CENTRE OF EXCELLENCE
CLIMATE AND DISASTER RESILIENCE

Early Warning Systems and Early Action in Fragile, Conflict-affected and Violent Contexts

Addressing Growing Climate and Disaster Risks

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Acronyms and abbreviations

ACLED	Armed Conflict Location & Event Data
AICS	AICS Italian Agency for Development Cooperation (Agenzia Italiana per la Cooperazione allo Sviluppo)
ANAM	ANAM National Meteorological Agency of Burkina Faso (Agence Nationale de la Météorologie)
CBDRM	CBDRM community-based disaster risk management
Centre of Excellence	Centre of Excellence Centre of Excellence for Climate and Disaster Resilience
CEOS	Committee on Earth Observation Satellites
CERF	Central Emergency Response Fund
CNES	French National Centre for Space Studies (Centre National d'Etudes Spatiales)
CNIGS	Haitian National Centre for Geo-Spatial Information (Centre National de l'Information Géo-Spatiale)
COP	Conference of the Parties
CPDP	community peace for development plan
CREWS	Climate Risk and Early Warning Systems
DRM	disaster risk management
DRR	disaster risk reduction
DTM	Displacement Tracking Matrix
ECMWF	European Centre for Medium-Range Weather Forecasts
EWEA	early warning, early action
EWS	early warning system(s)
EW4All	United Nations Early Warnings for All
FAO	Food and Agriculture Organization of the United Nations
FCV	fragile, conflict-affected and violent
FEWS NET	Famine Early Warning Systems Network
GBON	Global Basic Observing Network
GEO	Group on Earth Observations
GSNL	Geohazards Supersites and Natural Laboratories
HDP	humanitarian, development and peacebuilding

IASC	Inter-Agency Standing Committee
IBF	impact-based forecast
ICPAC	Intergovernmental Authority on Development Climate Prediction and Applications Centre
ICRC	International Committee of the Red Cross
IDP	internally displaced person
IGAD	Intergovernmental Authority on Development
IOM	International Organization for Migration
LDC	least developed country
MHEWS	multi-hazard early warning system(s)
MONUSCO	United Nations Organization Stabilization Mission in the Democratic Republic of the Congo
NDC	National Disaster Centre
NMHS	National Meteorological and Hydrological Service
NSAG	non-State armed group
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PDC	Provincial Disaster Centre
PDNA	post-disaster needs assessment
REAP	Risk-informed Early Action Partnership
RO	Recovery Observatory
Sendai Framework	Sendai Framework for Disaster Risk Reduction 2015–2030
SIDS	small island developing State(s)
SMA	Sudan Meteorological Authority
SOFF	Systematic Observations Financing Facility
SWALIM	Somalia Water and Land Information Management
UHM	Hydrometeorological Unit of Haiti (Unité Hydrométéologique d'Haïti)
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
WFP	World Food Programme
WMO	World Meteorological Organization

1. Introduction

1. Introduction

Countries experiencing fragility, violence and conflict are often unprepared for the increasing frequency and scale of extreme weather events and other impacts of climate change. Of the top 25 countries most vulnerable to the impacts of climate change (University of Notre Dame, 2023a, 2023b), a striking 19 have fragile and/or conflict-affected contexts.[1] Many populations within these countries are not covered by early warning systems (EWS),[2] and are thus at further risk of harm. They are also some of the over 130 million people globally who lack access to EWS, many of whom are in least developed countries (LDCs) and small island developing States (SIDS) (UNDRR and WMO, 2023). Extending EWS to "last-mile communities"[3] that include people who have been affected by violence, conflict and/or displacement is critically important.[4]

While EWS are vitally important for short-term action before extreme weather events, they also play an integral role in climate change adaptation and resilience. Weather and climate forecasts, and information dissemination arising from them, are crucial for enabling communities to better understand the evolving risks of climate change and to develop suitable short- and long-term plans to respond. However, while EWS are gaining more attention, there has been less focus on how countries with fragile, conflict-affected and violent (FCV) contexts can successfully implement EWS, including identifying elements of systems to adapt or additional considerations to account for given particular FCV circumstances.

The Early Warnings for All (EW4All) initiative, launched by the United Nations Secretary-General in November 2022 at the twenty-seventh session of the Conference of the Parties (COP) in Sharm el-Sheikh, aims to ensure everyone on Earth is covered by an EWS by the end of 2027 (United Nations, n.d.a). This goal opens up important space to consider how knowledge, resources and action can be directed to ensure that countries experiencing fragility, conflict and violence, and FCV regions themselves, receive EWS coverage. It is underpinned by important commitments made at COP 28 in Dubai on increasing awareness and financing of EWS in FCV contexts.[5]

This handbook is designed to outline current needs for EWS in FCV contexts and some of the challenges in EWS design and development. It aims to support implementation of EW4All and COP 28 commitments and is envisioned as an enabler to ensure countries with FCV contexts are supported within the wider ecosystem of EWS stakeholders. These stakeholders include regional climate centres, donor countries, humanitarian and development agencies, local and national authorities, civil society and other local actors.

The handbook draws from and complements global frameworks and existing guidance documents. Alongside the EW4All initiative, it aligns with the Paris Agreement priorities,[6] the main provisions of the Sendai Framework for Disaster Risk Reduction 2015–2030 (United Nations, 2015a),[7] and the targets and principles of the Transforming our World: the 2030 Agenda for Sustainable Development (United Nations, 2015b), including to "leave no one behind".

More specifically, the handbook is envisioned as an accompaniment to existing EWS checklists, including the 2018 World Meteorological Organization

[1] This figure was obtained through comparing countries in the ND-GAIN Country Index to the World Bank's list of countries with fragile and conflict-affected situations (fiscal year 2024) (World Bank, 2024).

[2] Throughout this handbook, the term "EWS" is considered to also include early action.

[3] "Last-mile communities" refers to populations living in remote or hard-to-reach areas that lack sufficient protection from climate risks, or who may be difficult to reach due to literacy and language barriers, migration status and other characteristics. Other phrases used later such as "last-mile connectivity" and "last-mile operators" refer to the work and staff needed to reach these populations.

[4] "Displaced persons" refers to refugees, asylum-seekers, internally displaced persons, returnees and stateless persons. In emergencies that involve refugees, the United Nations High Commissioner for Refugees (UNHCR) representative has the mandate to prepare for, lead and coordinate the refugee, and where applicable, returning refugee responses (IASC, 2018).

[5] For more information, see section 2.3.1.

[6] In particular to "provide financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts" (United Nations, n.d.b).

[7] Notably, Target (g) to increase the availability of and access to MHEWS and disaster risk information.

(WMO) multi-hazard early warning system (MHEWS) checklist (WMO, 2018), the EW4ALL checklist for gap analysis (UNDRR, n.d.a), the United Nations Office for Disaster Risk Reduction (UNDRR) Words into Action Guidelines on MHEWS (UNDRR, 2023a) and other guidance documents tailored to specific regions or populations, including the 2018 Caribbean Disaster Emergency Management Agency MHEWS checklist (UNDP et al., 2018).

In addition, the handbook draws on various publications focused on the application of MHEWS in complex environments by UNDRR, the International Committee of the Red Cross, the International Federation of Red Cross and Red Crescent Societies, the Red Cross Red Crescent Climate Centre, the Anticipation Hub and other EWS stakeholders. It seeks to highlight common considerations for FCV contexts identified in these and other pieces of work. It is accompanied by a policy paper – Early warning systems and early action in fragile, conflict, and violent contexts: Addressing growing climate & disaster risks – launched at COP 28 (Centre of Excellence for Climate and Disaster Resilience, 2023).

The handbook has been developed in coordination with a range of EWS stakeholders through a workshop and consultations held from September 2023 to January 2024; it is considered to be a living document and will be updated regularly.

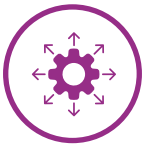
1.1 Objectives

The purpose of this handbook is to identify the basic requirements for EWS in FCV contexts and provide considerations and guidance to further the implementation of EWS in such contexts. It aims to:

- Support implementation of EWS in FCV contexts
- Foster common understanding and expectations of EWS in FCV contexts
- Enable common planning and approaches
- Support multi-stakeholder and cross-sectoral collaboration
- Strengthen monitoring of EWS in FCV contexts

It is intended as a stand-alone guide and also one that can be used in tandem with existing EWS guidance such as the 2018 WMO MHEWS checklist and the EW4All checklist for gap analysis. The handbook considers State actors as the central entry point for EWS development or strengthening, but also acknowledges that, when this is not possible, it is important to involve a range of stakeholders to ensure critical, life-saving EWS.

It thus provides considerations for designing, implementing and extending EWS in contexts where State governance is minimal or lacking, where non-governmental armed groups are in control of territory within conflict contexts, or in other situations of emerging, acute and protracted conflict. As with other existing guidance on EWS, the content should be tailored for context and is therefore envisioned as a springboard for further analysis and design of EWS at different scales in varying situations of fragility, violence and/or conflict.



1.2 Scope

This handbook focuses on EWS designed to detect and address natural hazards rather than the occurrence of conflict as a hazard to forecast. The intended audience of this handbook is government actors, non-governmental actors, and international

partners like humanitarian and development agencies with an interest in developing and strengthening EWS. While conflict is a key threat in many countries, the purpose of the handbook is to look at how EWS for natural hazards and risks can better function in FCV contexts and address the challenges that these contexts present to establishing or implementing EWS.

Some parts discuss incorporating conflict analysis and monitoring into risk assessments and to inform response protocols, but the handbook does not address conflict or violence forecasts. While many conflict-affected countries also experience fragility, many countries experiencing fragility do not experience armed conflict;[8] therefore, considerations for conflict contexts are presented separately from broader considerations.

1.3 Structure

Chapter 1 provides an introduction and defines the terms and scope, including linkages to key global initiatives and documents. It also provides an overview of the state of current knowledge on EWS in FCV contexts.

Chapter 2 presents cross-cutting elements, enablers and approaches to EWS in FCV contexts, with a focus on governance, coordination, finance and technology.

Chapter 3 presents considerations following the four main elements of EWS, also used as key pillars of the EW4All initiative:

- Disaster risk knowledge and management
- Detection, observation, monitoring, analysis and forecasting
- Warning dissemination and communication
- Preparedness and response capabilities (also known as preparedness to respond to warnings)

Chapter 3 provides guidance and considerations for each of the four pillars based on different elements of FCV contexts.

Chapter 4 draws on the examples and considerations presented, and concludes by proposing key components of a common vision for the effective implementation of EWS for all in FCV contexts.

Annex 1 provides examples of literature resources related to EWS, MHEWS, early action and anticipatory action in FCV contexts. **Annex 2** provides case study examples on the implementation of EWS in countries with FCV contexts, to showcase good practices and factors for wider consideration in EWS design and implementation.

1.4 Definition of terms

This handbook follows the Open-ended Intergovernmental Expert Working Group on Indicators and Terminology Related to Disaster Risk Reduction definition (UNDRR, n.d.b) of an EWS as:

> **"An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities, systems and processes that enable individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events.**

MHEWS (discussed here in relation to multiple hydrometeorological or geophysical hazards) are defined (UNDRR, n.d.b) as those that:

> **Address several hazards and/or impacts of similar or different type in contexts where hazardous events may occur alone, simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects. A multi-hazard early warning system with the ability to warn of one or more hazards increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities, involving multiple disciplines for updated and accurate hazards identification and monitoring for multiple hazards.**

While there are various definitions and typologies of fragility and conflict, this handbook draws on definitions and rankings of countries according to levels of fragility and/or conflict published by the World Bank Group in its annual review and 2020–2025 strategy (World Bank, 2020, 2024):[9]

> **Fragility: *Fragility* is defined as a systemic condition or situation characterized by an extremely low level of institutional and governance capacity which significantly impedes the state's ability to function effectively, maintain peace and foster economic and social development.[10]**

> **Conflict: *Conflict* is defined as a situation of acute insecurity driven by the use of deadly force by a group — including state forces, organized non-state groups, or other irregular entities — with a political purpose or motivation. Such force can be two-sided — involving engagement between multiple organized, armed sides, at times resulting in collateral civilian harm — or one-sided, in which a group specifically targets civilians.[11]**

> **Violence: *Countries with high levels of interpersonal and gang violence*, with major destabilizing impact, are identified based on the per capita level of intentional homicides. Gender-based violence (GBV) and violence against children (VAC) are also integrated into this definition.**

The Organisation for Economic Co-operation and Development multidimensional fragility framework offers components of fragility to guide effective action in FCV contexts, and may be a helpful guiding framework in some contexts (OECD, 2022a). Assessing risks and coping capacities, it examines six dimensions of fragility: economic, environmental, human, political, security and societal. Based on this assessment, it identifies extremely fragile and other fragile contexts listed by country, and provides information and resources on different countries' fragility through an interactive platform.

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[9] **"To capture the FCV situations which are of concern to the WBG, the classification is based on methodologies that distinguish countries in *Fragility* and/or *Conflict* situations**. The following definitions are used for the purposes of informing the FCS classification and are not intended for other institutional or legal purposes" (World Bank, 2024).

[10] State fragility generally includes deficiencies in core State functions: authority (including ability to control violence), capacity and legitimacy.

[11] For the purpose of this handbook, particular attention is placed on whether the State is party to a conflict and whether the conflict is geographically contained, including whether there is a separate authority in the conflict area, or whether conflict is widespread throughout the country.

These elements of fragility are worthwhile considerations for actors seeking to identify needs and projected challenges in the design and implementation of EWS in countries affected by FCV contexts. Effective types of investment and action may depend on different categories of fragility.

1.5 State of current knowledge

1.5.1 Gaps in literature

There is a critical gap in literature on how to effectively design and implement EWS in FCV contexts. A rapid evidence review undertaken for this handbook (see **Box 1**) has identified a strong need for more evidence to be generated or publicly shared to guide the EWS global community of practice, also presented in other research (Jaime et al., 2024). Most literature on disaster risk reduction (DRR) and conflict views climate disasters as separate to FCV conditions, and lacks analysis of how these conditions can influence or impede efforts to prepare for, mitigate or avoid extreme weather events. Evidence on MHEWS in FCV contexts remains significantly lacking, although there is increasing interest in addressing natural and conflict hazards.

1.5.2 Predominance of grey literature

Existing knowledge of EWS in FCV contexts mainly comes from grey literature rather than robust studies and academic literature.[12] A 2020 report provided the start of an agenda for expanding forecast-based action to situations of conflict. It clearly separated knowledge and guidance on forecast-based action for conflict and forecast-based action for hydrometeorological hazards in conflict situations (Wagner and Jaime, 2020). Grey literature on the topic also includes country case studies, such as from the Democratic Republic of the Congo, Niger (REAP, 2021), Somalia, South Sudan (Easton-Calabria, 2023), Sudan and Syrian Arab Republic.

These outputs often share findings of interventions rather than providing evidence or information on how programmes have adapted to FCV contexts, or addressed challenges that arose due to the particularities of these contexts. While valuable, work of this nature does not provide evidence or rigorous research on the design, implementation and outcomes of EWS in FCV contexts.

1.5.3 Practitioner knowledge and learning

Increasing interest by practitioners in addressing both natural and conflict hazards, sometimes under the umbrella of "climate security" has led to the development of working groups and insightful risk assessments and publications on climate and conflict.[13] In 2020, a practitioners' group focused on anticipatory action in conflict was created as part of the Anticipation Hub to advance knowledge, information-sharing and policy recommendations on the topic (Anticipation Hub, n.d.). The group's objective is to expand early warning and early action to areas and populations affected by conflict, as well as to explore the anticipation of conflict. An impetus for the creation of this group was the recognition that even when EWS and wider early action were established in an FCV context, they are generally created in accessible territories of a country less affected by FCV contexts.

Research and practitioner knowledge confirms that most violent and highly volatile contexts in countries affected by fragility or conflict are generally not covered by EWS. This illustrates the importance of expanding

[12] In this handbook, "grey literature" refers to documents not published by a commercial or academic publisher but instead materials by agencies, organizations or other actors. Examples of grey literature include policy briefs, reports and project documents. Grey literature may be published or unpublished.

[13] For example, an Expert Working Group on Climate-related Security Risks has been developed (E3G, 2019), and has produced several risk assessment reports for countries experiencing conflict and climate hazards (SIPRI, n.d.). The Stockholm International Peace Research Institute has also published a number of publications on the topic, e.g. Tarif (2024).

BOX 1

OVERVIEW OF RAPID EVIDENCE REVIEW METHODOLOGY

The methodology for reviewing the literature (academic and grey literature, including guidance and manuals) informing the design and implementation of EWS in FCV contexts comprised:

- **Searching academic and grey literature (see Annex 1 for relevant grey literature resources on EWS, including early action and anticipatory action, in FCV contexts), including searching:**
  - Scopus, Active Learning Network for Accountability and Performance, and Google Scholar databases
  - Resource databases on organizational/project websites (e.g. United Nations entities, WMO, Met Office, Red Cross Red Crescent Climate Centre, Risk-informed Early Action Partnership (REAP) and Climate Risk and Early Warning Systems (CREWS))
- **Using search terms such as:**
  - FCV, fragile and conflict-affected situations, fragile, conflict, conflict-affected, violent, unstable, war, international armed conflict and non-international armed conflict
  - EWS, including by pillar (sub) components, DRR and disaster risk management (DRM)
- **Searching for literature on analogous services delivery in FCV contexts (to capture relevant good practices to learn from)**

EWS from so-called stable areas of a country to the FCV-affected areas within that same country. However, moving EWS into these regions means encountering gaps and challenges across the EWS value cycle. For instance, work on monitoring and forecasting of climate hazards in FCV contexts notes a challenging lack of observational data in FCV contexts, which suffer from weak weather forecasting abilities and limited or no hydrometeorological infrastructure (Alliance for Hydromet Development, 2021).

1.5.4 Research on reliable forecasts

Although the number of studies examining the existence, reliability and usability of forecasts in FCV contexts is still limited, some research shows that "forecasts exist and could be used to provide early warnings in conflict-affected areas" (Jaime et al., 2022). An analysis of the historical forecast availability and communication for the most severe disaster events in 20 countries affected by protracted conflict over 20 years found that heavy rainfall was predicted in advance for 48 out of 50 flood events, with lead times of more than 3 days and probabilities of occurrence between 10% and 90%. In 16 out of 20 major drought events, a low rainfall forecast was relayed in advance of a disaster declaration, illustrating that in many countries, climate hazards are identified and information conveyed in advance (Jaime et al., 2022).

1.5.5 Need for more evidence and documentation

Overall, while grey literature, policy discussions and emerging agendas on addressing natural hazards in FCV contexts illustrate that this topic is of crucial importance, there is no substantial body of rigorous evidence on how to adapt, implement or scale EWS for FCV settings or evidence on the outcomes of such programming. A recent study shows the evidence gap in early warning, early action (EWEA) research in 20 countries affected by conflict, highlighting that research over the last 20 years has mostly focused on hazard and forecast analysis, while other elements of the EWEA value chain are limited (Jaime et al., 2024). Box 2 provides examples of valuable resources on broader DRM in FCV contexts and resources on conflict and fragility identified through the rapid evidence review.

Therefore, a clear finding is that practitioner and community experience and evidence on how to enable EWS in FCV contexts is largely undocumented. However, this is not the same as expertise, information and recommendations not existing. It instead demonstrates the need to capture knowledge and lessons learned as well as generate robust evidence to support the implementation of early warnings for all in FCV contexts.

1.6 Early warning system considerations for fragile, conflict-affected and violent contexts

When understanding elements of consideration for EWS development in FCV contexts, several overarching factors are important. This handbook particularly considers the timescale, type and geography of conflict and fragility, along with the main engaged stakeholders, summarized here as affected communities, government actors, non-governmental actors (including conflict actors) and international partners.

Figure 1 outlines a basic framework for considering different FCV contexts, along with actions that stakeholders might prioritize or aim for based on conflict/fragility geographical extent, duration and type.

Chapter 3 provides specific pillar considerations for FCV contexts.

BOX 2

KEY RESOURCES ON DRM AND DRR IN FCV CONTEXTS, AND RESOURCES ON CONFLICT AND FRAGILITY

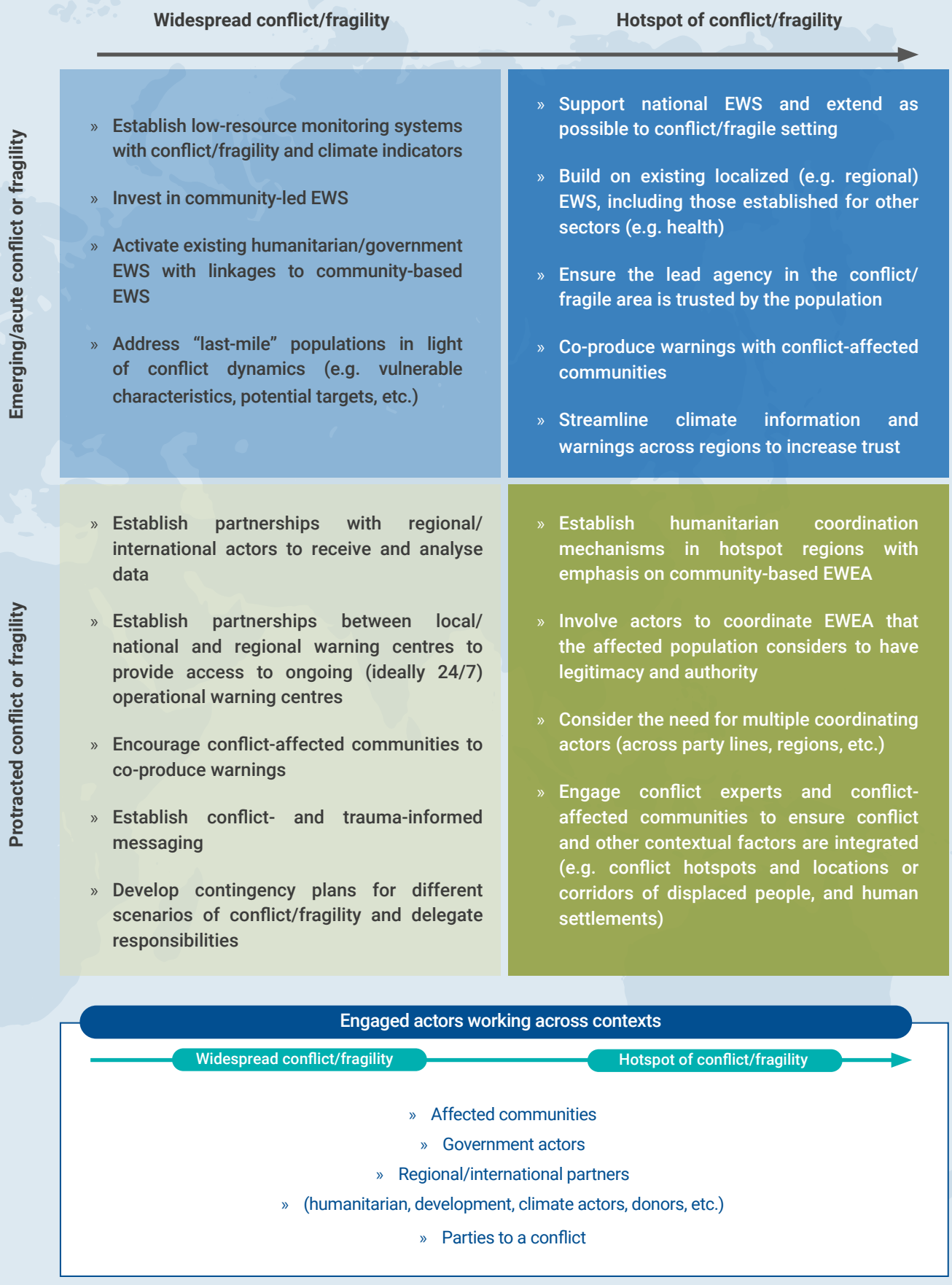
- *Disaster-Conflict Interface: Comparative Experiences* (UNDP, 2011)
- *Disaster Risk Reduction in Conflict Contexts: An Agenda for Action* (Peters, 2019)
- An agenda for expanding forecast-based action to situations of conflict (Wagner and Jaime, 2020)
- *States of Fragility 2022* (OECD, 2022b)
- A Review of Disaster Risk Management for Fragility, *Conflict and Violence Countries in the World Bank Portfolio: Fiscal Years 2012–2022* (GFDRR, 2023)
- *States of fragility* (OECD, n.d.)

Figure 1. Framework of settings, actors and considerations for EWS in different FCV context

Reading the figure from left to right, emerging or acute conflict can occur on a widespread basis across a country or be isolated to particular regions, or hotspots. Similarly, protracted conflict may affect a country over wide areas for years, or be confined to particular areas in otherwise fairly stable contexts.[14] These distinctions, while broadly depicted here, are important elements for considering the desirability and feasibility of certain types of EWS or actions to prioritize to support them. For instance, in a conflict hotspot where the relevant authorities are party to the conflict, coordinated humanitarian actors may work with affected communities to develop a parallel regional EWS in the absence of government engagement. Alternately, well-resourced community-led EWS may be the most effective and sustainable type of system in the midst of widespread acute conflict.

Different types, geographies and timescales of conflict also give rise to different stakeholders best placed to lead or support EWS, including affected communities, government actors, non-governmental actors (including civil society and conflict actors), and international partners who may be working at the national, regional or international levels (and often a combination of these).

14 Illustrative of the importance of contextualization, it should also be noted that even confined to certain geographies, violent conflict can affect a whole country. Negative impacts include weakening a national economy (e.g. by driving State resources away or increasing illegal trade) and strengthening the State security apparatus, which, over the long term, can be dangerous for democracy.


