate and ensure a comprehensive approach to disaster risk reduction and response. These recommendations are accompanied by a set of actions designed for various stakeholders engaged in early warning systems EWS. The actions are intended to facilitate the broader adoption, utilisation, and sustainability of the recommendations.

R1: Acknowledge that EWS capacities can be found across diverse stakeholders. Recommendation one emphasises the need to recognise diverse EWS capacities across stakeholders and contexts, highlighting the importance of local level capacities needed for supporting marginalised and vulnerable communities, especially in Least Developed Countries (LDCs). Recognise that the private sector and informal partners can have access to relevant EWS data, emphasising the importance of information and data sharing, capacity building, and collaboration.

Calls to Action

1. **Acknowledge diverse stakeholder value (immediate action):** State and non-state actors should foster a shared understanding of their varied roles and capabilities in the EWS value chain through open dialogue, promoting effective collaboration.
2. **Seek external resources for mutual benefit (short to medium term):** In the short to medium term, obtain external expertise and funding for EWEA projects (or developing EWS) that benefit both state and non-state actors, enhancing overall effectiveness.
3. **Address skills and resource gaps (medium to long term):** Conduct assessments to identify gaps in the EWS and EWEA capacity gaps and take action to address them. Evaluate the impact of collaborating with non-state actors, consider broadening state actors' mandates, or engage regional or international organisations for capacity development.

R2: Ensure EWS co-design processes incorporate local stakeholders. Recommendation two highlights the significance of incorporating local stakeholders into the design of early warnings for relevance and resilience. Inclusive processes, such as the participatory vulnerability and capacity assessment (PVCA) approach (amongst other engagement methods and tools), empower communities (specifically including the most marginalised and hardest to reach) to prioritise risks and access forecasts and early warning, ensuring their active participation in building climate resilience.

Calls to Action

1. **Incorporate local expertise (immediate action):** In developing EWS, governments should include local actors like non-governmental organisations (NGOs), community-based organisations (CBOs) and civil society organisations (CSOs) in design and implementation. By involving these stakeholders from the beginning, EWS can be customised to meet the specific needs of vulnerable communities.
2. **Adopt a people-centred approach (short to medium term):** Shift from traditional hazard-focused EWS to a people-centred and inclusive approach. Prioritise understanding of the early actions needed by at-risk populations and the factors influencing their decisions. Create action-oriented EWS information and messages, delivering them through channels accessible to vulnerable groups.
3. **Promote inclusive climate services (medium term):** Climate service and hazard warning providers, along with EWS designers, can employ tools like participatory vulnerability and capacity assessments (PVCAs) and citizen science approaches to data collection to engage community-level groups. This approach empowers communities to prioritise risks, localise forecasts, enhance access to forecasts and early warnings, and translate plans into resilience-building.

R3: Ensure a clear and inclusive governance and institutional set-up is in place. Recommendation three underscores the importance of establishing clear and inclusive governance structures and legal and policy frameworks open to embedding the needs of the most vulnerable in planning for the impacts of various hazards affecting different communities. Effective collaboration hinges on defining clear roles within government and with non-state actors, to prevent duplication of effort, enhance alignment and collaboration, facilitate access to key information across hazards, exposure and vulnerability and ensure coordinated and authoritative warnings are communicated to people.

Calls to Action

1. **Enhance stakeholder coordination (short to medium term):** All EWS stakeholders, including government agencies, non-state actors, and international organisations, should improve coordination at various levels and across sectors. This includes vertical integration, inter-ministerial coordination, and community involvement.
2. **Develop Standard Operating Procedures (SOPs) and transparency (short to medium term):** Decision-makers and EWS practitioners should establish SOPs for different hazards and multi-hazard scenarios, clarifying roles and responsibilities. Enhancing transparency in national decision-making processes improves accountability and aligns international technical assistance with national priorities.
3. **Establish inclusive legal and policy frameworks (medium to long term):** Legal and policy frameworks provide the foundation for all aspects of effective DRM. Government authorities and legal actors should create a policy and legal framework supporting an inclusive and adaptable EWS. This framework should encourage cooperation between state and non-state actors.

R4: Prioritise the establishment of trust as a dynamic process, encompassing cognitive and emotive dimensions. Trust is pivotal to collaboration and is the focus of recommendation four. The development of trust within partnerships, especially between state and non-state actors, requires understanding and acceptance of differences. Trust is dynamic and built on both cognitive and emotive elements and can be developed around focused collaboration and co-production (including co-development, co-delivery and co-evaluation as this dynamic process must be integrated within all parts of the value chain/cycle) of EWS.

Visualisation of State and Non-state actors

An explanation of the infographics on pages 9-10.

Narrative for Figure 1

Figure 1 provides a simplified mapping of state and non-state actors in early warning systems, as presented in this guide. It groups these actors across four levels: intergovernmental organisations with a global remit; regional bodies focused on specific geographies across multiple states; national actors whose scope reflect state boundaries; and sub-national actors working within specific areas in a given country.

At each level, critical stakeholders for effective early warning systems can be divided between state actors, such as government agencies and official institutions responsible for imposing rules, and non-state actors, encompassing all entities not established by the government (private sector, CBOs, CSOs, NGOs, etc.). Some actors, however, fall in a gray area in between the two, such as entities established through the signing of a treaty or the adoption of a law but remain independent from the government (such as the Red Cross Red Crescent or some research or educational institutions).

The typology presented here is illustrative, as the situation will differ in each country, and the list of actors presented here is not exhaustive given the diversity of stakeholders critical to an effective early warning system.

Narrative for Figure 2

Figure 2 provides a mapping of critical stakeholders according to the four main elements for the delivery of effective early warning systems: disaster risk knowledge; detection monitoring, analysis and forecasting of the hazards and possible consequences; warning dissemination and communication; and preparedness and response capability.

The circles are organised by colour, with state actors in blue, non-state actors in orange and actors cutting across both categories depending on mandate or context in green. Larger circles refer to the primary decision makers in the implementation of each quadrant of the early warning system, while smaller circles refer to secondary and tertiary stakeholders.

STATE ACTORS

INTERNATIONAL ACTORS

- **International WMO WIPPS Centres**
  - ECMWF, UK Met Office, FMI, MFI *etc*
- **UN agencies supporting EWS**
  - WMO, UNDRR, FAO, UNESCO, UNDP, UNICEF *etc*
- **UN Agencies providing humanitarian support**
  - OCHA, WFP, IOM, UNHCR FAO *etc*

REGIONAL ACTORS

- **Regional meteorological services**
- **Regional Development Bodies**
  - AU
  - CARICOM
  - ECOWAS
  - IGAD
  - SADC *etc*

NATIONAL ACTORS

- **Cabinet offices**
  - Ministry of agriculture
  - Ministry of education
  - Ministry of environment and natural resources
  - Ministry of health
  - Ministry of social protection and gender
  - Ministry of transport *etc*
- **Technical and scientific departments**
  - Geological hazard agencies
  - National Flood Forecasting & Warning Centre
  - National hydro-meteorological service
  - Statistical agencies *etc*
- **Public infrastructure providers**
  - Public energy utilities
  - Public transport agencies
  - Public water utilities *etc*
- **Public tele-communication regulators**
- **State media**
- **Civil protection agencies**
  - NDMA / Emergency Managers
  - Fire and Rescue
  - Hospitals and critical health facilities
  - Police *etc*

SUB-NATIONAL ACTORS

- **Local government**

NON-STATE ACTORS

INTERNATIONAL ACTORS

- **Private sector**
  - App providers
  - Food traders (agromet services + EWS)
  - Insurance sector
  - Private tele-communication companies *etc*
- **Media**
  - Social Media
  - Private media companies
  - Journalists *etc*
- **EA networks**
  - REAP
  - Anticipation Hub
  - Start Network *etc*

REGIONAL ACTORS

- **Regional EA networks**

NATIONAL ACTORS

- **National Red Cross Red Crescent Societies**
- **Research organisations**
- **Academia**
- **Universities**
- **Science advisory body**
- **Schools**
- Religious organisations *etc*
- National FOREWARN Hubs
- Marginalised groups, representatives, indigenous leaders
- **Civil society organisations and NGOs**
- Foundations *etc*
- Corporate social responsibility
- **Philanthropic organisations**
- **Commerce, private busineses**
- **Tele-comunications companies**

SUB-NATIONAL ACTORS

- Marginalized people *etc*
- Community leaders, CSOs and volunteer groups
- **Community**
- **Local chamber of commerce**
- **Local businesses**

- **International Federation of Red Cross & Red Crescent Societies**

DISASTER RISK KNOWLEDGE

- State
- Non-state
- Could be state and/or non-state depending on the context

National, subnational and local disaster management agencies

Prime minister / cabinet offices

Private sector

Insurance sector

Land use and urban planners

Red Cross Red Crescent National Societies

Community-based DRR & Emergency Management Comittees

Scientific and technical agencies such as meteorological and hydrological organisations

Research organisations

Citizen scientists

Non-governmental organisations

Infrastructure providers

Space agencies and international groups

Media

Community representatives involved in disaster/emergency and disaster risk management

DETECTION, MONITORING, ANALYSIS AND FORECASTING OF THE HAZARDS AND POSSIBLE CONSEQUENCES

Space agencies and international groups

Private sector

Energy utilities

Military authorities

National and local disaster management agencies

Humanitarian agencies

Communities using traditional/ indigenous techniques to monitor conditions

Research organisations

National Meteorological and Hydrological Services (NMHS)

Non-governmental organisations

Citizen scientists

Local gauge readers, local monitoring stations, community owned

Social media

Public health agencies

Aviaton authorities

COMMUNITY

National weather services

Red Cross Red Crescent National Societies

Non-governmental organisations

Community-based and grassroots organisations

Civil society organisation

Research organisations

Civil protection agencies

Community-based DRR & Emergency Management Committees

Disaster Risk Reduction and Management Departments

Media

Private sector

Businesses

Schools and education sector

Health authorities

Non-governmental organisation

Community-based organisation

Private sector communication companies

Radio stations

Research organisations

Local volunteers

Civil society organisation

Media

ITU

Red Cross Red Crescent National Societies

National Meteorological and Hydrological Services (NMHS)

Police

Emergency Managers

Telecommunication authorities

PREPAREDNESS AND RESPONSE CAPABILITIES

WARNING DISSEMINATION AND COMMUNICATION

Calls to Action

1. **Promote trust-building collaboration (short term):** State and non-state actors can organise workshops, establish collaboration platforms and host regular cooperation meetings to build trust among diverse EWS stakeholders, fostering cooperation and mutual trust. These activities facilitate effective collaboration by bridging trust gaps.
2. **Develop trust via co-production (short term):** Maintain trust by updating protocols and standard operating procedures (SOPs) at regular intervals to maintain relationships and foster collaboration and co-production.

R5: Ensure diverse and sustainable EWS funding covers all critical stakeholders. Sustainable funding is crucial to recommendation five, especially for the LDCs, Small Island Developing States (SIDS), and Fragile and Conflict-Affected States (FCAS) who face diverse challenges. Marginalised and vulnerable communities in LDCs, SIDS and FCAS should be central to funding plans and projects in these contexts. A shift from disaster response to preparedness (supporting resilience) requires sustained investment, and consortia for donor-funded projects and private sector engagement can stimulate innovation and support EWEA. It is also recommended that the State is encouraged to account for the cost of these services in their economic planning cycles once international finance has supported development and design of effective early warning systems.

Calls to Action

1. **Promote diverse funding mechanisms (short to medium term):** Encourage governments, international organisations, non-state actors, and private sector entities to explore various funding methods for EWS. This may involve public-private partnerships, donor-funded projects, or consortia creation. Governments should lead funding efforts, with international organisations providing guidance. Assess private sector involvement for fairness and sustainability.
2. **Establish transparent and accountable funding structures (medium term):** Develop transparent and accountable funding structures for EWS, ensuring efficient resource allocation and clearly defined roles and responsibilities. Align with international public-private engagement principles such as shared value, sustainability, and sovereignty. Collaborate among governments, international organisations, and donors to create these structures, supporting inclusive EWS.
3. **Engage decision-makers for effective early action (medium term):** International organisations can actively support governments to involve decision-makers, policymakers, and various government departments in creating a policy environment that supports the translation of early warnings into concrete actions. Recognise the complex political aspects of early action, including resource allocation and policy priorities. Encourage alignment of policy and institutional mechanisms to enable timely and appropriate responses to identified risks.

R6: Recognise the challenging and changing roles of state and non-state actors in fragile and conflict-affected contexts. Recommendation six acknowledges the political dimensions surrounding EWEA information. Political implications, when unmanaged, can impact the effectiveness of early warning systems. Effective collaboration with government agencies and non-state actors can help navigate this landscape, ensuring trust, information neutrality, and the translation of warnings into concrete action. The integration and acknowledgment of traditional knowledges is key to collaboration and generating inclusive early warnings.

Calls to Action

1. **Advocate for transparent and non-political EWS (short to medium term):** Advocate for transparent and non-political early warning systems that provide evidence-based forecasts impartially. Position EWS as non-political tools in politically charged environments. For external actors to engage in dialogue and partnerships with stakeholders, including government agencies and local actors, to ensure the credibility and effectiveness of early warning initiatives.
2. **Build collaborative partnerships and trust (medium term):** Encourage collaborative partnerships and trust-building among governments, non-state actors, international organisations, and donors in less developed contexts. These partnerships should involve sharing information, expertise, and resources while considering the unique political, historical, and cultural context of each situation. Promote inclusivity, dialogue, and collaboration to strengthen early warning systems.

R7: Ensure linkages to international processes. Recommendation seven outlines the role of international agencies in facilitating EWS implementation as a public good. These agencies can promote warnings as a global public good, encourage data use and availability, provide good practice use cases, and invest in capacity and capability building and strengthening.

Call to Action

1. **Promote early warnings as a global public good (immediate and ongoing):** International agencies should advocate for early warnings to be recognised as a global public good, available freely to all nations. This involves promoting the integration of warning data, sharing good practices adaptable to various contexts, and supporting capacity-building programmes. International agencies should also ensure that EWS funding is effectively allocated to benefit vulnerable populations. The ongoing nature of this action highlights the need for sustained advocacy and support to make early warning systems accessible and effective worldwide.

R8: Recognise that EWS learning is embedded across multiple stakeholders throughout the EWS value chain. Lastly, recommendation eight highlights the importance of monitoring, evaluation, accountability, and learning (MEAL) in the EWS value chain. MEAL frameworks aid in tracking participation and involvement, refining behaviour-centred EWS, and measuring the success of EWS elements and partnerships.

Call to Action

1. **Implement ongoing MEAL for EWS (immediate and ongoing):** Continuous and ongoing monitoring, evaluation, accountability, and learning (MEAL) processes are crucial for improving early warning systems and building community ownership. MEAL helps track participation, demonstrates impact, identifies lessons and guides scaling efforts. It enhances participation quality, identifies effective behaviours and messaging, and ensures equity. MEAL frameworks measure EWS success across its elements, inform system refinement, and make it a continuous process.

Collaboration is a recurrent theme across these recommendations, particularly in contexts with limited government capacity. The set of actions presented here encompass collaboration and engagement with diverse stakeholders (both horizontally and vertically), promoting inclusivity and a people-centred approach, establishing transparent and accountable frameworks, continuous improvement and monitoring, advocacy for accessible and effective EWS, capacity building and coordination, considering political factors and decision-making, and fostering trust through dialogue and open discussions. These themes collectively underline the significance of multi-stakeholder involvement, transparency, ongoing refinement, and community-centred approaches in strengthening EWS for the benefit of at-risk populations. In such cases, parallel systems can erode rather than support government departments and ministries to have a sustained opportunity to develop capability and capacity in EWS. This underscores the need for collaborative regional models like the Africa Partner Coordination Mechanism. Adequate funding is essential for supporting government institutions in their leadership role in EWEA, considering the multitude of actors involved and the need for coherent coordination.

1

INTRODUCTION

1.1. Background to this report

As climate change impacts continue to intensify (IPCC, 2022), there is widespread recognition that countries need to strengthen proactive risk management approaches such as early warning systems (EWS) that are linked to early action plans to reduce the weight of demands placed on overstretched humanitarian aid (IFRC, 2022), both during and after disasters. An increasing body of evidence shows that EWS enable populations to prepare for hazards and extreme climate events instead of relying on reactive (and costly) disaster response (Šakić Trogrlić et al., 2022). Multi-hazard early warning systems (MHEWS) can enable communities to act ahead of extreme events to mitigate their impact. These actions are referred to as early or anticipatory action, with an aim to help those most at-risk be better placed to prepare and protect lives and livelihoods (Anticipation Hub, 2022).

Although early warning and early action (EWEA) (REAP, 2022a) aims to reduce the impacts of extreme events, many people - particularly the most vulnerable - are still not covered by holistic, inclusive, and effective early warning systems to reduce the risks before a crisis (UNDRR and WMO, 2022). Gaps exist across most early warning systems.

There are many reasons why the most vulnerable groups are not getting the early warnings they need. Local government capacity to engage directly with communities proactively is often limited by funding, resources, and in some cases, trust. In some contexts, early warning messages are not reaching the most exposed groups, while in others, people get the alerts but do not understand the messages, do not trust them, do not know what action they should take, or may be unable to take the measures they know they need to.

Marginalised groups including women, children, people living in poverty, persons with disabilities, elderly people, migrants, marginalised language speakers, the LGBTQ+ population and other marginalised peoples tend to be excluded from decision-making processes on issues such as disaster risk management and response, meaning that EWS and early action plans often do not consider these groups in their design and implementation.

