Global Status of

Multi-Hazard Early Warning Systems

2025

UNDRR
UN Office for Disaster Risk Reduction

Early Warnings for All

WORLD METEOROLOGICAL ORGANIZATION

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Global Status of Multi-Hazard Early Warning Systems 2025

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Foreword

Kamal Kishore

Special Representative of the United Nations Secretary-General for Disaster Risk Reduction and Head of the United Nations Office for Disaster Risk Reduction

Celeste Saulo

Secretary-General of the World Meteorological Organization

What good is an early warning if it doesn't reach the right people or doesn't lead to life-saving action?

The disruption and devastation caused by disasters over the past year have once again underscored the critical importance of strengthening multi-hazard early warning systems to save lives and livelihoods.

But it is increasingly evident that simply having a system in place is not enough. Every component must work effectively and seamlessly to deliver on its promise. This challenge is compounded by the evolving nature of risks, with hazards such as extreme heat, wildfires, and floods becoming more frequent, more intense and more interconnected.

> *And yet there is reason for hope. Momentum is building towards Early Warnings for All – it is no longer an initiative, but a global movement. This shows measurable progress in comprehensiveness and effectiveness. Even more encouraging is the high level of commitment from countries and partners to accelerate action.*

We are moving from declaration to deeds which make a difference on the ground. The report on the Global Status of Multi-Hazard Early Warning Systems 2025 is a springboard to accelerate action. It provides a snapshot of progress in achieving Target G of the Sendai Framework for Disaster Risk Reduction 2015-2030 and is also a midterm stock-take of the progress made towards Early Warnings for All since its launch in 2022. More importantly, the report provides a forward-looking perspective: clear pathways and recommendations to close remaining gaps and accelerate implementation.

We are under no illusion about hard realities of tighter budgets, competing priorities and challenges facing multilateralism. But amid these complexities, there is one common denominator: the human desire and economic necessity to be safe from disasters. And one of the most cost-effective ways to achieve that is through multi-hazard early warning systems.

They are not a cost to taxpayers, but an investment in resilience.

> *Let us unite around achieving this goal and work to ensure that every country and every person is protected from disasters. Early warnings work. They must work for everyone, everywhere.*

Contents

Acronyms

ADDA	African Drone and Data Academy
AER	After-Event Review
AI	Artificial Intelligence
AMHEWAS	Africa Multi-Hazard Early Warning and Early Action System
APDIM	Asian and Pacific Centre for the Development of Disaster Information Management
API	Application Programming Interfaces
ASW	Accelerated Support Window
AWS	Automatic Weather Systems
BMS	Barbados Meteorological Service
CAP	Common Alerting Protocol
CARICOM	Caribbean Community
CB	Cell Broadcast
CDEMA	Caribbean Disaster Emergency Management Agency
C-DOT	Centre for Development of Telematics
CEB	Chief Executives Board
CEPREDENAC	Coordination Centre for the Prevention of Disasters in Central America and the Dominican Republic
CGIAR	Consultative Group on International Agricultural Research
CMA	Parties to the Paris Agreement
COP	Conference of the Parties
CRED	Centre for Research on the Epidemiology of Disasters
CREWS	Climate Risk and Early Warning Systems
DELTA	Disaster and hazardous events, losses and damages tracking and analysis
DEM	Department of Emergency Management
DRM	Disaster Risk Management
DRMKC	Disaster Risk Management Knowledge Centre
DRR	Disaster Risk Reduction
ECMWF	European Centre for Medium-Range Weather Forecasts
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCWA	United Nations Economic and Social Commission for Western Asia
EU	European Union
EW4All	Early Warnings for All
EWCM	Early Warning Connectivity Map
EWEA	early warning early action
EWS	Early Warning System
EWS-F	Early Warning Systems for Floods
FAO	Food and Agriculture Organization of the UN
FCV	Fragility, Conflict and Violence
FFGS	Flash Flood Guidance System
FRLD	Fund for responding to Loss and Damage
G7	Group of Seven
GBON	Global Basic Observing Network
GCF	Green Climate Fund
GEO	Group on Earth Observations
GFDRR	Global Facility for Disaster Reduction and Recovery
GGA	Global Goal on Adaptation
GHHIN	Global Heat Health Information Network
GHRS	Global Heat Resilience Service
GIS	Geographic Information System
GIZ	German Agency for International Cooperation
GLOF	Glacial Lake Outburst Flood
GNDR	Global Network of Civil Society Organisations for Disaster Reduction
HIPs	Hazard Information Profiles
IBF	Impact-based Forecasting
ICIMOD	International Centre for Integrated Mountain Development
ICPAC	IGAD Climate Prediction and Applications Centre
ICT	information and communications technologies
IFI	International Financial Institutions
IFRC	International Federation of Red Cross and Red Crescent Societies
IGAD	Intergovernmental Authority on Development
IGO	Intergovernmental Organisation
ILK	Indigenous and local knowledge
INFORM	Index for Risk Management
IOM	International Organization for Migration
ISC	International Science Council
ITCG	Interpillar Technical Coordination Group
ITU	International Telecommunication Union
IWMI	International Water Management Institute
JICA	Japan International Cooperation Agency
JRC	Joint Research Centre
LB-SMS	Location Based Short Message Service
LDC	Least Developed Countries
LGU	Local Government Units
LLDCs	Landlocked Developing Countries
M&E	monitoring and evaluation
MENA	Middle East and North Africa
MHEWS	Multi-hazard Early Warning System
MHRA	Multi-Hazard Risk Assessment
MMS	Maldives Meteorological Service
MNO	Mobile Network Operator
MOVE	Methods for the Improvement of Vulnerability Assessment in Europe
NAP	National Adaptation Plan
NASA	National Aeronautics and Space Administration
NCAT	National Capacity Assessment Tool
NDC	Nationally Determined Contributions
NDMA	National Disaster Management Agency / Authority
NETP	National Emergency Telecommunications Plans
NGO	Non-Governmental Organisation
NMHS	National Meteorological and Hydrological Services
NOAA	National Oceanic and Atmospheric Administration
NORCAP	Norwegian Capacity
PBS	Public Broadcasting Service
PDC	Pacific Disaster Center
RCRCCC	Red Cross Red Crescent Climate Centre
REAP	Risk-Informed Early Action Partnership
REWSC	Regional Early Warning System Consortium
RSMC	Regional Specialized Meteorological Centres
SAMUDRA	Smart Access to Marine Users for Ocean Data Resources and Advisories
SDS	Sand and Dust Storms
SFM	Sendai Framework Monitor
SIDS	Small Island Developing States
SINAPROC	National Civil Protection System, Panama
SMA	Sudan Meteorological Authority
SMS	Short Message Service
SOFF	Systematic Observations Financing Facility
STEM	science, technology, engineering, and mathematics
STREAM-EWS	Strengthening Resilience through Early Action and Impact Mitigation–Early Warning System
SUDTT	Sudan Urban Development Think Tank
SWFP	Severe Weather Forecasting Programme
TEC	Technology Executive Committee
TWG	technical working group
UN	United Nations
UNCCD	UN Convention to Combat Desertification
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	UN Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
UNICEF	UN Children's Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNSDCF	UN Ssustainable Development Cooperation Frameworks
UNU	UN University
USAID	US Agency for International Development
USD	United States Dollar
USGS	United States Geological Survey
WASH	water, sanitation, and hygiene
WCM	WMO Coordination Mechanism
WEF	World Economic Forum
WHCA	Water at the Heart of Climate Action
WIGOS	WMO Integrated Global Observing System
WIPPS	WMO Integrated Processing and Prediction System
WIS	WMO Information System
WMO	World Meteorological Organization
WRP	Weather Ready Pacific