Widespread conflict/fragility
Hotspot of conflict/fragility
Emerging/acute conflict or fragility
Protracted conflict or fragility
» Establish low-resource monitoring systems with conflict/fragility and climate indicators
» Invest in community-led EWS
» Activate existing humanitarian/government EWS with linkages to community-based EWS
» Address "last-mile" populations in light of conflict dynamics (e.g. vulnerable characteristics, potential targets, etc.)
» Support national EWS and extend as possible to conflict/fragile setting
» Build on existing localized (e.g. regional) EWS, including those established for other sectors (e.g. health)
» Ensure the lead agency in the conflict/fragile area is trusted by the population
» Co-produce warnings with conflict-affected communities
» Streamline climate information and warnings across regions to increase trust
» Establish partnerships with regional/international actors to receive and analyse data
» Establish partnerships between local/national and regional warning centres to provide access to ongoing (ideally 24/7) operational warning centres
» Encourage conflict-affected communities to co-produce warnings
» Establish conflict- and trauma-informed messaging
» Develop contingency plans for different scenarios of conflict/fragility and delegate responsibilities
» Establish humanitarian coordination mechanisms in hotspot regions with emphasis on community-based EWEA
» Involve actors to coordinate EWEA that the affected population considers to have legitimacy and authority
» Consider the need for multiple coordinating actors (across party lines, regions, etc.)
» Engage conflict experts and conflict-affected communities to ensure conflict and other contextual factors are integrated (e.g. conflict hotspots and locations or corridors of displaced people, and human settlements)
Engaged actors working across contexts
Widespread conflict/fragility
Hotspot of conflict/fragility
» Affected communities
» Government actors
» Regional/international partners
» (humanitarian, development, climate actors, donors, etc.)
» Parties to a conflict

2. Cross-cutting elements, enablers and approaches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2. Cross-cutting elements, enablers and approaches

A variety of cross-cutting elements, enablers and approaches important for the design and implementation of EWS exist in FCV contexts. The following four elements relating to the operating context of EWS development, as well as its direct implementation, are important: governance, coordination, finance and technology. This chapter overviews key considerations relating to these issues that are important for EWS stakeholders to discuss and be aware of, with the understanding that these will manifest or be relevant to differing extents based on context.

2.1 Governance

Governance is a critical foundation for EWS in any context in terms of stakeholder understanding of the existing governance landscape, as well as establishing or clarifying the roles, responsibilities and structures needed to enable EWS. In FCV contexts, particular attention may need to be paid to the different levels and types of authority and legitimacy particular actors hold.

A key consideration when designing and considering routes for implementing EWS in FCV contexts is the extent to which national government systems can be capacitated versus the level of external support needed to develop or sustain EWS, including by humanitarian, development and peacebuilding (HDP) actors and (sub) regional actors. Determining this involves analysis of the level and geographical extent of governance in a country, as well as regional governance mechanisms, alongside analysis of the extent to which EWS already exist.

Discussions on good governance in EWS focus on stakeholders such as: national disaster management agencies; meteorological, hydrological and geological agencies; governmental institutions; and local communities. However, governance in FCV contexts must also include a variety of other actors and considerations like non-State armed groups (NSAGs) and peacebuilding actors.

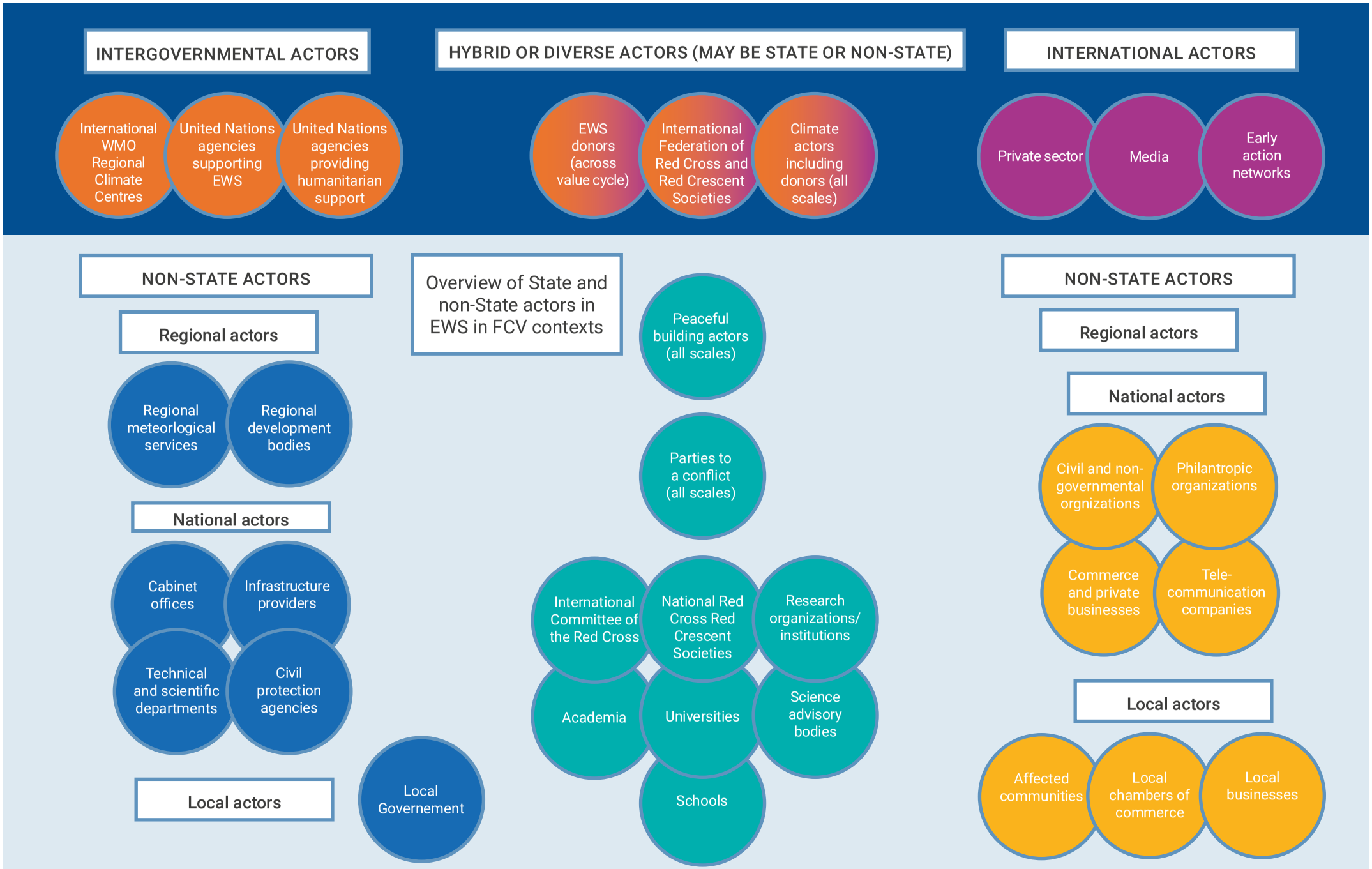
EWS are most effective when roles and responsibilities are delineated to different actors, and when the structures of authority and flows of communication and responsibility are clear to all involved stakeholders. In FCV contexts, this will likely necessitate engagement with non-traditional governance actors. This may take time and careful planning to identify or establish trusted connections for designing and implementing EWS.

2.1.1 Governance actors

FCV contexts have diverse and fluid groups of actors that may play a role in EWS. These should be considered beyond typical stakeholders such as National Meteorological and Hydrological Services (NMHSs) and central governments. This section overviews some of the key actors that may be important stakeholders when developing, strengthening or implementing EWS in FCV contexts.

In such contexts, humanitarian actors may, for example, play a key role in analysing forecasts and disseminating warnings, while regional meteorological services may step in to ensure forecasts are still produced for countries in conflict. Local businesses, affected communities and other local actors can be particularly crucial for understanding needs, enhancing communication and preparing for early action, especially in hard-to-reach areas (see also Pillars 3 and 4 in **Chapter 3**). **Figure 2** summarizes these and other types of actors important for EWS in FCV contexts.

Figure 2. Overview of State and non-State actors in EWS in FCV contexts



Source: Adapted from REAP (2023)

Non-State armed groups

In a conflict-affected or violent context, NSAGs (and sometimes belligerent State actors) are key actors in an EWS due to the ability they have to either hinder or enable its functioning (Gale, 2022). For this reason, a context and/or conflict analysis is necessary by stakeholders involved in EWS to understand to what extent and how parties to a conflict can or cannot be part of EWS and early action.

In some contexts, NSAGs may be the most suitable actor to disseminate warnings to populations. In others, limited or no involvement from these actors may be most appropriate, yet governance considerations should extend to how NSAGs are kept abreast of EWS and early action planning. If this does not occur, there is a risk that activities are perceived as threatening to NSAGs and may escalate conflict or tension.

While a range of context and stakeholder analysis tools exist in the humanitarian and development sector, utilizing or adapting tools to particularly account for a conflict context may be most useful when determining the role, risk of harm and opportunities for engagement with NSAGS.

Humanitarian actors

Humanitarian actors already play a variety of roles in FCV contexts, and may also assume new ones relating to EWS. In particular, as climate disasters increasingly unfold in conflict-affected contexts, protection-focused humanitarian organizations have a key role in EWS, notably in situations where they may be the sole humanitarian actor with civilian access (e.g. ICRC, 2023a). Existing humanitarian structures in affected countries may also provide important forms of coordination and information dissemination in support of EWS (see section 2.2 on coordination).

Alongside traditional responses to disasters arising from conflict and extreme weather events, humanitarian actors are increasingly involved in EWEA efforts and anticipatory action before extreme weather events (see Pillar 4). Many entities such as the International Federation of the Red Cross and Red Crescent Societies have spearheaded community-based EWS for disasters induced by natural hazards (e.g. IFRC, 2012). These and other responsibilities are typically seen as occurring towards the end of the EWS value cycle.

However, some humanitarian organizations have also become more directly engaged in earlier EWS stages such as forecasting and monitoring. For example, the World Food Programme (WFP) is a member of the Alliance for Hydromet Development, and through the Systematic Observations Financing Facility (SOFF), works in partnership with national meteorological services and governments to increase local weather and climate prediction products in countries it operates in, including those with FCV contexts (WFP, 2023).

A variety of other humanitarian organizations, such as those highlighted in the case studies shared throughout this handbook and in **Annex 2**, undertake important work on EWS in highly challenging and volatile FCV contexts. In some cases, they may be the only international actor present in a crisis, but often act in collaboration with local or national authorities.

Peacebuilding actors

Peacebuilding actors also play a particular role in EWS establishment or strengthening in a conflict-affected or violent context. They have been described in terms of their role as "top-level" leaders (e.g. military, political or religious leaders with high visibility), "middle-range" leaders (e.g. those respected in particular sectors such as ethnic/religious leaders, academics and intellectuals, or humanitarian leaders) or "grass-roots" leaders (e.g. local leaders, including heads of local non-governmental organizations, community developers or refugee camp leaders) (Lederach, 1998).

In different situations, various types or levels of peacebuilding engagement may help inform or actualize components of the early warning value cycle. For example, top-level leaders may confer authority and legitimacy over EWS planning and have the social or political capital to engage with non-State armed actors, while grass-roots leaders may be well placed to co-produce or disseminate early warning messages. Regardless of role, an understanding of peacebuilding actors is crucial to inform an EWS in conflict or post-conflict contexts.

The incorporation of peacebuilding into EWS considerations reinforces the HDP nexus, which is important to extend into EWEA more broadly. The Inter-Agency Standing Committee (IASC) makes explicit reference to the need for conflict sensitivity in anticipatory action and EWEA alongside other humanitarian programming as a means to address short-, intermediate- and long-term peace (IASC, 2020). This has also been noted as crucial in forced displacement settings, with cooperation on early warnings and broader climate adaptation encouraged as part of HDP nexus approaches (UNHCR, 2023). Box 3 overviews the importance of EWS in refugee and internally displaced person (IDP) camps, as well as the opportunities for coordination that the presence of humanitarian and other actors in camps can present.

BOX 3

EWS AND GOVERNANCE IN REFUGEE AND IDP CAMPS

Refugee and IDP camps are generally considered to be short-term solutions. However, displaced people often end up living in camps for many years. Nevertheless, camps often lack long-term strategic planning due to a variety of factors and limitations, and are instead better equipped to respond to urgent needs in emergency contexts.

Therefore, there is a strong need for EWS in refugee and IDPs camps, particularly because of the key challenges that these populations often face. These include restrictions on freedom of movement, meaning that evacuating camps during extreme weather events is often impossible, and restrictions on the type of building materials and infrastructure permissible in camps, which host governments often restrict to temporary rather than durable materials. These factors can increase the vulnerability of refugees to natural hazards.

In contrast to many other places, refugee camps often have significant humanitarian resources and a large humanitarian presence. This presents the opportunity to establish or strengthen EWS using existing humanitarian responses and coordination systems. It may mean utilizing existing communication mechanisms to disseminate early warnings before an extreme weather event, or engaging in dialogue with humanitarian actors to ensure the limitations of and potential for EWS in camps are considered.

It is crucial that EWS stakeholders adapt mechanisms to work within the restrictions of camps, which means understanding the legal rights of refugees, the dynamics between hosts and displaced people, the risk of conflict, appropriate actions for populations that may have had traumatic experiences, and how best to utilize different actors and capacities.

Whenever possible, existing national EWS should be extended into camps, such as has occurred with the Bangladesh national EWS Cyclone Preparedness Programme. This programme has been expanded to refugees through identifying, training and equipping at least 100 Rohingya volunteers in each of the 33 refugee camps in the country. These volunteers provide early warnings to trigger early action by individuals, families, the community and organizations. Early actions are adapted to the limitations of the camp context, where major evacuations or the mass movement of people are impossible and could pose further risks.

While displaced people are already considered a highly vulnerable population, expanding EWS to include those living in camps can reduce the risk of secondary displacement, minimize the destruction of often limited infrastructure, increase awareness of natural hazards and ultimately save lives.

Source: Easton Calabria et al. (2022)

The role of early warnings for conflict in peacebuilding operations and the HDP nexus is another area where greater engagement may enable the use of conflict monitoring tools of use to EWS in particular contexts.[16] While this handbook does not explore this option in depth, it is important to note the value and relevance of streamlining different types of EWS whenever possible, and at minimum ensuring coordinating actors are engaging with each other to minimize confusion and risk of harm for end users of different systems.

2.1.2 Governance considerations in civilian access

Gaining civilian access in FCV contexts to establish or implement EWS is related to a variety of governance considerations. This includes whether authorities are party to a conflict, whether there are multiple authorities (governmental or non-governmental) in a country, and the existence or extent of geographical divides (such as belligerent actor occupation) that may affect flows of information, communication and possibilities for action by affected populations.

For example, during active conflict, particular hazard-prone areas of countries may be inaccessible for extended periods of time. This can prevent detailed knowledge of hazards, vulnerabilities and exposure, and related threats. However, some humanitarian actors may still be present and able to address climate hazards, as was the case with the International Committee of the Red Cross (ICRC) and the Somali Red Crescent Society in Somalia before the 2023 El Niño rains (see Box 4). Similarly, the existence of a government-led EWS may be largely irrelevant in a particular region governed by non-State actors; parallel EWS or additional early warning strategies may therefore need to be developed to reach such populations.

BOX 4

SUPPORTING EARLY WARNING

The role of the International Committee of the Red Cross (ICRC) and the Somali Red Crescent Society in helping communities in Somalia prepare against the 2023 El Niño rains and ensuing flooding is one example of how humanitarian actors can support early warning. ICRC provided early warnings about the anticipated flooding alongside almost 75,000 sandbags across the country as an emergency measure

Source: ICRC (2023b)

[16] There are many forecasting tools examining conflict and political instability, including those designed by the European Union External Action Service, United States Government, intergovernmental and regional organizations in Africa including the African Union, the Economic Community of West African States, the Intergovernmental Authority on Development (IGAD), the Southern African Development Community and various United Nations entities. In addition, there has been growth in closed intelligence and open-source event data sets and modelling tools housed within non-governmental organizations and academia such as the United States Holocaust Memorial Museum Early Warning Project, the Integrated Crisis Early Warning System, the Armed Conflict Location & Event Data (ACLED) project, the Uppsala Conflict Data Program and the Violence & Impacts Early-Warning System. However, most efforts to anticipate and respond to collective violence have faced difficulties and limitations that have led to overall poor performance (Muggah and Whitlock, 2022).

2.1.3 Supranational governance mechanisms

Discussions of governance and EWS in FCV contexts also include examination of cross-border or regional governance mechanisms. For example, the cross-border exchange of warnings and observation data may be valuable in a conflict context where limited national/subnational data may exist.

Regional climate centres and regional specialized meteorological centres may take the lead in forecasting duties, for example, in countries with limitations to producing their own forecasts. For instance, the Intergovernmental Authority on Development (IGAD) Climate Predication and Applications Centre (ICPAC) works on advancing floods forecasting in the White Nile running through South Sudan and Sudan, and exemplifies how regional support can provide crucial transboundary collaboration (ICPAC, n.d.a).

However, regional conflict and tensions can impede information-sharing among governments. In the worst-case scenario, information may be withheld or used to deliberately mislead others. This should be carefully considered alongside efforts to cultivate cross-border information governance mechanisms.

In an FCV context, identifying and promoting mechanisms for risk governance are also important. For example, the adoption of the political declaration of the high-level meeting on the midterm review of the Sendai Framework illustrates a commitment and an awareness of the need for more rapid progress in strengthening risk governance proportional to the challenges of the twenty-first century (UNDRR, 2023b; United Nations, 2023).

The high-level meeting included a focus on the need for the prevention and mitigation of risks rather than just managing disasters after they take place. The political declaration commits Members to further invest in DRR and strengthening risk governance and preparedness for response efforts (UNDRR, 2023c). At a practical level, this may mean, for example, addressing the challenges of maintaining early warning equipment that may be destroyed, stolen or not maintained in FCV contexts.

Overall, political progress such as the commitments made at the high-level meeting is relevant for EWS where costly technical investments and time-intensive efforts to develop partnerships may lead to uncertain outcomes. To promote risk governance, a variety of actors must coordinate and invest in EWS in different ways.

2.2 Coordination

The United Nations General Assembly's landmark resolution 46/182, passed in December 1991, outlines the role of States in providing humanitarian assistance to "victims of natural disasters and other emergencies", stating that while the affected State has the primary role in coordination and implementation of assistance, international cooperation is, in many cases, also important (United Nations, 1991). The resolution also calls for the "systematic pooling, analysis and dissemination of early-warning information on natural disasters and other emergencies".

These commitments have been upheld in subsequent years through further resolutions; most recently, in 2022, the United Nations General Assembly reaffirmed existing principles surrounding engagement of the international community to support Members' efforts on disaster preparedness, and also called for the development of MHEWS. These and other resolutions are positive steps in efforts to develop EWS, and MHEWS in particular. At the same time, they indicate awareness of the sobering and escalating need to improve coordination to address conflict and disasters that are induced by natural hazards around the world.

Strong coordination is also imperative in the development of EWS in FCV contexts. However, silos are common in complex crisis situations. This increases the risk of isolated responses or the duplication of efforts in EWS development and

implementation. Even in other contexts, coordination challenges such as sectoral silos, limited communication between country and subnational offices, and fragmented responses among agencies limit the effectiveness of preparedness and response efforts. These issues risk being even more pronounced in FCV settings where competing needs and priorities, along with underfunded operations, may lead to less time, ability or incentive to cooperate.

Therefore, when considering humanitarian and development engagement in EWS in FCV contexts, it is imperative that coordination among humanitarian actors, among development actors, and between humanitarian and development actors is developed or strengthened and is considered a foundation for action. Improved coordination can streamline communication with other stakeholders, thereby increasing efficiency, as well as reducing the development of parallel systems.

The development of new early warning initiatives in FCV contexts should therefore begin with the coordination of ongoing efforts to ensure existing systems (government led, community based or otherwise) are included, learned from or built on. Dialogue with Resident and Humanitarian Coordinators, humanitarian country teams or United Nations country teams is necessary to ensure EWS align with and are fed into existing processes as much as possible.

Existing humanitarian and DRR coordination mechanisms should also be utilized to the extent possible, to avoid duplication and to ensure cohesion and engagement among relevant actors. As an example, Box 5 highlights the collaboration of government, regional and international actors in Somalia for reducing disaster risk, including through elements of EWS. DRR national platforms and humanitarian coordination groups may be important starting points for identifying existing and ongoing work in EWS, as well as for identifying areas for development or strengthening. Early warning coordination capacity should be funded and empowered to develop tailored coordination plans for developing EWS in relevant contexts.

BOX 5

EWS AND GOVERNANCE IN REFUGEE AND IDP CAMPS

Somalia is extremely vulnerable to a variety of risks, including those stemming from the impacts of ongoing conflicts, more frequent and severe natural hazards (including climate-related ones) and communicable disease outbreaks. These are compounded by weak shock-responsive social protection mechanisms.

The National Multi-Hazard Early Warning Center, established by Somalia's Ministry of Humanitarian Affairs and Disaster Management and led by the Somali Disaster Management Agency under the Ministry of Environment and Climate Change, seeks to reduce disaster risk in the country through increasing governance mechanisms, such as enhancing inter-institutional coordination of key public and private stakeholders.

The National Multi-Hazard Early Warning Center is complemented by the National Emergency Operations Center to respond to disasters. The Disaster Management Agency is responsible for mobilizing and coordinating local and international responses to emergencies through these centres. Risk-related information is provided through institutions and agencies, such as the Ministry of Energy and Water Resources, the Ministry of Agriculture and Irrigation, the Food and Agriculture Organization of the United Nations (FAO) Somalia Water and Land Information Management, ICPAC, the Famine Early Warning Systems Network (FEWS NET) and other regional organizations under the framework of MHEWS implementation.

The hazard information and responses provided through these EWS components provide an important foundation to reduce risks and strengthen the resilience of Somalia. They are also strengthened through ongoing coordination among a range of government and international actors, illustrating the value and importance of cross-sectoral and international partnerships in establishing effective EWS.

Source: Case study in **Annex 2**

2.2.1 Coordination with military actors

In FCV contexts, coordination with military actors is a primary consideration. Military actors have occupied an increasingly central space in the humanitarian landscape in past decades, leading to regular civil–military coordination and humanitarian engagement with different sets of military actors (Bollen and Kalkman, 2022). Often working in the same environments as humanitarians, national military actors are common first responders to climate and other types of disasters, with roles including infrastructure repair and implementing search and rescue operations. In international military operations, military engagement in EWS is likely to occur only when the environment is considered safe enough for development or recovery activities, in which case, it may be advisable for other actors rather than military personnel to engage in establishing or strengthening EWS.

Difficult decisions and challenges may arise in cases when EWS stakeholders engage (or do not engage) with military actors who are party to a conflict, with some research showing that civil–military relationships often deteriorate when "the military engages in humanitarian efforts in conflicts in which it is a belligerent" (Ferris, 2012). However, these same military actors may be the ones granting access to populations or they may be capable of undertaking particular tasks necessary for EWS such as the rapid resumption of telecommunications services after conflict.

While some important research on effective civil–military coordination exists in responses to natural hazards (e.g. The New Humanitarian, 2010), there is little documentation on practices for engagement or evidence on outcomes in relation to natural hazard EWS.

Clarity around rules of engagement is needed in the development and implementation of EWS in FCV contexts to ensure the safety and protection of different stakeholders, including civilian end users of EWS, as well as to capitalize on important opportunities for resource pooling. For example, military actors are often the first actors to re-establish road infrastructure and communications technology after conflict or climate disasters, which can provide invaluable support to humanitarian responses.

Military actors are also often closely linked to national governments, which may be issuing alerts and early warnings at the same time that they are party to a conflict, necessitating further nuance in other EWS stakeholders' engagement. IASC has long stressed that the direct delivery of humanitarian assistance by military personnel should be avoided.

Given this multitude of factors, the provision of early warnings and other information by military actors would ideally be evaluated by EWS stakeholders, ranging from national governments to humanitarian actors, based on the intended recipients of information and existing conflict or other dynamics in a particular context. Box 6 provides some recommended resources on civil–military coordination, particularly related to responses to natural hazards or complex emergencies.

BOX 6

RESOURCES ON CIVIL–MILITARY COORDINATION

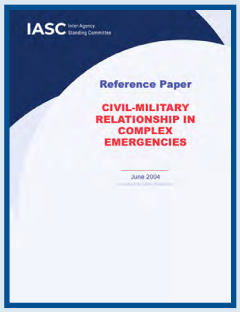
Reference paper:

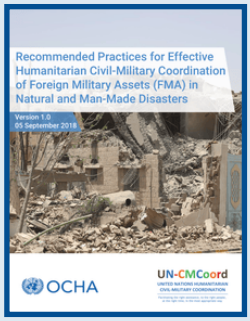
Civil-military relationships in complex emergencies (IASC, 2004)

Handbook on International Rules Governing Military Operations (ICRC, 2013)

Recommended Practices for Effective Humanitarian Civil-Military Coordination of Foreign Military Assets (FMA) in Natural and Man-Made Disasters (OCHA, 2018a)

UN-CMCoord Field Handbook Version 2.0 (2018) (OCHA, 2018b)





2.2.2 Role of United Nations peacekeeping operations

United Nations peacekeeping operations also include military and police personnel, with whom EWS stakeholders may engage or involve in FCV contexts. While most evidence on EWS and United Nations peacekeepers has focused on conflict monitoring, there are potentially transferable lessons and roles for natural hazard EWS.

The existence of initiatives such as the Community Alert Network and the roles of the community liaison assistants, described in Box 7, underscore the possibility of utilizing or drawing on the lessons learned through existing EWS by military actors, with the full understanding that this will not be appropriate or feasible in every context.

Ensuring coordination with non-State actors in conflict contexts is imperative. Civil society engagement is key to implementing people-centred approaches to early warnings and can be a "missing link" between actors developing EWS and recipient communities. Civil society actors can become involved in EWS at a variety of levels, ranging from policy analysis and strategy formulations based on the needs and interests of affected communities to tailoring the implementation of early warnings to specific local contexts and communities. Particularly in FCV contexts, which have limited formal institutional capacity and may have quickly evolving contexts, civil society actors can be instrumental for the effective localization of EWS.

For example, local organizations, including faith-based organizations, are often those with access to the most complex areas and are generally the implementing partners of United Nations entities and other organizations in FCV contexts. Therefore, they often have unique access to "hyperlocal" as well as international stakeholders, and thus may have an understanding of local and broad contexts that others lack. Civil society actors may also hold significant levels of trust and authority within communities in conflict contexts and therefore play an outsized role in influencing the uptake of early warnings and early actions.