However, over the last few decades, innovations in technology and improvements in scientific modelling through increased computational power have meant that the development of early warning systems, (particularly the ability to monitor, forecast, and disseminate warning messages through technologies), has significantly progressed, and EWS now cover around two-thirds of the global population (UNDRR and WMO, 2022). Despite this, many of the least developed countries (LDCs), small island developing states (SIDS) and fragile and conflict affected states (FCAS) - the very countries where the most vulnerable groups are facing the worst of climate change - lack effective MHEWS. In settings marked by severe crisis, such as occupied or war-torn territories, state actors, particularly national and local government, may lack access or coverage. It is precisely in these fragile contexts where vulnerabilities and low capacity converge, leading to the least preparedness and responsiveness to hazards and their effects.

The Sendai Framework for Disaster Risk Reduction 2015-2030 (UNDRR, 2015) calls for a "shared responsibility between governments and relevant stakeholders". With a renewed ambition over the last few years to achieve universal EWS coverage, demonstrated by the launch of dedicated initiatives such as Climate Risk and Early Warning Systems (CREWS), the Systematic Observations Financing Facility (SOFF), the Risk-informed Early Action Partnership (REAP) and Early Warnings for All (EW4All).

This paper proposes to provide an overview of the varying and sometimes cross-cutting roles of both state and non-state actors within the EWS value chain, and the relevant merits of utilising and including different actors in separate and interrelated parts of these systems, enabling a connection between top-down and bottom-up approaches.

1.1.1. Methods

Key terms

For this document, we refer to early action and the early warning early action value chain as the "actions to prevent or reduce the impacts of a hazardous event before they fully unfold predicated on a forecast or credible risk analysis of when and where a hazardous event will occur." (REAP, 2023).

Within this report, EWS actors or stakeholders are defined as any organisation, initiative or informal group that is involved (whether formal or informal) in producing, disseminating, transmitting, and acting upon disaster risk knowledge and warnings related to extreme weather and climate events.

State actors are defined here as individuals or entities that are associated with or represent a government or state. Non-state actors include individuals or organisations that have significant role in the value chain of EWS but do not report to any particular country or state.

In this paper, vulnerable and marginalised groups are defined as and applied to groups of people who are at a higher risk of experiencing harm, discrimination, exclusion, or oppression due to various factors such as socioeconomic status, race, ethnicity, gender, sexual orientation, disability, age, and other characteristics. It should be noted that vulnerable and marginalised populations represent a diverse population beyond what typical definitions (including in this report) may imply. Vulnerability can be understood as a spectrum and containing many diverse intersections that can exacerbate exclusion and oppression.

The selection of actors, both state and non-state, to be included in this report was performed during an online meeting of the REAP Early Warning Initiatives Working Group (EWI WG) on 2nd March 2023 in which sixteen members of the working group were present. The group explored two questions:

1. Who are the state and non-state actors in the EWS chain?

2. Where do state and non-state actors have a role under the four EWS pillars?

Group participants included academia, NGOs, United Nations (UN) agencies and networks, national meteorological services, donors, and foundations. The group used the World Meteorological Organization's EWS framework to guide discussions (WMO, 2018a). During the meeting, group participants used a Google Jamboard to group EWS actors as either state or non-state. Intergovernmental actors, such as UN agencies, were defined in this context as a distinct group of state actors, with authority based on intergovernmental state representation, international standards, agreements, and mandates. The group then reviewed the group-sourced actors and identified the entry points for those actors across each pillar of the early warning system. This mapping was reviewed and added to through consultation with a range of EWS stakeholders during the 2023 University College London's conference on Creating Effective Warnings for All, hosted by the Warning Research Centre.

1.1.2. Limitations and scope of this analysis

The confidence levels of predictive capability can differ significantly across weather hazards, extreme climate events and other hazards (e.g., such as earthquakes and tsunamis), and so preparedness and response strategies also vary. The World Meteorological Organization (WMO) Multi-Hazard Impact Based Forecasting and Warning Guidelines (WMO, 2018a) recommend engagement by all relevant stakeholders to agree thresholds for issuing early warnings and, more recently, these are being used to inform triggers for early action (UNDRR, 2023). In line with this approach, and in agreement across the EWI WG members, this paper focuses on early warning systems for weather and climate-related impacts only and does not detail the potential involvement of non-state actors in conflict dynamics.

It should be noted that the actors outlined within this report are not exhaustive – the list has been compiled by REAP EWI WG members and invited EWS stakeholder perspectives and is therefore bound by their experience and knowledge. The report aims to provide a clear overview of existing influential actors within EWS, and to share case studies that illustrate the ways in which diverse types of actors (state, non-state and intergovernmental) can come together in a variety of contexts, with differing levels of development and government capacity. In addition, this analysis does not focus on identifying actors involved in risk analysis, monitoring, communication, and preparedness for specific types of hazards. However, it should be noted that actors and organisations have been included based on EWS for climatic and high impact weather advisories and warnings, whether they are rapid or slow onset, including, for example, flooding, storms, tropical cyclones, drought, and dust storms.

In addition, the difficulty in assessing the extent of a given actor's positive or negative impact on the successful and timely delivery of a warning, and whether the warning is responsible for the early action taken, is recognised. All these factors are explored more in Section 2.

1.2. The importance of multi-stakeholder partnerships for EWEA

Multi-stakeholder partnerships and transnational public-private partnerships can be defined as a “hybrid type of governance, in which non-State actors co-govern along with State actors for the provision of collective goods and adopt governance functions that have formerly been the sole authority of sovereign nation-states” (Schäferhoff et al., 2009). It has been argued and demonstrated in specific cases that the pooling of resources across a range of state and non-state actors can increase the problem-solving capacity of governments for a variety of societal issues. Conversely, national governments have an important role in convening key stakeholders involved in supporting the creation, development and review of national legal frameworks, policies, strategies and plans in order to achieve stronger coordination, alignment and complementarity for early warning and action. It is therefore imperative that national governmental capacity is prioritised and elevated whenever possible by international actors supporting the development of early warning systems.

It is increasingly clear that EWS, and EWEA, must fully recognise the complexity and diversity of the actors who are, and can be, engaged across the four elements for multi-hazard early warning systems to be truly inclusive of the whole of society, reducing the risk of disasters and ensuring the most vulnerable are protected. Despite recent progress in incorporating cross-sectoral needs in early warning systems design, there remains significant work in ensuring multi-stakeholder partnerships represent the most at-risk populations to high-impact events in the national and local context, enabling efficient and effective delivery of early warnings.

Early warning system partnerships can, and often do, bring together diverse organisations and actors who need to understand the lead times and likelihood of a severe weather or climate event for mitigation. These can include state mandated agencies such as national meteorological services and national disaster management organisations, private companies, academic institutions, CSOs, Indigenous people (and organisations), international financing and development agencies, a variety of NGOs, local government, media, and of course, communities and citizens. Coalitions representing the organisations relevant to the design of multi-hazard early warning systems are a powerful asset in ensuring a national EWS is useful, used, and usable in aid of disaster risk reduction and increased preparedness. And these coalitions can facilitate agreement on what warning will be issued, when and by whom. Early warnings must be clear, coordinated, and consistent to empower users to act ahead of the peak impact of a disaster.

1.2.1. Information ecosystems in multi-stakeholder partnerships

The EWEA value chain that connects the science, data and observations to national and local-level preparedness and action is increasingly acknowledged for what it is: a complex mechanism that relies on a broad range of actors, organisations, and participants across and between international, regional, national, sub-national and local levels, who are often unaware of their complementary roles (REAP, 2024, forthcoming). The value chain is at risk of failure at many points, for example, if messaging lacks clarity, user needs are not considered, and/or where there is an implementation gap due to lack of capacity or capability.

Given the complexity of providing hazard forecasts in a changing climate, strong learning and evaluation and feed back mechanisms (i.e., information ecosystems) are paramount. An information ecosystem (UNHCR, 2015) describes the flow and use of information between all relevant EWS actors and parties. The warning to action information flow needs to be understood and mapped for specific disasters between the designated and mandated authorities at the national level, such as disaster management organisations – cascading through to local level – through scientific and technical agencies (this may include national meteorological and hydrological services, health authorities, geological services, agricultural authorities, ocean observing organisations etc.) to local governments and communities. Moreover, recent experience dictates there is a growing need to address concurrent, cascading, and compounded events, to understand the interrelationship, preparedness and responses needed by the various issuing agencies.

For every context, it is central to functioning EWEA systems that the burden or load across stakeholders is shared in a coordinated and collaborative way. This will optimise use of scarce resources to ensure effective EWEA delivery. It may be more complex and take time to coordinate across diverse actors, however, one organisation or group does not hold all knowledge, capacity, and capability required to cover the entire EWEA value chain.

It is also imperative that actors outside the mandated agencies are engaged in the curation, sharing and creation of early warning systems to ensure all vulnerabilities are mapped and therefore all impacts are accounted for wherever possible.

1.2.2. Aims of this paper

The present report is a synthesis of discussions from the Early Warning Initiatives (EWI) Working Group of the Risk-informed Early Action Partnership (REAP). This Working Group offers a dedicated space to exchange experiences, good practices and evidence on the design and implementation of early warning systems and services for early action. It encourages the sharing of views and experiences from across the EWEA communities, ranging across academia, NGOs, UN agencies and networks, national meteorological services, donors, and foundations. It is guided by the following question: What concrete actions have demonstrated the scalability of early warning systems that translate into effective early action?

As part of this EWI Working Group's contribution to the sense-making efforts of REAP, it established a workstream to investigate early warning systems that exist outside of government institutions. It examined the respective roles of state and non-state actors in the delivery of early warnings that lead to action across the four components of the 2006 United Nations Office for Disaster Risk Reduction (UNDRR) EWS Checklist. And, in the context of the design of the Early Warnings for All initiative (EW4All) and its dedicated Multi-Stakeholder Forum, the EWI Working Group aimed to provide some elements to the question: “Who do we refer to when we talk about early warning early action (EWEA) stakeholders?” From this initial brainstorming members of the working group analysed and categorised actor entry points in EWS to develop the categories presented in this paper. This exercise identified common threads and simplified the process of shaping recommendations. Once grouped, the categories were analysed based on their potential impact, feasibility, and relevance to the problem at hand.

The Early Warnings for All Initiative

Early Warnings for All (EW4All) is a groundbreaking initiative to ensure that everyone on Earth is protected from hazardous weather, water, or climate events through life-saving early warning systems by the end of 2027. With human-induced climate change leading to more extreme weather conditions, the need for early warning systems is more crucial than ever. Systems that warn people of impending storms, floods or droughts are not a luxury but a cost-effective tool that saves lives, reduces economic losses, and provides a nearly tenfold return on investment.

Early warning systems have helped decrease the number of deaths and have reduced losses and damages resulting from hazardous weather, water, or climate events. But major gaps still exist, especially in small island developing states and least developed countries. Despite the urgent need, only half of the countries worldwide report having adequate multi-hazard early warning systems. And even fewer have regulatory frameworks that connect early warnings to emergency and response plans. There also are big gaps in the global observing system required to generate forecasts.

The United Nations Secretary-General, António Guterres, in 2022 called for the World Meteorological Organization to lead a global effort to ensure that early warning systems protect everyone on Earth by 2027. EW4All is structured around the four key MHEWS elements or pillars, each led by an international agency:

1. Disaster risk knowledge and management, led by the United Nations Office for Disaster Risk Reduction (UNDRR)
2. Detection, observation, monitoring, analysis, and forecasting, led by the World Meteorological Organization (WMO)
3. Warning, dissemination, and communication, led by the International Telecommunications Union (ITU)
4. Preparedness and response capabilities, led by the International Federation of Red Cross and Red Crescent Societies (IFRC)

In addition, as part of the EW4All initiative, an annual Multi-Stakeholder Forum to enhance consultation and foster collaboration with a wider group of stakeholders.

This paper summarises this reflection and provide insights into categorisations of EWEA stakeholders and their models of collaboration, ultimately to aid impact on reducing risks of failure across the full value chain in EWEA. It is aimed at decision-makers at national, sub-national and local levels responsible for the design and implementation of early warning and early action systems (or parts thereof) to encourage diversity of organisations and networks included in the co-production of these systems, the delivery of warnings and development and implementation of action plans. It is also meant to be a resource for international and regional partners in providing capacity development support for the design of EWEA systems.

2

STATE AND NON-STATE ACTORS ACROSS THE EWEA VALUE CHAIN

The UNDRR definition of an early warning system is “an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events” (UNDRR and WMO, 2022). This is typically divided into four different elements as illustrated in Figure 3, below.

The four elements are supported by four cross-cutting issues which can impede the success of EWS if unaccounted for in their design and implementation: involvement of local communities, effective governance and institutional arrangements, consideration of gender and cultural diversity, and a multi-hazard approach. To overcome these barriers, understanding differing needs, risks, and capacities (for example, how a person’s sex, gender identity, age, physical ability, ethnicity, language, nationality, and many other factors can influence how they are impacted, how they can respond and recover) and incorporating these factors into EWS planning with an aim of actively addressing exclusion through meaningfully engagement is required.

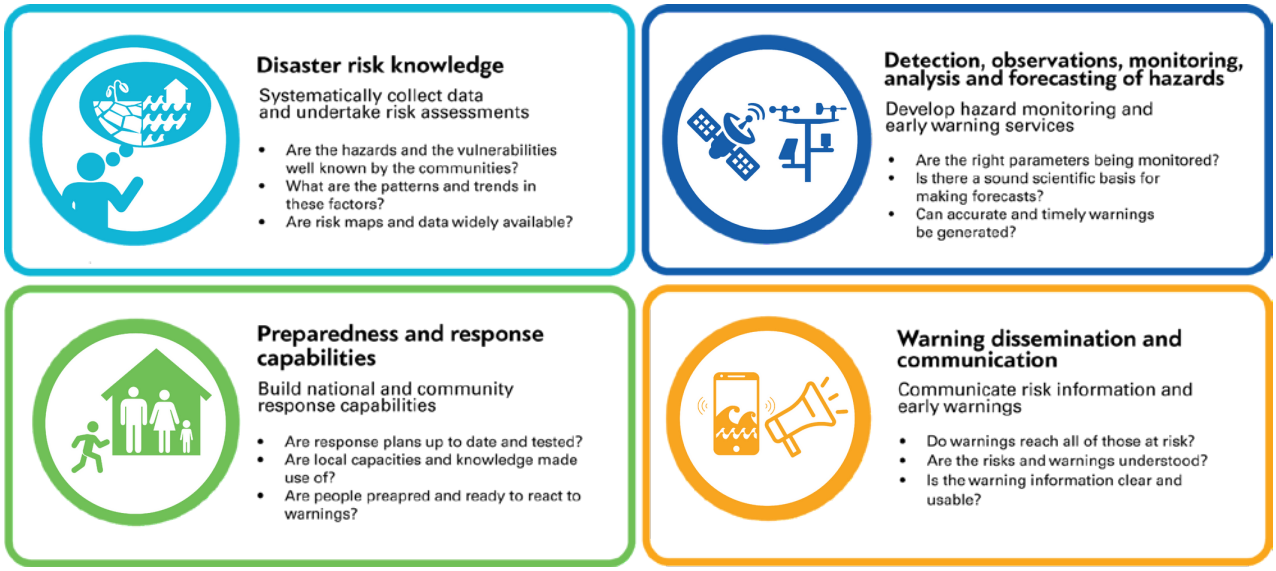

Figure 3. The four components of early warning systems (WMO, 2022).

It is crucial to consider both state and non-state actors in the design and implementation of early warning systems across the four elements or pillars (see Figure 3) - hazard monitoring, forecasting, prediction, disaster risk assessment, communication, and preparedness activities. State actors, such as government agencies and official institutions, play a pivotal role in coordinating and funding EWS, providing legal frameworks and resources. They possess the authority to enforce preparedness measures and mobilise resources during disasters. However, state actors may be limited by bureaucracy, inefficiency, and political factors that can hinder the timely and effective operation of EWS.

On the other hand, non-state actors, including community-based organisations, NGOs, and the private sector, can complement and strengthen EWS by bringing local knowledge, resources, and innovation. They often have a deep understanding of local conditions, cultural nuances, and community dynamics. Engaging non-state actors can help bridge the gap between top-down approaches and bottom-up grassroots efforts, making EWS more responsive and inclusive. Nevertheless, non-state actors may lack the necessary resources and infrastructure to sustain a comprehensive early warning system.

2.1. Disaster risk knowledge

Possible gaps and weaknesses in disaster risk knowledge

- Lack of full national coverage of risk knowledge or integration for multi-hazard risk assessment.
- Inaccessible data and information.
- Non-dissemination of risk information to relevant authorities and stakeholders.
- Limited ability to utilise and integrate risk knowledge at local levels and lack of understanding of risk from the perspectives of those who are most vulnerable.
- Lack of resources for working groups and taskforces of National Disaster Management Authorities (NDMAs) (which link the sub-national and local levels) to oversee that risk knowledge is integrated into EWS.
- Lack of recognition of Indigenous, traditional and local risk knowledge and its use in risk assessments.
- Lack of knowledge on how to utilise and combine Indigenous, traditional, local, generational and scientific knowledges.
- Standardisation of risk assessments are not aligned with existing mechanisms for risk information and data gathering.
- Gaps in capacity-building between national-level and local level counterparts for risk management.
- Government agencies may lack resources to develop a joint agenda, road map or strategy to identify and prioritise national needs to guide further action.
- Vulnerability and exposure assessment and mapping of local areas is insufficient where it does not comprehensively cover all hazards, vulnerabilities, livelihoods, social inclusion and exposure, in addition to expected climate change impacts across timescales.
- Limited understanding of how intersectional disadvantages and discrimination affect vulnerability.

Disaster Risk Knowledge refers to the comprehensive information on all the dimensions of disaster risk that includes hazards, exposure, vulnerability, and capacity, related to persons, communities, and assets (UNDRR, 2015). Understanding of disaster risk is essential in EWEA including determining what hazards to monitor, where is safe and unsafe, and who might be at risk or more vulnerable to impacts from those hazards. Whilst risk assessments are typically conducted at national level by state authorities, this information often lacks locally specific details, is not informed by local community knowledge, is inaccessible or not easily understood by non-technical specialists who must make decisions.