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Executive Summary

While disaster-related mortality has been largely contained over the last decade, in 2024, climate-related disasters resulted in higher financial losses than in past years, with tropical cyclones alone costing the world $135 billion.[1] The year was also marked by the annual global mean temperature exceeding 1.5°C above pre-industrial levels for the first time – the critical threshold identified in the 2015 Paris Agreement that marks the limit for avoiding the most severe impacts of climate change.

Despite advances in observing and predicting hydrometeorological events, the most devastating disasters of the past year were weather-related, and studies suggest that many of these events have been made more likely because of climate change. Flooding and flash flooding have been experienced in every part of the world with significant impacts. Severe storms and tropical cyclones have wreaked havoc in the Asia-Pacific region and in the Caribbean, while winter storms have brought blizzards, landslides and floods to Central Asia. Meanwhile, geological hazards have also had significant impacts with considerable loss of life – for example, in Myanmar and Afghanistan, where there were no early warning systems (EWS) for earthquakes or cascading hazards such as landslides. In contrast, across the Pacific, actions were taken for millions to be evacuated within minutes of the 8.8 Kamchatka Earthquake in July 2025, thanks to active monitoring, data sharing, improved modelling and the effective execution of pre-planned responses. This progress has been the result of a concerted effort by multiple stakeholders across the region to improve tsunami warning systems and preparedness following the devastating tsunami in Indonesia in December 2004.

In 2025, Pakistan experienced its most destructive monsoon seasons with intense rainfall and flash floods, as well as glacial lake outburst floods (GLOF). Glacier-related hazards are among several types of hazards featured in this year's report – alongside extreme heat, sand and dust storms (SDS), wildfires, and volcanic eruptions. Each of these hazards presents a different set of challenges in terms of prediction and in the provision of timely and appropriate advice. While some hazards and resulting impacts can be highly localized – for example, the very definition of "extreme heat" is linked to local climatology – others (e.g. SDS) pose risks to communities thousands of kilometres away. Concern over the impacts of these emerging hazards has led the United Nations to mobilize, including a call to action on extreme heat, the declaration of 2025 as the "International Year of Glaciers' Preservation", and the proclamation of 2025 to 2034 as the "Decade on Combating Sand and Dust Storms". Multi-hazard early warning systems (MHEWS) are at the heart of efforts to minimize the impacts of these emerging hazards.

The Early Warnings for All (EW4All) initiative, launched in March 2022, seeks to achieve universal coverage of early warnings within five years. Building on the Global Status Reports from previous years, this report sets out the current status of MHEWS, noting progress made, celebrating successes, identifying persistent gaps and recommending courses of action to be taken to meet the goal of EW4All. The key findings from this year's report are formulated around 12 topics, which include a focus on each of the pillars of EW4All – disaster risk knowledge; detection, observations, monitoring, analysis and forecasting; warning dissemination and communication; and preparedness and response capabilities – in addition to key principles and cross-cutting themes.

1 Throughout this report $ is used to denote United States dollar currency. Any use of "dollars" in the report refers to United States dollar currency.

Finding 1. Early warning systems are demonstrably saving lives.

Disaster-related mortality in countries with more comprehensive MHEWS capabilities is nearly six times lower than in countries with limited capabilities. While average mortality rates are reducing, the number of disaster-affected people continues to grow. This suggests that the impact of disasters is increasing, and it underscores the need for all countries to have more effective MHEWS. This discrepancy presents a challenge for defining success for MHEWS and measuring it effectively.

Finding 2. More countries are developing, implementing and improving their MHEWS, but critical gaps remain, especially in Africa and Least Developed Countries.

In its third year since the global call for EW4All, more than 60 per cent of all countries – and more than half of the countries in each region – have reported the existence of MHEWS. Continuing the positive trend observed in previous years, progress on MHEWS implementation has been made within each country, each region and across every pillar. A 45 per cent improvement has been seen in the comprehensiveness scores for MHEWS capabilities across all regions.

While much has been achieved, especially in Africa and among the least developed countries (LDCs), persistent gaps remain in some technical and geographical areas. There remains a moral imperative to prioritize technical and financial support to develop and implement effective and appropriate MHEWS in the LDCs, as well as in landlocked developing countries (LLDCs) and small island developing States (SIDS). They are disproportionately vulnerable to hazardous events and climate change, yet often have limited resources or capacity to cope with impacts. Country-led plans are crucial for ensuring targeted and coherent investments, the benefits of which can be sustained in the longer term.

Finding 3. People-centred, locally led approaches – underpinned by communication and dialogue – are enabling effective early action.

Warnings are only effective if they are received, understood, trusted and acted upon – by everyone. Placing local actors and communities at the heart of MHEWS design and equipping them to be active participants ensures that systems reflect local needs. For this reason, people-centredness and inclusivity have always been central principles underpinning best practice in MHEWS design, development and implementation.

Empowering local ownership – especially in marginalized and remote areas – enhances responsiveness and trust in warnings, which enables timely, anticipatory action. There is evidence of people-centred approaches being mainstreamed, with local communities contributing their knowledge and experience – including knowledge of hazards, risks and actions to take – through co-production activities and multi-stakeholder discussions. Community leaders have been acknowledged as highly influential actors within communication strategies and are crucial for increasing public engagement on MHEWS, especially among hard-to-reach populations. Meanwhile, drills and desktop exercises involving local populations are surfacing community knowledge, highlighting priority issues and identifying where there is a lack of key resources for response, while demonstrating the importance of each and every actor in the system. The extent to which MHEWS-related interventions are truly people-centred actions is increasingly being measured through specific indicators within the monitoring and evaluation (M&E) frameworks for projects, programmes and initiatives.