BOX 7

COMMUNITY NETWORK AND LIAISON ASSISTANTS

The United Nations Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO) has developed a Community Alert Network that allows communities in remote areas to issue protection alerts to MONUSCO via mobile phones and radios, which are mainly directed to national security actors for response (MONUSCO, 2014, 2016).

The network is managed by community liaison assistants, who are national staff acting as interlocuters between the peacekeeping mission, local authorities and local populations. As knowledgeable community members, such assistants are able to develop actionable response plans for community threats, as well as provide the mission with regular and ad hoc alerts and risk analyses (Kuhlenberg, 2016).

2.2.3 Coordination with non-State actors in conflict contexts

Other stakeholders such as members of scientific communities are important actors to be included in coordination mechanisms. These include mapping and geographical agencies as well as scientific research bodies such as scientific institutions, relevant government ministries, and consortia at national, regional and international levels. Scientific communities and data providers can bring objective information to support EWS, for example, through remotely sensed Earth observation data.

Other non-State actors in conflict contexts are likely pivotal to the outcomes of EWS. For example, in most armed conflicts where NSAGs are party to the conflict, engagement with these actors is key to facilitating access, protecting critical infrastructure (e.g. meteorological infrastructure or other critical early warning equipment) and safely engaging with communities (regarding the safety of humanitarian staff and community members). Peacebuilding actors including non-State actors also have pivotal roles to play in EWS, as well as fostering enabling environments for effective systems to be established in the first place.

2.2.4 Regional coordination

In FCV contexts, the presence or absence of regional coordination is key. For example, armed conflict can result in "spillover", with hostilities taking place across international borders, and often increases the fragility of neighbouring countries, even in situations where the conflict has not spread. Yet regional coordination in EWS provides the opportunity for strengthening systems in terms of information provision as well as contingency planning, such as regional agreements for housing data or even providing workspaces to employees of national disaster management agencies or meteorological agencies forced to leave their countries due to conflict.

For instance, in contexts where the government is an able collaborator in EWS, developing collaborations or coalitions with relevant regional bodies could develop capacity and safeguard data and learning within various institutions cross-regionally. The value of regional coordination and support for countries affected by fragility and conflict is all the greater due to the common issue of limited capacity, data and funding needed to develop robust EWS.

Promisingly, there are increasing regional efforts to strengthen EWS. For example, IGAD developed its DRM programme in 2004 to mitigate disaster impacts through improving MHEWS for IGAD states. ICPAC supported this work, providing a variety of climate services to Eastern Africa, including climate forecasting and climate information dissemination such as Hazards Watch (ICPAC, n.d.b). Countries supported include Somalia and South Sudan.

Collaboration at the Virunga Supersite in the Democratic Republic of the Congo (Box 8) also illustrates how scientific data can be generated and shared through regional and international collaborations that support the establishment of EWS and prioritize increasing access to resources for local scientists.

BOX 8

EWS AND GOVERNANCE IN REFUGEE AND IDP CAMPS

The Virunga Supersite is located in eastern Democratic Republic of the Congo, on the border with Rwanda and Uganda. It is the first supersite established on the African continent in a multi-geohazard, densely populated region. Volcanic hazards, earthquakes and landslides are natural hazards in the region, along with poor rain and surface water quality, and soil–dry gas vents. These hazards pose a permanent threat to over 3 million people living in the region, namely in Goma and Gisenyi cities and surrounding villages, and are compounded by over 25 years of armed conflict, which has led to the death of an estimated 6 million people. Earth observations have greatly improved the assessment and monitoring of hazard sources and their dynamics in in this critical, conflict-ridden context, producing essential information to evaluate, mitigate and reduce the impacts.

GEO (GEO, n.d.a) hosts the Geohazards Supersites and Natural Laboratories (GSNL) initiative, which promotes international scientific collaboration and open access to space- and ground-based data to improve geophysical scientific research and geohazard assessment for DRR. Through this initiative, high-resolution commercial satellite imagery from the Committee on Earth Observation Satellites (CEOS) space agencies (such as the French National Centre for Space Studies (Centre National d'Etudes Spatiales), the Italian Space Agency (Agenzia Spaziale Italiana) and the Argentina National Space Activities Commission (Comisión Nacional de Actividades Espaciales)) is made freely available.

This satellite imagery is provided to the GSNL science community. It complements the host geohazard institutions' work in monitoring hazards for early warnings while producing and disseminating disaster risk knowledge such as routine analyses (e.g. damage maps) and investigation and analysis to assess the likelihood of future hazards. The host national geohazard institutions (Goma Volcano Observatory and Civil Protection) work closely with national disaster management agencies and other local, national and regional institutions.

Previously, the active volcanoes were poorly studied and monitored due to limited qualified human resources and appropriate infrastructures. The establishment of the Virunga Supersite succeeded in bringing together local and international scientists and agencies from Africa, Europe, Japan and the United States of America. It supported them to access Earth observation data and potentially equipment for ground-based data collection, as well as building a pool of international collaborators, with positive local and regional implications. Local and international scientists can access (free of charge) high-resolution satellite data to produce information for decision-making by local authorities. Their collaboration has improved geohazard assessment and monitoring to further DRR in the region, exemplifying the effectiveness of local, regional and international cooperation on hazard assessment and early warnings.

For additional information, see GEO (n.d.b).

Source: Case study in **Annex 2**

2.3 Finance

There is a strong need for finance to enable EWS, as well as for the actions triggered as a result. This necessitates a variety of funding sources for the different elements of the EWS value cycle. Importantly, funding is necessary for ensuring EWS sustainability, not just for development or strengthening. There is therefore a need for all elements of EWS to be seen as a global public good whose existence and sustainability must be assured.

2.3.1 Commitments made at the twenty-eighth session of the Conference of the Parties

While financial support to improve DRR in conflict contexts is still nascent, commitments to FCV contexts made at COP 28 by a variety of donors illustrate an important growing awareness of the needed work in this space. The COP Presidency host day advanced climate action in fragile and conflict-affected contexts through a series of non-negotiated outcomes. These included a Declaration on Climate, Relief, Recovery and Peace, targeting financial support for adaptation and resilience, and a package of solutions to commit funding to increasing this flow of finance (COP28 UAE Presidency, 2023).

The Getting Ahead of Disasters Charter: A Charter on Finance for Managing Risks focuses on finance for managing risks. It presents proactive measures for action, pre-arranged finance, improved coordination through the alignment of finances across sectors, and enhanced delivery systems, with a focus on people-centred and localizing approaches, including through allocating and distributing finance (Getting Ahead of Disasters, 2024). It was driven by REAP, and launched by the United Arab Emirates COP 28 Presidency, and the Governments of Samoa and the United Kingdom of Great Britain and Northern Ireland as REAP co-chairs (Getting Ahead of Disasters, 2024). EWS in FCV contexts have much to benefit from these new climate finance opportunities, and must be included as an explicit component of follow-up discussions for action.

2.3.2 Limited funding

While welcome, these new financing opportunities are particularly important because of the hitherto limited funding available to increase EWS in FCV contexts. Broader climate finance has been limited in such contexts, with one analysis illustrating that conflict-affected countries receive only one third of the climate financing per capita than countries affected by climate change only (International Crisis Group, 2022).

Existing funds and funding mechanisms are not adequate to meet the needs in conflict-affected countries (Sitati et al., 2021). For example, while adaptation finance offers an important means to strengthen EWS in FCV contexts, overall levels of such finance are low and even diminishing (Climate Policy Initiative and Global Center on Adaptation, 2023). As highlighted in the United Nations Environment Programme (UNEP) 2023 adaptation gap report, over 50% more adaptation finance is needed for developing countries than had been previously estimated. The new estimated range is $215 billion to $387 billion per year (UNEP, 2023).

The gap was estimated at $194 billion to $366 billion annually due to growing needs and lower levels of funding (UNEP, 2023). This need is starker in countries affected by FCV contexts, as research finds a persistent “blind spot” in climate adaptation programmes relating to fragility, conflict and violence, driven by a lack of programmatic conflict sensitivity as well as a disinclination to invest in areas most affected by FCV contexts (Cao et al., 2021).

2.3.3 Gaps in funding across the value cycle

Different elements of the EWS value cycle appear to garner more funding than others, although this is difficult to track. However, overall investment across the value cycle appears to be lower in FCV

contexts than in non-FCV contexts. In addition, there is a discrepancy between the level of need versus the available funding for all value cycle components. For example, early action and anticipatory action programming saw an estimated 41% growth in projects from 2021 to 2022, yet much of this was implemented in regions affected by FCV contexts (Scott, 2022).

Of the estimated $700 million pledged for early action in 2021, $106 million went towards the development of EWS. This is a figure that falls significantly short of the $500 million target made by REAP (Scott, 2022). Upon further analysis, 65% of early action funding pledged in 2021 went towards system-strengthening and capacity-building efforts rather than direct funding for the implementation of programming actions (e.g. funding made available for direct assistance to at-risk populations ahead of a shock) (Scott, 2022). This illustrates another important gap in the actualization of early action programming in all contexts. The gap is exacerbated because the bulk of humanitarian financing remains allocated for rapid responses to already unfolding crises, despite progress in the funding of early action protocols and anticipatory action frameworks by a variety of funding mechanisms internal to international organizations. Substantial progress has been made; however, a stark need for further funding remains.

A key finance gap for EWS in FCV contexts lies in the funding of data for weather forecasting and climate predictions. There is a strong need for further investments in basic observation infrastructure and international data exchange. This includes the ground-truthing of global models through measurements taken locally, which requires financing that is rarely available. Without these, early action and anticipatory action lack the data to make informed decisions for programming.

The Global Status of Multi-hazard Early Warning Systems 2023 report advocates for strengthening and expanding the data ecosystem underlying MHEWS in recognition that the increasing complexity of disasters necessitates systematic data (UNDRR and WMO, 2023). As further mentioned in Pillar 2 (see **Chapter 3**), the 39 countries classified as fragile or conflict-affected by the World Bank in 2024 had an extremely low compliance rate of data stipulated by the Global Basic Observing Network (GBON). The creation of funding mechanisms such as SOFF (**Box 9**) and the CREWS initiative (**Box 10**) is an important means to direct attention and funding to this area.

BOX 9

SOFF FUNDING MODEL

SOFF is a new United Nations climate fund, co-created by WMO, the United Nations Development Programme (UNDP) and UNEP. Its purpose is to close the world's basic weather and climate data gaps. In its initial 1.5 years of operation, it provided readiness funding to 60 countries, with one third (20) of these classified as countries affected by fragility or conflict. It offers support in three phases: readiness, investment and compliance.

In the readiness phase, LDCs, SIDS and other countries eligible for official development assistance access technical assistance by well-established NMHSs with the ability to offer technical support on running an observing system. Based on outputs during this phase, countries are eligible to enter the investment phase, in which they receive grants to establish infrastructure and human and institutional capacity necessary to achieve GBON compliance. During the third phase of compliance, countries receive long-term, results-based grants to support operations and maintenance, with advisory support throughout.

In particular, SOFF offers a distinctive funding model highly relevant for strengthening EWS in FCV contexts through the following elements:

- Long-term grant finance in recognition of the global public good value of the data
- Peer-to-peer technical assistance provided by those who know how to run an observing system (e.g. advanced NMHSs)
- Collaboration with multilateral development banks and United Nations organizations as implementing entities, which blend SOFF finance with their own projects and programmes for comprehensive country support packages
- Quick proposal processing times of 3.7 months on average for countries to receive support

Source: SOFF (2023)

BOX 10

CREWS FINANCING MECHANISM

The CREWS initiative is a pooled fund that builds sustained institutional capacity for EWS. It funds projects to establish risk-informed EWS in LDCs and SIDS. UNDRR, the World Bank Global Facility for Disaster Reduction and Recovery, and WMO implement CREWS. Countries implement national and regional projects with the support of implementing partners.

Through a focus on people-centred partnerships that emphasizes local organizations and gender sensitivity, CREWS aims to increase countries' resilience and sustainability to address climate risks through EWS. This includes working directly with countries on capacity and management strengthening to improve cross-border collaboration and countries' access to and use of global products.

As CREWS has expanded, it has worked in countries affected by FCV contexts. At the end of 2022, it had projects being implemented in 23 fragile or conflict-affected countries. This includes countries with high numbers of displacement and protracted conflict such as the Democratic Republic of the Congo, as well as one where conflict has since broken out (Sudan). Conflict, violence and other challenges affected CREWS projects to varying extents in Afghanistan, Haiti and Mali into 2023. Engagement in countries that became classified as fragile or conflict affected, such as Sudan beginning in 2022, illustrate the importance of broader conflict sensitivity and contingency planning in EWS design and implementation, even in non-FCV contexts.

Source: CREWS (n.d.)

2.3.4 Current funding model

The current funding model for EWS overall is one that is disadvantageous for many FCV contexts. EWS funding is provided by a variety of funders that operate through funding individual projects and which generally last for a few years only. This is difficult for the development and sustainability of any EWS, but it is particularly challenging in FCV contexts where many elements of an EWS are underdeveloped or non-existent, meaning that a single project is unlikely to make a significant difference to the wider system. This is compounded by the short-term nature of funding in fragile and humanitarian contexts, which poses challenges for long-term systems development, in part as such funds are generally annualized humanitarian envelopes.

Limitations in FCV contexts may include few existing EWS, and limited capacity, funding and time by stakeholders to develop or implement them, compounded by likely disruptions and delays due to conflict or fragility. Given these realities, there is a need for a longer-term view of systems building to account for the often-low EWS starting point of many countries experiencing FCV contexts. To work towards this, donors may consider:

- Greater coordination of finance and implementation in EWS:
  - Development of pooled funds among donors to streamline projects and reduce risk.
  - Calls for proposals for projects to improve systems strengthening.
  - Multi-year and/or linked projects focused on a system-based approach to build capacity across the EWS value cycle.
  - Coordination of ongoing early warning initiatives in FCV contexts (government led, community based or otherwise) to link, support and/or scale up services.
  - Early warning coordination capacity funded and empowered to develop tailored coordination plans in relevant contexts, such as through an agency with a coordination mandate.

- Increased flexibility and contingency planning for projects or initiatives developing EWS:
  - Potential delays and disruptions in EWS systems building addressed before a funding allocation through flexibility or contingency planning to address timelines and/or budgets.
  - Contingency plans and/or business continuity plans included within EWS strategies as a necessary element of an EWS when being established. However, this involves resources for planning and upkeep (testing). If this is not feasible at a national level, contingency plans could also exist at the regional level and focus on the highest priority activities, such as early warnings.
  - A non-earmarked contingency fund within project or programme budgets to enable quicker responses to address problems in EWS arising from FCV contexts.

- Funding for the entire EWS value cycle:
  - The current status of EWS funding places significant attention on funding early action once a warning is provided, which has been largely enabled through humanitarian financing tools for anticipatory action. However, alongside increasing this action, further funding and capacity strengthening of all the elements of the value cycle must be established to produce a warning and implement early actions. This is essential in FCV contexts, as it is exceedingly difficult for significant funding for early action to be available if there is not a proper EWS or the capacity to implement it.

It is also important to consider that FCV contexts often bring their own financing challenges, which affect the implementation of all pillars of an EWS. A restricted funding environment may come from sanctions that make it challenging for either financial or in-kind

support to be received. This affects EWS investments and also broader financing for other adaptation measures such as clean technologies. Corrupt government officials or powerful armed groups may divert funding or equipment, even if they do arrive.

Careful analysis of specific contexts and flows of power and influence, as well as money and goods, is critical to decision-making on how best to capacitate EWS in complex contexts. This can include the development of new financing options or approaches, which may need lighter reporting requirements and facilitated application and access protocols in particular areas to account for the realities of limited time and access in FCV contexts.

The strategic use of existing funded projects before the eruption of conflict can also hold significant value for the design and implementation of EWS. Leveraging existing initiatives capitalizes on investments made across sectors and also offers the advantage of adaptability. Depending on their nature, projects can be swiftly rescoped and realigned to respond effectively to the evolving context of conflict.

This proactive approach optimizes available resources and also ensures a quicker and more agile response, harnessing the groundwork and infrastructure already in place. The ability to repurpose existing projects underscores the importance of foresight and flexibility in navigating the intricate dynamics of FCV environments, reinforcing the resilience and relevance of EWS in the face of emerging challenges.

To address the need for increasingly comprehensive support, a variety of possible arrangements from other areas of practice exist. These may be relevant models for financing EWS in FCV contexts, and include:

- Crisis modifiers, which are budget contingency lines built into grants that release a pre-agreed amount of funding when particular crisis thresholds are crossed. While crisis modifiers are often used in humanitarian and development programming to account for shocks, this approach could be used in programming for EWS to account for a conflict- or fragility-related crisis, such as extra funds released to ensure meteorological data are preserved and remain accessible in an increasingly volatile context where armed conflict may arise. Although considered an important innovative funding mechanism, crisis modifiers have also been criticized as often being triggered too late to achieve their protection aims, which is an important consideration when establishing how situational contexts could be monitored effectively.

- Pooled funds, which are multi-donor humanitarian financing mechanisms accessible to various humanitarian agencies to address humanitarian crises. In addition to enabling additional financing, they help address donor concerns around risk-taking, which make them appealing for the financing of EWS in FCV contexts. Existing pooled funds managed by the United Nations include those of the Central Emergency Response Fund (CERF), such as the CERF Climate Action Account unveiled at COP 28 to expand the use of anticipatory action (Peron, 2023), and country-based pooled funds (OCHA, n.d.a).

- Earmarked funding for EWS in FCV contexts to realize the outcomes and goals of EW4All and ensure countries affected by FCV contexts are included. While this may be useful for ensuring existing funding for EWS includes those in FCV contexts, earmarked funding is often considered less flexible in terms of how allocated funding can be spent. It is possible that the development and implementation of EWS in FCV contexts may necessitate more funding than allocated, thereby limiting possibilities for success.

» Climate finance mechanisms, which offer avenues for investing in EWS in FCV contexts. Existing mechanisms like the Global Environment Facility and Green Climate Fund, which already support EWS, offer important models for process and impact, including in FCV contexts. Other adaptation finance mechanisms include the Loss and Damage Fund agreed at COP 28. Mechanisms that support countries in implementing objectives and strategies related to national adaptation plans and nationally determined contributions under the Paris Agreement, the Sustainable Development Goals and DRR under the Sendai Framework are avenues that may be further relevant as EWS have increasingly become seen as a crucial element of country adaptation planning, and as more work focuses on increasing climate finance for countries affected by FCV contexts. However, research shows a significant gap in climate finance for countries experiencing FCV contexts, with the least funding going to the most fragile regions (Wong and Cao, 2022), illustrating the need and the challenge of climate finance for these contexts.

2.4 Technology

Established and emerging technologies play a key role in EWS. They can have a unique role in FCV contexts where additional hazards may require specific information and monitoring. Technology such as existing freely accessible remote-sensing data has incredible potential to be leveraged to shrink data gaps in countries affected by FCV contexts with limited observational data. Analytical tools and products can aid informed decision-making and forecasting. Information and communications technology infrastructure ranging from radio to social media is a critical component of creating and effectively disseminating early warning messages.

However, many of these tools are not being utilized to their fullest extent. This highlights a need to raise awareness about their existence by funding and implementing entities and to ensure accessibility by all EWS stakeholders. In addition, FCV contexts may bring additional risks to the use of technology, such as information and communications technology infrastructure being destroyed during conflict. The cost of such technologies can also be prohibitive, necessitating careful consideration of which technological tools make sense in the face of resource constraints.

Key technologies to increase the effectiveness of EWS discussed at the 2023 United Nations Framework Convention on Climate Change Technology Executive Committee deep dive on the topic (United Nations Climate Change, 2023) include many that may be particularly useful in FCV contexts where access may be challenging, such as using:

» Artificial intelligence to detect, monitor and forecast events, and enable communication with target groups before or during extreme weather events. The predictive analytics that artificial intelligence offers can, for example, inform planning for disasters through predicting collective behaviour.

» Remote-sensing and satellite technology to gather data as well as provide predictions to avert or minimize climate-induced loss and damage. This technology can be used in conjunction with telecommunications services to facilitate early warnings and the communication of risks.

» Mobile phone broadcasts and location-based short message service texts for sending and receiving warning messages in high-risk areas for extreme weather events.

There are also points of learning and potential collaboration from the field of conflict EWS, which has developed analytics over decades to help prevent conflict. Geospatial information technology (e.g. geographic information systems), remote sensing and satellite navigation systems (e.g. global positioning systems) are all used in conflict-related EWS to analyse risks, identify vulnerable populations and support policies that minimize particular risks (Panic, 2022).

Machine learning and natural language processing are increasingly being used to analyse large amounts of texts to detect changes in data such as language that may indicate impending violence. These and other methods are used to develop conflict models, risk indices and conflict forecasts by governments, private sector actors and academic institutions (Panic, 2022). As EWS continue to be designed, developed and implemented in FCV contexts, conflict and fragility monitoring tools based on these and other technological innovations may provide important data to inform multi-hazard early warnings.

These and other possibilities point towards the value of EWS actors strengthening coordination and linkages with science, technology and innovation stakeholders to advance EWS in FCV contexts. Potentially relevant stakeholders include geographic information system/mapping/statistical/space agencies; research and science/digital ministries in national and regional governments; and international/intergovernmental organizations and networks (e.g. the International Telecommunication Union, GEO, CEOS and international charters for disasters such as the International Charter on “Space and Major Disasters” (UNOOSA, n.d.a)), as well as private sector actors.

Utilizing different sets of tools and technologies, as well as expertise in a variety of fields, can enable the improved accuracy of forecasts and important social science knowledge of effective early warning communication for particular populations, conflict dynamics, historical community-based disaster preparedness and response activities, and many other areas. In FCV contexts, there is a need to consider new approaches for setting up effective EWS and better integrating evidence-based conflict sensitivity measures that are appropriate to different contexts.

3. Pillar considerations

3. Pillar considerations

3.1 Pillar 1: Disaster risk knowledge

Comprehensive information for the EWS value cycle on all the dimensions of disaster risk, including hazards, exposure, vulnerability and capacity, related to persons, communities, organizations, and countries and their assets

KEY ACTORS:

National, subnational and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities and geophysical agencies, and other sources of open access data; engineers; land-use and urban planners; researchers and academics (including from social science); United Nations country teams; regional entities and commissions; and organizations and community representatives involved in disaster/emergency management and DRM.

In FCV contexts, common challenges surrounding disaster risk knowledge include lack of availability and access to data and/or lack of access to populations due to conflict and/or fragility. Limited or lack of access may be due to issues such as geographic barriers (e.g. areas where hostilities are ongoing), damaged or destroyed infrastructure or data repositories such as weather stations, or negligible engagement with or from authorities in control of information and populations. There is a critical need to embed conflict analysis into the overall risk knowledge work.

In fragile contexts, data may be limited or unavailable as records may not have been kept, or may have been lost or destroyed during hostilities. Institutional memory and knowledge may be low, and/or the dynamic nature of conflict may make it difficult to collect robust and up-to-date data.

These and other challenges present barriers to the collection of comprehensive information on disaster risk, which are summarized below, along with considerations and example case studies to help inform practical ways to address them.

3.1.1 Challenges and considerations relating to unclear or changing stakeholders, and their roles and responsibilities

- Lack of clear governance in a territory, with multiple competing authorities or a governance vacuum due to frequently changing areas of control:
  - In a humanitarian context, coordination mechanisms established between humanitarian agencies with involvement from government (e.g. NMHSs) and affected communities to build on existing work and reduce potential duplication and taking place through or with the Inter-Cluster Coordination Group and Information Management Working Groups.[20]
  - Early warning coordination capacity funded to ensure ongoing engagement as EWS development continues.

› Coordination enhanced through seasonal meetings with different stakeholders (e.g. local government, emergency/disaster management organizations and other civil society organizations, humanitarian/development agencies, parties to the conflict, community representatives and climate scientists) in a particular region to present and share hazard and vulnerability data and discuss EWEA for the projected hazards/impacts.

» Multiple territories under control of different actors in one country:

› Multiple sources of authoritative natural hazard data and information identified (e.g. by a regional or international body with the capacity to understand, assess and interpret this information) to share information across boundaries. Streamlining sources of data and information across different authorities may help to minimize mistrust yet should be done only after a thorough context analysis.

› Multiple communications channels and implementation strategies opened with acting authorities in different regions. A country's NMHS has the authoritative responsibility to provide real-time information if it can. If it cannot (e.g. due to conflict and/or natural hazards), then contingency plans are implemented. In some situations, WMO Regional Specialized Meteorological Centres may be requested to provide support. If other actors such as humanitarian agencies or civil society organizations become involved in communications efforts, they should have legitimacy and authority by the affected population or government to coordinate information. In some circumstances, multiple coordinating actors may be needed to reach different populations. Multiple communications channels and implementation strategies may offer the most effective means of implementing EWS in acute contexts where authorities in different areas of a country are in conflict.

Considerations for conflict contexts

» Involved actors in coordination efforts are not a party to a conflict, or if they are, equal representation among parties should exist (as appropriate) to avoid conflict escalation through perceived preferences/alliances. Shared information is not used to target civilians or critical infrastructure; therefore, a careful, informed selection of involved actors and those given responsibility and access to information is necessary.

» Coordination is accompanied by dialogue with parties to the conflict on their obligations under international humanitarian law to protect and not target civilians and civilian infrastructure, including during a disaster.

› Trust-building and communication with conflict actors is undertaken to ensure EWS can function in conflict contexts. Ensuring conflict actors are aware of the type of activities undertaken by EWS stakeholders in areas under the control of different parties is critical. For example, if information-sharing or trust-building does not occur, evacuations can be thwarted or EWS (such as flashing lights from a community-based EWS) can be mistaken as an act of aggression. A conflict analysis and the inclusion of conflict experts should be included to facilitate building trust.

› Conflict and peacebuilding experts, representatives of conflict-affected communities and conflict actors are engaged to ensure conflict factors and context are adequately considered and integrated into risk management plans. This can help hazard and risk assessments to consider specific needs related to conflict as well as ensure they are conducted sensitively (e.g. through trauma-informed approaches). **Box 11** illustrates a community-based DRM approach undertaken by the International Organization for Migration (IOM) and government stakeholders in Papua New Guinea.