Often, local communities (that are affected by a hazard and/or threat) have a vast amount of knowledge that is useful in risk assessment. This information is needed to assess risks from meteorological hazards, to review plans, and in determining how to develop early action protocols.

It is important to note that risk remains a subjective issue, determined by a person's or institution's priorities and perceptions. Risk perception plays a significant role in disaster risk knowledge and how local populations, local government and emergency services understand, prioritise, and act on hazard / threat information. Recognising these different perceptions is vital in ensuring information is provided in a way that resonates with different stakeholders' priorities.

The roles and responsibilities of EWS stakeholders to develop appropriate disaster risk knowledge to support EWEA therefore requires integration from both state and non-state actors, preferably embedding a first mile (upstream community engagement) process that enables and fosters a co-production of disaster risk knowledge. The role of technocratic and participatory approaches in building disaster risk knowledge is critical to the success of co-production, education, understanding, and communication to enable action before a crisis.

It is also essential to ensure that risk knowledge is accessible and understandable to support effective early action. Establishing effective information networks to integrate research into practice (and practice into research) is needed to ensure risk information is holistic, useful, accessible, understandable, and actionable. The process of disaster risk knowledge needs to be co-produced, integrated, and shared via databases or repositories that facilitate transparency.

Comprehensive risk management, enabled through integrated disaster risk knowledge, is a key aim of EWS. Innovations in integrating and developing risk assessments with, for example, layered and use-tailored risk maps and developing methodologies for displaying or sharing risk information, is something that many nations do not have the capacity and capability to carry out alone. Some key entry points to enhance disaster risk knowledge include:

- Develop community-based or community-driven early warning systems.
- Enhancing scientific knowledge of the hazards via research and citizen science.
- Integrating traditional and scientific knowledge for historical data, and ongoing monitoring data.
- Developing gender, physical ability and inequality risk knowledge.
- Making sure knowledge is not siloed.
- Expanding vulnerability assessment through linkage to other vulnerability measures, such as social or poverty analysis.
- Sharing open-access and non-technical disaster risk knowledge in appropriate formats.

State actors – mandates and functions

The major roles of state actors who mainly comprise of government entities at the national, regional, and local levels include:

- Data collection for hazards, exposure, vulnerability.
- Undertaking multi-hazard risk assessments and providing risk knowledge to other mandated authorities to act on disasters and disaster preparedness.
- Integrating risk knowledge into plans and programmes.
- Working with state-delegated authorities to develop risk assessments for different sectors and geographical regions.
- Government may oversee efforts to standardise risk assessments across sectors to ensure compatibility and integration of different efforts.
- Inclusion of a range of risk knowledge, including local and Indigenous knowledge into risk assessments.
- Inclusion of vulnerability assessments and supporting their development.
- Legal mandates to provide a warning system to protect citizens. These include data collection, risk and vulnerability assessments (and the standardisation thereof across sectors), and the integration of risk knowledge into planning processes. These legal mandates also set out key roles for state and non-state actors.

NDMAs at national and subnational levels usually have a state mandated legally binding responsibility for implementing or laying down policies, plans and guidelines for management of disaster risk and laying the framework for effective response and recovery.

The responsibility for collecting data on hazards is often shared across multiple government agencies that are typically conducted by established scientific and technical agencies or surveys, such as through national meteorological and hydrological services (NMHS) or environmental agencies, although in some nations this also involves disaster management authorities.

Exposure, vulnerabilities, and risk assessments are typically carried out by both hazard related agencies and the national disaster management authorities. National scientific and technical agencies provide technical services for disaster risk knowledge and can support this element through information-sharing, issuing advisories, alerts, bulletins and early warnings (see Section 2.2 on observations and forecasts for more detail), increasing public awareness of risk, and monitoring climate change and projecting future risk.

Hazard-based agencies can provide or help with the technical classification of the broad range of events that can occur in a given locality. This involves identifying the spectrum of possible hazards, developing specific scenarios, analysing their impacts, and assessing the likelihood of occurrence for the scenarios described.

Land use and urban planners are usually mandated at a local authority or municipality level to ensure that hazard or disaster prone areas and/or vulnerable populations are taken into account when granting planning permission; utilising climate change scenarios to identify future at-risk areas and populations; encouraging sustainable planning; taking into account EWS and their role-out in local plans and the abilities for populations to act on the warning; and ensuring that risk is effectively communicated to communities when plans are put out for consultation and approval.

Non-state actors – mandates and functions

The main non-state actors around disaster risk knowledge are non-government organisations, research institutions, civil society groups, private sector entities, and individuals. Their major roles can include:

- Contributing to the development of scientific and technical knowledge related to hazard hazards, exposure, vulnerability, and capacity.
- Conducting research, developing innovative technologies, and providing expertise to enhance the understanding and collection of data around hazards, exposure, vulnerability, and capacity.
- Engaging with the local communities to understand the hazards and risks they are exposed to, perceptions of these, and potential solutions and approaches needed that can be co-produced.

Non-governmental organisations (NGOs) can be important actors in providing disaster risk knowledge about, with, and for vulnerable groups of people in different contexts where state or government capacity is limited to reach out to local levels. This can include women-led community-based organisations (CBOs), children and youth, NGOs representing people with disabilities, LGBTQ+ community, organisations working with migrants and other marginalised populations. NGOs often carry out local risk assessments in collaboration with communities at the beginning of projects - this data is often not in formats that are shared or integrated into national or state-led datasets. NGOs can encourage state actors to include risk knowledge from these communities in their plans and analyses and, in turn, transmit disaster risk information to these communities.

Community based disaster risk reduction and emergency management committees can similarly work at the community level to analyse information and data to provide a risk profile and education for local communities.

Academia and universities can be an important generator of disaster risk knowledge, which is required for informed and coherent decision-making. In-depth disaster studies and policy programmes may be comprehensively and systematically addressed by academic institutions where capacity may be lacking at the government level. To bridge science and research into practice, a shared understanding of the needs of practitioners, a common language used, and researchers playing an active role in providing translation of research outputs into practical documents should be adopted.

The media is an important actor in disseminating knowledge of disaster risk ahead of disasters occurring. They have significant skill sets and connections to inform and sensitise the public and other potentially affected parties, including providing education on their current and future risk to a variety of hazards. In some cases, the media may dramatise information or use misinformation that can create panic and generate a lack of credibility of any warning.

Similarly, citizen science can generate copious amounts of locally crowd-sourced data, as well as providing a way to improve public awareness. Citizen science disaster education can reduce risk in contexts where state capacity to undertake such programmes is lacking by helping citizens to make more informed decisions such as reducing exposure, improving preparedness and reaction, response, and recovery to a disaster.

Private sector expertise can be harnessed to develop various components, including a database and information management system, backup systems, data quality control methods, cloud computing utilisation, and tools for visualisation, decision support, and the transformation of data into actionable information. One practical example is the potential collaboration with the private sector and informal partners who may possess access to essential early warning system data. The insurance sector is an important repository of knowledge regarding the understanding of the economic risk of disasters and their likelihood.

Risk analysis platforms (which are often run by diverse sets of actors, such as technical consultants, universities, and private sector organisations) are important tools for comprehensive risk management open access models/platforms that make assumptions and data used transparent and give insurers control over the assumptions they would like to include in their policies. The open nature of some risk platforms can provide more consistency in risk management information. Model and platform interoperability can also be enhanced to address a range of hazards.

International actors – mandates and functions

The United National Office for Disaster Risk Reduction (UNDRR) has played a critical role in promoting evidence based and integrated approaches to disaster risk knowledge. UNDRR has presence in five regional offices where links can be facilitated between the national and global levels in terms of building a greater understanding of risk by national governments and other important actors. UNDRR can also provide resources for those actors to understand the links between disaster management and risk reduction to sustainable development, and aid capacity building in vulnerable and under-resourced nations.

Regional bodies, such as AMHEWAS (Africa Multi-Hazard Early Warning and Early Action System), CDEMA (Caribbean Disaster Emergency Management Agency), and the Regional Integrated Multi-hazard Early warning System (RIMES) play a crucial role in early warning and early action in their respective regions. These organisations also facilitate the exchange of vital data and information pertaining to weather, climate, and disaster risks within the region. Regional risk assessments are conducted to identify potential hazards and vulnerabilities, which in turn inform the development of precise and timely early warning systems.

2.2. Observations and forecasts

Possible gaps and weaknesses in observations and forecasts of hazards

- Gaps in observations (spatial resolution) which inhibit the ability of NMHSs to issue warnings for a number of hazards, and/or provide locally specific forecast information. Data gaps often exist for a variety of parameters including rainfall, temperature, humidity, wind force and direction, atmospheric pressure, water level, temperature and water discharge, sediment discharge, soil temperature, soil water pressure, and river or sea level.
- The quality of monitoring stations or their age and ability to transmit field data.
- Technical language used by agencies when providing forecast and warning information poorly understood by non-technical actors who need to make decisions.
- Lack of use of impact-based forecasting which can help decision-makers make more informed and timely decisions by providing insights into the potential impacts on specific sectors.
- Lack of resources for governmental task forces or working groups to share data and information, meet, and complete priority projects.
- Lack of capacity in government to direct donor funding for alignment of initiatives in hazard monitoring.
- Lack of monitoring equipment, or a lack of maintenance of equipment resulting in its failure.
- The quality of monitoring stations or their age and lack of ability to transmit field data in real-time.

State and non-state actors in the context of hazard detection, monitoring, analysis, and forecasting are typically constituted from government scientific and technical agencies such as meteorological and hydrological organisations, health authorities, ocean observing organisations and geophysical agencies; universities and research institutes; private sector equipment suppliers; telecommunication authorities; security experts; military authorities; and regional technical centres.

These actors are normally supported by national and local disaster management agencies, although in some cases monitoring and forecasting is also part of the national and local disaster management agency's role. Their roles and responsibility vary depending on the specific context, hazard types, among other considerations.

Collaboration and coordination amongst and between the range of actors is crucial for enhancing effectiveness of hazard detection, monitoring, analysis and forecasting especially around sharing of data, expertise, and resources.

State actors – mandates and functions

The major roles of state actors who mainly comprise of government entities at the national, sub-national, and local levels include:

- Develop legal and policy frameworks related to hazard detection, monitoring, analysis, and forecasting in addition to facilitating establishment of guidelines and regulations to address the risks associated with various hazards.
- Allocate financial resources and provide funding for the establishment and maintenance of hazard monitoring systems. Here, they also ensure that necessary resources, such as equipment, technology, and personnel, are available to support detection, monitoring, analysis, and forecasting efforts long-term.
- Collect data from monitoring networks and analyse it to identify hazards, assess their severity, and predict or forecast their potential consequences.
- Continually seeking improvements by utilising scientific and technological advancements to enhance data collection, analysis, and modelling capabilities.
- Establish and maintain early warning systems that aim to provide timely and accurate forecasts and warnings to the public and relevant stakeholders. These systems involve the integration of data from multiple sources to generate reliable hazard warnings.
- Assigning the alert or warning issued through internal, formal decision-making processes.

NMHSs are responsible for collecting and sharing high-quality weather-, climate- and water-related observational data within the Global Basic Observing Network (GBON). They provide essential services for weather, climate, and water-related matters, often directly connected to various government sectors like transportation, health, agriculture, energy, and disaster risk management. These services assist decision makers and the public in interpreting weather forecasts. Despite their importance, NMHSs often face challenges due to limited resources and varying mandates across different countries. Some NMHSs focus solely on data gathering and sharing, while others have broader responsibilities spanning multiple sectors. Their positioning within government structures can impact their visibility and collaboration with other departments involved in disaster response. In contexts with effective EWS, NMHSs engage across the entire process of Early Warning Systems (EWS), providing guidance and support to other stakeholders and service provides to enhance user engagement and collaboration.

National and local disaster risk management (DRM) agencies are typically a key actor in the development of observations and forecasts including the co-development of warning thresholds and lead times that are appropriate for the needs of local actors; identification of locations that require improvements in monitoring and forecasts; and sometimes supporting maintenance of monitoring stations where national hydro-meteorological agencies lack local capacity. A National MHEWS Technical Working Group with representatives from all relevant ministries, departments and agencies is in many cases set-up and coordinated by DRM agencies at the national and local levels. These multi-agency stakeholders work together to guide and direct the establishment of MHEWS at national and sub-national levels. Ideally, this group would cut across the wide range of vulnerabilities and contexts, hazards, and threats locally, nationally, and globally to examine and share knowledge of warning designs, practices, and lessons identified.

Military authorities may (especially in more climate vulnerable nations) assist governments in the monitoring of a variety of hazards that could compromise national security, alongside providing assistance in national and local disaster crisis management and responses.

Public health agencies can also provide sources of hazard monitoring information regarding rapid needs assessments of at-risk populations, health surveillance and risk factors.

Non-state actors – mandates and functions

The major roles of non-state actors which mainly comprise of non-government organisations, institutions, civil society groups, private sector entities, individuals, and Indigenous peoples and local communities, include:

- Contributing to the development of scientific and technical knowledge related to hazard detection, monitoring, analysis, and forecasting. Non-state actors, such as universities, research institutes and private sector, conduct research, innovate technologies, and provide expertise to enhance the understanding and prediction of hazards.
- Engage with the local community in hazard detection and monitoring efforts by raising awareness, provide education and training, and facilitate community-based monitoring initiatives. They also play a key role in empowering communities to participate in the identification and reporting of hazards.
- Advocate for policies and measures that strengthen hazard detection, monitoring, analysis, and forecasting. The non-state actors influence decision-making processes, raise public awareness, and support the implementation of effective strategies for improved forecasting and warning.
- Contribute to the interoperability of monitoring systems, promote data exchange, and facilitate joint analysis and forecasting efforts.
- In some cases, NGOs, CSOs, or community members will collect observation and monitoring data which can be fed into national data systems to inform national EWS or can be used locally for downstream nowcasting of warnings between communities (citizen science).
- Support and inform locally appropriate warning thresholds and lead times.

Local gauge readers working within community early warning systems can be especially important in flood prone and flood risk nations and regions. In some cases, local gauge readers have given flood-risk information with a four-to-five-hour lead time that has allowed and enabled communities to evacuate safely.

Communities using traditional/indigenous techniques (community-based monitoring) can provide vital data and information in the manifestation of disaster events and risk in rapidly changing environments such as the Arctic, mountainous regions, small island developing states (SIDS) and rainforests. This data can be used locally to feed into community owned and operated EWS and/or integrated into national or formal EWS.

Citizen scientists have, in some cases, been valuable in filling gaps through contributing local data. Citizen science research projects can help improve the various aspects of the warning value chain by providing observations and evaluation, data verification and quality control, engagement and education on warnings, and improvement of accessibility for warnings. These projects also help establish trust and credibility between the affected communities, and various government agencies involved.

In many contexts, community-based approaches to observations and forecasts have been supported or initiated by NGOs in the development or humanitarian sector. Local or national NGOs can work with local communities to co-develop warning thresholds based on their risk perceptions and lead time needs. In addition, humanitarian agencies may, in some cases develop specific anticipatory triggers in the absence of EWS that they can collaborate on and utilise to provide early warnings for specific communities or at-risk populations.

As with disaster risk knowledge generation, academic institutes and universities can be an important generator of monitoring data, analysis, and expertise for a range of hazards where there is a gap in state capacity or private initiatives. They also play a role in innovating novel approaches to monitoring environmental conditions using innovative technology and developing databases and sources.

Collaboration with mobile phone operators can play a pivotal role in enhancing earth observation data collection. One example of this synergy is the use of microwave signal attenuation to derive accurate rainfall estimates. Furthermore, this collaborative effort extends to sharing technology and knowledge for impact-based forecasting, where artificial intelligence (AI) companies contribute their expertise. An illustration of this is the development of flood models, which harnesses AI capabilities to improve forecasting and mitigation strategies. Such partnerships between diverse stakeholders can significantly advance our capacity to address environmental challenges and disaster preparedness.

Private sector companies often collect and monitor environmental data. e.g.:

- Energy utilities frequently collect and monitor hazard information to inform their own energy generation planning over the coming hours, days, weeks, and months for optimal use of infrastructure, resources, and fuel.
- Private sector equipment suppliers and technology partners may provide equipment and initiatives that develop early warning capabilities and link them to early action.
- Weather forecasts are essential for efficient and safe airport and marine operations. For example, there are specific hazards that are most impactful to airport operations that are prioritised by the aviation industry which includes: thunderstorms, icing, turbulence, low visibility, and severe weather events.

Media, particularly social media, can play a valuable role as a large source of crowdsourced data, although it does require procedures and processes to sort, extract, and analyse the data to feed into observations and forecasts mechanisms.

International actors – mandates and functions

The WMO, a UN Specialised Technical Agency, plays a crucial role in enabling reliable weather forecasts by facilitating the exchange of global observations through the WMO Integrated Observing System. With 193 member states and territories, the WMO oversees the Directors of NMHSs, who represent their countries' weather, climate, and environmental needs within the organisation. As a member-driven entity, the WMO establishes international standards (including on MHEWS) and regulations for early warnings, and NMHSs are responsible for adhering to these standards.

Regional technical centres can provide integrated MHEWS across continents, which generate and apply early warning information. Regional technical centres support Member States in enhancing monitoring networks and data management systems to ensure data availability and address gaps in multi-hazard early warning information.

Space agencies and earth observations are providing a growing variety, velocity, and veracity of data, with an enormous potential of this information to better support disaster risk management and provide early warnings.

To produce evidence-based and verified warnings, NMHSs must have access to atmospheric observations for a number of parameters and at sufficient granularity to provide forecasts and warnings at a fine enough scale for warnings to be acted upon. This data comes from a combination of sources, including ground-based weather stations, satellite observations, radar systems, weather balloons, and remote sensing technologies. Additionally, international cooperation and data sharing among meteorological agencies and research institutions are crucial for accessing a comprehensive and global dataset, ensuring that NMHSs can deliver timely and accurate warnings to protect communities and support informed decision-making. In addition, the use of global and regional models in disaster and extreme weather forecasting requires testing, verification and evaluation which often includes collaboration of meteorologists and researchers across nations and continents.