Finding 4. Comprehensive local and national governance is facilitating effective MHEWS.

MHEWS function best when they are embedded within a country's disaster risk governance frameworks, including disaster risk reduction (DRR) strategies and plans. The number of countries reporting DRR strategies and local plans for early warnings has increased year-on-year, and most countries with MHEWS capabilities also have DRR strategies. Importantly, there is also evidence of MHEWS capabilities being more comprehensive where DRR strategies are more advanced. These achievements are born out of a coherent, holistic approach that is locally led and which provides clarity over the roles and responsibilities that different parts of society – the public, private, civil and academic sectors – can play and how they should interact.

Many countries have – or are developing – national legislation and frameworks that can support MHEWS pillars, such as laws establishing National Meteorological and Hydrological Services (NMHSs), which are in place for more than half of all Members of the World Meteorological Organization (WMO). MHEWS governance frameworks are also being developed and implemented at the continental and regional levels and are especially relevant for managing transboundary hazards and impacts.

Strong governance is also crucial for long-term sustainability under national or local leadership and especially important for transitioning away from anticipatory action led by international actors or organizations within the United Nations system.

Finding 5. Effective stakeholder engagement and data sharing are supporting collaboration and coordination for MHEWS implementation.

Collaboration and coordination are facilitating MHEWS to scale up with an "all of society" approach, enabling all stakeholders to contribute.

Effective data sharing within and between countries is essential for delivering MHEWS at scale, especially in the context of transboundary hazards and impacts. It is also essential for impact-based forecasting, which requires knowledge of hazards, vulnerability and exposure, as well as potential impacts – with these impacts varying across and within sectors, locations and communities, and knowledge of them informed by analysis of past events. While good progress has been made, there is room for improvement, such as the need to remove data-sharing constraints that are artefacts of pre-existing institutional arrangements and structures.

Collaborative working is most effectively enabled by strong governance frameworks (see finding 4) and effective communication and dialogue, especially with local communities (see finding 3). Engaging positively with all stakeholders is essential for maximising their contributions and requires both careful management and sustained effort. Meaningful discussion during recent multi-stakeholder forums, technical working groups and communities of practice provides opportunities for countries and their stakeholders to share knowledge and learning in support of the goal of EW4All.

Finding 6. Financial mechanisms are investing in MHEWS, but funding must be targeted and sustained.

Finance is an enabler, but it needs to be the right type, at the right time and for the right duration. Through EW4All, momentum is building for the global scale-up of MHEWS, with more funding becoming available as multiple initiatives and funds pledge their support – but these mobilized resources need to match the ambition of EW4All.

Some financial mechanisms are constrained, with a predominant focus on infrastructure, equipment and capacity-building, and less on recurrent training, on-the-job coaching or making provisions for the ongoing costs associated with operations and maintenance. Yet all are required if the benefits of investments in infrastructure, equipment and systems are to be realized. Similarly, anticipatory action requires both "build" and "fuel" funds to establish and implement effective frameworks, and while some governments are beginning to use domestic resources, most anticipatory actions remain externally funded. In addition to financing MHEWS investments and operations, funding is also required to support participatory approaches that enable meaningful dialogues with MHEWS stakeholders – including public outreach and co-production – to inform the design and delivery of MHEWS.

National strategies and plans – including country-led EW4All roadmaps – are essential tools for developing a coherent, coordinated approach to funding the scale-up of MHEWS. They ensure that investments meet priority needs of countries and enable the unrestricted activities of one fund to complement and leverage the infrastructure or equipment provided by another. Meanwhile, M&E frameworks enable progress to be monitored.

The Global Observatory provides a way of monitoring progress on financing MHEWS scale-up. Analysis of data from nine international financial institutions, among other data sources, reveals that investments are being made on every continent. More than two thirds of investments are split between Africa and Asia, and more than a third of projects focusing on LDCs. While funding is most strongly associated with building capacities in disaster risk knowledge and in observations and forecasting, more than a third of all projects span all parts of MHEWS.

Finding 7. Innovation and new technology bring opportunities to scale up MHEWS, yet the digital divide remains.

The adoption and roll-out of innovations – including but not limited to new technologies – continues to drive the scale-up of MHEWS globally. Progress has been made within each pillar – from the development of an enhanced disaster-tracking system to the roll-out of digital tools to strengthen forecasting and warning dissemination capabilities with NMHSs. Digital tools are also helping vulnerable communities to stay connected before, during and after disasters, and they also enable the timely and proactive deployment of cash and voucher assistance.

However, for some countries, a persistent digital divide hampers progress. In particular, the online hosting of tools and databases – and the development of mobile applications – requires stable, high-bandwidth Internet connections and smartphones with sufficient data packages (see finding 10). Yet many stakeholders – from technical experts to local populations – in both urban and rural areas lack the necessary connectivity.

Advances in science and technology – for example, within forecasting – have led, and will continue to lead, to improvements in MHEWS capabilities. Rapid developments are expected as a result of artificial intelligence applications, which are already bringing huge efficiencies in the analysis of large datasets and the translation of warning messages into multiple languages. Innovations in how stakeholders work together to make the most of these new technologies will remain critical for realising their full potential.

Finding 8. The extent and depth of risk knowledge are improving but need further strengthening.

Focused efforts and investments in disaster risk knowledge capabilities are bearing fruit with a steady improvement in coverage and a more rapid improvement in the comprehensiveness of capabilities. The number of countries reporting limited capabilities has more than halved in the last year, and the roll-out of DELTA Resilience[2], an enhanced disaster tracking system, is expected to drive this further. The system will provide more complete and disaggregated disaster information that can be used before the onset of hazardous events to plan interventions that save lives and minimize impacts. However, still only a third of all countries are reporting capabilities in Pillar 1 and, despite improvement, the comprehensiveness of capabilities remains low in the Africa region.

The limited level and coverage of risk knowledge overall, and especially in the Africa region, calls for continued investment to roll out the knowledge systems – and associated best practice – for the collection, analysis and use of disaster risk knowledge across every aspect of MHEWS design and implementation. In this regard, it is encouraging to see from the latest financial data in the Global Observatory that as of July 2025, disaster risk knowledge has received the most funding allocations.

Finding 9. Observing and forecasting skills are improving, but comprehensive capabilities are not widespread, and emerging hazards bring additional challenges.

Driven by investments to modernize hydrometeorological infrastructure, a third of all WMO Members have fully automated their observation networks, resulting in improved data quality, frequency and timeliness, while reducing operational burdens. The number of WMO Members sharing data through the WMO Information System has more than doubled in the last two years.