3.1.2 Challenges and considerations in identifying, consolidating and assessing risk information and data related to hazards, exposures, vulnerabilities and capacities

» Limited or outdated data on vulnerability indicators, hazards and other dimensions of disaster risk due to conflict/fragility:

› Where little data at national level exist, outputs from regional or international bodies used (e.g. Centre for Research on the Epidemiology of Disasters, DesInventar, OpenStreetMap and ThinkHazard).

› The number of open data sources such as OpenStreetMap increased, as their data can help address the gap in government-collected information on exposure and vulnerability.

› Data-pooling on population vulnerability/exposure information increased or introduced from stakeholders involved in specific domains (e.g. health and infrastructure). Depending on the context, this may come from actors including humanitarians, local governments and civil society organizations.

› Unmapped, high-risk areas for natural hazards identified and mapped to inform impact-based forecasting, through tools such as OpenStreetMap or other available open-source mapping.

› Geospatial imagery collaborations initiated or strengthened to address the lack of current, accessible, high-resolution imagery, which complicates or impedes mapping efforts in many FCV settings.

» Limited institutional knowledge, institutional memory (ranging from archived information to informed personnel) or capacity, or risk of data/information loss:

» Processes for updating and maintaining access to collected data in case of access disruptions or hardware destruction identified. For example, data might be hosted by a regional body or a United Nations country team, Humanitarian Coordinator or similar.

» Data and analysis in external servers/databases stored where actors based outside the country can also access and analyse them through institutional partnerships. This is particularly relevant in contexts of ongoing or sudden fragility or conflict, when power may change hands quickly and the risk of losing or having limited hazard knowledge and data access may be high.

› When necessary, protocols established (including in cases diplomatic arrangements) to store data across regions.

BOX 11

PAPUA NEW GUINEA'S NATIONAL DISASTER CENTRE (NDC) (IOM)

IOM Papua New Guinea, in close cooperation with Papua New Guinea's NDC, is supporting the national, provincial and local governments to strengthen the capacity in disaster mitigation, preparedness, response and recovery in relation to complex emergencies and disaster-induced displacement

The IOM community-based disaster risk management (CBDRM) approach builds on communities' resilience measures against climate shocks in Papua New Guinea's conflict-affected and vulnerable rural areas. Vulnerable communities in disaster-prone areas have developed and operationalized community plans, building resilience at the local level, including through application of community-driven risk reduction solutions such as building homes in safe locations, installing safe drinking water sources and undertaking climate-smart farming techniques.

Through designing their own projects, community members have accounted for risks arising from conflict that they identified along with disaster risks. This approach highlights how international support can be chanelled to expand community-based preparedness measures and early actions, and the value of humanitarian and development collaboration with all levels of government to mitigate disaster risks in FCV contexts.

Source: Case study in **Annex 2**

» Collection of population data or data disaggregation may be misused by parties to a conflict or to actors in power to increase the risk of harm to populations:

  › When the confidentiality of data cannot be confirmed or the risk of misuse is high, it may not be ethical for data collection or disaggregation to be undertaken or shared. For example, in a situation with high ethnic tension, it may be inappropriate for data surrounding ethnicity to be collected or disaggregated due to the risks members of this population might face if their personal information were shared.

  › Alternative data sources such as national or regional population statistics, or the use of technology such as satellite imagery to identify images (e.g. the type of roof a house has), used as proxy indicators for poverty or other population data.

  › Software and data analysis for received data regularly updated, as data breaches may enable the targeting of civilians/infrastructure or the spread of misinformation that increase conflict or risk of harm.

» Information collected, provided or housed by State actors or those party to a conflict is seen as illegitimate/falsified, and not to be trusted:

  › Collaboration among regional/international actors, bodies and agencies with government actors may help assuage concerns regarding the legitimacy of risk information. However, trust and perceptions surrounding (il) legitimacy should be carefully considered to ensure evidence is not undermined through collaboration.

» Lack of processes for integrating conflict and fragility information into an EWS:

  › Conflict and fragility included as key risks to observe and monitor. As science and technology evolve, conflict monitoring tools are considered as a product to integrate into EWS.

  › Conflict, fragility and/or violence data integrated into risk assessment processes. This may include first identifying hotspot areas of FCV contexts, and then conducting detailed hazard assessments in these areas to identify populations with high vulnerability, and possible or likely compounding or cascading events. Context and stakeholder analysis can support the integration of FCV risk knowledge into an EWS (see also section 2.1.1).

  › A process established or confirmed, connected to an early warning coordination mechanism, to update new or emerging risks relating to these. Collaborations with external partners may enable more regular and robust updating and monitoring. Community-based monitoring with clear chains for quality-controlled information dissemination and documentation may be a key element of updating risk information, particularly in areas where widespread data collection or hazard monitoring (e.g. weather stations prone to destruction due to conflict) may be impossible.

Considerations for conflict contexts

» Existing hazard knowledge combined with conflict indicators and information on how hostilities are typically conducted in the context, such as those provided in the Armed Conflict Location & Event Data Project (ACLED) Conflict Index and Uppsala Conflict Data Program to provide current pictures of multiple hazards, including conflict. Gaining a picture of conflict-affected areas and the main natural hazards present within them can offer a basis for identifying opportunities and limitations for EWS, such as whether civilian evacuation in advance of a natural hazard is possible.

» Key tenets around data privacy upheld through a “do-no-harm” approach. In acute conflict, it may be unfeasible to develop or uphold national or international standards for data collection, sharing and assessment.

» Involved actors may need to rely on other measures/methods for information collection considered rather than primary data collection. In acute conflict where it is unfeasible to collect data, other sources of data such as regional age profiles of population, general famine forecasts and so forth may be useful proxy information for planning or when “real-time” action is necessary.

» Key areas for understanding hazards and vulnerabilities include conflict hotspots, locations or corridors of displaced people, and human settlements.

» Retrospective disaster analysis or forensic investigations in conflict contexts can be a powerful tool to identify data and information needs to enable early action. These methodologies can offer in-depth understanding of who, what, where and why people were affected by a hazard (and compound hazards) in conflict-affected contexts. This can help identify useful early actions for the future to reduce risks in complex environments.

Box 12 showcases a conflict monitoring tool developed by World Vision Mali to inform anticipatory action.

BOX 12

CONFLICT MONITORING TOOL TO INFORM ANTICIPATORY ACTION IN MALI (WORLD VISION)

Mali has a fragile and dynamic context due to a multifaceted crisis, which strongly affects the country's ability to monitor contexts and the longer-term accuracy of the data collected. Expanding insecurity towards the south of the country and increasing climate change impacts threaten the livelihoods of communities, including in areas where World Vision's programmes are being implemented. The country's constantly shifting circumstances, information and conditions necessitate ongoing contextual monitoring linked to anticipatory action. There is a strong need to mitigate disaster impacts on populations, livelihoods and assets, but it is difficult to develop and implement programmes without accurate information.

To address this need, World Vision Mali has expanded the context monitoring framework developed under fragile contexts programming approaches in pilot subnational zones. The framework covers multiple risks, utilizes primary and secondary data, and is designed to facilitate early warning and early action for conflict, displacement and disasters induced by natural hazards (e.g. floods and droughts) (World Vision, 2021). It is informed by other existing context monitoring mechanisms such as the warning mechanisms by the African Center of Meteorological Applications for Development and FEWS NET, State meteorological stations, and the System Analysis Program working group. Steps to develop the framework include:

Step 1: Risk profiling. Each area has identified its potential risks. These risks are then prioritized using criteria based on how probable or possible the risk is.

Step 2: Context monitoring. Each prioritized risk has an indicator developed along with thresholds classified as follows:

- **Green:** Normal situation (the risk must and can be managed by the area manager according to standard processes and capacities).
- **Yellow:** Alert (the mitigation and emergency planning team must jointly develop a contingency plan that includes mitigation (anticipatory action) and response plans).
- **Red:** High risk (alarming) (the disaster has happened, and a response is required; the emergency team is called, and the response plan is updated and implemented).

An accompanying dashboard is being developed to visually present the changing context. Indicators are monitored monthly, although the frequency of data collection may increase as needed, and new indicators can be included.

World Vision Mali has been working with the State technical meteorological services and other partners regarding anticipatory actions, which has increased effectiveness in preparedness and response. It will continue to work with local communities, CBDRM committees and local authorities to increase ownership of the monitoring process, development, mitigation and response plans, and to strengthen gender equality and social inclusion within anticipatory action.

This context monitoring mechanism emphasizes the importance of regular data collection and analysis in dynamic contexts, and the feasibility of dynamic decision-making in which interventions can be adapted as needed to meet project outcomes.

For additional information, see World Vision (2019, 2021, n.d.).

Source: Case study in **Annex 2**

3.1.3 Challenges and considerations in assessing exposure, vulnerabilities, capacities and risks

» Lack of multi-hazard analyses taking conflict and/or fragility into account:

› Compound climate–conflict or climate–fragility risk analyses conducted for short and longer lead time events to identify risk management solutions. In contexts where multiple armed actors or leaders may wield power or control territory at different points of time, it is important for EWS stakeholders to gain a thorough understanding of which communities may be considered vulnerable because of natural hazards and the behaviour or risk of marginalization by different actors in control of territory.

» Risks arising from the legacy of conflict evaluated in conjunction with climate risks:

› The potentially limited feasibility of infrastructure repair post-hazard considered as part of localized assessments.

› Broader risks taken into account, such as how key economic sectors may be affected by conflict or under the control of parties to a conflict.

» Lack of government or humanitarian access to populations:

› At-risk communities collaborated with, such as developing citizen science initiatives to conduct local assessments and mapping. This can provide current information as well as validate information from external sources (e.g. obtaining satellite imagery from the United Nations Satellite Centre or conducting anticipatory mapping in OpenStreetMap using satellite images). Useful mapping options include anticipatory remote mapping of high-risk areas, or mapping on the ground conducted by community groups, civil society organizations, Red Cross Red Crescent volunteers or other local stakeholders.

» Assets may be old, outdated or not functional due to conflict or government negligence:

› Loss and damage considerations take the impact of conflict/fragility of assets into account, along with resulting cascading humanitarian impacts.

› The state of assets/infrastructure assessed in relation to actual or potential destruction from conflict as some assets may be disproportionately at risk to natural hazards due to conflict. Conversely, humanitarian impacts from natural hazards may be exacerbated due to eroded critical infrastructure/assets from conflict.

Box 13 overviews a retrospective disaster analysis of tropical storms in Honduras that highlights the importance of understanding and preparing for compound events.

BOX 13

RETROSPECTIVE DISASTER ANALYSIS OF TROPICAL STORMS ETA AND IOTA IN HONDURAS, 2020

The Red Cross Red Crescent Climate Centre conducted a retrospective disaster analysis of the impacts from Tropical Storms Eta and Iota, which made landfall over Honduras within 2 weeks of each other in November 2020.

This illustrated the impacts of compound events in fragile contexts. Extreme rainfall caused flash flooding, river flooding and landslides. The combined effects of both tropical storms directly affected almost 0.5 million people, indirectly affected 4.5 million people, including the (temporary) displacement and evacuation of almost 1 million, and led to 2.8 million people needing humanitarian support.

However, research has shown that the humanitarian impacts of the tropical storms were also influenced by previous extreme weather events (including a drought and extreme flooding and landslides in 2018), as well as a severe dengue outbreak, the ongoing COVID-19 pandemic and an overall violent environment (Honduras had some of the world's highest annual homicide counts at the time). These compounding and cascading factors illustrate the importance of improving dynamic risk analysis and monitoring, to better identify potential hotspots that may be exacerbated by extreme weather events and to inform EWS and overall risk management.

Source: Red Cross Red Crescent Climate Centre (2023)

Considerations for conflict contexts

» Exposure, vulnerability and capacity data obtained through the established coordination mechanisms (e.g. for United Nations actors, through the Inter-Cluster Coordination Group and Information Management Working Groups). Where they exist, local non-governmental organization forums should be engaged.

» Careful consideration of whether information collected or shared may be used to harm populations. During conflict, civilians, services and critical infrastructure are at risk of being damaged or destroyed during attacks. There is therefore a risk that the quantification and mapping of people, areas and objects may provide data that are open to misuse by parties to a conflict. In conflict contexts, it may be safest for open-source mapping and data availability to be restricted to particular actors (who are non-party to the conflict).

» Conflict-sensitive vulnerability analyses conducted to avoid increasing conflict or vulnerability, with a thorough analysis of marginalized groups, including those aligned/perceived as aligned with particular parties to a conflict. In conflict contexts, vulnerability factors may increase (e.g. negative economic impacts of conflict) and may also be more present in particular groups (e.g. heightened vulnerability in populations associated with parties to the conflict or particular targets of them). There is a risk that targeted assistance to particular groups may also increase conflict or the population's vulnerability. The humanitarian principles of neutrality and impartiality are essential to maintain trust within communities and conflict actors when delivering assistance.

» Differing perceptions of risk by affected populations considered. Conflict-affected populations may have different perceptions of levels and types of risks than EWEA implementers (e.g. the perceived risk of family separation due to past experience may override the perceived risk of a flood/mudslide). This should be considered and understood as widely as possible when communicating information or recommending action. See Pillar 4 for a deeper discussion of this.

Box 14 provides examples of tools and resources providing databases, information tracking, and other information relating to disaster risk knowledge, FCV contexts and displacement.

BOX 14

TOOLS AND RESOURCES RELATING TO DISASTER RISK KNOWLEDGE, FCV CONTEXTS AND DISPLACEMENT

ACLED Project (ACLED, 2024)

Centre for Research on the Epidemiology of Disasters International Disaster Database (CRED, n.d.)

DesInventar Sendai (UNDRR, n.d.c)

Humanitarian OpenStreetMap (Humanitarian OpenStreetMap Team, n.d.)

Humanitarian responses plans (country-specific)

INFORM Climate Change Risk (European Commission, n.d.a)

IOM Displacement Tracking Matrix (DTM) (IOM, n.d.a)

ThinkHazard! (GFDRR, n.d.)

UNEP World Environment Situation Room (UNEP, n.d.)

United Nations Office for the Coordination of Humanitarian Affairs (OCHA) Humanitarian Data Exchange (OCHA, n.d.b)

3.2 Pillar 2: Detection, monitoring, analysis and forecasting

Multi-hazard monitoring and forecasting services with a sound scientific and technological basis

KEY ACTORS:

National and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities, ocean observing organizations and geophysical agencies; universities and research institutes; private sector equipment suppliers; telecommunications authorities; security experts; military authorities; civil–military experts; United Nations country teams; UNDP; UNDRR; OCHA; quality management experts; and regional technical centres.

FCV contexts raise a variety of challenges relating to hazard detection, monitoring, analysis and forecasting. Monitoring/observing and forecasting capacities are generally already limited in these contexts. A significant issue that can lead to cascading problems is limited availability, quality and quantity of hazard data, which impedes the development of informed monitoring and forecasting services and mechanisms. For example, conflict or negligence may have caused the damage, destruction or disuse of weather stations, thus limiting the availability of historical and current data and the ability for observations and monitoring to take place.

A lack of capacity due to restricted funding or competing priorities may mean there are limited staff or equipment available to collect or update data. While regional and global models exist to monitor and predict hazards, local or national actors in FCV contexts may lack the access and capacity to use these. Limited access to the Internet, Clouds, data portals, processing systems and other equipment may pose challenges in this regard, and models may not be calibrated to local contexts. Hostilities may also impede access to sites for observation or other forms of data collection.

Fragility, violence and conflict can erode trust in authorities and institutions, limiting the ability of certain actors to generate and issue warnings. In volatile contexts, even long-standing trusted relationships between providers of monitoring and forecasting services and end users can quickly disappear if governance structures change. Humanitarian or other types of partners may develop their own products, which can unintentionally add to confusion and limit trust in predictions. A larger challenge may be a lack of clarity in roles relating to monitoring, forecasting and the issuing of warnings. Box 15 overviews efforts to globally generate, align and share observational data through GBON compliance, and points towards the dire need to increase such data availability in countries affected by FCV contexts.

Furthermore, in FCV contexts, hazards often do not happen in isolation. Due to extreme vulnerabilities, populations are exposed to multiple hazards concurrently in addition to conflict. This makes the forecasting and monitoring of these dynamics more complex. These and other challenges are addressed below.

BOX 15

GBON COMPLIANCE IN COUNTRIES AFFECTED BY FCV CONTEXTS

In January 2023, it became mandatory for all WMO Members to generate and exchange the internationally agreed GBON data. This is a way to improve forecasting skill and capacity through standardizing and increasing available global observations.

The 39 countries classified as fragile or conflict affected according to the World Bank (World Bank, 2024) have extremely low compliance rates. For example, these 39 countries deliver only 7 of the 579 mandated data points for surface observation and 6 of the 118 mandated radiosonde observation data.

Increasing funding to enable countries affected by FCV contexts to make and/or share observational data is critically needed to close this gap.

Sources: SOFF (2024); SOFF (personal communication, 2024); WMO (n.d.a)

3.2.1 Challenges and considerations in putting monitoring systems in place

» Gaps in data availability, quality and quantity, due in part to limited funding, limited access to areas for data collection, damage or destruction of hydrometeorological historical records, observational weather stations and other equipment, and/or limited trained staff to collect or update data:

› NMHSs in FCV contexts have full access to regional/international monitoring data. Ensuring national–regional/international linkages are established can be an important first step for countries with FCV contexts to receive monitoring data.

› A combination of remote sensing, regional/global forecasting and low-technology sensors/cameras in conjunction with community-based monitoring systems considered to provide monitoring in FCV contexts where access and resources may be variable or limited.

› Partnerships established with regional/international actors to receive and analyse data to increase the quality of data analysis. Collaboration between State and non-State actors, and regional/international bodies and agencies, may provide the most robust form of monitoring given potentially weak institutional capacity. For example, the SOFF model of facilitating peer-to-peer advisory support among NMHSs offers long-term, open-ended technical assistance to countries with significant data gaps, including many experiencing fragility, conflict or violence.

› A "good-enough" range of data analysis/prediction/and warning established, tailored to specific countries and conflict contexts. For instance, this range may focus on broad levels of information (e.g. general rather than specific areas of cyclone landfall) if capabilities or time availability are low. Alternatively, focusing on key regions and hazards, and particular time frames and products for specific users, may offer the best use of limited resources.

› Dialogue with parties to the conflict undertaken on the importance of protecting civilian infrastructure such as observational weather stations, servers and storage locations for historical records and allowing access for staff to monitor and collect data and conduct repairs.

Box 16 showcases CREWS Afghanistan's work to increase data and institutional capacities.

Box 17 presents the work of SOFF in South Sudan, which seeks to support the South Sudan Meteorological Services and increase the number of GBON-compliant stations in the country.

BOX 16

INCREASING DATA AND INSTITUTIONAL CAPACITIES (CREWS AFGHANISTAN)

Afghanistan is one of the world's most climate-vulnerable countries. Despite being naturally prone to hydrometeorological hazards, international and non-international armed conflicts have taken a huge toll on the population's ability to prepare for such hazards. CREWS Afghanistan helps to addresses these challenges through increasing access to EWS, and by improving climate risk knowledge and management in the country.

This work consists of three pillars: (a) strengthening the development and delivery of fit-for-purpose early warning and hydrometeorological services, (b) increasing the generation of open access data and knowledge products on hydrometeorological and climate services and facilitating regional cooperation and (c) deepening understanding of climate change impacts on agriculture and water, and other key socioeconomic sectors that are highly vulnerable to climate change.

In its first 3 years of implementation, the project has increased institutional capacities in hydrometeorology, including development of the hydrometeorological concept of operation and service delivery strategy. It has also piloted CBDRM activities, which have improved the warning communication and preparedness of communities.

For additional information, see CREWS (2022).

Source: Case study in **Annex 2**

BOX 17

SOFF SUPPORT TO SOUTH SUDAN

South Sudan was one of the initial focus countries of the United Nations EW4All initiative, and has successfully completed the SOFF readiness phase. This support is crucial as the country is one of the most vulnerable to climate change. In recent years, it has experienced unprecedented flooding alongside droughts, high rates of malnutrition, epidemics and other public health emergencies. These have occurred alongside, and have been exacerbated by, ongoing conflict and instability.

Despite being of critical importance, the South Sudan Meteorological Services faces significant limitations in terms of observations capacity and corresponding infrastructure, human resources and expertise. The country does not have any GBON-compliant stations, which is an essential component to improve forecasts globally and nationally. Without continuous and reliable data, early warnings and early or anticipatory action may not be possible, or will be poorly informed. This is exacerbated by the impacts of political instability, conflict and hazards such as flooding, which may prevent effective humanitarian assistance.

Through SOFF, South Sudan is accompanied by GeoSphere Austria as peer adviser and the African Development Bank as the implementing entity. Two key challenges affecting the entire EWS value chain identified by the peer advisers through field visits were the limited legal framework sustaining the institution, which affects resources and sustainability, and the limited coordination among humanitarian and government institutions to support EWS development. Greater coordination is needed to ensure services are not duplicated and instead are built on existing efforts to avoid redundancy and to support service sustainability.

For the first stage of the phased SOFF investment support, the country is receiving $2.5 million, which will enable the installation of five manual weather stations and four automatic weather stations, as well as the rehabilitation of one station. The African Development Bank's programme to Build Resilience for Food and Nutritional Security in the Horn of Africa will add five automatic weather stations, and SOFF support will ensure their sustained operation. Coordination between SOFF, the programme and the CREWS East Africa project is optimizing resources and contributing to the development of crucially needed EWS in South Sudan. In addition, links to EW4All activities will be established through the investment phase.

Sources: GeoSphere Austria (personal communication, 2024); SOFF (2023)

Considerations for conflict contexts

» Importance of processes for integrating conflict and fragility information into an EWS:

› Conflict and fragility included as key risks to observe and monitor; as science and technology evolve, conflict monitoring tools are considered a product to integrate into EWS.

› A process established or confirmed, connected to an early warning coordination mechanism, to update new or emerging risks. Collaborations with external partners may enable more regular and robust updating and monitoring. Community-based monitoring with clear chains for quality-controlled information dissemination and documentation may be a key element of updating risk information, particularly in areas where widespread data collection or hazard monitoring may be impossible (e.g. weather stations prone to destruction due to conflict).

› Weather monitoring conducted as part of a more comprehensive hazard monitoring process. Whenever possible, this should follow national mandates for developing or strengthening different systems, roles and responsibilities for different hazards. In FCV contexts, monitoring different hazards including biological and technological, plus the volatility of conflict dynamics, from intercommunal tensions, ethnic tension to protest and high-level political discrepancies, is essential as part of a DRM strategy.

3.2.2 Challenges and considerations in putting forecasting and warning systems in place

» Volatile and quickly changing environments and hazards:

› If requested by national authorities, partnerships between local/national and regional warning centres (e.g. emergency management offices) established to provide access to ongoing (ideally 24/7) operational warning centres. This can help address potentially low levels of national capacity, the volatility of conflict contexts, and the likelihood of low staffing in FCV settings.

› Mechanisms established to enable cascading flows of information between different producers and providers of forecasting and warning systems to link sources of information and types of data. Such linkages (e.g. between subnational warning systems and national/regional/international centres) may enable the most accurate and efficient warning system in instances of conflict or fragility where central government authorities are unable or unwilling to disseminate information, funding is limited and/or high levels of mistrust may impede uptake of early action. However, it is critical to evaluate whether hazard monitoring functions may place communities at risk by conflict actors.

Box 18 illustrates the development of an impact-based forecast (IBF) bulletin in Ukraine.

BOX 18

DEVELOPMENT OF AN IBF BULLETIN FOR HUMANITARIAN OPERATIONS IN UKRAINE (CIMA RESEARCH FOUNDATION, ITALIAN RED CROSS, WMO, THE EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS (ECMWF), AND THE NATIONAL METEOROLOGICAL SERVICES OF THE REPUBLIC OF MOLDOVA AND UKRAINE)

The conflict in Ukraine, escalated by the Russian Federation's invasion in 2022, has precipitated a grave humanitarian crisis. Among many other challenges, frequent cyberattacks in the early stages of the conflict hindered communication with national authorities, complicating the rapid transmission of essential information, such as meteorological bulletins, which are critical for coordinating international relief efforts in the country.

The Prevention Preparedness Response to natural and man-made Disasters in Eastern Partnership countries phase 3 programme, funded by the Directorate-General for European Civil Protection and Humanitarian Aid Operations and led by the Swedish Civil Contingencies Agency, adapted its long-term capacity-development plan to help address Ukraine's urgent humanitarian needs.

This adaptation led to the creation of an IBF bulletin, a crucial resource offering detailed information on weather events and their effects on vulnerable groups and key infrastructure. This collaborative initiative involved partnerships with the CIMA Research Foundation, Italian Red Cross, the national meteorological services of the Republic of Moldova and Ukraine, WMO and ECMWF.

The bulletin's development, incorporating thresholds, emerged from a rapid assessment phase engaging end users. This phase evaluated impacts on critical exposed elements like road networks, logistics, IDPs, refugees and border crossings. Additionally, a multi-hazard mapping study was conducted, considering floods and wildfires, and the potential presence of unexploded ordnances, utilizing data from the Violent Incident Information from News Articles database developed by the University of Michigan. These maps offer scenarios that may be activated by the IBF, providing further essential information for humanitarian actors in the region.

The IBF bulletin was developed using open data sets and global models, merging weather data with insights on specific vulnerable elements and infrastructure. This tool, tailored to Ukraine's unique context, provides actionable insights for humanitarian interventions. It represents one of the first internationally acknowledged initiatives to establish a structured civil protection framework in a complex humanitarian crisis. The Italian Red Cross has fully integrated the bulletin to operationalize its response plans, embedding EWEA strategies. This enables anticipatory action in the field, allowing daily plan adjustments based on the information provided. The bulletin has evolved in response to the changing situation, with thresholds being modified to align with the needs of the exposed elements.

For additional information, see CIMA Research Foundation and Italian Red Cross (2023).