Regional bodies can serve as the linchpin for coordinating regional early warning systems, forging connections with national meteorological and disaster management agencies to guarantee the harmonised and seamless integration of early warning systems across countries. Their activities encompass capacity-building initiatives, equipping national agencies involved in early warning and disaster management with the necessary technical and operational skills.

2.3. Warning dissemination and communication

Possible gaps and weaknesses in warning dissemination and communication

- Dissemination plans and procedures may not be sufficient to enable warnings to reach the community level to enable vulnerable populations to take early action that can save lives and livelihoods.
- Infrastructure and networks (e.g., ICTs, telephone lines, mobile phone connection) and networks may be poor and lack investment and upgrades to support warning dissemination from national down to local level.
- Transportation and telecommunications infrastructure may be affected by the hazard event.
- A lack of standard operating procedures (SOPs) and their testing that demonstrates and exercises how warnings are disseminated and communicated from the national to local levels.
- Public media messages may be poor at communicating the information in an understandable way or promote the use of misinformation and lack of trust amongst the public.
- Digital divides may inhibit the most vulnerable having access to technology that supports receiving warnings (i.e., lack of access to television, mobile phones, the internet).
- Content of warning information may be unsuitable for local populations, particularly the most vulnerable, including language, literacy, technical jargon, understandable and actionable content.
- Dissemination channels and communication content is often not co-designed with or tailored to specific user groups.

Just as it is important for the government to lead efforts in early warning messaging for their citizens, it is equally important to consider how this early warning information is disseminated and communicated for it to result in early action. Early warning needs to reach not just a proportion of a population, but as many as possible to ensure that all are protected from the potential impacts of a hazard. Messages must be simple, easily understood, and actionable by the intended community. For this to happen, it is important to ensure dissemination and communications systems, protocols, and structures, are in place and that trust has already been built by the time early warnings are delivered.

The content and format of warning information needs to be tailored to the specific user in a way that is accessible, understandable, and actionable. To achieve this, a range of actors with different skill sets and mandates should be involved in designing systems, plans, and protocols and implementing the dissemination and communication of early warning information if it is to reach everyone. This can make standardised warning systems less accessible if they are to be locally effective.

Various channels are available to use for dissemination of early warning messages. Radio, TV, and mobile phones (broadcast SMS, cell-broadcasting, and social media platforms) can be used to disseminate messages and information. Social networks are effective in disseminating information and warnings, as well as in educating the public, and informing relevant authorities. Additionally other more localised tools such as sirens, drums, lighting signals or someone using a speaker can be incredibly effective. Social media is increasingly used by state and non-state actors to inform the public about impending events and convey important information. Before, during and after disasters, social media platforms can be used to disseminate information about disasters and to collect data relevant to the implementation of preparedness, response and recovery activities and measures.

Care should be taken to analyse the advantages and disadvantages of each channel in specific contexts. In all cases, there is a need to diversify how early warning is disseminated and build in redundancies for it to be effective if the messages are consistent. Both formal and informal networks supported by state and non-state actors need to work

in unison to deliver coordinated and coherent early warning messages that cover everyone and avoid unnecessary duplication, confusion or contradictory messages.

In addition to identifying dissemination channels, there is a need to understand which channels are most appropriate for specific user groups, considering aspects such as accessibility (including access to technology), and trust.

Community channels, local and Indigenous knowledge tend to be trusted by local communities as in many cases, this is how communities receive trusted information. In some contexts, there is a severe digital divide to accessing technology, or technology has also been used for propaganda. In contexts where the government is unstable, or untrusted, alternative sources and dissemination channels are needed to provide early warning information to communities at risk, otherwise the warning may not be believed or acted upon.

Non-traditional channels such as youth engagement and the arts (music and songs, poetry, stories, dance, and drama) can also be used to disseminate warnings. Non-traditional ministries such as ministries of education, gender and children can use resources such as women's groups, youth groups and school clubs to disseminate early warning messages and advisories to communities. Similarly, they can be used to collect feedback for evaluation of the effectiveness of early warning leading to improvement.

Early warnings for climate hazards are essential for helping communities prepare for and stay safe in the face of extreme weather events and other related hazards such as wildfires and floods. The effectiveness of these warnings relies heavily on the clarity and accessibility of the messages, bulletins, or alert levels. The language used in these communications should be simple and easily understandable by all members of the community, regardless of their literacy level or language spoken. Using visual aids, symbols, or colour-coding can be particularly helpful in conveying the severity and urgency of the situation, as not everyone may have the same level of reading proficiency. Additionally, considering cultural and local context in crafting these messages is crucial, as it ensures that the warnings resonate with the target audience and are more likely to be taken seriously and acted upon. By addressing these communication aspects, early warnings can be more inclusive and effective, saving lives and minimising the economic and non-economic losses and damages associated with climate-related events.

Contextualisation and community participation in developing early warning messaging, and use of as many channels as suits the community, can enable effective early warning and early action. For weather, water and climate related hazards, user interface groups at national and subnational level can be used to co-produce messaging with the community, in tandem with the possible implications on specific sectors. Social science research such as social listening technology can be used to collect feedback and inform change of strategy for community outreach and messaging (SMN Argentina, 2024).

Tourists, non-nationals, and migrants need to be reached as part of the warning, particularly in the context of hazards that non-locals may not be familiar with, which may be compounded when combined with unfamiliarity of the local geography and resources. Cell-broadcast technology can assist in many cases, but for those without access to mobile phones, getting the message to transient populations remains challenging. Information boards, checklists, and shelters are vital for tourists in remote and dangerous environments.

Alert level systems, which are sometimes known as status levels, condition levels, or colour codes, are utilised worldwide to communicate warnings and emergency information regarding various hazards. These systems offer a structured framework for public and civil authorities to assess and coordinate their response to evolving emergencies. They play a crucial role in making the public aware of escalating or de-escalating crises. The language, symbols, or colours used in these alert level systems must be clear and universally understandable. This is particularly important to ensure that people of all literacy levels and language backgrounds can quickly grasp the severity of a given situation. By employing straightforward and inclusive communication methods, alert levels help provide credible and relevant information, serving as a reliable source in a world where misinformation and unreliable information can proliferate. However, an alert level cannot provide all the data needed by decision-makers, including the public. Therefore, alert levels need to be accompanied by a wide range of communication tools/channels to aid all stakeholders in understanding the situation and being able to make informed decisions.

State actors – mandates and functions

The major roles of state actors who comprise of government entities at the national, regional, and local levels include:

- Disseminating state-sanctioned early warnings to the relevant authorities and organisations through different media channels to get to the local level. Including public channels (e.g., website) and direct channels (e.g., emailed bulletin).
- Issuing or disseminating warnings to the public e.g., through push SMS (either from one central agency, or in collaboration with other organisations).
- Local-level state authorities ensure that early warnings are issued to communities and their administrations for effective preparedness, evacuation, and response.
- In some cases, state actors set up procedures to communicate warnings in a variety of languages, formats, and adopt cultural references / norms where needed. This includes considering gender, age, physical ability and nationality when issuing and communicating a warning.
- Simplification of technical content by the central scientific/technical government department to ensure it is understood and can be acted upon at the local level.
- Establish the legal and policy frameworks which mandate responsibilities and assign funding to purchase equipment in at-risk communities to aid communication in the event of disaster, such as phones, loudspeakers, and sirens.

Forecasts created by NMHSs are often disseminated to a number of central national actors who may then further disseminate warnings or advisories downstream to affected actors at the local level, who then reach communities using many different administrative channels.

National disaster and emergency managers must ensure that warnings are generated and delivered to the local level, and this can be a challenge where there are limited resources (in terms of human, technological, infrastructure and economic). The role of tailoring messages to the local circumstances and hazards is often the responsibility of local emergency managers.

Emergency services responder agencies such as police, firefighters, civil protection, the military, and health workers can provide a service to NMHSs or public weather services (PWS) by translating weather forecasts into sector-specific alerts to broker them for public warning and/or local early warning systems. Similarly, emergency services can also pass warnings to the local level from NMHSs or PWS.

Telecommunications authorities may provide some crucial support for the development and dissemination of early warning messages to ensure timely and understandable alerts to those at risk.

In some contexts, state actors such as NHMSs, civil defence, or national disaster risk management agencies have a central dashboard or platform that semi-automates the link between forecast information and dissemination of early warning alerts. Such portals can collect information from various sources into one location, to be analysed quickly for early warning. These portals can 'translate' the forecast information into a standardised template with pre-agreed communication content in multiple formats ready for dissemination. There is often a manual authentication step before dissemination. One or more dissemination channels are used to send the alert from the central authority that monitors and issues the warning to the intended recipients. In many developing country contexts, this sort of central platform may not exist, and translating forecasts into warnings is a time intensive process.

In other scenarios, state actors such as the NHMSs or NDMAs have funding to research and engage with at-risk communities to co-develop warning dissemination channels and the content of warning messages. But this is often a rarity in developing countries.

Non-state actors – mandates and functions

The major roles of non-state actors which mainly comprise of non-government organisations, institutions, civil society groups, private sector entities, individuals, and Indigenous peoples and local communities, include:

- Enhancing dissemination of the warnings through communication channels such as local radio and television.
- Ensuring that warnings reach the local level and those most at risk through direct communication with these communities (knocking on doors, loudspeakers, etc.)
- Ensuring that warnings on social media are elevated when an event is due to take place and limiting the dissemination of misinformation.
- Contributing to narrowing the digital divide through community investment in communications technologies and infrastructure.
- Informing and co-developing plans and procedures that consider preferred dissemination channels and communication content of warnings with communities at risk.

Communities and individuals who directly experience the impacts of climate change should hold a significant role in shaping the methods and content of warning systems. Collaborating with NGOs, CBOs, CSOs, and state authorities responsible for issuing alerts is crucial to ensure that communication strategies are tailored to their specific needs. This entails a comprehensive approach that embraces diverse dissemination channels, multiple languages, and adaptable communication formats. It also involves considering factors like gender, age, physical ability and nationality in the process of issuing and conveying warnings to guarantee that the information is not only accessible but also truly responsive to the unique circumstances and vulnerabilities within these communities.

A range of media organisations are essential to deliver early warning information to as many people as possible. This is most effective when government mandated organisations work closely with media outlets to develop protocols to share warnings with the public. Radio stations and broadcasting services (including terrestrial and satellite) can disseminate alert messages and advice to the public in case of a disaster or emergency. Print media can provide important education to the public on protection, including evacuation measures. Journalists should be aware of and trained in past major disasters, drawing lessons from the coverage and the public response that this may or may not have induced. NGOs, CSOs, and CBOs often play a pivotal role in making sure early warning messages reach communities at risk in a timely, understandable, and actionable way. NGOs, CSOs, CBOs and communities are important actors in disseminating warnings at a very local level and have perhaps (in strongly bound and/or resourced communities) household level risk information and relationships that can be crucial in mobilising the early action of individuals. Local volunteers can assist in the dissemination of early warnings, especially in cases where warnings are found to be inaccessible to marginalised populations or disseminated in an inaccessible format to local people.

With their existing relationships with communities and people at-risk, these types of organisations and groups play a key role in ensuring residents and communities take action to protect themselves when early warnings are released. This is especially important where there are found to be gaps in non-technical aspects of EWS. These agencies and organisations can help members of the public in accessing alerts, understanding the meaning and the severity of alerts, and in taking action to protect lives and livelihoods.

Research organisations play a pivotal role in the development dissemination of early hazard warnings. These organisations contribute significantly to the development of the scientific knowledge and models that underpin effective warning systems. They may conduct in-depth research to better understand the various hazards, their patterns, and potential impacts, which in turn informs the accuracy and reliability of early warnings, or conduct research on how best to design, integrate, and communicate warnings with a wide range of stakeholders. Furthermore, research organisations often collaborate with government agencies, non-governmental organisations, and other stakeholders to share their findings and expertise, helping to shape the content and format of warnings. Their contributions to the dissemination process involve not only the generation of credible data and information but also the translation of complex scientific findings into accessible and actionable alerts.

Research organisations are instrumental in bridging the gap between scientific insights and practical, life-saving communication with the public and relevant authorities, ultimately enhancing overall hazard preparedness and response efforts.

The private sector may also play a critical role in the dissemination of early hazard warnings. This involvement encompasses a range of activities, including partnering with mobile phone operators to transmit warnings directly to individuals, leveraging private media channels for broadcasting alerts, and utilising push notifications through popular social media platforms. Additionally, the private sector can contribute to the co-production and dissemination of climate information. For example, companies like rice exporters can share agro-meteorological data and insights with rice producers, enabling them to make informed decisions based on weather and climate patterns. These collaborations between the private sector and public authorities are instrumental in expanding the reach and effectiveness of early warning systems, ensuring that valuable information reaches a wider audience and empowers individuals and communities to prepare for and respond to hazards.

International actors – mandates and functions

The International Telecommunication Union (ITU), as the UN's specialised agency for information and communication technologies (ICTs), aids better communication and delivery of 'last mile' warnings by providing a global framework within which resilient telecommunication infrastructure can be built and maintained. ITU provides education and capacity building in the use of digital technologies for warnings and alerts, and guidance in leveraging mobile and other telecommunication systems for early warnings to save lives and livelihoods. ITU also assists regulatory authorities in adopting public systems, advocating, and sharing knowledge across communities, and encouraging overall alignment of disaster communications.

The Common Alerting Protocol (CAP) has been adopted by ITU and provides a format for exchanging all-hazard emergency alerts and public warnings over all kinds of ICT networks, allowing a consistent warning message to be disseminated simultaneously over many different warning systems, thus increasing warning effectiveness while simplifying the warning task. Additionally, these messages can be instantly translated into the user's relevant language, or work with other technology for those persons who may be deaf, hard of hearing, blind, partially sighted, and deafblind. However, it should be noted that while CAP does facilitate multilingual messaging, this is only possible for languages that already have technological capacity (written and uni-coded alphabet, machine translation capacity, etc.). Approximately half the world's languages have no written form, meaning that such emergency alerts are inaccessible to a high percentage of the global population. CAP supports audio messaging, but the standard includes sending a written warning first. However, it should be noted that while CAP does facilitate multilingual messaging, this is only possible for languages that already have technological capacity (written and unicoded alphabet, machine translation capacity, etc.). Approximately half the world's languages have no written form, meaning that such emergency alerts are inaccessible to a high percentage of the global population. CAP supports audio messaging, but the standard includes sending a written warning first.

CAP enables authorities to deliver early warnings and alerts to all people and communities at risk, and up to the global scale using different technologies. This is a critical step to make sure people receive the warnings, but they also need to be able to understand, believe, and act on those warnings.

Regional bodies (e.g., such as AMHEWAS and CDEMA) can play a role in contributing to clarity and consistency in the dissemination of critical information through the standardisation of warning messages across multiple countries in a region.

2.4. Preparedness and response capabilities

Possible gaps and weaknesses in preparedness and response capabilities linked to early warnings

- Lack of capacity or resources to respond to warnings and act early.
- Lack of guidelines for preparedness and response at the local level due to lack of capacity and varying capabilities in different locales.
- Inadequate training, outreach and/or familiarisation of early action options for local communities to take based on warnings.
- Lack of clarity on the role of actors in early action for different hazards from the national to the local level.
- Lack of information on vulnerability and capacity to effectively prepare and respond before the hazard event.
- Lack of contingency plans and Standard Operating Procedures for disaster preparedness and early response such as evacuation protocols.
- Inadequate evacuation routes and/or safe places, not considering vulnerable group needs, often designed for the majority population.
- Lack of support for vulnerable people to take early action, limited understanding of barriers to taking early action for the most marginalised.
- Lack of consideration or adaptation for particularly marginalised groups including transient and tourist populations.
- The need for preparedness and response requirements to be reviewed over time as contexts change, evolve, and adapt, especially as personnel change.
- Lack of exercises and drills to test plans and procedures.
- Lack of pre-arranged finance that allows early and anticipatory based on forecasts and warnings (REAP, 2022b).
- Lack of pre-translated warning templates into which relevant specific data can be input to facilitate rapid warning roll-out.

Preparedness and response capabilities in relation to early warning systems refer to the actions taken early, in anticipation of a hazard, based on a forecast or warning. The response here refers to responding to the warning alerts, not responding to the disaster after it has occurred. These actions are designed to save lives, reduce health impacts, ensure public safety, minimise economic and non-economic losses and damages to ensure the needs of affected people can continue to be met in a way that promotes dignity.

In order for action to be taken by different actors at the local level, a range of different measures need to be undertaken, including ensuring that early response plans have been developed, are fit for purpose, practised, and operational; ensuring the public are aware of and familiar with plans in case of a disaster or emergency; and ensuring that the plans have been thoroughly tested, evaluated and fed back into improving these capabilities. Coordination plans between key actors and groups is vital, alongside running drills and exercises to evaluate their practical application.

Part of the process of preparedness is generating awareness around hazards. This can be via public awareness campaigns and outreach activities, materials, and resources, that are seldom financed, yet can generate strong good relationships with key agencies and the public. Education and engagement have consistently been shown to be one of the cheapest and more effective preparedness tools.

Many countries manage disasters at the local level through disaster management action plans – these represent a strategic state or regional approach, which is then translated into action for the responsible authorities and actors at a town, community, or district level.