However, less than a tenth of WMO Members – and no LDCs – comply fully with the requirements of the Global Basic Observing Network that is needed to drive the global weather and climate models.

Just over a third of all countries report having multi-hazard monitoring and forecasting systems, and the majority have comprehensive capabilities. However, the lack of operational systems and infrastructure hampers the delivery and scale-up of MHEWS in LDCs, especially in the Africa region and in the Americas and the Caribbean. Most countries benefit significantly from the global products from meteorological centres of the WMO, which provide an essential foundation for forecasting and early warning services at the national level. However, they are not always available at the spatial resolution required to produce detailed predictions at the local level. Despite this, the vast majority of NMHSs are providing early warnings that enable early action.

Regional centres and flagship programmes are scaling up to meet the demand for MHEWS, and are strengthening the technical capabilities within LDCs, LLDCs and SIDS. While the WMO Severe Weather Forecasting Programme (SWFP) now covers 85 countries, technical capacity for IBF remains weak, and the sharing of cross-sector datasets is insufficient (see finding 5).

Specialist systems have been developed – for example, for flash flooding – but new hazards are emerging, including GLOFs and SDS. While MHEWS develop for these emerging and often transboundary hazards, improved communication is needed to ensure populations have accurate knowledge, understanding and perceptions about the emerging risks to inform actions that can save lives. This is especially important for sudden or hard-to-track hazards like earthquakes, volcanic eruptions, and landslides.

Finding 10. Enabled by improvements in digital infrastructure, warnings are reaching more people but need to be sustained.

More than half of all countries have reported capabilities in warning dissemination and communication, with over half of the countries in each region reporting a comprehensive capability.

Recent progress includes the roll-out of cell broadcast (CB) and location-based SMS, now operational in 44 countries, and communication plans with agreed roles and responsibilities for the media. At the regional level, regulatory mandates, such as the European Union's directive on mobile alerts, have accelerated the uptake of CB. Nationally, collaboration with telecom operators, broadcasters and technology providers ensures both compliance and innovation. In addition to these technical advances, the potential of AI to enhance communication and dissemination is significant, with early examples of how warning messages can be tailored to meet user preferences for content and language.

Improvements in the availability, accessibility and affordability of the Internet, mobile broadband and mobile phones provide opportunities for the collection of data as well as warning dissemination. Similarly, the adoption of the Common Alerting Protocol (CAP) standard ensures that consistent messages are sent across multiple platforms. While CAP training has been completed by nearly two thirds of WMO Members, CAP use is not being sustained, with close to half of all WMO Members yet to issue a CAP alert.

Despite advances in technology, some communities remain hard to reach, and inequalities persist, particularly in rural parts of developing countries. If warnings are to reach everyone, everywhere, a multichannel approach is needed, supported by clear, consistent warnings and advice from a single authoritative voice. To ensure no one is left behind, digital tools need to complement traditional systems. Low-tech and no-tech solutions remain important, as is the integration of traditional and local knowledge, the use of participatory approaches and community dialogue (see finding 5), which build trust in MHEWS.

Finding 11. Momentum is building for anticipatory action and planned responses that save lives, but plans need to be embedded and keep pace with the growing complexity of risk.

Where preparedness and response plans exist and are activated, lives and livelihoods can be saved. Pre-emptive action is an example of anticipatory action when taken in response to forecasts. Globally, 2.7 billion people were pre-emptively evacuated between 2015 and 2023, more than half of these in the Asia-Pacific region. The number of evacuees has increased dramatically in the last year, especially within the Arab States, indicating that more countries – and communities – are taking pre-emptive action.

The Asia-Pacific region has the highest overall coverage for preparedness and response, with a third of reporting countries in the region declaring comprehensive capabilities. In contrast, and despite significant improvements in the last year, coverage and comprehensiveness are lower in the Africa region and across the Americas and Caribbean.

Early warnings alone do not always lead to timely and effective action; they are dependent on the development and activation of plans with the mindset and resources needed to act. The creation of new tools, guidance and training on anticipatory action has built momentum for early action, with the number of frameworks and plans in place (or undergoing development) increasing year-on-year. In 2024, a third of the anticipatory actions were in countries affected by fragility, conflict and violence, proving that anticipatory action can be implemented even in challenging, dynamic situations. Encouragingly, national governments are playing an increasingly central role in driving anticipatory action and inter-agency collaboration is improving. However, anticipatory action is not happening at the scale required or for all hazards – only a quarter of all countries have anticipatory action plans, and many frameworks focus on single hazards, rather than taking a multi-hazard approach.

2 Disaster and hazardous events, losses and damages tracking and analysis system

To turn early warnings into timely, life-saving measures, governments must integrate anticipatory action into disaster risk management and related sectors like climate, health and social protection. This involves embedding it in laws, policies, forecasting, financing and preparedness plans to ensure swift and coordinated responses before disasters strike.

Finding 12. EW4All continues to stimulate MHEWS scale-up.

Momentum is gathering around the global scale-up of MHEWS, and EW4All has become a unifying agenda for adaptation and resilience. As a result, initiatives and programmes – both pre-existing and new – are aligning with the goal of EW4All. The data held in the Global Observatory shows that funds are being mobilized.

At national, regional and global levels, EW4All is bringing together key stakeholders through national consultations and a series of multi-stakeholder forums. EW4All is also catalysing or supporting other peer-to-peer interactions such as South-South cooperation and twinning. Meanwhile, EW4All partners and pillar leads are establishing crucial regional coordination mechanisms and expanding the coverage of flagship programmes like SWFP.

The EW4All dashboard is an important monitoring tool that shows the progress made within and across each pillar, region and group, and documenting evidence of progress, including through this report. However, as the initiative reaches the halfway stage in 2025, while progress is tangible, a concerted effort is required to ensure that every person on Earth is protected by MHEWS.

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Introduction

Image Source: ©WMO Calendar Competition/2024/Muhammad Amdad Hossain

1. Introduction

1.1 Disasters are costlier than ever

While disaster-related mortality has been largely contained over the last decade, in 2024, climate-related disasters resulted in higher financial losses than in past years, with tropical cyclones alone costing the world $135 billion.[3] The number of disaster-affected people also continues to rise.

Disasters triggered by natural hazards claimed a high toll in the last decade, causing devastating suffering and economic hardship for individuals and communities globally. Over 40,000 people on average were reported killed or missing each year between 2015 and 2024 due to disasters, and a further 121 million people were affected each year.[4] While these numbers underscore the severe human impacts, the Centre for Research on the Epidemiology of Disasters (CRED) estimates that the numbers could have been much higher if a major earthquake or tsunami had affected populated areas (CRED, 2025).