Source: Case study in **Annex 2**

Considerations for conflict contexts

» Contingency plans for natural hazard monitoring and forecast developed for fail-safe systems during acute conflict or State fragility to account for the increased likelihood of power and communications blackouts/disruptions.

» System-wide tests and exercises of warning systems may be inadvisable in contexts where tests/exercises may increase population mistrust or, in the worst-case scenario, induce actions that increase the risk of harm.

3.2.3 Challenges and considerations in putting institutional mechanisms in place

» Lack of clear governance in a territory, with multiple competing authorities or the creation of a governance vacuum due to frequently changing areas of control:

› In a humanitarian context, coordination mechanisms established between humanitarian agencies with involvement from government (e.g. the national meteorological agency) and affected communities as far as possible, to generate and issue streamlined warnings and reduce potential duplication and taking place through or with the Inter-Cluster Coordination Group and Information Management Working Groups.

› Various lines of credibility and trust established as needed (e.g. different actors engaging with different populations/parties to a conflict) to ensure warnings are disseminated as widely as possible and most effectively.

› Food security outlooks include the systematic and consistent communication of hydrometeorological forecast information.

» Multiple territories under the control or influence of different armed actors or authorities in the country:

› Neutral sources of regional and global hydrometeorological forecast production and monitoring identified to be shared across or with particular attention to areas of control or influence. Streamlining sources of data and information across different authorities may minimize mistrust.

› Multiple different plans and documents for monitoring networks considered or drafted for hazards in different regions based on acting authorities and possibilities or limitations for collaboration.

Box 19 illustrates how CREWS Burkina Faso has sought to strengthen national capacities for EWS to increase the dissemination and uptake of climate and weather information, as one way of increasing the reach of EWS in an FCV context.

BOX 19

STRENGTHENING NATIONAL CAPACITIES FOR EWS SERVICE DELIVERY IN BURKINA FASO (CREWS BURKINA FASO)

Burkina Faso has experienced ongoing non-international armed conflict since August 2015, along with extreme climate variability, including extreme floods and droughts. In 2022, the country's security and political instability deteriorated significantly due to deadly attacks by armed groups against civilians, military force violations during counter-terrorism operations and two military coups.

A key aim of CREWS Burkina Faso has been to support the National Meteorological Agency of Burkina Faso (Agence Nationale de la Météorologie) to develop EWS and to strengthen its cooperation with agriculture, food security, civil protection, humanitarian stakeholders and the media. While EWS are in place in the country, many challenges and barriers impede the provision of warnings related to hazards and food security that can trigger effective action. This includes limited mapping of high-risk areas or centralized information to systematically document risks or disasters. CREWS has sought to address these gaps through the installation of 50 automatic weather stations and 100 rain gauges, training of relevant technicians to strengthen human resources, implementation of an operational EWS, and ensuring the availability of high-quality and accessible weather information for end users.

Through CREWS Burkina Faso's work, important lessons have been learned for the design and implementation of future projects. Twinning arrangements and institutional partnerships with multiple meteorological services offer more sustainable technical assistance compared to consultancies that yield only short-term collaborations. Standardization and normalization of partners' work can be facilitated as an important form of capacity development, and can be supported by many partners. This includes standardization in the use of technical regulations, guidelines and recommended practices, to provide all partners with a familiar work structure.

Regional cooperation can be a cost-effective strategy to improve national capacity by leveraging regional capacity through cascading forecasting, regional training centres and regional calibration centres instead of building national infrastructure and competencies anew.

For additional information, see CREWS (2022).

Source: Case study in **Annex 2**

Considerations for conflict contexts

- The legitimacy of organizations tasked with generating and issuing warnings established to counter contexts where trust in authorities may be eroded.
- Increased investment in and establishment of impact-based forecasting and anticipatory action systems in conflict-affected contexts.
- Early action plans based on global forecast models in conflict-affected countries. This ideally includes increased rates of analysis of the skill and false alarm ratios to increase accuracy in areas where historically little forecast information may have been analysed.

Box 20 provides examples of tool and resources relating to detection, monitoring, analysis and forecasting of climate, conflict and attendant hazards.

BOX 20

TOOLS AND RESOURCES RELATING TO DETECTION, MONITORING, ANALYSIS AND FORECASTING OF HAZARDS RELATED TO CLIMATE, CONFLICT AND THEIR IMPACTS

Emergency Response Preparedness – Risk analysis and monitoring – multi-hazard (IASC) (UNHCR, 2018)

ACLED Project (ACLED, 2024)

ECMWF (ECMWF, 2024)

AGRHYMET Regional Centre (UNOOSA, n.d.b)

FEWS NET (FEWS NET, n.d.)

Global Flood Awareness System (European Commission, n.d.b)

ICPAC (ICPAC, n.d.b)

IOM DTM (IOM, n.d.a)

United Nations High Commissioner for Refugees (UNHCR) Emergency Handbook (UNHCR, n.d.a) (in particular entries on Interagency Tools for Preparedness (UNHCR, n.d.b))

WMO World Weather Information Service (WMO, n.d.b)

3.3 Pillar 3: Warning dissemination and communication

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

KEY ACTORS:

National and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities and geophysical agencies; military and civil authorities; civil–military experts; telecommunications organizations (e.g. national telecommunications regulators, and satellite and mobile phone network operators), media organizations (e.g. television, radio and social media) and amateur radio; businesses in vulnerable sectors (e.g. tourism, care facilities for older people and maritime vessels); community-based and grass-roots organizations; and international and United Nations entities.

Warning dissemination and communication are crucial in advance of climate hazards, yet both have distinctive challenges in FCV contexts. For effective communication, it is essential to understand power dynamics in an FCV context to identify who should communicate appropriate early warning messages to avoid exacerbating tensions. From a dissemination perspective, it is important to understand appropriate channels, such as whether radio infrastructure is functioning or the most widespread means of communication in a particular region.

In an FCV context, limited governance may impede the development of communications systems or coordination mechanisms at the national level, with additional complications of separate communications channels needed for areas under different control. In some conflict settings, armed actors cut all telecommunications in certain areas, leading to communications blackouts that can impede warning dissemination.

The aim of last-mile connectivity also becomes harder with conflict-affected populations who often become displaced or are on the move, who may have lost assets including mobile phones, and who may be highly mistrustful of any information sources stemming from government or authority figures. The volatility and significant everyday challenges inherent to many FCV contexts may also affect the uptake of warning messages, even if they are received, as the risk perceptions or competing priorities of affected populations may necessitate tailored and trauma-informed messaging. These and other considerations are presented below.

3.3.1 Challenges and considerations in putting organizational and decision-making processes in place and making them operational

» Lack of existing coordinated communications systems across actors and/or geographies due to conflict or

fragility, including issues of multiple armed actors or authorities who may have limited territorial control or influence:

  - Coordinated contingency plans in place for community members, government actors, organizations or agencies to act as de facto communications leads.

  - Parallel warning systems established as needed across political/conflict lines to ensure as many people are reached as possible.

- Hard-to-access populations due to conflict or location:

  - Community-based warning systems established with monitoring systems in place for key hazards in a particular region.

- Limited telecommunications services due to fragility/conflict:

  - Alternate low-resource communications systems in place to alert populations. This may include flashing lights, radio alerts and/or messages over loudspeakers on vehicles, ideally community led, with the aims of ensuring the most disconnected segments of populations are reached and not putting populations at risk of further harm. This also requires dialogue with armed actors or parties to the conflict to explain the type of signals that are being sent and their purpose, to help protect communities when sending these messages.

Box 21 provides information on how Indigenous warning systems have been combined with government communications to strengthen EWS in Papua New Guinea.

BOX 21

IOM PAPUA NEW GUINEA AND PAPUA NEW GUINEA NDC

In Papua New Guinea, identified communities have promoted the application of Indigenous knowledge as a form of EWS to strengthen community response to natural hazards. A garamut (large slit drum made from a log) or conch shell trumpet – part of the Indigenous EWS – was linked with mobile phone and radio communications from the provincial disaster office.

To increase data and community ownership, IOM installed rain gauges in areas prone to flooding, including at schools, churches, government offices and designated disaster evacuation sites. These rain gauges are easy for people in rural communities to monitor and maintain, and were complemented by flood markers placed on eight existing piers. IOM field staff facilitated training on how to read and monitor the rain gauges, and a community member volunteered to oversee the reading and maintenance of the gauges and to monitor flood lines. This plan supports the community-based facilitation of evacuation warnings during heavy rainfall.

Source: Case study in **Annex 2**

3.3.2 Challenges and considerations in establishing and operationalizing communications systems and equipment, and establishing the security of essential infrastructure

» Lack of governance capacity or willingness to form contracts and partnerships with telecommunications companies for EWS:

› Legislation surrounding the role of telecommunications companies in early warning replicated from other contexts to promote mandated early warning communication.

» Lack of time and capacity to develop systematic, wide-reaching communications systems:

› Capacity developed or increased for Common Alerting Protocol[22] guidelines to help alerting authorities issue trauma-informed messages.

› Community-based EWS promoted and invested in, with an emphasis on conflict sensitivity.

3.3.3 Challenges and considerations in effectively communicating impact-based early warnings to prompt action by target groups

» Multiple communications channels for warnings opened with acting authorities in different regions. Involved actors should have legitimacy and authority by the affected population to coordinate information; multiple coordinating actors may therefore be needed. Parallel efforts may offer the most effective means of monitoring and issuing warnings in acute contexts where authorities are in conflict or there is a risk of escalation through communication. Messages may be communicated in multiple languages.

» Risk of harm by taking early action for natural hazards due to conflict/fragility hazards:

› Messages and communications strategies co-produced with target communities.

› Early warnings include information on conflict events or contexts to inform the population on feasibility of action. In contexts where this is deemed too sensitive, safe courses of action informed by conflict events could be included as appropriate.

› Impact-based warnings take level of conflict/fragility into account, such as an awareness of the state of critical infrastructure before a climate hazard.

› Target groups include displaced people and people on the move (e.g. irregular migrants, and pastoral and semi-pastoral groups).

» Lack of trust in information disseminated:

› Core local systems used as the communications base for EWS.

› Consistent information conveyed across political/conflict divides, including through different media sources, to promote trust in messaging.

[22] The Common Alerting Protocol is the international standard format for emergency alerting and public warning, developed by the Organization for the Advancement of Structures Information Standards and used by the International Telecommunication Union.

› Uncertainty communicated, including what is known and not known about an event.

› Messaging is trauma informed and culturally/contextually aware of the fragility and/or conflict environment.

› Reliable channels established to communicate new risks (e.g. through social media or internal communications channels). When possible, warning messages that combine climate and conflict hazards should be disseminated. However, it is also crucial to consider the weaponization of information, such as parties to a conflict either disseminating false information (e.g. to encourage civilian evacuation along particular routes) or using information to plan attacks. The potential for misinformation and the unintended consequences of disseminating information should be carefully considered.

Considerations for conflict contexts

» Humanitarian actors with access to disaster areas may be well placed to tailor warning messages and disseminate them, in acute conflict settings. In such instances, armed actors should be alerted to this to facilitate trust and increase the effectiveness of EWS.

» Particular consideration may be needed surrounding the wording of messaging given differing risk perceptions of conflict-affected populations, who may have different risk tolerances to citizens who have not experienced conflict.

» Conflict-affected communities co-produce warnings to ensure messages are conflict sensitive (e.g. trauma informed or designed to promote trust).

Box 22 shares tools and resources related to the co-production of warnings as well as on wider early warning and response systems building.

BOX 22

TOOLS AND RESOURCES RELATED TO THE CO-PRODUCTION OF WARNINGS AS WELL AS ON WIDER EARLY WARNING AND RESPONSE SYSTEMS BUILDING

Warnings in Violence and Conflict: Coproducing Warnings with and for Those Most at Risk (Peters et al., 2023)

Common Alerting Protocol online training (ITU, n.d.)

Practical Guide: Early Warning and Response Systems Design for Social Conflicts (UNDP and Organization of American States, n.d.).

3.4 Pillar 4: Preparedness and response capabilities

Institutions and people enabled to act early and respond to a warning through enhanced risk education

KEY ACTORS:

National and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities, ocean observing organizations, conflict monitoring organizations and geophysical agencies; military and civil authorities; humanitarian and relief organizations (e.g. national Red Cross and Red Crescent Societies and ICRC); peacebuilding organizations; schools; universities; informal education sectors; media organizations (e.g. television, radio and social media); businesses in vulnerable sectors (e.g. tourism, maritime and care facilities for older people); non-governmental, community-based and grass-roots organizations, including faith-based organizations; and international and United Nations entities.

Reducing risks and preparing and responding to hazards, whether climate or otherwise, is a core component of an EWS and a foundational element of protecting populations. In FCV contexts, these efforts are often complicated or impeded by a variety of factors, including other risks and hazards. However, such complications underscore the importance of adequate anticipatory and response capabilities.

Challenges arising from FCV contexts include limited existing access to at-risk populations to conduct DRR and disaster response efforts, due to reasons such as conflict or limited infrastructure like roads. Displaced populations may be particularly hard to reach, especially in informal settlements or while on the move. Added challenges in reaching and communicating with these populations may be that they are also less familiar with their new environment, lack local knowledge and may have less trust in authority figures. This reinforces the need to develop tailored strategies for effective EWEA with displaced people (Easton Calabria et al., 2022).

Telecommunications and infrastructure may be eroded or non-existent, necessitating creative and unorthodox forms of risk education. A lack of funding and time for disaster preparedness on the part of acting authorities or humanitarian and development agencies – frequently due to other ongoing crises – means that hazards are often dealt with as they unfold, increasing the likelihood of large-scale, compound or cascading risks. Simulations of EWS implementation may also not be possible due to safety concerns of participants, and/or lack of funding or time.

Limited time and funding on the part of at-risk populations can also complicate disaster preparedness, as early actions may not be taken due to competing priorities related to safety and daily survival strategies.

FCV contexts also raise challenges to the ability to recommend or take early action. In a conflict context, actions such as evacuation to community shelters must be carefully considered in light of the risk of shelters becoming targets (intentionally or unintentionally), the limited accessibility of some marginalized groups to actions that may be led by other groups/factions, and factors such as the potential for tension or conflict within shelter or assistance points by different groups. **Box 23** highlights some of the challenges in implementing and evaluating anticipatory action in Afghanistan experienced by FAO.

Early action for people affected by conflict can often be the only lifeline to reduce risks due to the lack of long-term investment in risk reduction and adaptation in their local environment. Early action can help address critical residual risks, such as large risks of mortality increased by, for example, decaying and failed infrastructure that are compounded by heavy rainfall to induce unprecedented floods.

BOX 23

CHALLENGES IN ANTICIPATORY ACTION IMPLEMENTATION AND EVALUATION IN AFGHANISTAN DUE TO CONFLICT AND REGIME CHANGE (FAO)

In 2020–2021, Afghanistan experienced a severe drought that had a significant impact on the country's agriculture and water resources. Instead of waiting for the situation to deteriorate, in December 2020, FAO acted on the warning signs of drought and worsening food security conditions. The project aimed to mitigate the adverse impacts of the drought in the northern rain-fed cultivation areas of Afghanistan, specifically Samangan Province, by providing assistance and facilitating access to agricultural inputs to at-risk families. FAO provided support to over 7,680 vulnerable smallholder farming households (an estimated 53,810 people), through agriculture packages, livestock health kits and training, multipurpose cash transfers and cash for work.

An impact analysis showed that the actions helped reduce the impact of drought on agricultural livelihoods, with positive effects on food security and socioeconomic indicators (FAO, 2023). However, the project's implementation was affected by the security situation at the time, given the change in Afghanistan's political leadership. This led to issues with timing of the project activities as well as data-collection plans that were specifically designed in line with the qualitative and quantitative methods to assess key outcomes.

Pre-agreed timelines were altered, and the project's activities were sometimes brought forward. In some cases, such as in cash activities, distributions were advanced by a month. This had a significant impact on the project's original design, as well as the analytical outcomes, which were originally designed to assess how the types of interventions and the timing of interventions may affect beneficiary communities.

Collecting data in politically sensitive and conflict situations is extremely difficult. Due to the increased conflict, displacement and lack of access to project sites, disruptions in data collection were unavoidable. Data collection was halted and then restarted when the situation allowed. The break in the collection likely affected the results, and the recollection of families on the impact of the intervention. Due to the security situation, data were collected only on male participants, leading to a male bias. It is likely the results of the analysis would have changed if women were interviewed and their experiences included.

Despite designing a technical quasi-experimental approach for the quantitative analysis of the interventions, FAO was not able to collect the required number of data points needed to show significance within the quantitative models developed for the analysis. This made it difficult to analyse many key impacts of the intervention through the analytical approach that was originally designed.

These and other challenges illustrate the complex environments where action and learning relating to anticipatory action take place.

Sources: FAO (2023), FAO (personal communication, 2024)

3.4.1 Challenges and considerations in the development and operationalization of disaster preparedness measures

» Variety of competing risks to account and prepare for:

› Disaster preparedness, including plans or standard operating procedures, co-produced with affected communities to identify additional non-climate hazards and risks as well as community-based protection and risk reduction measures already being implemented.

» Limited funding and prioritization of disaster preparedness due to other ongoing crises:

› Disaster preparedness efforts coordinated as part of wider EWS coordination to reduce silos and to enable information and updates to be shared across ministries, agencies and other relevant actors.

› Disaster preparedness streamlined as far as possible into existing programming or awareness-raising campaigns to be cost- and time-effective.

› Awareness raised of compound and cascading risks arising from natural hazards and ongoing crises of relevance to promote the uptake of warning messages and early action.

» Lack of clear governance, multiple territories under control of different actors in one country or a governance vacuum due to frequently changing areas of control:

› Multiple last-mile operators activated and mobilized as relevant to access particular communities and/or areas of countries to account for various lines of control and influence of authorities.

› Trusted, neutral coordinators for last-mile operators (e.g. agencies working across party lines) identified to promote the streamlining of information and warnings across geographies and populations.

» Volatile environments with quickly changing security risks:

› Early actions developed and designed through multi-hazard risk assessments that account for FCV contexts.

› Early actions changed or adapted at regular intervals based on informational updates on conflict and/or fragility to ensure actions do not pose additional risks and threats.

› Contingency plans developed, informed by climate projections and conflict/fragility monitoring, to account for different scenarios of conflict or fragility with roles and responsibilities delegated accordingly. Plans include strategies to address compound risks generated by climate and FCV contexts, and cascading hazard events.

» Difficulty in testing EWS:

  › Exercises undertaken to simulate EWS and identify key areas to improve in a safe and time-effective simulation.

» Limited access to at-risk populations for preparedness and response:

  › Longer-term investments achieved for last-mile operators and community-based EWS to account for limited population access.

  › Dialogue with parties to the conflict/armed actors conducted to facilitate humanitarian access to allow for preparedness and response activities.

» Risk of harm by taking early action due to conflict/fragility hazards:

  › Information provided about hazards and expected impacts that does not specify actions to take, as recommending particular actions may lead to harm (e.g. evacuation into a conflict territory).

Box 24 presents the OCHA-facilitated early action intervention in South Sudan in 2022, which arose in part due to warnings regarding the risk of compounding and cascading crises from extreme flooding.

Considerations for conflict contexts

» Organizations or agencies with the most population access and communication with acting authorities designated as leads in territories affected by armed conflict and violence to expand opportunities for warnings and actions. Such organizations or agencies should be identified based on consensus with key EWS stakeholders, including affected communities.

» Disaster preparedness measures, including response plans, account for the short- and long-term effects of conflict, ranging from blocked evacuation routes to limited or non-existent infrastructure or shelter. All measures are evaluated through a do-no-harm approach.

» Actions taken by EWS stakeholders to engage with armed actors to identify appropriate evacuation routes and shelters that can be agreed upon and protected from hostilities by parties to the conflict.

» The recommendations of early actions such as evacuation to community shelters carefully considered in light of the risk of: (a) shelters being damaged or destroyed during hostilities, (b) limited accessibility of some marginalized groups to actions that may be led by other groups/factions and (c) the potential for tension/violence within shelters or assistance points by different groups.

» It may be inappropriate in conflict contexts to test the effectiveness of early warning dissemination processes, preparedness and response to warnings to avoid the risk of harm to civilians. Instead, the testing of internal processes and protocols among involved actors (e.g. local government and humanitarian actors) could identify coordination, communication or gaps in information that need addressing.

BOX 24

OCHA-FACILITATED EARLY ACTION BEFORE EXTREME FLOODING IN SOUTH SUDAN

In South Sudan, large-scale early action in 2022 illustrated the potential for advanced planning and funding to avert disasters in complex settings. The country had experienced four consecutive seasons of intense annual flooding since 2019. In early 2022, forecasts showed there was a significant risk of catastrophic flooding in the most flood-prone areas of South Sudan during that year's rainy season. However, the forecasts were not reliable enough to develop a formal anticipatory action framework. This was largely due to limited on-the-ground observational data due to years of conflict.

Rather than not act at all, OCHA facilitated the development and implementation of a pilot early action project together with partners in Unity State, South Sudan. The project was funded via allocations from two OCHA-managed pooled funds – CERF and the South Sudan Humanitarian Fund – and was intended to anticipate and actively mitigate the projected impacts of severe flooding. Six United Nations entities implemented the interventions (FAO, IOM, UNHCR, United Nations Children's Fund, United Nations Population Fund and World Health Organization). Much of the response was centred around Rubkona County, where Bentiu town and the Bentiu IDP camp – hosting over 100,000 IDPs who had experienced conflict and/or flooding – are located.

The existing humanitarian presence in the area and existing camp coordination supported the implementation of activities. Early actions varied from building dikes to providing cash grants to female IDPs to buy firewood in an effort to minimize their need to walk long distances in flood-water to collect wood. All actions were intended to mitigate flood encroachment and reduce potential displacement due to flooding or to minimize flood-related impacts before they compounded and caused even greater need.

Given several dike breaches at the Bentiu IDP camp in October 2022, several informants working in the camp highlighted the value of the dike building and reinforcement that had been completed in previous months. They considered that alone had made the early action a success. Results of project implementation also illustrate positive outcomes in terms of lower-than-anticipated malnutrition and waterborne disease rates, alongside anecdotal evidence of increased support from cash transfers and livelihood support.

Sources: OCHA (2022); Easton-Calabria (2023); ISDC (2023)

3.4.2 Challenges and considerations in conducting public awareness-raising and education campaigns

» Large-scale hard-to-reach populations:

› Existing trusted sources of communication within communities utilized to target public awareness-raising and education campaigns, including through community leaders able to effectively communicate information and thus increase dissemination.

› Community-based EWEA promoted through ongoing investment and training, ideally with clear linkages to broader sources of warnings and information (e.g. regionally and nationally).

» Lack of community trust in information and sources, and/or misuse of information by actors with influence:

› Awareness and education strategies for particular regions or populations co-produced with communities in ways that account for FCV contexts, rather than undertaking a "one-size-fits-all" communications approach.

› Public education to increase community hazard awareness includes direct points of contact with relevant civil society or humanitarian agencies in the absence of government presence or in situations where the government is not considered a trusted actor by populations.

› Reliable media (e.g. broadcasting media or social networks) utilized across political/conflict lines to improve public awareness to reach the most people as well as reduce misinformation.

Considerations for conflict contexts

» Conflict dynamics, such as analysis and understanding of ethnic or intercommunal tensions, considered when developing early warnings and actions.

» Public awareness-raising and education campaigns take a trauma-informed approach that accounts for concerns arising from experiences in conflict (e.g. the risk of family separation during evacuation). Co-producing messaging with affected communities enables appropriate messaging for particular contexts.

» Public awareness-raising and education campaigns on hazards include climate hazards and compound risks arising from conflict and climate hazards.

» Public awareness-raising and education campaigns tailored to the specific needs of conflict-affected vulnerable groups such as refugees, other displaced people and child soldiers, and include considerations for other populations such as prisoners of war.

» Communications channels appropriate for conflict and climate hazard EWEA are explored.

3.4.3 Challenges and considerationsin testing and evaluating public awareness and response

» Testing of public awareness and response may cause harm or disproportionately use limited resources:

› Common barriers in particular areas identified, such as limited physical or communications infrastructure that

may present the biggest challenge to implementing preparedness and response plans, and public awareness-raising efforts tailored accordingly. When possible, lessons learned from previous emergency and disaster events in the country, or in similar contexts, to further inform planning in instances where testing and evaluation are limited.

› Good practices and lessons learned from other FCV contexts to support EWEA in contexts where limited previous emergency and disaster event and response documentation exists.

Considerations for conflict contexts

» Good practices from local, regional and national conflict warning and monitoring systems (Defontaine, 2019) examined to establish good practices for raising public awareness and responses for climate hazards.

» Evaluation of public awareness-raising strategies and programmes for effectiveness include specific analysis of the awareness for particular subpopulations affected by conflict, such as displaced people, child soldiers and former weapons bearers.

» Evaluation of public awareness-raising strategies and programmes for effectiveness includes consideration of localized and generalized conflict to better understand how specific experiences/ incidents of conflict may affect awareness strategies and programmes.

Box 25 presents tools and resources relating to early and anticipatory action in conflict settings.

BOX 25

TOOLSANDRESOURCESRELATING TO EARLY AND ANTICIPATORY ACTION IN CONFLICT SETTINGS

Disaster Risk Reduction in Conflict Contexts: An Agenda for Action (Peters, 2019)

An agenda for expanding forecast-based action to situations of conflict (Wagner and Jaime, 2020)

Anticipatory Action in Refugee and IDP Camps: Challenges, Opportunities, and Considerations (Easton Calabria et al., 2022)

The Tumerington case: a role-playing exercise for designing anticipatory action (Anticipation Hub, 2023)

Anticipatory Action in Conflict Practitioners' Group (Anticipation Hub, n.d.)

4. Conclusions

4. Conclusions

While difficult, improving the EWS capacity of countries and regions experiencing FCV contexts is possible, and certainly necessary. EWS led by stakeholders ranging from governments to communities in FCV contexts have been developed with success, illustrating that, in different situations, natural hazards can be identified and information about them conveyed in time for people to take action. However, many of these systems must be strengthened and expanded, and many more must be developed in countries affected by conflict, violence and fragility.