State actors – mandates and functions

The major roles of state actors who mainly comprise of government entities at the national, sub-national, and local levels include:

- Creation of integrated and comprehensive legal and policy frameworks for disaster preparedness and response that clarify roles and responsibilities of all actors.
- Ensuring that actors at the local level are empowered to act before disasters occur.
- Co-development of evacuation and early action protocols with affected or at-risk communities and local actors.
- Delivering training and drills for local communities, government, and national actors to practise plans and protocols outside of crisis events.
- Building and maintaining safe routes and safe places.
- Supporting evacuation and early action for the most vulnerable members of society.
- Pre-positioning national and local resources and support in response to forecasted impact.
- Ensuring technical systems are invested in at a local scale to ensure that hazard, risk, warnings, and early action plans are understood at a local level.
- Ensuring finance is triggered based on forecast information and delivered in a timely manner and to the local level.
- Establishing the appropriate infrastructure to enable people to act on warnings, such as via purpose-built evacuation shelters, household flood defences, and flood defences (engineered or natural based) in a timely manner.
- Developing outreach and engagement materials to enhance knowledge and action preparedness.

Local governments or local authorities are integral to effective preparedness and response to early warnings. They should be empowered by national governments, have considerable knowledge of the hazards to which their communities are exposed and be actively involved in the design and maintenance of early warning systems and early action preparation. Local authorities may have data on people's vulnerabilities and their requirements for support. They often have a mandate for supporting the development of local early action protocols and delivering training or supporting practice of those early actions with communities. They should understand early warning information received from national levels and be able to advise, instruct, engage, and support the local population in a manner that increases public safety and reduces the possible loss of resources on which the community depends.

National disaster risk reduction and management agencies have a role to play in providing guidance to local authorities on the development of early action protocols, as well as supporting or leading on the development or financing of safe routes and spaces. The division of roles and responsibilities between national and local government departments will vary across contexts.

National weather services can assist in the preparedness for disasters and extreme climate events by aiding the training of communities before such events may occur. This can include developing and performing planning exercises or meteorological 'testbeds' during normal times to enhance the delivery, access and use of products and tools, supporting the robust linkage of forecasts and warning levels with early action protocols that may also help communities in reducing losses from events and in being prepared for the next.

Health authorities and public health providers aim to promote, protect, and improve the health of individuals and communities ahead of (and after) major disasters. Public health workers are often called upon to participate in a coordinated response to save lives and prevent unfavourable outcomes to vulnerable populations. Health authorities are usually engaged in state-mandated training and exercises to optimise their preparedness and response to a variety of disasters.

Schools and the education sector are pivotal in providing secure environments during extreme weather and climate hazards. They often serve as designated emergency shelters, offering essential facilities and coordinating with local authorities to ensure community safety, while ensuring the continuity (or rapid resumption) of education. Schools develop and practise emergency plans, stock critical supplies, and serve as communication hubs for relaying valuable information. Their central location ensures accessibility, and they may also offer support services like counselling and first aid. Education and training provided by schools are key in equipping individuals with the knowledge and skills to protect themselves during crises.

Non-state actors – mandates and functions

The major roles of non-state actors which mainly comprise of non-government organisations, institutions, civil society groups, private sector entities, and individuals include:

- Raising awareness of impending disasters and disaster risk amongst commun ities.
- Holding to account government and other state actors where and when there are failures in EWS.
- Co-developing locally specific early action protocols.
- Delivering regular or one-off training for local communities to be prepared as the 'first responders.'
- Activities to support in response to warnings.
- Identification and building of safe routes and safe spaces.
- Provision of resources to support early action, including evacuation kits.

Communities actively engage in responding to climate events and hazards by preparing for them, organising evacuations and shelters, aiding in the search and rescue efforts, sharing essential resources, and maintaining effective communications channels. They are instrumental in building resilience through initiatives like flood control systems, advocacy for climate change mitigation, and participating in recovery and reconstruction efforts. Their ability to adapt and learn from experiences enhances their capacity to respond effectively to future climate events. Ultimately, communities are at the forefront of climate event responses, playing a pivotal role in safeguarding lives and advocating for long-term climate resilience within their local contexts.

Local organisations, including NGOs, CSOs, and CBOs, and National Red Cross and Red Crescent Societies are often found at the forefront of disasters as they unfold and occur, aiding in areas such as evacuation support and coordination, health, education, water supply and sanitation, shelter, and infrastructure. These organisations can also act as catalysts and intermediaries by enhancing communication and accelerating collective actions to improve response to early warnings, preparedness, and resilience building. NGOs, CSOs and CBOs can play a similar role to local authorities in co-developing early action protocols, developing and maintaining local evacuation routes and safe places, providing training to practise responses to warnings, and supporting communities and vulnerable groups to take early action. The specific roles and responsibilities are context specific; NGOs, CSOs and CBOs can work in collaboration with local authorities or can provide these supportive services when local government capacity is limited or unavailable.

National Red Cross and Red Crescent Societies fulfil their auxiliary role to the public authorities by strengthening local preparedness capacities to ensure timely and effective humanitarian assistance to prevent and alleviate human suffering. For this specific and distinctive partnership to work well, it is important to agree on which areas the National Society (e.g. in disaster risk management, emergency response, public health and social services) supplements or substitutes public services, and describe these roles in sectoral laws, policies, plans and agreements, so that they are well coordinated with the work of relevant ministries and partners in different country settings across the EWEA value chain.

Disaster preparedness is sometimes systemically embedded into many humanitarian operations for a risk-informed humanitarian response. There has been recent progression from the humanitarian community to utilise forecasts and warnings not only to respond to disasters, but to also act in advance of hazards. The humanitarian sector and anticipatory action practitioners often support communities in developing and implementing early action protocols and contingency plans, and in the coordination of logistics before (in addition to during and after) disasters. The humanitarian sector has also played a key role in advising national and local governments in using risk and hazard data to trigger cash assistance, forecast-based finance, or early action programmes.

As well as assisting in pre-disaster education and preparedness regarding actions to undertake in the event of specific hazards, the media (as a whole, including social media, print, radio, and broadcast media) can assist the public by linking them to help and support.

Local businesses are integral to disaster preparedness and response against weather hazards. They provide crucial resources, including equipment and materials, and engage in community outreach to raise awareness about safety measures. Collaboration between local authorities and businesses is vital to ensure their contributions align with community needs and are integrated into broader disaster management plans, ultimately fostering effective disaster preparedness and response efforts that benefit both businesses and the local community.

In many communities, the main community-facing large-scale information distributor is the a religious institution and therefore their role in information sharing, warning dissemination and prepredness should not be underestimated. communities can also play a role in early action for climate hazards, offering shelter, community support, and a platform for raising climate awareness. They collaborate with local authorities, share resources, provide moral guidance, and offer educational programmes to enhance climate resilience. However, their invovlement should be inclusive and respectful of diverse beliefs and characteristics. Partnerships with other organisations and government agencies can strengthen their effectiveness in addressing climate-related challenges.

The private sector plays a multifaceted role in enhancing early warning capabilities and preparedness for climate hazards. Firstly, it actively supports small and medium-sized enterprises by fostering the development of early warning systems, ensuring business continuity, and providing essential training for staff. Secondly, through agreements and partnerships, the private sector leverages its resources, such as amateur radios and safety shelters, when appropriate, to bolster disaster response and communication. Moreover, it facilitates access to pre-arranged financial resources for forecast-based early actions, such as risk-pooling mechanisms. In doing so, the private sector significantly contributes to the overall resilience and preparedness of communities and businesses in the face of climate-related hazards.

International actors – mandates and functions

Early warning and anticipatory action have been a core part of the IFRC network's work for decades, with a focus on people-centred, (as defined by UNDRR and WMO: "accessible, understandable, usable and relevant disaster risk information and assessment" (UNDRR and WMO, 2022) community early warning and anticipatory action systems. Since 2014, the Red Cross Red Crescent network has been pioneering technical improvements to the anticipatory action approach by developing forecast-based financing to ensure early warning leads to early action by supporting the development of pre-agreed anticipatory action plans including agreed triggers for action that are tied to pre-arranged financing.

Early warning and anticipatory action is a major element of the services that 191 National Red Cross and Red Crescent Societies provide, whose staff and volunteers are present before, during and after emergencies in many communities. IFRC network has a long-lasting experience on early warning systems designed with the communities, for the communities and with strong linkages with meteorological services and national authorities to act on the warnings.

In 2018, IFRC pioneered an anticipatory financing by creating a funding mechanism that is released before a hazard materialises based on pre-agreed plans through the anticipatory pillar of the Disaster Response Emergency Fund (DREF). IFRC envisions to increase DREF funding allocated for anticipatory action to 25% by 2025. Anticipatory pillar of DREF provides an opportunity to National Red Cross and Red Crescent Societies to access funding for preposi-tioning and readiness activities, as well as take anticipatory actions based on triggers, which are encompassed in the Early Action Protocols (EAPs).

Currently, more than 40 National Societies have developed and activated such plans, however, it is a lengthy and resource heavy process with no reliable funding behind to develop such pre-agreed plans. It is not the development of plans per se that requires time and resources, but the process behind which is strengthening institutional capacities of National Societies to develop such plans. These include but are not limited to building coordination mechanisms with national meteorological services and other institutions that can issue reliable forecasting, skills and capacities to understand and act upon the forecasts, support services such as finance, HR and admin that are equipped to work with anticipatory financing and actions, and testing and simulating anticipatory actions with the communities at identified high risk areas.

In addition, IFRC network relies heavily on the Red Cross and Red Crescent Climate Centre (RCCC) expertise on climate science to sensitise on the topic, develop triggers for anticipatory action and conduct evaluations. Together with the German Red Cross and RCCC, IFRC established Anticipation Hub to foster practical learning and peer-to-peer exchange across the practitioners. IFRC also hosts and is a member of Risk-informed

Early Action Partnership to accelerate anticipatory action across develop ment, climate, humanitarian stakeholders.

Initiatives such as the Start Network, a global network of humanitarian organisations, champions innovative approaches to disaster management, including the 'Start Fund.' This fund offers anticipatory finance for climate hazards and other crises by pooling resources from various donors and members, ensuring rapid availability when crises are predicted. Through partnerships with local organisations and a focus on early warning systems, the network leverages local expertise to make informed, decentralised decisions. The Start Fund's flexibility allows country based teams to allocate funds swiftly in response to emerging crises, ultimately empowering timely interventions that save lives and reduce the impact of disasters in vulnerable communities globally. This approach has been trialled and tested by organisations such as WFP, FAO, and the Start Network.

Regional bodies and actors – mandates and functions

Regional bodies (e.g., such as the African Union and the Caribbean Disaster Emergency Management Agency) play a crucial role in early warning and early action in their respective regions. Resource mobilisation is another significant function, as they actively assist in securing financial and technical resources to enhance national and local early warning and response capabilities. Before and during disaster events, these bodies step in to orchestrate response efforts, deploying resources and expertise while facilitating the flow of information between affected countries and international organisations. Advocacy and policy development are also on their agenda, championing policies and strategies that advance early warning and early action at both national and regional levels. Finally, they engage in public awareness and education campaigns, fostering an understanding of the significance of heeding early warnings and taking appropriate actions among various communities. In essence, these regional entities serve as indispensable intermediaries and coordinators, bolstering preparedness and response to disasters and emergencies, thereby mitigating risks to lives and property within their respective regions.

3

RECOMMENDATIONS FOR ENHANCING COLLABORATION AND CALLS TO ACTION

This paper emphasises the critical role played by both state and non-state actors in the development of functional and effective early warning early action systems. The absence of non-state actors in the design and implementation of these systems can lead to significant gaps in the EWEA value chain, potentially resulting in loss of lives and other severe economic and non-economic disaster impacts. Even when state actors recognise resource constraints that prevent them from ensuring early action before extreme weather events, collaboration with non-state actors does not always materialise. Failures in EWEA systems typically do not arise from isolated policies or actions but stem from a lack of holistic consideration of how all activities and actions interconnect in the broader context. It is essential to comprehend the factors that either promote or hinder cooperation among EWEA actors and to find ways to address these dynamics.

R1: Acknowledge that EWS capacities can be found across diverse stakeholders

The set up and operation of early warning systems and initiatives require a complex interplay of state and non-state actors. The range of skillsets and multiple mandates from across diverse actors in an EWEA value chain needs to be recognised, and the value of each actor acknowledged. Before effective collaboration can take place, state mandated actors need to acknowledge that effective EWS requires collaboration across state and non-state actors; no one organisation can fully own and run an EWS without input or interaction with other actors (state or non-state).

In alignment with the WMO Policy Framework for Public-Private Engagement (WMO 2018b), which applies to all entities beyond government or state-mandated ministries, the pursuit of external expertise and funding can be considered when it serves the mutual interests of both state and non-state actors involved, and when the resulting initiatives also yield benefits for society. The identity and responsibilities of these actors within the EWEA value chain will vary depending on the specific context and should be customised to the evolving circumstances of each case.

The capacity and capabilities within national state organisations and structures, whether formal or informal, can fluctuate significantly depending on the context and the organisation itself. In situations where state actors face limitations in terms of resources and capacity to establish a comprehensive end-to-end early warning system, it is imperative to identify competent and skilled non-state authorities or actors who can take the lead and coordinate specific aspects within the early warning ecosystem. This approach ensures that the EWEA system remains robust and responsive, even in situations where state resources are constrained.

Assess gaps and skill sets

It is crucial to identify areas where specific actors may lack the necessary skills or resources, as this forms the foundation for devising strategies to connect state led EWS with other actors or to bolster state capacity where feasible. When conducting assessments of capacity development through the involvement of non-state actors, particular attention must be given to the following inquiries:

1. Is the deficiency in capacity being reinforced through collaboration with these actors?
2. Would expanding the responsibilities and/or resourcing of state actors resolve the issue?
3. Can international actors, such as UNDRR or WMO, contribute to capacity development programmes or projects?

Recognising the various levels of actors required to contribute to an effective and purposeful EWS is imperative, encompassing actors from the local to national, and even international levels. Capacity development and the sustainability of EWS at the local level should be a significant consideration and assessment. For instance, it is common to find gaps in the responsibilities of actors supporting marginalised or vulnerable communities, particularly in least developed countries (LDCs). However, there exist both state and non-state actors with relevant expertise who can play a pivotal role in bridging the needs of these communities with EWS design and delivery.

Key actions

1. **Acknowledge the value of diverse stakeholders (immediate action):**
   State-mandated actors and organisations can promote a shared and clear understanding of the diverse skill sets and mandates of both state and non-state actors within the EWEA value chain. Engaging in open dialogues and discussions involving a diverse range of actors can help in grasping the significance of each actor's contributions and lead to a shared understanding of their roles, facilitating effective collaboration.

2. **Seek external expertise and funding for mutual benefit (short to medium term):**
   Seek external or non-state expertise and funding for specific EWS projects that benefit both state and non-state actors, with a focus on mutual advantage. This should be implemented in the short-to-medium term to enhance the effectiveness of EWS initiatives.

3. **Address skills and resources gaps (medium to long term):**
   All actors involved in EWS, including state and non-state actors can conduct thorough assessments of capacity development to identify gaps in skills and resources. Action to address these gaps can then be taken by considering whether collaboration with non-state actors is reinforcing the lack of capacity, whether widening the mandates of state actors is a solution, or if international actors such as UNDRR or WMO can assist in capacity development programmes or projects.

R2: Ensure EWS co-design processes incorporate local stakeholders

The primary objective of EWS is to provide timely and relevant hazard information to individuals and sectors at risk, granting them sufficient time to take pre-emptive measures before a potential disaster unfolds. Consequently, EWS must be tailored to the specific needs of the people at risk right from the grassroots level. To achieve this, it is imperative to involve local stakeholders, encompassing both state and non-state actors, as well as community members, in the collaborative design of EWS to ensure its alignment with the community's requirements. A key gap in achieving local engagement is the failure to assess and understand the best and most appropriate ways to communicate with local actors. This includes needing to collect data on the preferred languages and formats of communication and funding measures to mitigate language barriers where possible (for example, by paying for translation of key documents).

Inclusion and local leadership are of paramount importance in this process, as they significantly contribute to enhancing resilience among those most vulnerable to climate-related shocks and stresses, thereby ensuring the long-term sustainability of the system. Many efforts to foster these principles commence with the adoption of the Principles for Locally led Adaptation (Principles for Locally Led Adaptation | International Institute for Environment and Development, n.d.). Local actors and stakeholders can take various forms, including local governments, but there often exists an overlooked wealth of information and a diverse array of local non-state actors, such as NGOs, CSOs, and CBOs.

These non-state actors frequently possess a deeper and more intimate understanding of community needs and maintain long-standing and trusted relationships within the communities they serve. Therefore, these organisations play a significant role in the co-design and delivery of early warning systems, right from the inception and throughout their development and operationalisation, to ensure their effectiveness for the benefit of people at risk.

The Principles of locally led adaptation (IIED, n.d.).

1. Devolving decision making to the lowest (most local) appropriate level - giving local institutions and communities more direct access to finance and decision-making power over how adaptation actions are defined, prioritised, designed and implemented; how progress is monitored; and how success is evaluated.

2. Addressing structural inequalities faced by women, youth, children, persons with disabilities and displaced people, Indigenous Peoples, and marginalised ethnic groups - integrating gender-based, economic, and political inequalities that are root causes of vulnerability into the core of adaptation action and encouraging vulnerable and marginalised individuals to meaningfully participate in and lead adaptation decisions.

3. Providing patient and predictable funding that can be accessed more easily - supporting long-term development of local governance processes, capacity, and institutions through simpler access modalities and longer term and more predictable funding horizons, to ensure that communities can effectively implement adaptation actions.

4. Investing in local capabilities to leave an institutional legacy - improving the capabilities of local institutions to ensure they can understand climate risks and uncertainties, generate solutions, and facilitate and manage adaptation initiatives over the long term without being dependent on project-based donor funding.

5. Building a robust understanding of climate risk and uncertainty - informing adaptation decisions through a combination of local, Indigenous, and scientific knowledge that can enable resilience under a range of future climate scenarios.

6. Flexible programming and learning - enabling adaptive management to address the inherent uncertainty in adaptation, especially through robust monitoring and learning systems, flexible finance, and flexible programming.