Across all disasters, direct economic loss has cost the world over $1 trillion since 2015, accounting for 0.3 per cent of the total gross domestic product from all reporting countries between 2015 and 2024.[5] Major disaster events continue to impose heavy economic loss on some of the most vulnerable countries. For example, tropical cyclones alone cost the world $135 billion in 2024 (Munich Re, 2025).

Last year (2024) was the first year the annual global mean temperature exceeded 1.5°C above pre-industrial levels (WMO, 2025).[6] This is the threshold identified in the 2015 Paris Agreement that marks the limit for avoiding the most severe impacts of climate change. Although this one-year measurement does not confirm failure of the long-term goal – measured in decades – it signifies a dangerous trend where every fraction of a degree increase in temperature can result in more damaging impacts.

The most devastating disasters in the past year were weather-related, responsible for 93 per cent of overall financial losses (Munich Re, 2025). Severe storms are becoming more frequent and more extreme. Studies by World Weather Attribution have shown that Hurricanes Helene and Milton were significantly more severe and carried much more rainfall than they would have if they had occurred in a world without climate change (Clarke, and others, 2024; World Weather Attribution, 2024c). Similarly, the intense rainfall that resulted in flash floods in Valencia, Spain (World Weather Attribution, 2024b) and the weather conditions that led to severe flooding in Brazil (World Weather Attribution, 2024a) were both twice as likely to occur as a result of climate change.

1.2 Early warning systems save lives

Evidence continues to suggest that multi-hazard early warning systems (MHEWS) correlate well with lower mortality rates and fewer people affected by disasters. As in years past, data from the Sendai Framework Monitor (SFM) suggests a correlation between more comprehensive MHEWS and reduced disaster mortality and affected populations.

As illustrated in table 1, countries with "substantial" to "comprehensive" MHEWS have a six-times lower disaster-related mortality rate compared with that of countries with "limited" to "moderate" MHEWS (see table 1, Sendai Framework Target A). While overall mortality rates per 100,000 population have reduced since data for 2024 was included, the ratio has remained the same.

Similarly, countries with substantial to comprehensive MHEWS coverage have just over a third of the number of disaster-affected people compared to countries with limited to moderate MHEWS coverage (see table 1, Sendai Framework Target B). However, the number of affected people per 100,000 population continues to grow across all countries,[7] which suggests that the impact of disasters is increasing and underscores the need for all countries to have more effective MHEWS.

Table 1. Mortality and number of disaster-affected people per 100,000 population, 2005–2024, by comprehensiveness of MHEWS (source: SFM, as of March 2025)

MHEWS comprehensiveness	Mortality (Target A)	Number of affected people (Target B)
Limited to moderate (score 0–0.5)	3.57	3,761
Substantial to comprehensive (score 0.51–1)	0.57	1,433
Ratio (limited/moderate vs substantial/comprehensive)	6.2 times higher	2.6 times higher

1.3 About multi-hazard early warning systems

1.3.1 Definitions

An early warning system (EWS) is defined as:

> An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities, systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events. (UNDRR, 2017)

MHEWS are EWS that are designed and implemented to provide warnings in more complex situations. They are defined as:

> Multi-hazard early warning systems 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. (UNDRR, 2017)

3 Throughout this report $ is used to denote United States dollar currency. Any use of "dollars" in the report refers to United States dollar currency.

4 https://sendaimonitor.undrr.org/

5 Ibid.

6 https://www.un.org/sustainabledevelopment/blog/2025/01/press-release-wmo-confirms-2024-as-warmest-year-on-record-at-about-1-55c-above-pre-industrial-level/

7 Globally, there has been a 136 per cent increase in the proportion of populations that are affected by disasters between the last two decades, as disaster-affected people increased from 1,200 per 100,000 population during 2005 to 2014, to 2,839 during 2015 to 2024.

1.3.2 Pillars of multi-hazard early warning systems

The four pillars of single EWS and MHEWS were originally proposed in 2006 and remain a central concept, mirrored by the structure of the Early Warnings for All (EW4All) initiative (*see figure 1*).

The four pillars are interconnected; an MHEWS can only operate successfully if every pillar is connected, coordinated and working. However, a balance of capabilities across the four pillars is also important. Even in the case of countries with comprehensive MHEWS capabilities, early warnings do not automatically result in timely and effective action. Similarly, at the other extreme, while it is highly desirable for all countries to have comprehensive observation and forecasting systems, even in the absence of conventional MHEWS infrastructure, localized community-based and hybrid approaches can also deliver timely and meaningful alerts. "People-centred" MHEWS recognize that systemic pressures shape access to resources. MHEWS need to be designed around factors such as gender, age, disability, language and culture to improve how individuals and communities can take timely and appropriate actions to minimize the risk of harm and loss. People-centred MHEWS also recognize the strengths that communities bring to effective MHEWS through Indigenous and local knowledge (ILK), community-based monitoring and observations, trusted communication networks, and civil society actions – all of which can complement technology-based solutions.

Hazards do not occur in isolation from other factors such as vulnerability and exposure, which may themselves be modified by the occurrence of a hazardous event or other factors. Examples of this include increased numbers of displaced people living in temporary shelters as a result of flooding or conflict. In addition, one hazard might occur alongside or trigger another hazard, so evolving from a single-hazard to multi-hazard EWS is crucial. For example, storms can bring strong winds and extreme precipitation, which may cause flooding, which can in turn trigger landslides – the concept of primary, secondary and tertiary hazards. Furthermore, MHEWS should relate to overall disaster risk reduction (DRR) efforts and preparedness planning. Warnings across multiple hazards and across different timeframes can inform long-term approaches to risk management. Identification of relevant hazards to monitor (section 2.3) should be based on continuous risk assessments (section 2.2).

Figure 1. EW4All pillars

1.3.3. Preparation of this report

The sections of this report follow the structure of the EW4All logic model, organized around the four pillars of MHEWS, together with cross-cutting enablers and principles that support the effective delivery of MHEWS.[8]

This report draws on multiple sources and the latest available data to assess global progress in MHEWS. These include input and data from SFM[9] (data up to 31 March 2025); the EW4All Dashboard, a centralized online platform designed to monitor and visualize the progress of EW4All (data from various dates, through July 2025); and agencies such as the International Federation of Red Cross and Red Crescent Societies (IFRC), World Meteorological Organization (WMO), and the International Telecommunication Union (ITU). Within this report, this data has been complemented with media reports on disasters and hazardous events as well as case studies contributed by agencies to illustrate the implementation of MHEWS, with a focus on recent performance. More information about the data sources used in this report is in Annex B. While primarily based on secondary data, the content has been enhanced by inputs from the EW4All Monitoring and Evaluation Working Group and, as a result, it offers a broad overview of MHEWS status worldwide.