While certain elements of EWS likely need to be tailored or adapted to be most effective for FCV contexts, many of the key needs remain the same or even more important than in other contexts. At the same time, there are additional important considerations for FCV contexts, including the need for new indicators and monitoring tools, and additional compounding and cascading risks.

To conclude, this chapter draws on considerations and examples to present the following key components of a common vision for the effective implementation of EWS for all in FCV contexts.

1.

EWS provided as a basic service for all, even in FCV conditions

Across the humanitarian sector, there is an aim for continuity of services in crisis situations, to ensure every human being has their basic rights fulfilled with regard to access to food, safe water, shelter, health care and education. There is a concomitant need for EWS to be understood as a type of basic service whose continuity must be assured, even in the midst of overlapping crises.

2.

EWS building approached as a long-term endeavour that must be supported through coordinated finance and investments across timescales and sectors

There is a need for a long-term view of systems building to account for the EWS starting point of many countries experiencing FCV contexts. Challenges may include few existing systems, and limited capacity, funding and time by stakeholders to develop or implement them, compounded by likely disruptions and delays due to fragility, conflict or violence. Better coordination of finance and projects, and longer-term investments can support the development of more sustainable and robust EWS.

3.

Inclusive EWS developed, which are trusted by affected communities and co-produced with them to take account of the nuances and dynamics of FCV settings

Promoting inclusion and developing trust among the stakeholders of EWS development and the end users of early warnings are critical. This is particularly true in FCV contexts where trust in governments and other systems of authority has often been eroded. Steps to achieve this include increasing the participation of women and girls, displaced people and conflict-affected populations in co-producing EWS and EWEA more broadly, including in outreach and education efforts surrounding EWS.

In this regard, the principles of locally led adaptation offer key areas for guidance and consideration. Levels of inclusion in EWS and resulting people-

centred solutions are closely tied to levels of trust in populations surrounding early warnings, meaning that lives are and can be saved through community co-production and inclusion, including through community-based EWEA systems.

4.

Regional and international centres and actors provide and share technical support, capacity-building and coordination of national EWS, to exchange learning and knowledge and ensure EWS become an accessible common good for all

FCV contexts raise a variety of challenges relating to hazard detection, monitoring, analysis and forecasting. A significant issue that can lead to cascading problems is limited availability, quality and quantity of hazard data, which impedes the development of informed monitoring and forecasting services and mechanisms.

Limited funding, capacity and time among national EWS stakeholders in FCV contexts means that regional and international collaboration and partnerships are foundational supports to national systems. This is particularly true in instances of acute fragility or conflict, where national actors may be unable to perform essential duties on site and may rely on external actors to continue to monitor and provide forecasts to enable EWEA.

The EW4All agenda – "a formidable but essential challenge" (World Bank, 2023) – represents an opportunity and a demand for populations living in FCV contexts to gain the protection that EWS can offer. The considerations presented above offer an important road map for coordinating, learning from and investing in EWS in FCV contexts and planning for the work to come.

5. Annexes

Annex 1. Examples of relevant literature resources

Examples of literature resources related to early warning systems (EWS), multi-hazard early warning systems (MHEWS), early action and anticipatory action in fragile, conflict-affected and violent (FCV) contexts.

Title	Aim/objective
MHEWS/EWS	
Words into Action: A Guide to Multi-hazard Early Warning Systems **(UNDRR, 2023a)**	Aims to guide governments, stakeholders and partners on the institutionalization, operationalization, monitoring and strengthening of people-centred inclusive MHEWS that enable early action. It provides knowledge to enable implementation of effective MHEWS, through presentation of key theoretical and practical aspects to consider for development and/or reinforcement.
Multi-hazard Early Warning Systems: A Checklist **(UNDP et al., 2018)**	Provides a practical tool consisting of major components and actions that national governments, community organizations and partners within and across all sectors can refer to when developing or evaluating EWS. The guidance document aims to provide national stakeholders supporting EWS implementation in Caribbean countries with guidance on how the checklist should be applied, including the data-collection process, reporting and validation of the results.
Multi-hazard Early Warning Systems: A Checklist **(WMO, 2018)**	Updates and refines an earlier document and incorporates the acknowledged benefits of MHEWS, disaster risk information and enhanced risk assessments through the lens of the Sendai Framework for Disaster Risk Reduction 2015–2030. It is structured around the four key elements of EWS, and aims to be a simple list of the main components and actions to which national governments, community organizations and partners within and across all sectors can refer to when developing or evaluating EWS.

The roles of state and non-state actors in early warning and early action: Capacity gaps and collaboration **(REAP, 2023)**	Draft document providing an overview of the State and non-State actors involved in EWS at the local, national and international levels. It also outlines their roles and contributions across four key areas of the EWS value chain. Eight recommendations accompanied by a set of actions are provided.
Disaster risk reduction	
Navigating Fragility, Conflict, and Violence: A Handbook for DRR Practitioners **(Red Cross Red Crescent Climate Centre, forthcoming)**	Considerations and recommendations on disaster risk reduction in FCV contexts, aimed at the Red Cross Red Crescent Movement and partners. It is divided into stages of knowledge and action, including conflict sensitivity and guidance on compound risk.
Disaster-Conflict Interface: Comparative Experiences **(UNDP, 2011)**	Reports on interactions between conflict and disasters caused by natural hazards. It presents comparative experiences and lessons learned alongside case studies from diverse regions.
Anticipatory action/forecast-based action	
An agenda for expanding forecast-based action to situations of conflict **(Wagner and Jaime, 2020)**	Discusses forecast-based action for hydrometeorological hazards in conflict situations and forecast-based action for humanitarian impacts of conflict.
The Future of Forecasts: Impact-based Forecasting for Early Action **(ARRCC et al., 2021)**	Outlines the steps and tools needed to develop impact-based forecasting: from understanding risk to producing, issuing and verifying fit-for-purpose impact-based forecasts and warnings. It includes case studies from countries around the world to highlight the development and use of impact-based forecasting services for users and producers.
Anticipatory Action in Refugee and IDP Camps: Challenges, Opportunities, and Considerations **(Easton Calabria et al., 2022)**	Provides considerations and recommendations for early warning, early action and anticipatory action in refugee and internally displaced person camps with case studies of Bangladesh and the Syrian Arab Republic. The Bangladesh case study provides a good practice of extending national EWS into camps.

Annex 2. Case studies of early warning system implementation in fragile, conflict-affected and violent contexts

The following case studies were submitted by members and partner organizations of the Centre of Excellence for Climate and Disaster Resilience to support this handbook in contextualizing some of the outlined challenges and approaches in establishing and strengthening early warning systems (EWS) in fragile, conflict-affected and violent contexts.

Acknowledging that each context varies widely, these short case studies offer examples of how organizations have developed or supported programming to further EWS in particular contexts affected by fragility, conflict and violence.

A2.1 Case studies submitted by CIMA Research Foundation

Impact-based early warnings for humanitarian actors: The case of severe weather and floods in Sudan (Sudan Meteorological Authority (SMA), CIMA Research Foundation and NORCAP)

Introduction to context

Extreme weather events such as floods and droughts, to which Sudan is frequently exposed, are a real threat in an extremely fragile and vulnerable social context. Sudanese institutions are severely weakened by the conflict that erupted in April 2023, with serious difficulties in operating and delivering their mandate. Member institutions of the National Council for Civil Defence, responsible for disaster management in Sudan, had to relocate, moving their centres of operations from Khartoum to Port Sudan and Wad Madani. SMA had no access to the central office premises and could not ensure the proper functioning of weather monitoring and forecasting services.

Given the circumstances, the national institutions leading the Early Warnings for All (EW4All) initiative in the country required enhanced capacity to adapt to the challenges and ensure continuity, while pursuing improvements in disaster preparedness. With the start of the 2023 rainy season, SMA formulated a climate service rescue plan aimed at garnering support from regional and international organizations, to support the performance of essential weather services and early warning functions. This plan and associated motivation set the direction for a joint effort among different project and initiatives to provide coordinated assistance and improved capacity to SMA and the Sudan EWS.

Overview of the initiative

The recent conflict in Sudan has profoundly changed the context and scenario in which the disaster risk reduction (DRR) partners operate, making it more complex while increasing the need and urgency to support civil protection and, above all, humanitarian operations in the country.

Immediately after the start of the conflict, consultations were launched with various actors at the national level (member Institutes of the National Council for Civil Defence) and international level (African Union Commission, World Meteorological Organization (WMO), Intergovernmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC), Regional Specialized Meteorological Centre Kenya, NORCAP, European Civil Protection and Humanitarian Aid Operations, and the Italian Agency for Development Cooperation (Agenzia Italiana per la Cooperazione allo Sviluppo; AICS)) with the aim of evaluating current needs.

The first round of consultation highlighted the urgent (monitoring and response to the rainy season) and long-term (restoring services and ensuring daily operations) needs of the DRR actors. SMA considers the technical assistance initiatives that were ongoing before the conflict to be of great importance, and cites them as a source of cooperation and support to guide restoration of essential services.

The goal is to enhance Sudan's climate services and contribute to the development of a robust EWS aligned with the EW4All initiative through various projects in the region (e.g. Climate Risk and Early Warning Systems (CREWS) Greater Horn of Africa; the AICS-funded Fighting Climate Change. Early Warning and Civil Defense for Floods and Droughts in Sudan-APIS project, the Severe Weather Forecasting Programme in partnership with the Regional Specialized Meteorological Centre and Water at the Heart of Climate Action). The collaborative efforts already under way have generated notable momentum that is worth building upon, particularly considering the pivotal role of SMA as the focal point and its coordination responsibilities for EW4All implementation.

Key challenges

The conflict situation exacerbates the natural hazards to which the Sudanese population is exposed. It is therefore necessary to give continuity to early warning activities, supporting emergency operations and humanitarian intervention, also considering emerging vulnerability conditions and response capabilities. Institutions are missing adequate logistics capacity, as well as experiencing a lack of personnel and infrastructure. This presents serious barriers to the effectiveness of the coordination mechanism to inform and prepare at-risk communities.

The massive flow of displaced people is of major concern. It is generating a volatile environment with tremendous difficulties for needs assessment. It is also generating competition for resources. To overcome these challenges, there is a critical need to stabilize national institutions, fortify climate services' logistical capacities, and align these efforts with the prevailing humanitarian context. This multifaceted approach is essential for enhancing the resilience of communities facing the compounded impacts of conflict and natural hazards.

Innovative solutions

The conflict erupted when the rainy season (May to October) was imminent, making it necessary to find alternative and timely solutions to provide warning information in a context of increased vulnerability. Several efforts have been made to produce a prototype of an impact-based forecast (IBF) bulletin dedicated to national and international humanitarian actors, delivering real-time information on how extreme hydrometeorological events might affect vulnerable areas. It now provides updated forecasts on weather-related events, and it can be overlaid with the presence of internally displaced persons (IDPs), the population, and the locations of humanitarian workers' clinics and infrastructure.

The bulletin, designed in the framework of the AICS-funded and CIMA-led initiative APIS, is based on daily outputs of numerical hazard prediction models run using virtual technologies (Cloud services), as it is not possible to transfer hardware technologies on site. The weather forecast model has been up and running for Sudan since July 2023, while the hydrological chain Flood-PROOFS for East Africa, jointly implemented with ICPAC, is providing impact-based forecasts for Sudan. Based on these results, the severe weather extreme bulletin is produced daily for humanitarian actors. Daily results are generated on the Cloud and automatically made accessible through the web to SMA colleagues in multiple formats (e.g. netCDF, tif and png), with suitable file sizes for the country's Internet capacity.

The bulletin also leverages the information and methodology already available at the continental scale through the Africa Multi-Hazard Early Warning and Early Action System for DRR.

Pillars of concern

The pillar of concern is detection, monitoring, analysis and forecasting.

Taking into account the current needs and context, project partners are focusing on two main lines of intervention: (a) to maintain the capacity of the flood and drought monitoring and forecasting service, avoiding the loss of experienced and technical staff, with support from local experts as well as secondment mechanisms for Sudanese experts to regional institutes (IGAD/ICPAC; African Union Commission Africa Multi-hazard Early Warning and Action System Situation Room) and (b) support the humanitarian response in the management of flood- and drought-induced emergencies in the country, in a context of increased vulnerability and need for rapid and reliable information, to facilitate coordination among the actors.

Lessons learned

Recognizing the lack of adequate means for intervention, the adaptability shown by Sudanese colleagues is commendable and a source of inspiration and motivation for joining efforts in providing coordinated support in current and future initiatives.

Under pressure and extreme difficult circumstances, sharing common practical goals is key to overcoming challenges and fostering collaboration among actors.

Furthermore, Cloud solutions for running the numerical weather prediction model, efforts for establishing semi-automated routines for computing the IBF and the implementation of alternatives and low-bandwidth solutions for sharing results with SMA colleagues in Sudan, enabled the possibility to restore forecasts and warnings for Sudan in time for the rainy season.

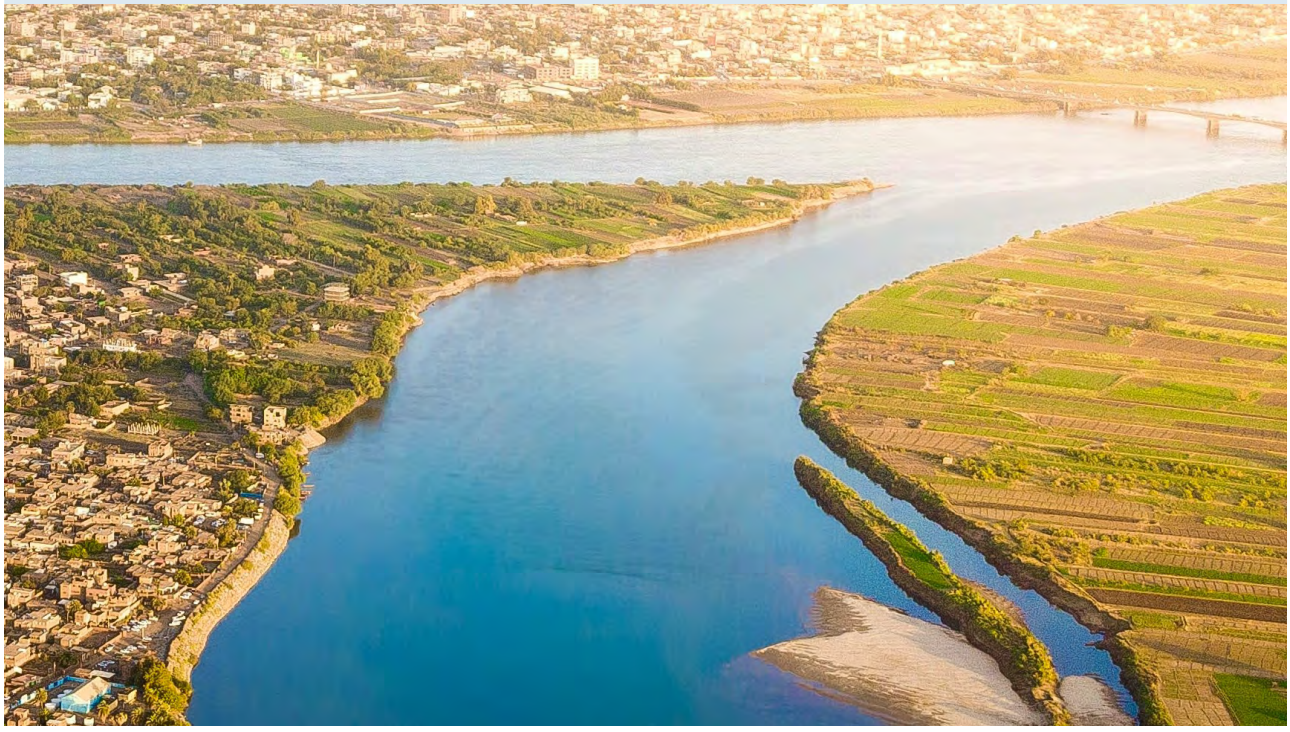
Planning is possible and also needed under unforeseen emergency conditions, requiring flexibility, patience and coordination with a positive and safety-first attitude despite stressful conditions.

Links to resources

Early warning and disaster risk reduction: Training at CIMA Foundation

Hydro-meteorological forecast bulletin for Sudan

Sudan Meteorological Authority (SMA) at COP 28



Development of an IBF bulletin for humanitarian operations in Ukraine (CIMA Research Foundation, Italian Red Cross, WMO, European Centre for Medium-Range Weather Forecasts (ECMWF), and the national meteorological services of the Republic of Moldova and Ukraine)

Introduction to context

The conflict in Ukraine, escalated by the Russian Federation's invasion in 2022, has precipitated a grave humanitarian crisis. This intricate situation involves a diverse array of stakeholders – government bodies, international organizations, non-governmental organizations and scientific communities – all focusing on addressing multifaceted challenges such as displacement, infrastructure damage and environmental hazards.

Despite Ukraine's robust civil protection system, the conflict has redirected most available resources towards addressing the humanitarian crisis. Additionally, frequent cyberattacks in the early stages of the conflict hindered communication with national authorities, complicating the rapid transmission of essential information, such as meteorological bulletins, which are critical for coordinating international relief efforts in the country.

Overview of the initiative

The Prevention Preparedness Response to natural and man-made Disasters in Eastern Partnership countries phase 3 programme, funded by the Directorate-General for European Civil Protection and Humanitarian Aid Operations and led by the Swedish Civil Contingencies Agency, adapted its long-term capacity development plan to address Ukraine's urgent humanitarian needs.

This adaptation led to the creation of the IBF bulletin, a crucial resource offering detailed information on weather events and their effects on vulnerable groups and key infrastructure. This initiative was a collaborative effort, involving partnerships with the CIMA Research Foundation, Italian Red Cross, the national meteorological services of the Republic of Moldova and Ukraine, WMO and ECMWF.

The bulletin's development, incorporating thresholds, emerged from a rapid assessment phase engaging end users. This phase evaluated impacts on critical exposed elements like road networks, logistics, IDPs, refugees and border crossings.

Additionally, a multi-hazard mapping study was conducted, considering floods, wildfire hazards and the potential presence of unexploded ordnances, utilizing data from the Violent Incident Information from News Articles database developed by the University of Michigan. These maps offer scenarios that may be activated by the IBF, providing further essential information for humanitarian actors in the region.

Key challenges

Operating in the volatile conflict zone of Ukraine presented significant challenges, including ensuring the accuracy of data collection and dissemination, and effective coordination among diverse agencies. In the initial months of the conflict, robust data sets for analysis were not accessible from external institutions. Additionally, the consortium faced difficulties in accessing the expertise of Ukrainian meteorologists, which was crucial for preparing and disseminating a daily IBF needed to support the humanitarian intervention. Timely information was needed to understand the impact of adverse meteorological events on logistic networks and on IDPs who were moving in masses during winter without adequate clothing or fuel. The lack of such information hindered the execution of a risk-informed plan.

Innovative solutions

The IBF bulletin was developed using open data sets and global models, merging weather data with insights on specific vulnerable elements and infrastructure. This tool, tailored to Ukraine's unique context, provides actionable insights for humanitarian interventions. It represents one of the first internationally acknowledged initiatives to establish a structured civil protection framework in a complex humanitarian crisis.

The Italian Red Cross has fully integrated the bulletin to operationalize its response plans, embedding early warning to early action strategies. This enables anticipatory action in the field, allowing daily plan adjustments based on the information provided. The bulletin has evolved in response to the changing situation, with thresholds being modified to align with the needs of the exposed elements.

Pillars of concern

IBF development encompassed all four pillars of work as outlined in the multi-hazard early warning system (MHEWS) checklist:

1. Disaster risk knowledge: A rapid risk assessment identified key hazards affecting Ukraine during the conflict. The selection of monitored hazards (like temperature, rain, cold waves, biometric indices, snow cover and wildfire indices) was based on their relevance to humanitarian interventions and the exposed elements considered by the bulletin.

2. Detection, observation, monitoring, analysis and forecasting of hazards: Initially utilizing open data, collaboration with ECMWF and WMO enabled access to sophisticated numerical weather prediction models through the South-East European Multi-Hazard Early Warning Advisory System programme, thus enhancing the bulletin's efficiency.

3. Warning dissemination and communication: The bulletin is shared with relevant stakeholders, and tailored for specialized users rather than general public dissemination to avoid misinterpretation.

4. Preparedness and response capabilities: The bulletin's primary goal is to integrate modern early warning, early action strategies into humanitarian interventions and provide timely information to strengthen response mechanisms through proactive planning.

Lessons learned

- The importance of adaptable strategies within international programmes, especially when dealing with areas that have volatile political situations. The necessity and added value of collaboration among various stakeholders and projects.

- The effectiveness of localized data integration and use of open data sources in humanitarian responses.

Links to resources

Floods, fires and unexploded ordnance: the PPRD EAST 3 multi-hazard mapping

Science, civil protection and humanitarian aid: CIMA Research Foundation and the Italian Red Cross work together for Ukraine

Supporting the humanitarian effort in Ukraine

Ukraine: Impact-based forecasting as a situational awareness tool for humanitarian interventions

Ukraine: Multi-risk mapping of foundation

VIINA

Annex A2.2 Case studies submitted by Climate Risk and Early Warning Systems

Increasing data and institutional capacities (CREWS Afghanistan)

Introduction to context

The 2021 Global Climate Risk Index ranked Afghanistan sixth for climate impact and vulnerability. The country is naturally prone to hydrometeorological hazards, but the persistence of wars and internal conflicts reinforce and perpetuate Afghans' lack of preparedness for natural hazards. This affects the safety of people and also key economic sectors, namely agriculture, urban energy and transportation. Climate change impacts are projected to worsen; therefore, establishing accurate and timely hydrometeorological, early warning, climate and disaster information services is urgently needed to minimize human and economic losses in the country.

Despite the limited resources available, initial steps for the development of the meteorological and hydrological services in the country have been developed through projects funded by the World Bank within various governmental organizations, including the Afghanistan Meteorological Department and Water Resources Management Department. A road map on strengthening hydrometeorological and early warning services in the country was prepared in 2018 by the World Bank to strengthen the capabilities of national institutions by identifying the gaps and challenges in producing and delivering fit-for-purpose weather, climate and hydrological information and services, as well as EWS.

Overview of the initiative

CREWS Afghanistan aims to improve access to hydrometeorological, climate and EWS services, and to strengthen the knowledge of climate risk management and resilience-building for Afghanistan's population. This consists of three pillars: (a) strengthening the development and delivery of fit-for-purpose early warning and hydrometeorological services to Afghan people, (b) fostering the creation of open access data and knowledge products on hydrometeorological and climate services and facilitating regional cooperation and (c) deepening the comprehension of climate change impacts on sensitive key socioeconomic sectors, such as agriculture and water.

In the initial 3 years of implementation, the project progressed well in achieving its intended outputs. The project bolstered institutional capacities in hydrometeorology, including the development of the hydrometeorological concept of operation and service delivery strategy. Additionally, it improved warning communication and preparedness by piloting community-based disaster risk management (CBDRM) activities.

Overview of the initiative

While the programme design considered Afghanistan's fragile, conflict-affected and violent environment, the government takeover in August 2021 was a major, unforeseen disruption, which posed immense challenges to the programme. Many staff members left the agencies with which CREWS had been collaborating, and re-establishing connections with in-country institutions became a challenging task. Thanks to a robust partnership established between the two co-implementing agencies – the World Bank and WMO – as well as relevant stakeholders, the programme team managed to maintain a lifeline of communication with in-country institutions. Although basic, this communication was vital in ensuring the continuity of programme activities and safeguarding the development gains achieved thus far.

Overview of the initiative

- Before the takeover by the interim Taliban administration, the security situation on the ground in Afghanistan was highly volatile, especially in rural areas. For technical agency staff, accessing these areas was extremely challenging and dangerous. In response, the programme harnessed innovation to deploy effective EWS. A Cloud-based drought early warning tool was designed to monitor and detect drought conditions in the country at an early stage. An essential innovation in the development of the tool was the reliance on satellite-based indices, derived from Google Earth Engine. These allowed the CREWS team to guide the attention of technical agencies towards key actions and decision-making processes necessary to initiate response actions.

- Empowering local communities to prepare for and respond to natural hazards is a multifaceted challenge. The CREWS project pioneered CBDRM in Afghanistan, adopting a value chain approach. This approach utilized innovative tools such as low-cost weather stations, a weatherboard mobile app and community risk mapping tools based on geographic information systems. Communities were actively involved and co-developed these plans throughout the entire process. This ensured the disaster plans created were deeply understood and embedded within the communities, thus fostering greater awareness and more informed planning for critical infrastructure.

Overview of the initiative

While taking into consideration the whole MHEWS value chain, the project focused on Pillars 2 and 4: detection, monitoring, analysis and forecasting, and preparedness and response capabilities. Specifically, the project aimed at building consensus among key government stakeholders and supporting decision-making for drought monitoring and early warnings, as well as building community resilience to climate-related disasters.

Overview of the initiative

- The development of hydrometeorological services should prioritize an end-user-oriented approach. Engaging local organizations and building on existing community structures can help ensure last-mile connectivity. They offer an important advantage by providing face-to-face communication, which is especially valuable in mainstream disaster risk management (DRM) at the local level and disseminating early warning information.

- Enhanced regional collaboration and peer-to-peer exchange could significantly enhance the effectiveness of hydrometeorological services. Afghanistan could benefit from and contribute to regional hydrometeorological modernization initiatives in South and Central Asia that allow it to leap-frog technologies, methods and systems, as well as enable transboundary risk information exchange.

- Institutional coordination along the entire hydrometeorology value chain for data and service providers and users must be established and strengthened. Coordination of observation networks, forecasting, EWS and disaster response is essential to avoid duplication, build economies of scale, and ensure an effective supply chain in the production and delivery of services.

Links to resources

CREWS Afghanistan Project Proposal

CREWS Project Progress Report (July – December 2021)

CREWS Project Progress Report (January – June 2022)

Strengthening Hydromet and Early Warning Services in Afghanistan: A Road Map

Strengthening national capacities for EWS service delivery in Burkina Faso (CREWS Burkina Faso)

Introduction to context

Burkina Faso is a country in West Africa with a large portion of the workforce depending on rainfed agriculture, and an urbanization rate that is growing rapidly. The country is subject to extreme climate variability. Specifically, it experiences persistent dry spells and extreme rainfall events, combined with a rainy season that lasts for 3–4 months with specific convective precipitation patterns leading to flooding. From 1991 to 2009, Burkina Faso experienced 11 major floods, which affected nearly 400,000 people and claimed 93 lives, three major droughts that affected nearly 100,000 people, and many episodes of epidemic diseases.