7. Ensuring transparency and accountability - making processes of financing, designing, and delivering programmes more transparent and accountable downward to local stakeholders.

8. Collaborative action and investment - collaboration across sectors, initiatives, and levels to ensure that different initiatives and various sources of funding (humanitarian assistance, development, disaster risk reduction, green recovery funds and so on) support one another, and their activities avoid duplication, to enhance efficiencies and good practice.

Emerging strategies in the realm of EWS are evolving from traditional notions of people centred EWS and are integrating social and behaviour change theories and practical experience to introduce a fresh, behaviourally informed EWS framework. Unlike the conventional approach that primarily revolves around hazard data and analysis, this new paradigm commences by identifying the preferred early actions of populations exposed to vulnerability, along with the behavioural factors that shape their decisions to undertake these actions.

Under this framework, it becomes evident that early warning information collection and dissemination must align with these identified early actions. For instance, the information provided should be contextually relevant to prompt actionable responses, and the messages should be conveyed through channels that are accessible and meaningful for all vulnerable groups within the affected population. This shift in focus from hazard-centric analysis to a behavioural perspective ensures that an EWS is not merely informative but also tailored to encourage timely and effective responses from populations.

Inclusive processes in delivering climate services are pivotal in ensuring that forecasts and climate scenarios translate into resilient decision-making. Central to this endeavour are inclusive tools, one of which is the PVCA approach. The PVCA approach is designed to empower both women and men at the community level, allowing them to collectively identify and prioritise the risks they encounter. Moreover, it facilitates the development of plans to enhance their access to regular forecasts and early warnings. These plans are then transformed into actionable activities. Simultaneously, the PVCA approach outlines the external assistance they require, which may come from local government services and external agencies, to bolster their climate resilience. By putting these inclusive tools into action, it becomes feasible to empower communities to effectively reduce risks from climate challenges and ultimately build resilience (Ahmed, 2020).

Key actions

1. **Incorporate local knowledge and actors into EWS co-design (immediate action):**
   Those leading EWS design and implementation should involve local actors, including local governments, NGOs, CBOs, and CSOs, in the co-design of early warning systems. Local stakeholders should be engaged from the outset to ensure that EWS are tailored to the specific needs and vulnerabilities of the communities at risk.

2. **Adopt a people-centred and inclusive approach (short to medium term):**
   Designers and implementers of EWS can transition from traditional hazard-focused EWS design to a people-centred approach. This shift should prioritise understanding the early actions that exposed and vulnerable populations need to take in response to hazards and the behavioural factors influencing their decisions. Design EWS information and messages to be action-oriented and disseminate them through channels that are relevant and accessible to vulnerable groups.

3. **Promote inclusive tools and climate services (medium term):**
   Climate service and hazard warning providers, EWS designers and agencies involved in their design can utilise inclusive tools such as PVCA and citizen science approaches to data collection to engage groups at the community level. This approach allows communities to prioritise risks, localise forecasts, develop plans to access forecasts and early warnings, and translate these plans into preparedness and early action activities. Additionally, these actors should ensure that climate forecasts and scenarios provided by climate service providers are accessible and result in informed decisions that strengthen longer-term resilience.

R3: Ensure a clear and inclusive governance and institutional set-up is in place

A policy and legal framework for inclusive EWS, which is responsive to the needs of the most vulnerable and the hazards affecting different communities learning from the present and taking into account future threats, and which encourages cooperation (both internally and externally) is essential to enabling collaborations between all competent actors within the value chain. Clear roles and responsibilities need to be defined to avoid duplication of efforts and to enhance alignment across areas of expertise and mandates to enable optimal working, which has an impact on downstream interactions with external actors and non-state organisations at all levels.

Laws, policies, and institutional arrangements have a crucial role to play in supporting all aspects of disaster risk management including disaster risk reduction, preparedness, and response, as well as facilitating international assistance when the scale of a disaster exceeds national capacities. This has been recognised in key international instruments, such as the Sendai Framework for Disaster Risk Reduction 2015–2030 (UNDRR, 2015). Laws and policies are also key for planning processes and can mandate the development and periodic updating of relevant SOPs and plans for EWEA, as well as the protection and inclusion of marginalised and at-risk groups. The IFRC Guidelines on Disaster Risk Governance include key recommendations on these topics. The IFRC has also developed a number of guidelines and tools to support decision-makers familiarity with international standards and legal frameworks, improve domestic legislation and address the legal barriers that can stand in the way of effective risk reduction and disaster management (IFRC, 2019).

Coordination

Governments are advised to take overall ownership of EWS, supported by accountability, sustained commitment and the necessary funding. A willingness on behalf of the government in question to work collaboratively with non-state actors, and capacity to deliver on an EWS mandate is of course a prerequisite to this approach.

The WMO, through the NMHSs, play a key role as the leading voices on an international and respective national level for decision-support information in disaster preparedness, prevention, and response in the field of meteorological and hydrological hazards. However, given the multitude of additional hazards outside of the area of responsibility of these institutions, these actors must work with others responsible for hazards outside their remit to develop a coherent coordination framework for MHEWS that defines clear responsibilities for both government and non-state actors.

It is important to recognise that effective coordination needs to take place at distinct levels, including national to subnational coordination for vertical integration; inter-ministerial/sectoral coordination for horizontal cooperation at the national and subnational levels; and community coordination, including community co-production, to enhance local engagement and ownership. As indicated throughout this publication, these roles should be incorporated into the legal and policy frameworks to formalise coordination.

To facilitate working and sharing across the formal, informal, and private sectors, the groups should convene through regular meetings, formalised working groups or task forces, or intentional agreements between state ministries or non-state actors to strengthen coordination or data sharing agreements amongst all relevant stakeholders. For example, a lead agency can coordinate the collection, dissemination, and communication of warning data, while hazard monitoring agencies issue warnings for specific hazards. Regular training and exercises within and between these groups can be beneficial to agree a shared strategy, identify weaknesses, update protocols, and adapt to changing contexts. Non-state actors have a crucial role to play in these sorts of working groups by aligning their mandates and providing expertise and advice to governments (including providing a bridge to first mile needs of communities and facilitating feedback mechanisms for improvement), thereby promoting a holistic approach to early warning early action.

Successful coordination structures can be learned from existing mechanisms, for example: the Africa Partner Coordination Mechanism emphasises coordination, collaboration, cooperation, and consultation; the REAP EWI Working Group provides a platform for a range of EWS actors to share lessons of effective early warning coordination; the humanitarian system serves as a model for clear coordination structures; and DRM activities by their remit and nature involve multiple sectors, agencies, and levels of governance.

Collaboration across state and non-state actors can also facilitate cross-sectoral engagement in policy and/or advocacy exercises where a shared goal is desired, and the strength of partnerships can facilitate development of national or regional policymaking. In many cases, actors of the same type may already be adapted to sharing information between themselves (i.e., local, and international NGOs or CSOs), but data and information sharing across state and non-state actors can require a lengthier process due to the differing mandates, processes, and goals of organisations.

Decision-making processes

The needs of decision-makers within EWS for climate or weather events varies significantly due to the different sectoral aspects, organisational cultures, vulnerabilities involved, economic considerations and actor capabilities and capacities. The development of standard operating procedures (SOPs) for different hazards can facilitate timely and better decision-making. SOPs can help technical roles and responsibilities within the EWS but can also be used to clarify relationships and responsibilities related to other actors across the EWEA value chain including warning providers, disaster managers, media, communities, etc. Linkages between technical aspects of SOPs and their socio-economic implications are important to provide policy guidance to practitioners in various aspects related to MHEWS. Thus, SOPs can also provide guidance to support policy and decision-makers on DRR and EWS.

In addition, being transparent about decision-making at the national level (the overall outcome of decisions and information used) can aid international technical assistance to be oriented more towards national gaps and needs. This also encourages governments to be more transparent to citizens on the policy and decision-making process. This also helps provide accountability, especially if a disaster occurs.

Key actions

1. **Enhance coordination across actors (short-to-medium term):**
   All actors involved in EWS can improve coordination among stakeholders involved in EWS, including government agencies, non-state actors, and international organisations. This coordination should occur at multiple levels, from national to subnational, and across different sectors. It includes vertical integration, inter-ministerial/sectoral coordination, and community engagement.
2. **Develop standard operating procedures (SOPs) and enhance transparency (short to medium term):**
   Decision-makers, technical experts and EWS practitioners should develop SOPs for different hazards within the EWS to facilitate better and timely decision-making. SOPs should clarify roles and responsibilities for various actors in the EWS value chain. Additionally, transparency in decision-making processes at the national level can be improved to enhance accountability and orient international technical assistance toward national needs.
3. **Establish a clear policy and legal framework (medium-to-long term):**
   Government authorities, policy makers and legal actors can develop and implement a policy and legal framework that supports an inclusive EWS responsive to the needs of the most vulnerable and adaptable to various hazards. This framework should incorporate principles of cooperation between state and non-state actors.

R4: Prioritise the establishment of trust as a dynamic process, encompassing cognitive and affective dimensions

In the complex landscape of EWS, where multiple, diverse actors with varying interests, priorities, approaches, as well as distinct cultures, vocabularies, and values converge, it is imperative for them to acknowledge, comprehend, and embrace their differences. This awareness and acceptance of diversity are crucial in building mutual trust and fostering constructive dialogue among the stakeholders, as highlighted by The Partnering Initiative in 2016 (The Partnering Initiative, 2016).

Trust plays a pivotal role in the collaboration between state and non-state actors and the establishment of strong and secure connections along the EWS value chain. It is important to view trust-building as a dynamic process that draws from both cognitive aspects, which involve perceptions of trustworthiness founded on expectations of predictability and reliability in behaviour, and affective elements, encompassing emotions like care, concern, and good will.

Typically, a certain level of cognitive trust (technical ability to perform a function) needs to be established before affective trust (strength of a relationship) can fully develop, and interpersonal trust serves as the bedrock upon which interorganisational trust can be built. In essence, trust is a cornerstone for productive cooperation in the diverse and multifaceted landscape of EWS, enabling actors to work together effectively and enhance resilience in the face of hazards and disasters. Consideration of the relative level of trust (and therefore willingness to engage) within a partnership or between two actors is especially important where:

- Collaboration between state and non-state actors is not the norm.
- Contexts where there are gaps in trust and responsibilities of state actors such as in LDCs or FCAS
- Sustainability of state actors is a priority.
- Level of trust in the government and/or the private sector is low or damaged.
- Contexts where multiple agencies are producing warnings that provide different messages and levels of accuracy.

Key actions

1. **Promote and utilise trust-building collaboration (short term):**
   Both state and non-state actors can organise and encourage regular trust-building workshops and dialogues that bring together diverse EWS stakeholders, including government representatives, In addition, practical and tangible actions to share data, practice joint communication and co-develop plans can build relationships and trust to between individuals and groups. non-state actors, and international organisations. These events should focus on understanding and accepting differences, both cognitive and emotive elements of trust, and fostering an environment of cooperation and mutual trust. Such activities can help bridge trust gaps and lay the foundation for effective collaboration. In addition, practical and tangible actions to share data, practice joint communication and co-develop plans can build relationships and trust to between individuals and groups.
2. **Develop trust via co-production (short term):**
   Maintain trust by updating protocols and standard operating procedures (SOPs) at regular intervals to maintain relationships and foster collaboration and co-production.
3. **Build capacity and capability of non-state actors (short term):**
   Support marginalised and underrepresented groups to develop the confidence and skills to take part in and influence consultations and workshops, which they may not have traditionally participated in. Support marginalised and underrepresented groups to develop the confidence and skills to take part in and influence consultations and workshops, which they may not have traditionally participated in.

R5: Ensure diverse and sustainable EWS funding covers all critical stakeholders

To establish inclusive and people-centred EWS, securing essential funding is of utmost importance, particularly through strong legal frameworks that address the various aspects of comprehensive risk management (including earmarking funds for EWEA-specific activities). This funding is primarily required to facilitate the time-consuming process of building these systems from the ground up and gaining a comprehensive understanding of the national context and the specific needs of individuals at risk from various hazards. Additionally, it plays a crucial role in mapping the roles and participation of both state and non-state actors in early warning and early action initiatives. In the long-term, institutional funding is required to operationalise, maintain, and continually improve an effective EWS. Notably, LDCs, SIDS, and FCAS often have limited resources, making this an even more challenging endeavour.

Furthermore, funding allocation in many contexts still leans heavily towards disaster response rather than preparedness. Addressing this challenge necessitates a shift in investment priorities, particularly from external sources, towards preparedness. The development of EWS requires investment in various aspects, including resources, personnel, the enhancement or diversification of skill sets, protocol development, infrastructure installation for both initial setup and ongoing use, and maintenance.

Adequate funding for collaboration and coordination is vital to support government institutions in their leadership role in early warning efforts. Given the multitude of diverse organisations involved in the EWEA value chain, often unaware of their complementary roles, this coordination is essential. One promising approach to foster collaboration is the creation of consortia for donor-funded projects and programmes aimed at enhancing state capacity and promoting inclusive EWS. However, it is important to note that project-based methods and the fragmented nature of these initiatives can potentially limit the long-term sustainability of EWS improvements.

This challenge is further exacerbated by project cycle funding, which may lead to inherent uncoordinated redundancies and, overall, leave communities unsupported. Non-state actors involved in EWS efforts are particularly affected by these issues. Finding solutions to these funding challenges is essential to ensure the long-term effectiveness and sustainability of EWS.

The private sector can have a positive impact in cases where funding is scarce. The WMO Policy Framework for Public-Private Engagement (WMO, 2018b) states that "private sector entities have been active to a varying extent in the full value chain of activities, starting with observations; extending to data acquisition tools and technologies, information generation and processing technologies; and culminating in product dissemination and services." Greater engagement of private sector actors, be it through the inclusion of professional bodies in working groups or closer collaborations in the implementation of specific components of Early Warning Systems (EWS), has the potential to stimulate innovation and foster the exchange of ideas for the enhancement of EWS delivery. However, the involvement of the private sector requires careful evaluation to ensure that EWS are supported and implemented in an equitable and sustainable manner.

Critical considerations include assessing whether EWS impose economic barriers that hinder access to vital information, potentially leading to the exacerbation of inequalities. Additionally, it is essential to evaluate the sustainability of EWS initiatives, especially if businesses decide to withdraw their support for financial reasons, and to determine issues related to data ownership. These factors must be thoroughly examined to strike a balance between the advantages of private sector engagement and the need to ensure fair and enduring EWS implementation. The Policy Framework for Public Private Engagement includes a set of principles that need to be considered when implementing these partnerships:

1. Advancing the overarching goals articulated in the WMO Convention (protection of life and property; safeguarding the environment; contributing to sustainable development; promotion of collection of meteorological data; promotion of capacity-building; meeting international commitments; contributing to international cooperation).
2. Shared value ('win-win' solutions for private and state benefit).
3. Sustainability (matters critical to sustainability of forecasting should be undertaken by the private sector).
4. Advancing together (a new approach to a better engagement with private and academic sectors as well as to investment policies, both national and through development financing, should be promoted to support and enhance the provision of high-quality products and services to users in all countries based on need).
5. Level playing field (public and private sector communities should both have the opportunity to propose cooperative arrangements or other forms of engagement which will facilitate working together, when appropriate).
6. Integrity (public agencies should seek to engage in mutually beneficial relationships to the benefit of society).
7. Sovereignty (how weather, climate and hydrological services are to be arranged and provided within their sovereign nations should be respected).
8. Transparency (information on the nature and scope of major arrangements should be available to the concerned entities and to the public at large).

Key actions

1. **Promote diverse funding mechanisms (short to medium term):**
   Governments, international organisations, non-state actors and private sector entities can be encouraged to explore diverse funding mechanisms for EWS. This may include exploring public-private partnerships, donor-funded projects, or creating consortia for EWS initiatives. Governments should take the lead in seeking funding and coordinating efforts, and international organisations can provide support and guidance. Private sector engagement should be assessed critically to ensure equity and sustainability.

2. **Establish transparent and accountable funding structures (medium term):**
   Develop transparent and accountable funding structures for EWS, ensuring that resources are allocated efficiently and that there is a clear delineation of roles and responsibilities. This includes considering the principles of international framework for public-private engagement, such as shared value, sustainability, and sovereignty. Governments, international organisations, and donors should work together to establish these structures to support inclusive EWS.

3. **Engage decision-makers for effective early action (medium term):**
   International organisations can actively support governments to involve decision-makers, policymakers, and various government departments in creating a policy environment that supports the translation of early warnings into concrete actions. Recognise the complex political aspects of early action, including resource allocation and policy priorities. Encourage alignment of policy and institutional mechanisms to enable timely and appropriate responses to identified risks.

R6: Recognise the challenging and changing roles of state and non-state actors in fragile and conflict affected contexts

FCAS contexts may need more support from non-state actors to strengthen their early warning capacities as state actors may be less stable, under-resourced, and/or have issues related to trust with communities at risk. The exact roles of state and non-state actors in EWS in FCAS contexts will be highly variable and specific to the political, historical, and cultural context, the interactions between and dynamics of each.

The Global Public Policy Institute and the Red Cross Red Crescent Climate Centre's 'An Agenda for Expanding Forecast-Based Action to Situations of Conflict' (Wagner and Jaime, 2020) provides a set of recommendations for non-state actors seeking to expand Forecast-based Action (FbA) to situations of conflict. These recommendations encompass diversifying early warning sources to consider both climate-related hazards and conflict risks, investing in data collection and decision-making capabilities, pre-agreeing specific actions based on early warnings with flexibility, exploring access to funding mechanisms for anticipatory actions, identifying champions to advocate for early action, fostering multi-sectoral collaboration with various organisations and institutions, and integrating anticipatory actions into the broader disaster risk management continuum. By proactively adapting to the complexities of early action in conflict settings and implementing these recommendations, non-state actors can effectively enhance their humanitarian efforts, ultimately mitigating the impact of crises and saving lives in challenging contexts. A recent study also focused on the state of knowledge of EWEA for climate hazards in countries affected by armed conflict and high levels of forced displacement found that only 24.35% of academic research between 2004 and 2022 focused on the social aspects of EWEA, such as understanding vulnerability and exposure, warning communication and dissemination, early action planning, and financing systems. Given the complexities of operating in conflict contexts, this calls for attention on investment to aid the understanding of the political, social and economic dynamics that can jeopardise EWEA effectiveness (Jaime, et al., 2024). This also raises the point on the importance of enabling non-state actors such as research institutions to conduct research that can help advance knowledge to help develop fit for purpose EWEA processes in these complex contexts.