The report uses regional and country group definitions from the United Nations unless otherwise stated.

1.4 Multi-hazard early warning systems unifying global agendas

MHEWS are increasingly acknowledged as an important element in global policies and frameworks for DRR and climate action.

Amid mounting recognition of the pivotal importance of MHEWS, United Nations Secretary-General António Guterres launched the EW4All initiative in 2022, with the ambitious goal of ensuring that every person on Earth is protected by EWS within five years.[10] A sequence of actions over the past decade has contributed to the momentum for MHEWS support, culminating in this ambitious goal.

More than 10 years ago, the Sendai Framework for Disaster Risk Reduction 2015-2030 was designed. It includes a dedicated target on MHEWS (Target G) to "Substantially increase the availability of and access to multi hazard early warning systems and disaster risk information and assessments to people by 2030" (UNDRR, 2015). Data from the measurements of the Sendai Framework underpins this report.

That same year that the Sendai Framework was designed, the Paris Agreement was adopted at Conference of the Parties (United Nations Climate Change Conference 2015 or COP21), in which Article 8 – focusing on loss and damage – indicates EWS as a specific area of cooperation and facilitation to enhance understanding, action and support (UNFCCC, 2015). Also, at COP21, the Climate Risk and Early Warning Systems (CREWS) initiative was established (see section 4.1.1).

Within the Paris Agreement (Article 7), the Global Goal on Adaptation (GGA) aims to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change with a view of contributing to sustainable development (UNFCCC, 2015). COP28 Parties to the Paris Agreement (CMA[11]) adopted the targets of the UAE Framework for Global Climate Resilience, one of which is: "by 2027 all Parties have established multi-hazard early

8 https://wmo.int/sites/default/files/2023-11/Theory-of-Change_EW4All_FINAL.pdf

9 See www.undrr.org/sfm and www.sendaimonitor.undrr.org, with official statistics reported by governments and coordinated by the United Nations Office for Disaster Risk Reduction (UNDRR) as the custodian organisation.

10 https://www.un.org/en/climatechange/early-warnings-for-all

11 https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-serving-as-the-meeting-of-the-parties-to-the-paris-agreement-cma

warning systems".[12] Indicators for the target have been developed,[13] and their adoption is expected to be a key outcome at the 30th United Nations Climate Change Conference (COP 30) and the 7th Conference of the Parties (COP30/CMA7) in Belem, Brazil in 2025. Meanwhile, Parties continue to progressively report on MHEWS as part of their National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs).

The Santiago Network (established in 2019 as part of the Warsaw International Mechanism for Loss and Damage) catalyses technical assistance to enhance actions that avert, minimize and address loss and damage in developing countries that are particularly vulnerable to the effects of climate change (UNFCCC, 2019). MHEWS are identified as a key area needing technical assistance across developing countries. The Fund for Responding to Loss and Damage[14] was established to finance initiatives that assist developing countries to respond to the economic and non-economic loss and damage associated with the negative effects of climate change. Setting up and strengthening EWS has been listed as an example of activities that could be supported under the programming areas.

At the 15th Conference of the Parties (COP15) to the Convention on Biological Diversity in 2022, the Kunming-Montreal Global Biodiversity Framework was adopted to reduce threats to biodiversity, including through the development and implementation of EWS (UN Environment Programme [UNEP], 2022). The United Nations Convention to Combat Desertification emphasizes the importance of MHEWS to manage and mitigate the impacts of drought and land degradation, and held a dedicated session at COP16 in 2024. In 2024, the G20 South Africa 2025 DRR Working Group emphasized "universal coverage of EWS" as one of its six priority areas during its inaugural declaration,[15] and it has been retained in the work plan for the 2025 South African Presidency of the G20 DRR Working Group.[16]

Thus, global scale-up of MHEWS emerges as a unifying action for turning the coherence across multiple global agreements and frameworks into action at the regional, national and local levels. Chapter 3 of this report explores the purpose of the EW4All initiative and the progress that has been made during 2024.

1.5 Selected hazards and analysis of MHEWS for recent events

MHEWS are put to the test during hazardous events, especially those that potentially lead to high-impact disasters and catastrophic events. Analyses of MHEWS performance in the aftermath of these events provide valuable insights into good practices and lessons that are critical for the continuous improvement of MHEWS at various levels. This section provides an analysis of selected recent events, the role of MHEWS in each and, where available, a commentary on the effectiveness of the system.

In Valencia, Spain, intense rainfall in October 2024 led to flooding, killing over 200 people, displacing thousands more, and destroying homes, infrastructure, and livelihoods. Despite advanced meteorological systems, early warnings were reportedly delayed or ineffective, and communication and coordination between national and local authorities were fragmented with severe consequences.[17] Flooding also killed hundreds of people in Chad (ACAPS, 2024), Niger, Nigeria, Pakistan and Afghanistan (CRED, 2025), where advanced EWS for flooding were seen to be lacking. In July 2025, flash flooding in Texas, United States, was caused by the combination of volatile weather, unusual humidity and the local landscape, killing over 100 people and leaving many more missing. Issuing timely early warnings was challenging due to the rapid onset of rain overnight when most were sleeping.[18] Further, many people in the area were visitors who were unfamiliar with local risks and what actions to take. [19, 20]

Elsewhere, severe storms and tropical cyclones had major effects throughout the year. In September 2024, Typhoon Yagi caused nearly 500 fatalities in Myanmar and 350 in Viet Nam. A review found that the warning value chain for Yagi performed well but could be improved with better real-time application of data, forecasting consistency and impact-based forecasts (Chunyi, and others, 2024). In May 2024, Cyclone Remal affected approximately 4.6 million people in Bangladesh, despite the country's advances in MHEWS.[21] In the North Atlantic basin, Hurricanes Helene, Milton and Beryl have been among the most costly storms in the Americas over the past year (CRED, 2025), despite improvements in forecasting models. Meanwhile, in 2024, Afghanistan suffered from severe winter storms bringing blizzards, landslides and floods, killing nearly 1,200 people (ACAPS, 2024; CRED, 2025).