The increasing occurrence of these extreme events is having serious consequences for the population, infrastructure, environment and economy. Moreover, the fragile context of Burkina Faso has been further undermined by the ongoing war and civil conflict the country has endured since August 2015. In particular, the country's security and political instability significantly deteriorated in 2022 due to deadly attacks by armed groups against civilians, military force violations during counterterrorism operations and two military coups.

Overview of the initiative

The objective of CREWS Burkina Faso is to improve the capacity of the National Meteorological Agency (Agence Nationale de la Météorologie; ANAM) and to strengthen its cooperation with agriculture, food security, civil protection, humanitarian stakeholders and the media, to develop EWS that deliver relevant information to end users. EWS are in place in the country, but they often encounter many challenges and barriers in providing warnings related to hazards and food security that can trigger effective action. For instance, there is limited mapping of high-risk areas and limited centralized information available for systematic documentation of risks or disasters.

To overcome these gaps, CREWS is installing 50 automatic weather stations and 100 rain gauges, strengthening human resources by training relevant technicians, implementing an operational EWS, and ensuring weather information is of high quality and available at the user level. All these activities have been implemented with the support of multiple meteorological services including those of France, Morocco, Senegal and Spain, and coordinating partners such as the United Nations Development Programme (UNDP) and the World Bank.

Despite the fragile local context, the project has resulted in tangible outcomes: (a) the assessment of baseline capacities for hydrometeorological forecasting and warning, with specific guidance about how to use investment resources made available to the country by the World Bank; (b) the provision of enhanced agrometeorological warning services in three pilot zones; (c) the development and adoption of the ANAM strategic plan; (d) the registration of 242 automatic weather stations of the Observing Systems Capability Analysis and Review Tool/Surface database and the solution of communications issues in nine manual synoptic stations; and (e) the training of ANAM forecasters and operational staff on numerical weather prediction interpretation, limited area modelling, crop modelling, flood modelling, subseasonal forecasting, and sand and dust storm forecasting to inform the future warning system with a seamless approach.

Overview of the initiative

Two main challenges were faced throughout the project design and implementation stages. The first was insecurity and widespread violence. Specifically, one pilot area out of the three had to be excluded from the project because of excessively high risks in accessing the area. The second was political instability and corruption. The high turnover of government representatives translated into more time and resources spent on building trust and developing relationships with new counterparts.

Overview of the initiative

The tangible results of CREWS Burkina Faso are closely associated with the innovative solutions that have been put in place. Burkina Faso's fragile context and political instability put the sustainability of the project at risk. This challenge was mitigated by an agreement with all national institutions on the project's needs and priorities to ensure their long-term support.

Similarly, the government faced many challenges in binding contractors to implement scale-up projects funded by the World Bank. The high uncertainty of economic returns and political instability made the proposals unappealing. An innovative solution was collaboration between WMO and the World Bank for the project's scale-up. In particular, the initial results of the pilot project designed and implemented by WMO could also benefit from the scale-up framework financed by the World Bank and implemented by WMO and contractors employed through WMO.

Overview of the initiative

While taking into consideration the whole MHEWS value chain, the project mainly focused on Pillars 2 and 4: detection, monitoring, analysis and forecasting of hazards, and preparedness and response capabilities. Specifically, the project aimed at improving the capacity of ANAM, strengthening its cooperation with key stakeholders and increasing the effectiveness of Burkina Faso's EWS.

Overview of the initiative

CREWS Burkina Faso offers important lessons to consider in the design and implementation of future projects. First, twinning arrangements and institutional partnerships with multiple meteorological services are more suitable for providing sustainable technical assistance compared to consultancies, as these types of collaboration tend to progress after the end of the project. Second, capacity development supported by many partners can be facilitated through standardization and normalization of partners' work with the use of technical regulations, guidelines and recommended practices to provide all partners with a familiar work structure. Finally, regional cooperation can be a cost-effective strategy to improve national capacity by leveraging regional capacity through cascading forecasting, regional training centres and regional calibration centres instead of building national infrastructure and competencies anew.

Overview of the initiative

Burkina Faso: Strengthening National Capacities for Early Warning System Service Delivery

CREWS Project Status Report (2019)

CREWS Project Progress Report (July – December 2020)

CREWS Project Status Report (January – June 2021)

Climate services to reduce vulnerability in Haiti (CREWS Haiti)

Introduction to context

Haiti is one of the most vulnerable countries in the world. Some 98% of the Haitian population is at risk of at least two of the following natural hazards: earthquakes, cyclones, floods and droughts. This vulnerability, together with other risk factors, translates into social unrest and political instability, which hinder the sustainable implementation of development and resilience projects. The catastrophic consequences of the 7.0 moment magnitude earthquake in 2010 have initiated the re-establishment and improvement of the National Meteorological Service. The project, Climate Services to Reduce Vulnerability in Haiti, was supported by Environment and Climate Change Canada.

In 2015, the Hydrometeorological Unit of Haiti (Unité Hydrométéologique d'Haïti; UHM) was established following the unification of Haiti's meteorological and hydrological services under the Ministry of Agriculture, Natural Resources and Rural Development. Since the beginning of the CREWS Haiti project in January 2021, political, institutional and environmental instabilities have increased, thus negatively affecting the country, its population and the project.

In August 2021, a 7.2 magnitude earthquake followed by heavy rainfall struck Haiti, killing more than 300 people. This paused several project activities for weeks. The political and security instability in the country further deteriorated following the assassination of President Jovenel Moïse in July 2021 and the rise of gang violence. Against this background, UHM still faces numerous institutional and structural challenges, some of which the CREWS Haiti project aims to address.

Overview of the initiative

The objective of CREWS Haiti is to improve the capacity of UHM to develop and deliver co-produced multi-hazard alerts, as well as to strengthen its cooperation with key ministries, priority sectors and communities, with the aim to increase the effectiveness of Haiti's EWS. In particular, the project focuses on three components: (a) enhancing UHM capacity to deliver high-quality services to the Direction Générale de la Protection Civile (General Directorate of Civil Protection) and other stakeholders, (b) establishing and improving hydrometeorological warning system and (c) enhancing preparedness and response capacities at national and community levels.

Despite numerous challenges in implementing the project, tangible outcomes have already been delivered: (a) a finalized UHM national strategic plan, (b) a signed memorandum of understanding between UHM and Direction Générale de la Protection Civile, which will govern and intensify cooperation, (c) several training workshops held with the Civil Protection and National Centre for Food Security, which will improve the understanding of meteorological information provided by UHM, (d) simulation exercises and updated risk management plans in pilot communities, which will strengthen the preparedness of the most vulnerable populations and (e) implementation of an integrated flood management system.

Key challenges

Haiti remains stuck in a multidimensional crisis of instability with political deadlock, gang violence, protests, severe inflation, and a new cholera outbreak exacerbating humanitarian needs and complicating efforts to alleviate the dire situation.

The security situation has a direct impact on project stakeholders. For example, gang violence created security concerns that left the project focal points unable to leave their houses for several months in 2022. This situation negatively affected the project implementation during the reporting period and caused activities to be completely on hold from September until December 2022. As a consequence, a no-cost extension was proposed until December 2024.

Innovative solutions

Determining whether a solution is innovative needs to be assessed in the country context. Given the highly volatile environment, CREWS Haiti's priority is to ensure the Haiti Meteorological Service stays operational and continues to provide services for its stakeholders.

When the Haitian population, including project focal points, could not leave the country or their homes due to gang violence on the streets of Port-au-Prince, a video conferencing system was installed. Although this was not initially included in the project proposal, it was agreed upon request of UHM. This proved to be highly valuable in maintaining communication with Haitian and international stakeholders.

To ensure knowledge transfer from Haiti's neighbouring countries, a replication of the flood management system in place in the Dominican Republic is being installed, and technical support agreements have been agreed with Cuba. Similarly, a collaboration agreement with UNDP Haiti ensured in-country support for project implementation.

Pillars of concern

While taking into consideration the whole MHEWS value chain, the project mainly focused on Pillars 2 and 4: detection, monitoring, analysis and forecasting of hazards, and preparedness and response capabilities.

Specifically, the project aimed at improving the capacity of UHM to develop and deliver co-produced multi-hazard alerts, and at strengthening its cooperation with key ministries, priority sectors and communities, which will increase the effectiveness of Haiti's EWS. This approach has been connected with targeted initiatives to strengthen the preparedness of Haiti's most vulnerable population.

Lessons learned

The experience of CREWS Haiti has provided diverse points of reflection to be considered in the design and implementation of future projects.

First, projects in volatile environments ought to have a flexible design to permit fast reactions and changes, if needed. Second, it is of utmost importance to involve local focal points and in-country partners in every project activity and all decision-making, since they are the most suitable to assess the current situation and if and how a planned activity can be implemented.

Finally, sustainability in fragile contexts may not seem a priority given the sheer number of needs and gaps, yet it is key. Sustainability considerations need to be incorporated into project design and every step of implementation. For example, if scholarships are granted for certain National Meteorological and Hydrological Service staff members, recipients should be bound by contract to stay at the Service for a certain length of time. (In Haiti, it has been observed that well-trained staff members tend to seek opportunities outside the country.)

Links to resources

CREWS Project Progress Report (January – June 2021)

CREWS Project Progress Report (July – December 2021)

CREWS Project Progress Report (January - June 2022)

Draft: Haiti Project Proposal

Coordination for EWS in Somalia (Somalia's Ministry of Humanitarian Affairs and Disaster Management and the Somali Disaster Management Agency)

Introduction to context

A humanitarian crisis characterized by ongoing conflicts, worsening climate shocks, natural hazards, communicable disease outbreaks, and weak social protection mechanisms makes Somalia an extremely vulnerable country to natural hazards. In this context, the implementation of the National Multi-Hazard Early Warning Center, established by Somalia's Ministry of Humanitarian Affairs and Disaster Management and led by the Somali Disaster Management Agency under the Ministry of Environment and Climate Change, enhances interinstitutional coordination of key public and private stakeholders that fosters governance mechanisms to reduce disaster risks in the country.

Overview of the initiative

The Somali Disaster Management Agency, responsible for mobilizing and coordinating local and international responses to emergencies, created the National Multi-Hazard Early Warning Center and the National Emergency Operations Center for undertaking emergency response actions during disasters.

Both centres receive risk-related information collected by several organizations or institutions, such as the Ministry of Energy and Water Resources, the Ministry of Agriculture and Irrigation, the Food and Agriculture Organization of the United Nations Somalia Water and Land Information Management (SWALIM), ICPAC, the Famine Early Warning Systems Network (FEWS NET) and other regional organizations in the framework of the implementation of an MHEWS.

The components of an EWS are the basis of a solid strategy to reduce risks and strengthen the resilience of Somalia.

Pillars of concern

Disaster risk knowledge: SWALIM is implementing a flood platform, the Ministry of Humanitarian Affairs and Disaster Management is building a hazard profile database and a disaster loss database, the Somali Institute for Development Research and Analysis has mapped vulnerabilities at the community level for developing district DRM activities, and the United Nations Office for Disaster Risk Reduction (UNDRR) Regional Office for Arab States is finalizing multi-hazard risk profiles for Somalia.

Pillars of concern

Hazard detection and warning dissemination: Risk-related information is collected and disseminated by various organizations. SWALIM is delivering the 24 hour and 7 day rainfall forecasts, monthly vegetation index, daily temperature forecasts and daily soil moisture forecasts under the flood risk and response information management system. FEWS NET is providing early warnings and analysis on acute food insecurity. The National Multi-Hazard Early Warning Center plays a crucial role in disseminating the forecast and warning information supplied by various organizations. Warning dissemination coverage throughout the nation is nearly 50%. The UNDRR Regional Office for Arab States multi-hazard risk profiles for Somalia will be useful to assist IBF capabilities.

Preparedness and response capabilities: Development partners and non-governmental organizations are conducting public workshops and education campaigns for awareness-raising. Oxfam has established early warning committees to develop a contextualized CBDRM approach. The committees are trained to monitor easy early warning indicators and develop contingency plans for human-made and natural hazards.

Lessons learned

Words into Action: A Guide to Multi-hazard Early Warning Systems

Annex A2.3 Case studies submitted by the Group on Earth Observations

Local and international collaboration at the Virunga Supersite, Democratic Republic of the Congo (GEO)

Introduction to context

The Virunga Supersite is located in eastern Democratic Republic of the Congo, on the border with Rwanda and Uganda, in a multi-geohazard, densely populated region. Natural hazards in Virunga and the Lake Kivu basin include volcanic hazards (lava flows, volcanic gases and ash, as well as acid rain from Nyiragongo and Nyamulagira active volcanoes), earthquake hazards, landslides, poor rain and surface water quality, and soil–dry gas vents. At least 3 million people living in the region, including in Goma and Gisenyi cities and neighbouring villages, are permanently concerned by the risks caused by these natural hazards.

Additionally, this is a conflict region where armed groups have been fighting for the control of mining areas for several decades, and which has led to the death of an estimated 6 million people. About 1 million conflict-displaced people live in camps in and around Goma city. This situation has increased the number of people at risk and their vulnerability, concentrating them in a small area between the potentially explosive Lake Kivu region to the south and active volcanoes and rebels to the north and north-west.

Despite the strong need for assessing and monitoring natural hazards in this area, the biggest concern remains limited accessibility because the armed parties control routes. Working with local communities is one of the key strategies that has allowed the monitoring network to remain operational. This network is formed of seismic, geodesic and gas stations, which have biweekly field visits for additional data collection and station inspection for maintenance and data download. Remote-sensing techniques complement this work, which provide frequent and regular Earth Observatory data on larger areas with limited human exposure.

Overview of the initiative

GEO has an initiative called the Geohazards Supersites and Natural Laboratories (GSNL) initiative. Under this, high-resolution commercial data from the network of Committee on Earth Observation Satellites (CEOS) agencies (such as the Italian Space Agency (Agenzia Spaziale Italiana) and the Argentina National Space Activities Commission (Comisión Nacional de Actividades Espaciales) are made available to the GSNL science community. This can complement host geohazard institutions' work in producing and disseminating disaster risk knowledge such as routine analyses (e.g. damage maps) and investigation and analysis to assess more hazards to come. The host national geohazard institutions work closely with the national disaster management agency and other local and national institutions.

Overview of the initiative

Virunga is the first supersite established on the African continent in a highly populated multi-hazard region. It was established in a critical context, as little was known about the Virunga hazards sources and their dynamics, and little done as measures to evaluate, mitigate and reduce their impacts. Similarly, the active volcanoes are poorly studied and monitored, because of the lack of qualified human resources and appropriate infrastructures.

Establishment of the Virunga Supersite was aimed mostly at helping bring together local and international scientists and agencies, supporting them with access to Earth observation data and potentially equipment for ground-based data collection, as well as building a pool of international collaboration. This supersite is thus based on collaboration between Virunga local scientists and international scientists and agencies to improve geohazard assessment and monitoring in support of DRR in the region. The local and international scientists can access (free of charge) a variety of high-resolution satellite data from international space agencies and produce input data that they deliver to local decision-making authorities.

The Virunga Supersite has allowed: (a) the building of collaboration between the Goma Volcano Observatory and some of the world's leading institutes specializing in studying and monitoring active volcanoes and assessing volcanic hazards, (b) free access to commercial satellite data (e.g. from COSMO-SkyMed, Pleiades and SAOCOM-1) for hazard assessment and volcano monitoring, (c) activation of the Copernicus Emergency Management Service over Virunga volcanoes and (d) the production of hazard, risk and recovery maps for management of future Nyiragongo volcanic eruptions.

Using remote-sensing satellite and ground-based data, the Virunga Supersite scientific community has supported the Goma Volcano Observatory's response to the 2021 Nyiragongo and Nyamulagira May 2023 eruptive crisis. Virunga Supersite partners have provided key training to Goma Volcano Observatory researchers to improve their capacity for data collection, processing and interpretation. Some of these partners have also donated equipment for ground-based data collection.

Partners include CEOS and partner agencies (e.g. Agenzia Spaziale Italiana, the French National Centre for Space Studies (Centre National d'Etudes Spatiales; CNES) and Copernicus), the Italian National Institute of Geophysics and Volcanology (Istituto Nazionale di Geofisica e Vulcanologia), the United States Geological Survey Volcano Disaster Assistance Program, the EarthScope Consortium, the Volcano Active Foundation, and many other regional and international institutions and agencies.

Key challenges

- Risks to personal safety, including intimidation, violence and kidnapping
- Trauma and suffering of others leaving emotional and psychological scars
- Need for sustainable finance/support as CEOS high-resolution satellite provision is voluntary

Innovative solutions

- Team composed of local and international scientists and agencies
- Strong involvement of local community (and sometimes the United Nations humanitarian entities) for the security of scientists and for the monitoring of instruments deployed in the field
- Capacity transfer by training local scientists so they gradually become independent to assess and monitor hazards to reduce disaster risk in their own region

Pillars of concern

- Producing, using and accessing disaster risk knowledge and innovation

Lessons learned

- Education/training of local scientists and agencies is key for reducing disaster risk
- Accessing infrastructure remains a key factor for producing information to communicate to decision-making local authorities
- Develop multidisciplinary teams composed of scientists and local community members while remaining neutral in the conflict

Links to resources

Biennial report for permanent supersite/natural laboratory

Goma Volcano Observatory Virunga Supersite

GSNL proposal for permanent supersite

Research at the intersection of 'human rage and nature's fury'

The 2021 Nyiragongo (DR Congo) eruptive crisis monitored by multi-sensor satellite remote sensing data

Virunga volcanoes supersite biennial report: 2017-2019

Volcanic risk in Democratic Republic of the Congo

An Earth observation service in Haiti (GEO)

Introduction to context

Haiti has not held presidential elections since 2016, and the country has been in a fragile state since the 2010 earthquake that killed over 200,000 people. The country has been in a state of electoral and constitutional turmoil since the assassination of the president in July 2021. The following month, another earthquake caused significant damage.

In the morning of 14 August 2021, a 7.2 magnitude earthquake struck the Southern Peninsula of Haiti. The earthquake was followed on 17 and 18 August by heavy rain from the Category 3 Tropical Storm Grace. Around 800,000 people were affected, and an estimated 650,000 people – 40% of the 1.6 million people living in the affected departments – needed emergency humanitarian assistance.

The Government of Haiti, supported by a World Bank–European Union–UNDP partnership, launched a post-disaster needs assessment (PDNA) to estimate the damage caused by the two events.

Overview of the initiative

An Earth observation service called the Recovery Observatory (RO) Demonstrator uses geospatial information made available via a partnership between CEOS, the World Bank, UNDP and the European Union.

This service helped to develop a comprehensive estimate of the damage caused by the earthquake, which was immediately followed by Storm Grace, including the acreage affected by earthquake-induced landslides, agricultural damage and environmental impacts. The results provided the PDNA and supported the recovery framework, allowing the tripartite team to set funding targets for specific projects related to agriculture and environment.

Key challenges

The PDNA was required rapidly, but the challenging security situation meant that few people were deployed in the field and able to conduct ground surveys.

Innovative solutions

RO provides imagery and satellite-derived products for the post-disaster recovery phase. The RO Demonstrator has served as a test bed for the establishment of sustainable services using satellites to support recovery. It uses new and cutting-edge Earth observation tools and geospatial information for PDNAs. Leveraging satellite data including commercial imagery and derived products, RO provides maps and analysis at various scales, ranging from broad area coverage to hotspots at higher temporal and spatial resolution.

The maps generated may be updated weekly, monthly or quarterly, as required. The RO Demonstrator also provides overviews of changes in land use and cover and integrates essential ancillary data. The products can be used to determine the extent and scale of damage and losses, characterize impacts on livelihoods and environment and assess general and sectoral needs.

Activating the RO Demonstrator allowed the Government of Haiti (Earth Observations Risk Toolkit, n.d.) and the PDNA team to make damage estimations for two sectors: agriculture and the environment. The teams were able to use satellite imagery exclusively to quantify acreage affected by earthquake-induced landslides, and then merge this information with land-cover data to estimate agricultural damage and environmental impact. The analytical results demonstrated the unprecedented impact of the earthquake and heavy rains on agricultural area losses, as well as devastation in the Macaya National Park site due to large landslides. The results also provided information on the impacts on the road and path networks.

The RO Demonstrator showed there were 694,902 ha of landslides and 4,114 ha of loss of tree vegetation in all three affected departments (Grand'Anse, Nippes and Sud) of the Southern Peninsula. Landslides affected 412 ha of dense agricultural crops, 567 ha of dense agroforestry systems, 1,251 ha of medium dense agricultural crops and 154 ha of pasture. The most significant damage was in the crop subsector, with serious damage to agricultural land due to landslides ($13.9 million) and to hydroagricultural infrastructure ($2.4 million). The livestock subsector suffered damage of $4.9 million and the fisheries subsector of $0.55 million.

These data from the RO Demonstrator, combined with information on the economic value of land, augmented and validated the PDNA. The data also supported the recovery framework, as the tripartite team used them to set funding targets for specific agricultural and environmental recovery projects. In particular, the damage estimate was critical for PDNA stakeholders (European Union, UNDP and United Nations Environment Programme (UNEP)) to be able to determine the amount of aid to request at a donor conference organized by the Government of Haiti with United Nations support on 16 February 2022. In addition to the PDNA team and the Government of Haiti, UNEP Haiti used RO results to understand the impact on Macaya National Park and plan future activities related to this large biosphere reserve.

A series of capacity development activities for the Haitian National Centre for Geo-Spatial Information (Centre National de l'Information Géo-Spatiale; CNIGS; a public agency in Haiti, within the Ministry of Planning) took place before the 2021 disasters (in person in 2018 and 2019, and remotely in 2020), through CEOS and the French Space Agency CNES.

Innovative solutions

Pilot after Hurricane Matthew in Haiti. The staff at CNIGS were trained on how to use open software for image analysis using openly available satellite imageries to generate and annually update a national land-cover map, which is a critical layer for all change-related products. This was used for the aforementioned damage assessment in Macaya National Park after the 2021 earthquake to continue monitoring the changes. This is also a base layer for the country's national environmental information system. This training enabled CNIGS to generate risk information products for the Haiti Civil Protection Agency.

Pillars of concern

Pillars 1 and 4.

Lessons learned

- Technology/innovation, especially remote-sensing satellite observations, are helpful when access to ground-based observations is limited.

- Capacity development of the national actor before the conflict/disaster can pay off and promote coordination/collaboration within the national government (CNIGS supporting the Civil Protection Agency), as well as between the national and international stakeholders (CNIGS and CEOS/World Bank/European Union/UNDP).

- Coordination/international collaboration is key for the success, but a sustainable funding mechanism is needed. The RO is still in demonstration mode, activated through the voluntary efforts of CEOS space agencies and PDNA partners, which committed to perform several RO activations between 2021 and 2024. Making this service a longer term (or established/permanent) service would require financing from partners. Although a few staff members of the European Union, the World Bank and UNDP work together to run this service, many responsibilities fall on the space agency side (CNES). A much more active role from the DRR/DRM and recovery community is needed to make this service sustainable.

Links to resources

Earth observations support recovery following 2021 Haiti earthquake

Papua New Guinea National Disaster Centre (NDC) (International Organization for Migration (IOM))

Introduction to context

IOM Papua New Guinea, in close cooperation with NDC, is supporting the government at the national, provincial and local levels to respond to complex emergencies, reduce disaster-induced displacement, and mitigate the negative impacts of displacement on those affected through strengthened capacity in disaster mitigation, preparedness, response and recovery.

It is working with local communities to reduce exposure to natural hazards, build resilience and facilitate climate change adaptation through community-based planning interventions on DRR that build awareness of disaster vulnerability and the capacity to implement mitigation and response measures. IOM is reaching displaced and vulnerable populations, stabilizing local villages and empowering them to establish self-led disaster coping mechanisms. At the national and provincial levels, IOM works with authorities to draft DRM strategies linked to the Papua New Guinea National Disaster Risk Reduction Framework (2017–2030).

IOM DRR programming contributes to the efforts of Papua New Guinea to implement the Sendai Framework for Disaster Risk Reduction 2015–2030 by advancing mobility-based strategies in DRR and resilience. In so doing, IOM is supporting Papua New Guinea in enhancing its preparedness and response capacity to migration crises, as well as linking disaster management to development. IOM Papua New Guinea works closely with different partners including faith-based organizations, community-service organizations, non-governmental organizations and the private sector in implementing its DRR and DRM programming.

The country faces complex challenges through its diverse ethnic composition. Intercommunal conflicts, often driven by competition over land and natural resources, can escalate and disrupt social cohesion, economic development and public services. Papua New Guinea grapples with a complex interplay of conflict, fragility and climate security imperatives that necessitate holistic and focused action to mitigate community tensions and future displacement.

The IOM approach in Papua New Guinea recognizes the role of local groups in addressing the country's unique challenges. Community-based planning programming embraces localized approaches that aim to amplify community ownership, strengthen capacities and ensure interventions align with the specific needs and priorities of communities. These efforts support community-based governance, customary peacebuilding initiatives and civil society capacity-building as agents of peace.

Implemented in Papua New Guinea's conflict-affected and vulnerable rural communities, IOM operations have harnessed community resilience against climate shocks through the IOM CBDRM approach. This method aims to reduce the risks of climate-induced displacement and conflicts by facilitating the development of community peace for development plans (CPDPs). These plans guide the implementation of community-driven initiatives, resulting in community-focused priorities, including the installation of safe drinking water sources, the establishment of multipurpose community resource centres (under CPDPs) and promoting village peace dialogues that have contributed to customary peace compacts in various areas.

Overview of the initiative

IOM Papua New Guinea's DRR interventions have: contributed to training community, provincial and national stakeholders on a range of DRM-related topics; supported provincial governments in the development of DRM strategies and standard operating procedures; helped vulnerable communities develop DRM plans and measures; and supported the resilience of long-term IDP communities. Project interventions continue to foster partnerships with key stakeholders such as NDC, the provincial disaster centres (PDCs) and CBDRM committees, as well as donors, humanitarian partners and other development actors.