Many factors within the political context need to be considered, as they bear the risk of influencing the effectiveness of early warning systems. At the same time, EWS themselves can become politicised, where certain parts of government and/or non-state actors desire to control these systems and prevent other actors from access and flows of information. Conflict-sensitive EWS are therefore crucial in fragile and conflict-affected settings. Considerations include:

- Government volatility: High staff turnover and changing political priorities within governments can affect continuity and long-term commitment to early warning systems. Political instability can disrupt the implementation and maintenance of these systems, leading to gaps in early warning capacity.
- Recurring disaster cycles: In some contexts, recurrent disaster cycles can result in a culture of emergency response rather than proactive risk reduction. This often results in insufficient resources, both human and financial, being allocated to early warning initiatives. The lack of sustained investment hinders the development and effectiveness of these systems.
- Gaps in government institutional capacity: In many contexts, there are gaps in state institutional capacity across the EWEA value chain. These gaps include areas such as hazard monitoring and forecasting, information dissemination, community engagement and response coordination and are exacerbated by the high staff turnover rate. There are likely to be challenges to last-mile early warning dissemination in conflict settings due to access restrictions. Non-state actors (including conflict parties) can help fill these gaps by providing expertise and resources, as well as facilitating safe access to communities, if requested.
- Humanitarian principles: During political ambiguity and volatility, the humanitarian principles (humanity, impartiality, neutrality, and independence) remain a beacon to guide the practice of humanitarian actors and are central to secure access to affected populations. However, humanitarian actors engaged in the EWEA value chain face a dilemma when deciding whether and/or how to collaborate closely with government actors, which can affect their perceived neutrality, particularly in conflict settings. The potential role of the military and humanitarian actors in areas affected by conflict, as part of civil-military cooperation that often exists in the humanitarian sector, is a topic that is important for consideration in conflict settings.

In settings with limited government capacity, which may include Least Developed Countries (LDCs), Small Island Developing States (SIDS), or Fragile and Conflict-Affected States (FCAS) and where government trust is low, running parallel systems can worsen challenges. Multiple systems for disaster response, public services, or conflict resolution may have a significant impact on state capacity. This allocation of resources and personnel across parallel systems leads to inefficiencies and hampers government coordination across and within state actors and with non-state actors. In areas where government capacity is nearly absent, these parallel systems disrupt coordination between non-state actors and government institutions, resulting in gaps in service delivery and fragmented crisis responses. A balanced, nuanced approach is needed to access and increase financing to strengthen government capacity (UNDRR-WMO CoE, 2023) while allowing non-state actors to complement efforts. For example, a 2022 study highlighted the role of global providers of forecast information to enable forecasts in conflict areas where national forecasts are often limited (Jaime et al., 2022). However, it should be noted that context is key and there may be exceptions to this approach, i.e. when working with government agencies may cause more harm than not working with them. Taking a conflict sensitive approach, including considerations of collaboration, clear communication, transparency, awareness of political and social context, and trust-building are essential for addressing the unique challenges posed by limited government capacity and trust issues in these contexts. The role of coordination networks, such as the Anticipatory Action in Conflict practitioners group of the Anticipation Hub, is important in such cases in advancing collaboration, coordination and joining learning among non-state actors.[1]

Early warning systems serve the critical purpose of offering evidence-based forecasts for a wide spectrum of hazards in a transparent manner. Their objective is to ensure that governments, organisations, civil society, and the affected populations are well-informed and adequately prepared to anticipate and mitigate potential risks effectively. These systems are designed to operate as non-political instruments in an inherently political environment. However, challenges can emerge when the information they generate is considered sensitive or has been directed from certain actors, especially in regions marked by political instability such as FCAS In such situations, information can be used in political discussions, subject to interpretation, and, in some instances, can contradict political narratives.

1 https://www.anticipation-hub.org/anticipatory-action-in-conflict-practitioners-group

Moreover, in conflict-affected environments where early warning information carries political significance, armed non-State actors exercising either government-like functions or control over territory and population must respect and protect the human rights of individuals and groups (Walch, 2018). Acting as de facto governments, these actors may leverage their networks and relationships to gather and distribute early warning information to communities. While their involvement can bolster the efficacy of early warning systems in such contexts, it is crucial to note that these actors are not politically neutral. Rather, their independence from any specific political party can enable them to offer information independent of the state. It is therefore critical to exercise caution regarding the intentions of such non-state actors, as they may also have the capacity to utilise information for nefarious purposes.

It is important to note that early warning systems primarily offer information on potential hazards and associated risks to both state and non-state actors. The translation of this information into effective early action hinges on the political will and commitment of relevant stakeholders. Decisions to take early action in response to warnings involve intricate political considerations, including resource allocation, policy priorities, and coordination between government departments and non-state actors. The success of early action relies on the alignment of policy and institutional mechanisms that enable timely and appropriate responses to identified risks. Therefore, in addition to delivering accurate and timely early warning information, early warning initiatives must actively engage with decision-makers and policymakers to create a policy environment conducive to translating warnings into tangible actions.

Key actions

1. **Advocate for transparent and non-political EWS (short to medium term):** Advocate for the establishment of transparent and non-political EWS that provide evidence-based forecasts in a neutral manner. Promote EWS as non-political instruments in inherently political environments. Engage in dialogue and foster partnerships with relevant stakeholders, including government agencies and local actors, to ensure the credibility and effectiveness of early warning initiatives.

2. **Build collaborative partnerships and trust (medium term):** Encourage collaborative partnerships and trust-building between governments, non-state actors, international organisations, and donors in least developed contexts. Collaborative partnerships should involve sharing information, expertise, and resources. These partnerships should also consider the political, historical, and cultural context of each specific situation. Promote inclusivity, dialogue, and collaboration to strengthen early warning systems and enhance their effectiveness.

R7: Ensure linkages to international processes

International agencies play a pivotal role in advancing the implementation of EWS as a public good that primarily serves the most vulnerable populations. They contribute to this mission through various means, promoting people-centred approaches to EWS in the following ways:

- **Promoting warnings as a public good:** International agencies advocate for the recognition of early warnings as a public good, emphasising that they should be accessible and beneficial to all nations worldwide.
- **Encouraging free data use, availability, and integration:** They encourage the free-of-charge use, availability, and integration of critical data, ensuring that essential information is accessible to those who need it, regardless of economic or political boundaries.
- **Developing and funding capacity-building programmes:** These agencies take a lead role in developing and funding capacity and capability-building programmes and projects, equipping communities and organisations with the knowledge and skills necessary for effective EWS implementation.
- **Ensuring funding alignment and optimisation:** International agencies work to ensure that funding and financial resources for EWS are effectively aligned and optimised, maximising their impact in supporting at-risk communities.
- **Identification and development of country case studies:** They identify and develop country case studies that offer valuable insights and opportunities for other nations to leverage new knowledge and recommendations for the development of their own EWS, thereby promoting knowledge-sharing and mutual support among countries.

Key action

1. **Promote and advocate for early warnings as a public good (immediate and ongoing):**

   International agencies should promote warnings as a global public good for all nations. This involves advocating for the free availability and integration of warning data, encouraging the use of good practice cases that can be adapted in different settings, and providing support for capacity and capability-building programmes. Furthermore, international agencies should work to ensure that funding for EWS is properly aligned and optimised to benefit the most vulnerable populations. The ongoing nature of this action emphasises the importance of continual advocacy and support to make EWS accessible and effective worldwide.

R8: Recognise that EWS learning is embedded across multiple stakeholders throughout the EWS value chain

Effective monitoring, evaluation, accountability, and learning (MEAL) in the context of EWS play a crucial role in the journey toward community ownership of EWS over time. MEAL processes help in several ways, including tracking participation and involvement, providing evidence of what works and its impact, and informing initiatives for scaling up.

By improving the quality of participation, MEAL efforts contribute to the identification of effective behaviours and their determinants. They also aid in the development of appropriate messages and ensure equity in both behaviour change and early warning programming. MEAL is not only invaluable in the initial design of a behaviour centred EWS but also for ongoing feedback and adjustments necessary for refinement and improvement as part of the MEAL cycle, ensuring the sustainability of the EWS.

MEAL frameworks are integral for assessing the success of EWS across different elements, encompassing risk knowledge, monitoring of hazards, and forecasting, warning dissemination and communication, and preparedness to act. Additionally, MEAL processes for effective partnerships contribute to understanding the success or relative failure of EWS for different actors within the system. This holistic approach to MEAL is instrumental in promoting accountability, learning, and ultimately, the effectiveness of EWS.

Key action

1. **Implement effective MEAL for EWS (immediate and ongoing):**

   Implementing effective MEAL processes is essential for improving EWS and fostering community ownership over time. MEAL helps track participation and involvement, provides evidence of what works and has an impact, and informs initiatives for scale-up. It is crucial for enhancing the quality of participation, identifying effective behaviours and their determinants, developing appropriate messages, and ensuring equity in both behaviour change and early warning programming. MEAL frameworks also play a key role in measuring the success of EWS in across the four elements. They aid in understanding the effectiveness of EWS for different actors within the system and enable continuous refinement and improvement, making it a continuous and ongoing process.

4

CONCLUSION

The success of Early Warning Early Action and Early Warning Systems is contingent on a holistic approach that encompasses not only technical aspects but also social, political, and cultural dimensions. Collaboration between state and non-state actors is pivotal, and trust-building is a principal component of effective partnerships. Moreover, making EWS people-centred and inclusive, addressing the unique needs of vulnerable communities and ensuring diverse capacities and sustainable funding are key factors in the success of EWS.

Understanding that early warning capacities can be found across a range of stakeholders and that learning is embedded throughout the value chain reinforces the idea that EWS is a collective effort. International cooperation and partnerships are crucial to advancing the global goal of reducing disaster risks and building resilience. By recognising the multifaceted nature of EWEA and addressing these eight recommended areas, stakeholders can work together to save lives and reduce the impacts of disasters on vulnerable communities worldwide.

ANNEXES

ANNEX 1: CASE STUDIES OF STATE AND NON-STATE ACTOR ROLES IN EWS

Christian Aid's Experience in Developing Forecast Use from Kenya, India, and Nicaragua[2]

Developing Climate Services in Kenya

The Sustainable Agricultural Livelihoods Innovation (SALI) project by Christian Community Services Mount Kenya East (CCSMKE) was initially designed as a marketing intervention with farmer groups in the semi-arid areas of Embu County in central Kenya. However, mounting climate challenges affecting crop production led to farmer groups seeking additional support to enhance their capacity to cope with climate variations as an integral part of their efforts to access markets. Mbeere District, where the project was implemented, predominantly relies on agriculture, complemented by free-range livestock and poultry. Holding sizes vary across the district, with crop varieties and practices tailored to the region's specific conditions. In recent years, the area experienced a decline in rainfall reliability, prompting farmers to adapt by shifting to drought-resistant crops and modifying planting strategies. The project aimed to improve farmers' understanding of seasonal forecasting and climate science and effectively apply this knowledge to enhance their resilience to climate-related challenges. The window of opportunity for disseminating climate information and facilitating its application was a critical aspect of the project's implementation, with a significant focus on making the most of the time between seasonal forecasts and the onset of rains.

State Actors

Kenya Meteorological Department (KMD): KMD was responsible for releasing seasonal forecasts, which were crucial for the project's planning and implementation.

Non-State Actors

CCSMKE initiated the Sustainable Agricultural Livelihoods Innovation (SALI) project, focusing on marketing intervention in the semi-arid regions of Embu County, central Kenya. As climate challenges began to affect crop production, CCSMKE expanded the project to enhance farmers' capacity to manage climate variations and improve market access.

Farmers: Local farmer groups in Mbeere District, particularly in areas like Karii, Siakago, Kerwa (northern part), and Gategi, Kithenya (southern part), were the primary beneficiaries and participants in the project. These groups consisted of farmers with varying sizes of landholdings, mainly cultivating crops such as maize, cowpeas, green grams,

2 https://www.christianaid.org.uk/sites/default/files/2022-07/developing-climate-services-experience-feb-2015.pdf

beans, sorghum, cotton, pigeon peas, cassava, dorico beans, bullrush, finger millet, and hybrid maize varieties. Their agricultural practices and cropping choices were influenced by changing rainfall patterns and increasing climate uncertainty.

Christian Aid: Christian Aid played a significant role in organising community and national workshops, collaborating with CCSMKE and the Humanitarian Futures Programme (HFP). These workshops aimed to enhance understanding of climate science and the application of seasonal forecasting among the participating farmer groups and project staff.

Humanitarian Futures Programme (HFP): HFP was involved in organising workshops alongside Christian Aid to strengthen the knowledge of seasonal forecasting and climate science among the participating farmer groups and project staff.

International and Local Climate Scientists: International and local climate scientists participated in the workshops and collaborated with farmer groups to enhance their understanding of seasonal forecasting, climate science, and related areas. They contributed to the development of a framework for delivering updated climate information and supporting its effective application.

International Actors

Greater Horn of Africa Climate Outlook Forum (GHACOF): GHACOF played a crucial role in providing seasonal forecasts. Farmer groups received these forecasts, which helped them make informed decisions about their agricultural practices in response to anticipated rainfall patterns.

Summary and Impact

The case study demonstrates the significant impact of incorporating non-state actors, specifically local indicators, and climate forecasts, in agricultural decision-making. The local indicators provided by community members, even with modernisation and reduced traditional practices, continue to be valued for predicting climate-related events. While traditional knowledge persists, changes in land use, such as deforestation, have affected the utility of some of these indicators.

The partnership between non-state actors like the community groups and state actors like the KMD enhances the effectiveness of climate services. Farmers in the region are keenly interested in seasonal forecasts as they influence crucial pre-season decisions, such as crop choices, seed selection, and planting times. The integration of scientific forecasts, which provide an additional layer of information, complements local indicators. Farmers noted the importance of local indicators in filling gaps in the scientific forecast's coverage.

The adoption of mobile technology, particularly SMS forecasts, offers a promising communication channel, although challenges with reliability exist and additionally, it is important to acknowledge that device access only aids access to warnings if the warning itself is accessible and in the significant majority of most vulnerable communities, this has to be in audio format. Nevertheless, the ability to receive 7-day forecasts tailored to their location was highly appreciated by farmers, enabling more precise decision-making for tasks like planting and pest control. Farmers have shown a high degree of confidence in forecasts when both local indicators and scientific forecasts agree. In collaboration with Safaricom, this platform has now expanded over the years to cover thousands of SMS forecast users.

The impact of integrating forecasts into agricultural practices is positive, with most farmers attributing yield improvements of more than 5% to their forecast-informed decisions. The improved yield results from making more accurate decisions about planting, crop types, and varieties that better match the anticipated seasonal conditions. The study suggests that a more in-depth quantitative analysis may provide further insights into the yield impact of climate forecasts, but these qualitative findings support the hypothesis of a 10-20% yield improvement.

In summary, the case study underscores the critical role of non-state actors and local knowledge in improving the resilience and productivity of agricultural practices in the face of changing climate patterns. The collaboration between non-state actors and state actors in delivering climate services, including seasonal and 7-day forecasts, holds the potential for positive impacts on agricultural outcomes and should be further developed to benefit local farming communities.

Developing Climate Services in India

The intervention in this case study, led by the Gorakhpur Environmental Action Group (GEAG), was aimed at promoting environmentally sustainable agriculture in Uttar Pradesh, India, with a specific focus on the vulnerable Ganges flood-plain. This initiative, which began in 2011, was designed to bolster the resilience of small-scale farmers by providing them with crucial weather forecasts and agro-meteorological guidance.

Non-State Actors (GEAG)

- GEAG took the initiative to address the climate-related concerns of small-scale farmers in the region. They lead and executed the intervention.
- The organisation played a pivotal role in developing and disseminating climate services, including a customised a 5-day weather forecast. This was accomplished through an in-house climatologist and a network of rain gauges and observatories.
- GEAG provided tailored agro-meteorological recommendations, considering seasonal variations. These recom mendations covered essential aspects such as pest control, irrigation managemen t, and compost application.
- Inclusivity was at the core of their approach, actively engaging with farmers. GEAG offered training and conducted monthly reviews to gather feedback and enhance the reliability of the forecast.
- The integration of local knowledge and traditional weather indicators enriched the forecast's value to the community.

Community and Farmer Involvement

- Communities within the project area enthusiastically embraced climate services to improve their agricultural practices and resilience against climate fluctuations.
- These communities seamlessly integrated climate services into their management and implementation pro-cesses, ensuring broader access to these services through various means.
- Farmers leveraged the 5-day forecasts to make informed decisions about their agricultural activities, leading to notable cost savings and increased yields.
- The community actively participated by providing feedback and responses, actively contributing to the contin-uous improvement of the forecasting system.
- Valuing the significance of local knowledge and traditional indicators, these insights were thoughtfully incorpo-rated into the forecasts.
- Farmers also expressed a keen interest in expanding the range of services, aspiring to access seasonal forecasts and gain insights into long-term climate impacts.
- Sustainability and scaling of the project were emphasised, with a commitment to retaining the value of local knowledge and enhancing agricultural advice within the forecast system.