Pakistan has experienced one of its most destructive monsoon seasons in decades, with cascading and compounding hazards resulting in extensive loss of human life, mass displacement and destruction of livelihoods and infrastructure. In August 2025, a combination of intense rainfall, flash floods, and localized cloudbursts devastated large swathes of Khyber Pakhtunkhwa region. The humanitarian situation escalated rapidly due to the high intensity of rains, fragile mountainous terrain and already vulnerable socioeconomic conditions of affected communities.[22] Meanwhile, in Punjab, around 24,000 people were evacuated due to the risk of riverine flooding resulting from upstream releases and near-full reservoirs along the Sutlej, Chenab and Ravi, with similar warnings issued by the Provincial Disaster Management Authority in Sindh province. Simultaneously, glacial lake outburst floods (GLOF) on 22 August destroyed over 330 houses, with the risk of further GLOFs occurring.[23] With heavy rain, thunderstorms and strong winds set to continue, an urban flooding warning was also issued.[24]

Heavy rainfall in southern Brazil caused floods and localized landslides in May 2024, resulting in 184 deaths and tens of thousands of people displaced, affecting 90 per cent of the Rio Grande do Sul state. Studies indicate that authorities issued risk alerts days in advance, but that these would have been more effective with better institutional coordination, impact-based warnings and community-centred communication strategies (Marengo, and others, 2025). In the Enga province of Papua New Guinea, a landslide – notably difficult to predict and warn about – killed at least 670 people in May 2024 and marked one of the most consequential disasters in the country's history.[25] Similarly, in southern Ethiopia, a landslide in July 2024 killed over 200 people,[26] and a landslide in Tarsin (a village in the western Jebel Marra region of Sudan) on 31 August 2025 left hundreds missing.[27]

Post-event assessments are important for understanding what role MHEWS played in the events and how they could be improved – for example, monitoring that uses satellites and artificial intelligence (AI) to identify small changes in land movement – and to what extent local populations were aware of risks and what actions to take.

12 Part of Target 10 (a): "Impact, vulnerability and risk assessment: by 2030 all Parties have conducted up-to-date assessments of climate hazards, climate change impacts and exposure to risks and vulnerabilities and have used the outcomes of these assessments to inform their formulation of national adaptation plans, policy instruments, and planning processes and/or strategies, and by 2027 all Parties have established MHEWS, climate information services for risk reduction and systematic observation to support improved climate-related data, information and services".

13 See the final list of potential indicators: https://unfccc.int/documents/649629; and the final technical report: https://unfccc.int/documents/649630.

14 https://www.frld.org/about#block-mandate

15 https://g20drrwg.preventionweb.net/media/105535

16 https://g20.org/wp-content/uploads/2024/12/Issue-Note_DRR-WG-1.pdf

17 https://www.gndr.org/2024-spain-floods-early-warning-action-coordination-and-localisation/

18 https://www.bbc.com/news/resources/idt-3e86df88-5679-4f65-914f-97014d8a188f

19 https://news.climate.columbia.edu/2025/07/15/a-disaster-expert-explains-why-the-texas-floods-were-so-devastating/

20 https://www.bbc.co.uk/news/articles/c0rvp24wvrqo

21 https://www.adpc.net/ver25/ImpactStories.asp?q=2041

22 https://www.bbc.com/news/articles/cn0xjd7wvy1o

23 https://reliefweb.int/report/pakistan/pakistan-flood-relief-2025-daily-sitrep-05-aug-22-2025

24 https://reliefweb.int/report/pakistan/pakistan-monsoon-floods-2025-flash-update-7-09-september-2025

25 https://reliefweb.int/disaster/ls-2024-000080-png

26 https://www.reuters.com/world/africa/death-toll-ethiopia-landslides-rises-257-un-says-2024-07-25/

27 https://x.com/IGAD_CPAC/status/1963538482082844865/photo/1

Box 1

EWS averts lightning disaster: Case study from Barbados

On 4 August 2024, a tropical wave – monitored by the Barbados Meteorological Service (BMS) – created unstable conditions just as the Soca 5.0 concert was set to begin at the National Botanical Gardens. Initially, BMS issued a thunderstorm watch, later upgraded to a warning in coordination with the Department of Emergency Management (DEM) and the Minister of Home Affairs.

Based on risk assessments and historical patterns, the event was postponed and the venue evacuated. The decision was not based solely on instinct or precaution. Using geospatial tools and lightning strike data provided by BMS, authorities confirmed that multiple lightning strikes occurred within a 5-kilometre radius of the venue on 4 August. Given the presence of thousands of attendees, metallic stage equipment and barricades, the site was highly exposed.

A geographic information system (GIS)-based buffer analysis after the event confirmed that a minor westward shift in the storm's path could have resulted in direct strikes at the concert location. In such a setting, even a single lightning strike could have caused mass casualties. By integrating risk data with real-time weather forecasts, Barbados avoided what could have been a national tragedy.

Lessons learned from this event include the importance of using multiple communication channels, addressing concerns in real time and fostering public trust long before a hazardous event occurs.

Earthquakes occur with little or no warning, but under the right conditions, earthquake EWS can provide valuable seconds of advance notice, enabling people to seek protection or to increase the safety of critical infrastructure – for instance, by triggering mechanisms that safeguard the operation of oil and gas pipelines. Earthquake EWS was not available for the moment magnitude (Mw) 7.7 earthquake in Mandalay, Myanmar on 28 March 2025. The event claimed the lives of at least 5,000 people, affected over half a million more and incurred economic losses of approximately $1.7 billion. Similarly, no warning was available for the 6.0 magnitude earthquake in Afghanistan on 31 August 2025, which killed more than 2,200 and injured 3,600 (as of 9 September).[28] The impact of the Afghanistan earthquake was compounded by other factors, including displaced populations due to forced returns from neighbouring countries, and with the continued threat of cascading hazards (e.g. landslides) due to heavy rain.

However, tsunami EWS have advanced considerably over the years, as seen following the Mw 8.8 Kamchatka earthquake on 30 July 2025.[29] The event triggered tsunami warnings across the Pacific region almost immediately, with millions of people actively responding to instructions to evacuate, including nearly 2 million people in Japan. Notices and evacuations at this scale were largely absent in the tsunami events of 2011 (Japan) and 2004 (Indian Ocean), which cost thousands of lives and from which valuable lessons have been learned and acted upon.

28 https://reliefweb.int/report/afghanistan/un-calls-1396-million-help-half-million-people-eastern-afghanistan-affected-devastating-earthquake
29 https://www.bgs.ac.uk/news/kamchatka-earthquake-highlights-the-advances-in-tsunami-early-warning-systems/

1.5.1 Featured hazards

In addition to flooding, severe storms, landslides and other "headline" hazards, climate change is exacerbating hazards that have previously received less attention. Meanwhile, EWS for geohazards, such as volcanoes, are receiving growing attention. This section features recent hazardous events alongside considerations for EWS, with early reporting of related EWS activities that have taken place over the past year.