Under a recently concluded project funded by the United States Agency for International Development ($2.8 million), IOM Papua New Guinea organized a training of trainers on camp coordination and camp management, the Displacement Tracking Matrix (DTM), CBDRM and building back better. The trainers helped to roll out training in eight provinces, leading to the training of more than 200 additional participants for each of four areas of training. Non-food items and shelter kits were prepositioned in six strategic locations and partly distributed following various events, awareness-raising materials were developed and distributed in English and local languages, and displacements were better mapped through the publication of 18 DTM assessments.

The project supported the review of nine provincial DRM strategies. Eight vulnerable communities developed CBDRM plans and received support to implement DRM activities. Moreover, 60 farmers in IDP communities in East New Britain Province received training and equipment to increase community resilience and food security.

Key challenges

- The extended dry spell in parts of the country posed a significant setback in the implementation of activities related to sustainable food production. The training for farming communities went well, but it was impossible to apply the outcome of the training in the agricultural plots, evaluate the food production and impact, and produce alternative innovative options.

- Security risks restricted movements to selected field locations (e.g. tribal fighting in the Highlands region).

- Papua New Guinea held its national general election in July and August 2022. The period of counting the votes and announcement of election results caused violence and security risks, especially in the Highlands region. This prompted the United Nations in Papua New Guinea to suspend operations in that region. In-person operations by United Nations staff in selected parts of the Highlands were restricted for a period exceeding 2 months.

Innovative solutions

In all communities, the CBDRM and CPDP (Papua New Guinea Post-Courier, 2020) planning exercise involved multi-tier activities including pre-planning, awareness-raising, intensive planning, CBDRM planning and CPDP review, and feedback sessions. The process started by briefing the communities about the purpose of the CBDRM planning exercise and discussed key concepts such as hazards, risks, mitigation, preparedness, disaster, resilience and community-based planning. The project ensured full participation of all members of the community (including youth, women, elderly persons and persons living with disabilities) in identifying and mapping hazards and risks, as well as assessing communities' vulnerabilities and capacities, and mitigation strategies that build resilience.

IOM supported the CBDRM and CPDP communities to implement their priority projects in their communities. Community-driven priority projects were implemented with material, financial and technical contributions from community members and the government. The IOM contribution was mainly technical and in-kind with materials such as cement, water storage tanks to construct or rehabilitate resilient safe drinking water supply systems, thereby mitigating hazards and risks, including those caused by prolonged dry seasons. This intervention has also improved community access to safe drinking water. Installing multipurpose community resource centres promoted preparedness as the centres were used to conduct training and awareness-raising sessions on disaster management and for evacuation centres in times of disaster.

In implementing CBDRM and CPDP, IOM engaged women, men and youth upon delivery of community project materials and installation of community infrastructures such as water points and multipurpose community resource centres. Provision of solar lights for the multipurpose community resource centres helped to improve safety, especially of women and girls at night (IOM, 2020).

Pillars of concern

Disaster risk knowledge

Vulnerable communities in disaster-prone areas developed and implemented their community plans. These included building resilience at the local level through application of community-driven risk reduction solutions (IOM, 2022) such as building homes in safe locations, installing safe drinking water sources, and undertaking climate-smart farming techniques. The CBDRM plans and CPDPs were officially launched and signed by representatives from the community, ward councillors and local authorities (provincial, district and local levels).

The CBDRM plans and CPDPs serve as a planning and resource mobilization tool to build resilient communities to different disasters induced by natural hazards. Following the CBDRM and CPDP planning exercise, the project facilitated discussions among the provincial government, each target community and IOM on resource mobilization and cost-sharing to implement risk mitigation projects prioritized by the CBDRM plan and CPDPs. Accordingly, prioritized community projects were implemented with support from IOM (in-kind and technical support) and with contributions from the provincial governments.

Lessons learned

Detection, observation, monitoring, analysis and forecasting

The application of Indigenous knowledge has been promoted in identified communities as a form of EWS to strengthen community response to natural hazards. The use of a garamut (large slit drum made from a log) or conch shell trumpet as part of the Indigenous EWS was linked with mobile phone and radio communications from the provincial disaster office.

Rain gauges, which can be easily monitored and maintained by people in rural communities, have been installed in 26 locations, mostly at schools, churches and governmental offices, as well as sites to be utilized for evacuation during disasters. The rain gauges were installed in the areas prone to flooding and were complemented by flood markers placed on eight existing piers. IOM field staff facilitated training on how to read and monitor the rain gauges. A volunteer community member was also designated to oversee reading and maintaining the gauges and monitor flood lines to facilitate an evacuation warning mechanism in each target community in times of heavy rainfall.

Warning dissemination and communication

Communities, local authorities and partners improved disaster knowledge through use of awareness-raising pamphlets on different kinds of hazards such as the El Niño and La Niña climate patterns, earthquakes, floods, tsunamis, volcanoes and droughts. These were developed, reviewed and refined with inputs from NDC and the National Weather Service. Refined in Tok Pisin (Pidgin) and English languages, the pamphlets were disseminated to various audience such as communities and disaster centres, in print and electronic forms.

IOM also raised public awareness using billboards, radio, print and TV messages and a successful partnership within the Papua New Guinea public broadcasting station. This mutually beneficial relationship enabled communities to showcase their efforts and also to inform the public at large about DRM and mitigation.

Preparedness and response capabilities (2020–2023)

NDC, PDCs, local communities and partners have increased their preparedness capacity following upskilling by IOM DTM, CBDRM, CPDP on safe shelter construction and camp coordination and camp management (Loop, 2021a, 2021b; United Nations Papua New Guinea, 2021).

The upskilling by IOM through national-level training of trainers as well as roll-out of subnational trainings by IOM and local authorities utilized training manuals that were refined and endorsed by NDC. The national-level training of trainers enhanced knowledge and skills of 65 men and 8 women on DTM (21 men and 3 women), CBDRM and safe shelter construction (23 men and 2 women) and camp coordination and camp management (21 men and 3 women).

The PDC staff upskilled by IOM co-facilitated with IOM delivery of provincial-level training to 599 men and 203 women in the following: DTM (167 men and 39 women), CBDRM (123 men and 55 women), safe shelter construction (151 men and 58 women) and camp coordination and camp management (158 men and 51 women) (Loop, 2021c; Papua New Guinea Post-Courier, 2021).

Working closely with NDC and PDC, and in coordination with DTM, the project deployed 18 DTM field missions assessing displaced communities in the Autonomous Region of Bougainville, Madang, Hela, Southern Highlands, East Sepik, Western, Western Highlands, Jiwaka, Eastern Highlands and Morobe Provinces (IOM, n.d.b). The DTM information products, including reports and site profiles, informed response planning by NDC, PDCs, DTM and partners.

Lessons learned

- Coordination with stakeholders was effective, and stakeholders were positive about IOM contributions and information-sharing.

- Despite the challenges to develop sustainable projects, IOM ensured the project was owned by the government, thus strengthening the relationship between the government and communities, and provided continuing support and contact with previous communities assisted.

- IOM tried to ensure gender was considered in the project. Women were trained to participate in CBDRM facilitation or other training, and women and other vulnerable groups were included in CBDRM at the community level. There were ad hoc discussions taking place within the community about gender, but this was done by those who may be more knowledgeable in the topic and not in a consistent manner.

Links to resources

Communities affected by conflict pledge to promote peace

IOM trains disaster responders to strengthen disaster preparedness

IOM, USAID, France and the Australian Government partner to aid Mt. Bagana volcano-affected communities in Papua New Guinea

IOM, USAID train local communities in Papua New Guinea on safe shelter construction

Strengthening capacities in using data for peacebuilding

"We are now better prepared": Local communities launch and implement disaster risk management plans in Hela Province

Bor Flood Risk Management Project (IOM)

Introduction to context

Although South Sudan accounts for a small fraction of the world's greenhouse gas emissions, it bears the brunt of global climate change impacts. The country is already experiencing the adverse effects of a warming climate, but it has limited capacity and resources to prepare and cope with increased climate variability and volatility. As of September 2021, 525,975 people were recorded as displaced due to climate-related disasters, of which 310,393 people were newly displaced. Of course, natural hazards do not occur in a vacuum and often coalesce with other factors, including conflict and population movements, with the effects of flooding frequently exacerbating the drivers of tension and violence in many parts of the country.

Bor in Jonglei State and its immediate surroundings is one of the areas worst affected by flooding in the country. Recent weather- and climate-related disasters have resulted in a high number of fatalities. Furthermore, it is evident that increased flooding and a more unpredictable climate is likely to see a rise in clashes over already scarce natural resources, further compounding the inextricable link between climate change, peace and security. Confronted with these challenges, South Sudan urgently requires financial and technical support to strengthen the government's climate information base and put in place mechanisms that better protect communities, including vulnerable populations such as women and youth, against floods and climate shocks.

The Bor Flood Risk Management Project is focused on three interlinked and mutually reinforcing outcomes to:

- Strengthen the knowledge base on the susceptibility of communities to disaster-related risks
- Strengthen capacities for effective community response to climate-related shocks through participatory DRM mechanisms and EWS
- Enhance resilience to climate-related shocks through strategic infrastructural interventions in targeted locations

Overview of the initiative

The initiative is in accordance with the National Disaster Management Policy, through which priorities include: Pillar 3 on EWS and effective preparedness planning; Pillar 4 on traditional mitigation and coping capacities; Pillar 5 on post-integration recovery and stabilization; and Pillar 6 on public awareness and institutional linkages.

IOM conducted a lidar survey to acquire high-resolution data for a digital elevation model/digital surface model, which will be used to develop a two-dimensional hydraulics model to understand the hydraulics characteristics to further identify the key flood control infrastructures in the project area.

IOM has also constructed telemetric stations that are connected to the server room in the Ministry of Water Resources and Irrigation in Juba. At the community level, IOM has formed CBDRM committees and equipped them with DRR knowledge. Furthermore, the project also provides renewable energy to Bor State Hospital through the solarization project.

Key challenges

- Lack of historical data (hydrological, topographical and climatological) limits options for developing the flood model. Various data sources including satellite-based data were used.
- Political dynamics and high turnover of government officials.
- No EWS was in place. Working with relevant stakeholders to reactivate the early warning technical working group at the State level. Working together with radio, church leaders, chiefs and CBDRM members to disseminate key messaging for flood prevention.
- Low knowledge/capacity on DRM. DRM training was provided to the local authority and community at the *payam* and *boma* levels. IOM also worked with Dr. John Garang Memorial University of Science and Technology to establish a postgraduate diploma programme on DRR.

Innovative solutions

- An aerial survey, including the use of lidar and global positioning system technology, to map the project area and address the data gap. The lidar survey was conducted to develop a digital elevation model and digital surface model, while high-precision global positioning system devices were used as ground control points.
- Development of a hydraulics/flood model to understand the hydrologic characteristics and identify the flood control infrastructures.
- Installation of telemetric stations to monitor hydrologic parameters along the Nile River. The telemetric stations were connected to the server room at the Ministry of Water Resources and Irrigation in Juba.
- Establishment of a DRM committee at the State, county, payam and boma levels, to capacitate members with DRR knowledge. Direct involvement of different population groups including men, women, youth, chiefs and church leaders in some project activities.
- Establishment of a postgraduate diploma programme on DRR.
- Reactivation of the early warning working group at the State level.
- Construction of flood control infrastructures including basic and gated culverts, drainage networks and pulping stations. Also dike maintenance, tree plantation and piloting of small livelihood activities.

Pillars of concern

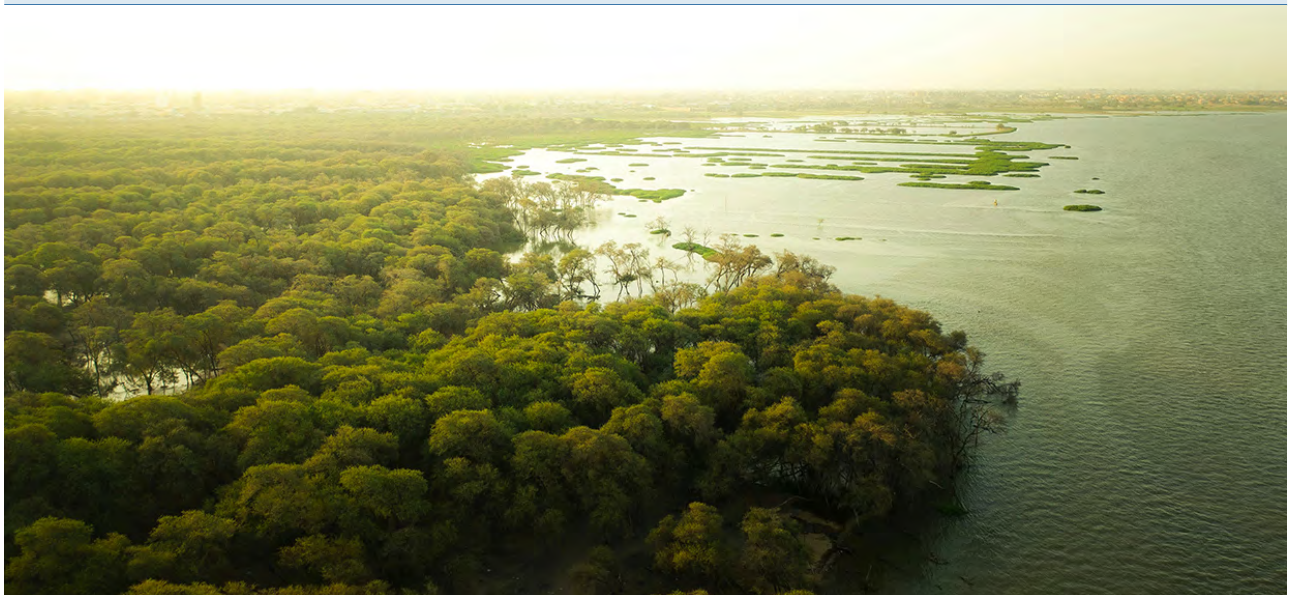
- Pillar 1 on disaster risk knowledge: capacitating the government and local community with DRR knowledge.
- Pillar 2 on detection, observation, monitoring, analysis and forecasting of hazards: construction of telemetric stations.
- Pillar 3 on warning dissemination and communication: communicating DRR messaging through radio, bulk messaging, chiefs and church leaders.
- Pillar 4 on preparedness and response capabilities: establishing a DRM committee at the State level and CBDRM committees in five payams (blocks) and 22 quarter councils. The CBDRM committees are developing a DRM plan.

Lessons learned

- Continuous engagement with relevant stakeholders and community members is crucial. Various DRM-related issues were discussed during the continuous engagement process, ensuring project ownership.
- Continuous and timely collection, monitoring and dissemination of information related to climate or hazards.
- A hydrological study including a hydraulics/flood model is a useful tool to inform the intervention/programme.

Links to resources

Flood Risk Management Project: Construction & Infrastructure Improvement in Bor Town - Jonglei State, South Sudan



Conflict monitoring tool to inform anticipatory action in Mali (World Vision)

Introduction to context

Mali faces a crisis resulting from a combination of armed conflict climate change and political instability. The political instability has resulted from a series of coups and armed conflicts since 2012. The health emergency related to the COVID-19 pandemic has exacerbated the vulnerability of populations already affected by the security crisis.

The conflict, alongside many years of drought and the recent floods in some parts of the country, have disrupted agriculture, leading to a decreased harvest. This, together with the war in Ukraine, has led to an increase in the prices of food and other basic goods, which has sharply reduced the purchasing power of many people. The main source of income for the population is subsistence agriculture and herding. However, many markets are dysfunctional due to the insecurity.

This situation has weakened the protection of civilian populations limited access to essential social services, and aggravated the prevalence of food insecurity and malnutrition. In 2013 responding to the crisis in Mali the international community developed a United Nations peacekeeping mission (United Nations Multidimensional Integrated Stabilization Mission in Mali) to support the Malian authorities in securing more stability. However persistent disagreement between the Government of Mali and the United Nations mission led the government to request the withdrawal of the mission by the end of December 2023.

As of September 2023, 391,961 IDPs were identified in Mali through IOM DTM. Some 66% of them were children below 18 years old and 57% were women. The main reasons for this displacement were the armed conflict (66%) and tensions between communities (33%). These IDPs are among the most vulnerable, and need special attention and prioritization for any action to be designed and implemented within the intervention area.

In the meantime the Government of Mali is increasing its capacity to address the security threats caused by armed groups, mainly in the centre and northern parts of the country.

In addition to insecurity the country is clearly being affected by the increasing impacts and environmental deterioration as a result of climate change.

Climate-related hazards in Mali include droughts floods and crop pests. These challenges constrain access to even the most basic services, such as water, sanitation and healthcare. It is evident that climatic change impacts will continue to affect the country's development and the nutrition and health of its inhabitants due to erratic rainfall increased crop pests rainfall shortages and breaks during critical growing periods as well as past desertification over the last 50 years.

This deterioration also exacerbates the humanitarian needs of the most affected populations who cannot anticipate, prepare for or reduce the impact of those hazards. The most highly stressed regions of the country are in the south-west where agriculture is concentrated including Sikasso Mopti Koulikoro, Kayes and Segou. These regions are critical to the country's continued food security and are also endowed with many ecosystem services that are deteriorating. They also have high population densities and poverty levels.

Sikasso Mopti Kayes and Segou (plus Koulikoro) are the regions where most of World Vision Mali's interventions have taken place. With the expansion of the Category 3 Sustained Humanitarian Response, the northern regions (mainly Gao, Timbuktu and recently Ménaka) are also benefiting from World Vision's humanitarian interventions in the country.

Overview of the initiative

World Vision Mali has expanded the context monitoring framework developed under fragile contexts programming approaches (World Vision, 2021) in pilot subnational zones to cover multiple risks and be applicable in all operational zones to facilitate early warning and early action for conflict, displacement and natural hazards (floods/drought). The first year was used as a pilot to learn from experiences and for expansion.

Key challenges

Overall Mali is understood to be a fragile and changing context due to multifaceted crises. Long-lasting effects produced by development programmes could be eroded due to a disaster. The impacts of climate change combined with the expansion of insecurity towards the southern part of the country pose a growing threat to the livelihoods of communities where most of the current programmes are being implemented.

Mali's dynamic context, where circumstances, information and conditions are constantly changing, requires ongoing monitoring of the context linked to anticipatory action to either mitigate or reduce the impacts of disasters on vulnerable populations and their assets and also strengthen resilience through pre-emptive steps to increase project development gains.

Innovative solutions

For this intervention, World Vision Mali has developed a mechanism that links context monitoring to anticipatory action through several steps:

Step 1: Risk profiling. Each area has been asked to identify potential risks for their area. Those risks are then prioritized based on whether the probable impacts are expected to be moderate or major.

Step 2: Context monitoring. Each prioritized risk has an indicator that was developed along with thresholds. The thresholds are classified as follows:

- **Green:** Normal situation (the risk must and can be managed by the area manager according to standard processes and capacities).
- **Yellow:** Alert (the mitigation and emergency planning team must jointly develop a contingency plan that includes mitigation (anticipatory action) and response plans).
- **Red:** High risk (alarming) (the disaster has happened, and a response is required; the emergency team is called, and the response plan is updated and implemented).

To support the process, a dashboard is being created, which provides a visual of the changing context. Indicators are monitored monthly; frequency of the data collection may increase if the context requires so. If new indicators need to be monitored, the system is agile enough to easily adapt to this requirement. Data sources are primary (from formal and anecdotal data collection) and secondary (from reliable sources describing the changing context).

Innovative solutions

The context monitoring system that World Vision is developing will build off existing context monitoring mechanisms such as warning mechanisms, informed by specialized African Center of Meteorological Applications for Development services and FEWS NET, State meteorological stations and the System Analysis Program working group. This warning mechanism provides information on Mali's food security trends, by showing information on the agricultural situation including yields, gaps and the level of coverage of needs. World Vision is taking the lead in the Mopti area, especially in Djenné Circle, to conduct survey research to inform the system.

In Mali, World Vision has been working with the State technical meteorological services and other partners with regards to anticipatory action, which has led to effectiveness in preparedness and response. World Vision will continue working with local communities and CBDRM committees and local authorities to strengthen gender equality and social inclusion related to anticipatory action and to ensure ownership of the process and development of mitigation and response plans.

This context monitoring mechanism emphasizes the importance of analysing the data collected and reflecting as a team on how ongoing interventions may need to adapt to remain relevant and sustain project outcomes. In addition, the MHEWS will be linked to anticipatory action protocols further linked to pre-agreed financing mechanisms.

Pillars of concern

Disaster risk knowledge: as part of Step 1, each area will identify the risks for their area and prioritize these based on the most impactful and most likely.

Detection, monitoring, analysis and forecasting of hazards and possible consequences: this is Step 2. The risks are made into monitored indicators and have three thresholds to inform action. In addition, teams meet monthly to discuss the data collected from this source and validate with other sources (e.g. networking, security data, monitoring and evaluation data, and accountability data) to analyse changes in context and what it means for continuous implementation, relevance, preparedness, mitigation and security.

Warning dissemination and communication: data are incorporated in a dashboard that provides a visual of change in context at the local and national levels. The EWS is linked to anticipatory action protocols and pre-agreed financing mechanisms for rapid and informed action.

Preparedness and response capabilities: World Vision Mali has a disaster management team supporting the implementation of the MHEWS linked to anticipatory action. This team provides ongoing coaching and training to the area managers on ensuring preparedness and strengthening the response capabilities. In addition, most area programmes work closely with communities to strengthen DRM at the community level by developing community-based preparedness plans.

Lessons learned

- Take time to set up the context management system. Most offices already have some level of context monitoring in place, thus it is important to spend time understanding what has already been done and how, to ensure no duplication but rather complementarity.

- Take time to build the anticipatory action protocols and link them to pre-agreed financing mechanisms and ensure all staff are clear about how the process works.

- Develop an agile approach, to make changes based on lessons learned from implementation.

- Strengthen the capacity of the area programme managers and their frontline staff to mindset change in integrating anticipation action into their programming for sustainable actions.

- Involve programme staff from the beginning, to foster the development of a culture of prevention by taking ownership of mitigation initiatives to secure the investments made by their programmes.

Links to resources

A brighter future for fragile contexts

Disaster management

FCPA - Fragile Context Programme Approach: Designing for impact in fragile context

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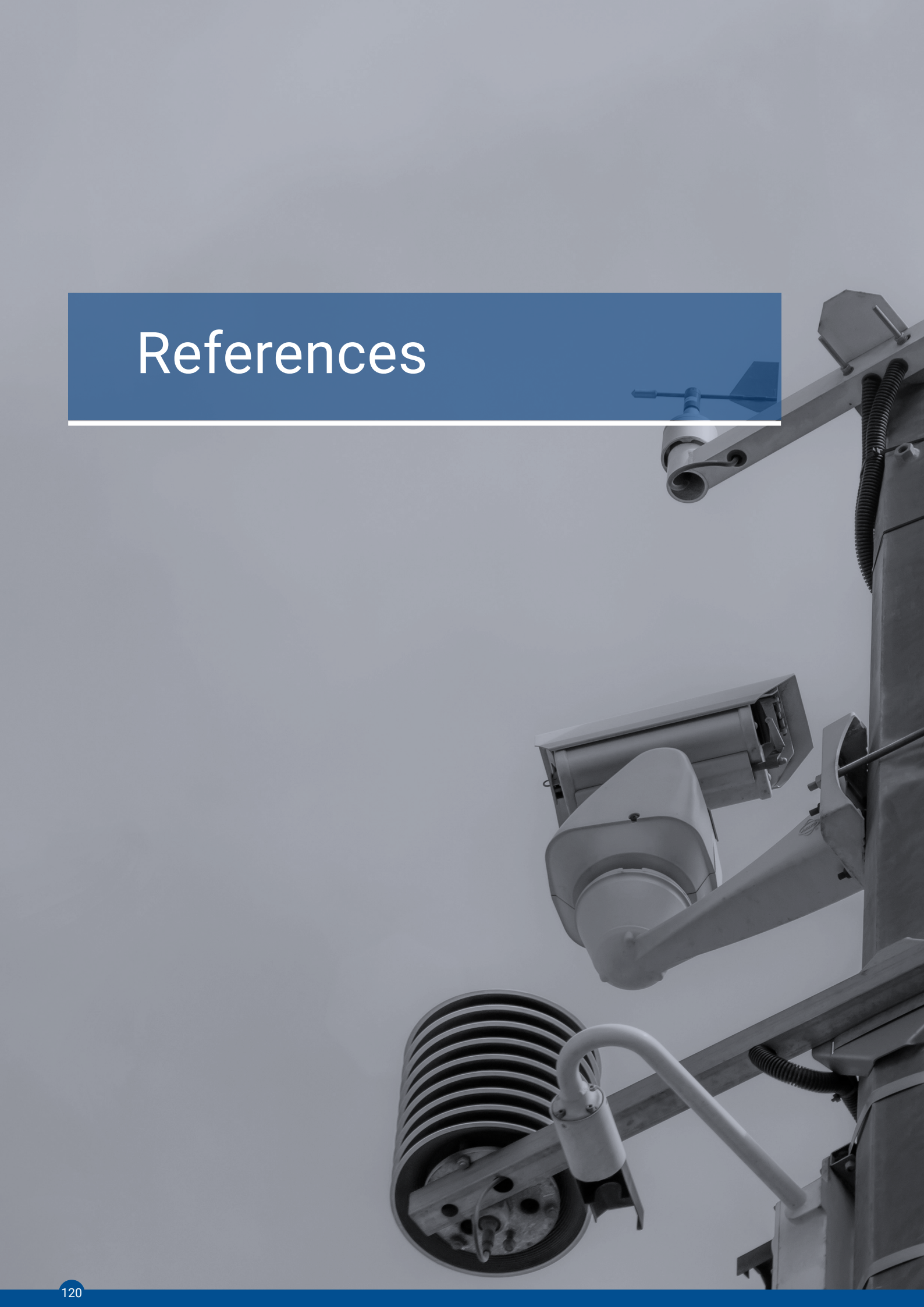

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