State Actors (Indian Meteorological Department - IMD)

- IMD played a vital role by providing essential weather data and information, complementing GEAG's forecast.
- Collaborative efforts between IMD, GEAG, the Ministry of Earth Sciences, and the Narendra Deva University of Agriculture and Technology (NDUAT) led to the refinement and cross-checking of the in-house forecast.
- IMD's weather stations and data were seamlessly integrated into the forecast, elevating its accuracy and reliability.
- The inclusion of IMD's flood warnings for the Rapti River basin enhanced the forecast's relevance, particularly during flood events.

Outcomes

- The results of this intervention were notable and impactful, with increased crop yields being a prominent outcome, especially in areas where farming decisions were informed by the 5-day forecast.
- The cost-effectiveness of agricultural practices significantly improved, as farmers achieved cost savings by using inputs like irrigation and biopesticides more efficiently, benefiting both ecological and conventional farming approaches.
- Farmers honed their pest control measures, thereby reducing risks and associated costs.
- Enhanced resilience was evident as households made informed decisions, such as storing essential items during heavy rain.
- The timing of harvests was optimised, reducing post-harvest losses.
- Improved household welfare was observed as families made better decisions regarding childcare, travel, and maintenance.
- The 5-day forecasts were widely considered highly reliable, with a reliability range of 75% to 100%.
- The value of local knowledge and traditional indicators persisted alongside the 5-day forecasts.
- Interest in expanding the range of services was evident, with a desire to access seasonal forecasts and gain insights into long-term climate impacts.

Sustainability and scaling were recognised as key priorities, with ongoing efforts to expand the system and enhance compatibility with other forecasting initiatives in Uttar Pradesh.

Developing Climate Services in Nicaragua

Centro Humboldt's approach in Nicaragua involved taking a comprehensive view of climate change, considering both national and long-term perspectives. Despite a decline in overall poverty, rural areas continue to grapple with inequality, exacerbated by the country's vulnerability to natural disasters such as floods, cyclones, landslides, earthquakes, and volcanic eruptions. The western dry corridor faces recurrent droughts, jeopardising food security and local livelihoods, especially in the coffee sector, threatened by coffee rust. Changing climate patterns, marked by rising temperatures and altered rainfall, have significant repercussions for agriculture and crop suitability. To better understand the impact of greenhouse gases on regional climate, Centro Humboldt developed a regional climate model using the UK Meteorological Office's PRECIS programme. The overarching goal of the project was to enhance community resilience, promote knowledge management, and advocate for climate change adaptation in Nicaragua.

State Actors

Instituto Nicaragüense de Estudios Territoriales (INETER) is a state-affiliated institution and collaborates with non-state organisations like Centro Humboldt in climate modelling and provides expertise in the field.

Non-State Actors

Centro Humboldt: This non-governmental organisation leads climate change efforts in Nicaragua and collaborates with various stakeholders to address the issue. It operates independently of the government.

Nicaraguan NGOs (CIEETS and Nochari): These local non-governmental organisations partner with Centro Humboldt to implement climate change projects. They focus on community resilience, knowledge management, and advocacy, operating independently of the government.

INSMET (Cuba): INSMET collaborates with non-state group Centro Humboldt, providing expertise and training on climate modelling, making it a non-state entity in the context of Nicaragua's climate change initiatives.

Local communities: These are non-state entities actively participating in climate adaptation projects, providing vital input and experiences in the process.

Farmers: Farmers are individuals involved in agriculture, and their involvement in the project reflects the engagement of non-state actors, as they are not directly affiliated with the government.

Bosawas Biosphere Reserve: While it is a natural reserve and not an organisation, its involvement in the study emphasises the importance of non-state entities, as it undergoes potential environmental changes due to climate change.

International Organisations

UK Meteorological Office as an international development actor that provided the PRECIS programme for climate modelling. It plays a role in the state's efforts to understand the regional impacts of climate change.

Outcomes

The case study on climate change adaptation in Nicaragua underscores the importance of a collaborative approach involving technical and community expertise. This collaboration included state-affiliated and non-state actors working together to develop climate model outputs that could be comprehensible and valuable to local farmers' decision-making processes (Ewbank et al., 2019). The response to Cyclones Eta and Iota in 2020 showed how effective the Centro Humboldt system had become, especially through increased use of social media communication, providing early warning information despite COVID and other challenges. The project extended technical support to local municipalities, their Food Security and Nutrition Municipal Commission (COMUSAN) members, and the local Instituto Nicaragüense de Tecnologia Agropecuaria (INTA) to bridge the gap between technical climate data and its practical utilisation in agriculture and disaster preparedness.

Crucially, local communities actively engaged in the project by establishing rain gauges in their areas. This not only contributed to the calibration of a regional climate model but also empowered them with the ability to make informed decisions related to agriculture and disaster management. The collaboration brought about a significant improvement in agricultural decision-making. Farmers started using rain gauge data to align rainfall patterns with crop phenology, optimise planting schedules, and mitigate risks associated with droughts and floods. This transition from experience-based decision-making to data-driven strategies significantly bolstered their resilience.

Empowering women was another notable outcome of the collaboration. The partnership with Nochari led to increased involvement of women in agriculture, marketing, and decision-making processes. This empowerment resulted in improved family health, enhanced access to markets, and reduced vulnerability to climate change and disasters. Furthermore, the collaboration led to remarkable enhancements in crop yields. Access to knowledge on organic farming, seeds, agricultural training, and the application of climate information through rain gauges translated into substantial increases in staple crop yields, averaging nearly 75%. Diversification of crops, including fruits, vegetables, and medicinal plants, further enriched diets, and food security, contributing to better income generation and access to markets. Community dialogues facilitated by the collaboration allowed local authorities and communities to address priorities, even in the absence of significant policy changes. These discussions gave rise to various local projects targeting issues like deforestation, river contamination, and infrastructure improvements. While technology played a pivotal role, the integration of climate data with local indicators, such as cloud behaviour and traditional forecasting methods, emerged as a valuable practice for enhancing climate services.

This collaborative effort between state and non-state actors yielded a range of positive outcomes, including improved community resilience, enhanced agricultural practices, increased women's empowerment, and more informed local decision-making processes, all incorporating climate information and models for more effective climate adaptation strategies. However, in March 2022, the Nicaraguan Government deregistered and shut down Centro Humboldt (along with thousands of other international & local CSOs). This illustrates some of the difficulties non-state actors may experience working with the government in fragile contexts. Whilst the agrometeorological service was effectively ceased, community-managed weather stations (over 350 at their peak, including automatic weather stations) are still collecting data and many (200+) are submitting it to CafeNica, the national association of coffee producers, for use in their forecasting app. Centro Humboldt is now based in Guatemala and Christian Aid is supporting the locally-led climate services model through partners in Honduras.

The DARAJA Programme[3]

DARAJA, which means 'bridge' in Swahili, is a service and partnership that aims to improve weather and climate information services (WCIS), including early warnings of extreme weather, for urban users. Co-production with vulnerable communities and key service providers is at the heart DARAJA's approach to creating and communicating people-centred forecasts and warnings. DARAJA has been implemented in the informal settlements of Nairobi and Dar es Salaam, reaching 982,000 residents, as an inclusive weather and early warning communication service. Through a process of co-production, disparate actors were brought to work together, which allowed vulnerable communities to sit at the same table as extreme weather forecasters, climate risk experts, media representatives, government officials and the Red Cross Red Crescent, and share their perspectives, experiences, and perceptions of climate risk. The communities played a vital role in analysing the existing system, identifying the main barriers, and proposing the most relevant solutions - resulting in weather and climate information services that were tailored to their needs. Communities have also co-designed local awareness activities and preparedness plans for extreme weather events. Feedback channels created among all the stakeholders have led to increased responsiveness, trust, and improved forecasts from the NMHS. The resulting services that are co-delivered by the community, also provide a sense of ownership, and encourage uptake within the community.

In the context of the DARAJA project in Nairobi, there was a focus on how to collaborate to improve access to weather and climate information (WCI) and enhance its utilisation among the local community.

State Actors

Kenya Meteorological Department (KMD): KMD is the primary state actor responsible for providing accurate weather forecasts and climate information. They engage with non-state actors and the community through the DARAJA project. KMD works to bridge the gap between the community and state actors, responding to user needs by improving the presentation of weather information, addressing user questions, and fostering better relationships with stakeholders.

Non-State Actors

Community leader (James Kirika): Community leaders like James play a crucial role in engaging with the DARAJA project. They participate in co-designing pilot services, making the community aware of the importance of weather forecasts, and helping community members access WCI. They also undergo training to understand and interpret weather forecasts, thus acting as intermediaries between state actors and the community. Their role includes educating the community on the relationship between weather and early action to mitigate climate-related risks.

Main intermediary (KDI): KDI serves as the primary non-state intermediary between state actors like KMD and the community. KDI plays a pivotal role in facilitating the project's activities, engaging with stakeholders, and expanding its social network to other informal settlements. The organisation contributes to community awareness, training, and knowledge sharing regarding weather and climate information.

Radio Presenter/Journalist (Philip Muhatia from Pamoja FM): Radio presenters and journalists act as communication channels between state actors and the public. They work to simplify complex weather terminology to improve the understandability of forecasts for their audience. They incorporate WCI into their content planning processes and use their platforms to reach a broader audience with timely and trusted information.

Kenya Red Cross (KRC): As a non-state actor, KRC serves as a disaster risk reduction officer and collaborates with KMD and the community. KRC participates in workshops and training sessions, understanding the implications of climate information, and using it for early planning and early action. They have improved their hazard communications by incorporating weather forecasts into their messages.

3 https://darajacommunity.net/

In this case study, the state actor, KMD, provided accurate weather information, and non-state actors such as community leaders, intermediaries (KDI), radio presenters, and NGOs (KRC) played pivotal roles in bridging the gap between the state and the community. They facilitated access to weather information, improved its understandability, and promoted its utilisation for early action and risk reduction.

The Adaptation Consortium (ADA) County Climate Information Services (CIS) Plan

The Adaptation Consortium (ADA) is an organisation dedicated to assisting county governments in Kenya in integrating climate change considerations into their development and planning processes. They achieve this through the implementation of the County Climate Change Fund (CCCF) mechanism.

The CCCF empowers local communities by allowing them to prioritise and invest in projects that enhance the resilience to climate change. Originally known as the County Adaptation Fund (CAF), the CCCF was first piloted in Isiolo County in 2012-2013, with the support of various organisations including the Ministry of State for Development of Northern Kenya and other Arid Lands (MDNKOAL), the International Institute for Environment and Development (IIED), Kenya Meteorological Department (KMD), and the Resource Advocacy Programme (RAP).

Developing Decentralised, User-relevant Climate Information in Kenya[4]

KMD, in collaboration with the ADA Consortium, initiated the development of a groundbreaking County Climate Information Services plan in Kitui County. This plan aimed to generate climate information vital for decision-makers in County Governments and key livelihood groups, fostering resilience to climate change.

State Actors

KMD, County Governments, National Drought Management Authority (NDMA), Ministries of Environment, Livestock, Planning, Agriculture, and Water.

Non-State Actors

ADA Consortium (Christian Aid, International Institute of Environment and Development - IIED, Anglican Development Services-Eastern - ADS-E).

The County CIS plan, having undergone a successful pilot phase in Kitui, has achieved significant milestones in its endorsement and adoption. The formal support from both the County Government and the Kenya Meteorological Department (KMD) marks a crucial step, positioning the plan as a recognised template for nationwide implementation. This recognition is underscored by its integration into the KMD Strategic Plan, emphasising its role in the decentralised delivery of services across all 47 counties. Furthermore, the initiative is actively expanding, with plans for County CIS development underway or completed in the five Arid and Semi-Arid Lands counties targeted by the Adaptation (ADA) Consortium. Additional support from the DFID Weather and Climate Information and Services (WISER) programme extends this effort to four more counties in Western Kenya. Internationally, the approach taken in Kenya has influenced similar ventures in Tanzania, showcasing the project's broader impact. Within KMD, the process has gained official recognition, paving the way for scaling up to encompass all counties. Designated responsibilities for County CIS plans have been assigned to KMD County Directors of Meteorology, and the initiative has been incorporated into the strategic framework for service decentralisation. The ongoing success of the plan is assured through a robust framework developed by ADA, facilitating regular monitoring and evaluation at both County Government and KMD headquarters, ensuring continual enhancement and effectiveness.

4 *https://site.adaconsortium.org/wp-content/uploads/2022/09/CIS-Plan-Developing_Decentralised_User_relevant_Information.pdf*

The success of the County CIS plan can be attributed to key principles guiding its development. Inclusive planning has been paramount, emphasising widespread consultations across decision-making levels, diverse sectors, and livelihood groups. The integration of regular feedback and review mechanisms has played a pivotal role in fostering inclusivity, ensuring that the plan is reflective of the varied needs and perspectives within the community. Another critical aspect is the generation of credible climate information, achieved through the co-production of advisories with technical expertise drawn from various sectors. This collaborative approach enhances the plan's credibility, as it combines scientific knowledge with practical insights. Furthermore, the sustainability of the initiative is ensured through a two-fold strategy. Firstly, by demonstrating tangible benefits through comprehensive baselines and regular monitoring, the plan establishes its effectiveness over time. Secondly, by identifying opportunities for financial support, including grants such as the DFID Weather and Climate Information and Services (WISER) programme, the plan secures the necessary resources for long-term viability, emphasising the importance of financial backing in sustaining impactful projects.

Protecting Civilians in Sudan: The Jeddah Declaration and Collaborative Action[5]

The case study focuses on Sudan's efforts to protect civilians and address the compounding challenges of armed conflict and climate change through the signing of the Jeddah Declaration. Signed on May 11, 2023 by the Sudanese Armed Forces and the Rapid Support Forces, the declaration aimed to formalise their commitments under international humanitarian and human rights law, emphasising rules to guide their conduct in delivering essential services, healthcare, and humanitarian assistance.

Sudan faces significant climate risks, ranking 177th out of 192 countries in vulnerability. The Jeddah Declaration became a critical instrument for recognising legal obligations in the midst of ongoing conflict, providing an opportunity to demonstrate how adherence to international humanitarian law can address the dual consequences of climate change and conflict.

Key State Actors

Sudanese Armed Forces (SAF): As a central state actor, the SAF, a party to the conflict, committed to upholding international humanitarian and human rights law. Their recognition of obligations demonstrated a commitment to ensuring the well-being of civilians and providing essential services in accordance with established legal frameworks.

Rapid Support Forces (RSF): Similar to the SAF, the RSF, as a state actor involved in the conflict, became a signatory to the Jeddah Declaration. Their commitment echoed the recognition of legal obligations, further emphasising the joint commitment to protect civilians and provide essential services.

Collaboration with Non-State Actors

Humanitarian Organisations: The Jeddah Declaration underscored the importance of collaboration with non-state actors, particularly humanitarian organisations. Emphasising humanitarian access, the declaration recognised the crucial role of these organisations in delivering assistance, addressing immediate needs, and preparing for potential climate-related challenges.

Climate Resilience Organisations: Non-state actors focusing on climate resilience played a vital role in addressing Sudan's climate risks. Their involvement in anticipatory actions, such as distributing provisions, implementing protective measures, and supporting evacuations, aligned with the goals outlined in the Jeddah Declaration.

5 https://www.anticipation-hub.org/news/sudan-protecting-civilians-and-alleviating-the-consequences-of-both-conflict-and-climate-change

The collaboration between state and non-state actors involved mutual recognition of legal obligations. State actors, by committing to upholding international humanitarian and human rights law, created an environment conducive to the effective operation of humanitarian and climate resilience organisations. This collaboration highlighted the interdependence between various actors in ensuring the well-being of civilians and mitigating the compound risks of conflict and climate change in Sudan.

The Jeddah Declaration resulted in the formal recognition of legal obligations by state actors, providing a public acknowledgment of their responsibilities. Lessons learned included the role of legal frameworks as catalysts, the importance of collaboration with non-state actors, addressing compound risks comprehensively, utilising anticipatory actions, and leveraging public acknowledgment for accountability in complex humanitarian contexts.

The collaborative efforts outlined in the Jeddah Declaration serve as a model for addressing the intertwined challenges of conflict and climate change. By formalising commitments and fostering collaboration, Sudan took a significant step toward ensuring the protection of civilians and building resilience in the face of complex humanitarian crises.

ANNEX 2: LIST OF RESOURCES

1. CREWS's Operational Procedures Note No 4: People-Centred Risk-Informed Early Warning Systems (https://www.ifrc.org/document/people-centred-early-warning-systems)
2. WISER's Building Blocks for Co-producing Climate Services (https://www.africaportal.org/publications/building-blocks-co-producing-climate-services/)
3. WISER's Manual for Co-production in African Weather and Climate Services (https://www.preventionweb.net/publication/manual-co-production-african-weather-and-climate-services)
4. WMO Publication on Co-production (Available via WMO Library) (https://library.wmo.int/doc_num.php?explnum_id=11246)
5. Information on Co-production from the Met Office (https://www.metoffice.gov.uk/about-us/what/working-with-other-organisations/international/projects/wiser/co-production)
6. WMO Publication on Integrating Private Sector and Other Stakeholders (https://library.wmo.int/doc_num.php?explnum_id=11246)
7. IFRC's Community Early Warning System Toolkit (https://www.ifrc.org/document/community-early-warning-systems-cews-training-toolkit-field-guide)
8. IASC's Standard Operating Procedures for Early Action to El Niño/La Niña Episodes (https://interagencystandingcommittee.org/iasc-reference-group-risk-early-warning-and-preparedness/iasc-inter-agency-standard-operating-procedures-early-action-el-ninola-nina-episodes-2018)
9. WFP's Anticipatory Action case studies (https://www.wfp.org/anticipatory-actions)
10. Servicio Meteorológico Nacional's (SNM) Good practices for interacting with users of meteorological, climate and environmental services (https://repositorio.smn.gob.ar/handle/20.500.12160/2713)

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REAP
Risk-informed
Early Action
Partnership