Extreme heat

The United Nations Secretary-General's call to action on extreme heat[30] emphasizes the urgent need for international cooperation to address the multifaceted impacts of heat. EWS play a major role in the four critical areas of caring for the vulnerable, protecting workers, boosting resilience of economies and using data and science, as well as contributing to climate change mitigation.

As highlighted in section 1.1, 2024 was the first year the annual global mean temperature exceeded 1.5°C above pre-industrial levels (WMO, 2025). This past year also marks the tenth year in a row that temperatures have ranked among the hottest on record. This manifested in some of the most extreme temperatures on record, reaching 50˚C in India, Pakistan, Saudi Arabia, Japan, the United States of America and Mexico, according to the Global Heat Health Information Network (GHHIN) (GHHIN, 2025).

Rising temperatures are already having an impact – in 2024, extreme heat caused thousands of deaths globally. The impacts are not the same for everyone; extreme heat adversely impacts the most vulnerable groups – babies, pregnant women, older persons, and displaced people – and people who are more exposed to heat due to the nature of their work or a lack of shelter. A new report shows that both outdoor and indoor workers face increased risks, and productivity drops 2 to 3 per cent for every degree above 20°C (WMO and WHO, 2025). In Saudi Arabia, heat claimed approximately 1,300 lives, and in the United States, over 1,000 deaths were recorded in two cities alone (Phoenix and Las Vegas). India and Pakistan also suffered high death rates attributed to heat, with over 700 and nearly 600 lives lost, respectively (CRED, 2025). On the African continent, extreme heat events hit 42 of the 54 countries in 2024,[31] and Europe was the fastest-warming continent (Copernicus Climate Change Service and ECMWF, 2025).

While many weather hazards have national and/or global alert systems, a global heat EWS does not exist. This is because the definition of "extreme heat" is highly localized, based on local climatology as well as impacts on different sectors. Thus, there is an urgent need for communities and countries to consider appropriate thresholds for extreme heat warnings in their local area as the basis of a future warning system. It may also be possible to develop a global system, but it would likely be based solely on generic heat-stress calculations rather than local data relating to the prevailing and expected conditions. In December 2024, an expert consultation acknowledged the need for a global common framework to address extreme heat risk, and they recommended (among other things) improved EWS with co-produced, impact-based alerts for disaster management strategies (GHHIN, 2025). At the local level, forecasting extreme heat and issuing warnings is relatively achievable for heat compared to other hazards, which are difficult to predict within specific timeframes (e.g. earthquakes) or locations (e.g. landslides). Given the increasing risks associated with extreme heat and to reduce the high levels of excess deaths it causes, a global heat EWS is urgently needed.[32, 33]

The Global Heat Resilience Service (GHRS)[34] is a collaborative initiative led by the Group on Earth Observations (GEO), C40 Cities Climate Leadership Group, the Global Covenant of Mayors, and the International Business Machines Corporation (IBM), with support from WMO, UNDRR and other partners. GHRS responds to the United Nations call for action on extreme heat by providing city leaders with neighbourhood-level heat risk insights through high-resolution heat maps and climate projections for 2030 and 2050. It is currently being developed and tested in Brazil (São Paulo, Rio de Janeiro, Salvador, Belo Horizonte, Cáceres, and Coxim), India (Bangaluru), and Sierra Leone (Freetown). The digital decision-support tool leverages AI in three ways: downscaling global climate data to 100 m resolution using foundation models; integrating diverse data sources from satellites, censuses, and socioeconomic indicators to identify vulnerability hotspots; and enabling scenario planning to model different intervention strategies and identify the most effective combinations of policy, physical, and nature-based solutions to address citywide heat risks. With prototyping targeted for completion by mid-2026, GHRS plans to expand testing and refinement to over 30 cities starting in the second quarter of 2025. The aim is to help urban planners make informed decisions about urban planning, infrastructure upgrades and service delivery to manage heat risks in their local contexts (see section 2.6.6.1).

Sand and dust storms

The United Nations has declared 2025 to 2034 as the "Decade on Combating Sand and Dust Storms", recognising the severe impacts that sand and dust storms (SDS) have on health, agriculture and socioeconomic well-being. EWS are a vital component in assessing and addressing risks to these mega hazards. The global recognition of SDS highlights the urgency of strengthening EWS as a critical mechanism for managing this transboundary hazard.

Every year, an estimated 2 billion tonnes of sand and dust, an amount equal in weight to 350 Great Pyramids of Giza, enter the atmosphere.[35] Nearly 80 per cent of this amount emanates from North African and Middle Eastern deserts.[36] Significant emissions also originate from Central Asia, East Asia, and parts of the Pacific, affecting populations far beyond source regions.

In mid-April 2025, SDS swept across southern Iraq and northern Saudi Arabia, reportedly sending nearly 4,000 people to emergency rooms across the region. Low visibility and high winds closed airports, and harmful air quality closed schools.[37] In recent years, similar severe SDS events across Central Asia and the Arabian Peninsula have reinforced the need for regionally coordinated forecasts and alerts.

While natural sources contribute substantially to global dust emissions, climate change-related factors – such as higher air temperatures; less precipitation; stronger winds; and more frequent, severe, and long-lasting droughts – are exacerbating the conditions that contribute to SDS. In addition, anthropogenic factors such as human-driven changes to land use – including land degradation, agriculture, water diversion and deforestation – are increasing risks further (ESCAP and APDIM, 2018).

SDS pose risks across society – not only in the areas where they originate, but across borders thousands of kilometres away. Localized impacts are often the most damaging, yet remain the hardest to forecast with precision. Hundreds of millions of people are exposed to poor air quality from SDS, seriously impacting short- and long-term health, and disrupting both education and employment. The electricity sector suffers when solar production is disrupted, causing losses of hundreds of millions of dollars, and this is likely to worsen as reliance on renewable energy increases. The aviation industry must cope with harmful dust particles on aircraft engines and visibility challenges, which cause flight delays, diversions and cancellations. Agriculture is impacted by large amounts of sand and dust, often contaminated with high salt content that is toxic to plants and can lead to lower yields and failed crops. Impacts can also be indirect – for example, high-altitude glaciers are also increasingly affected by SDS as dust deposition accelerates ice melt, amplifying downstream water-related risks (ESCAP and APDIM, 2021).

To address this challenge, a new global partnership to enhance EWS for SDS was formed in December 2024 and will support WMO regional centres.[38] The objective is to direct research efforts to assist countries in addressing issues related to EWS for SDS and improve forecasting, as well as studies on mitigating the various impacts of SDS. The strategic implementation plan for this partnership focuses on leveraging the expertise, human resources and technological capabilities available at the regional level.

30 On 25 July 2024, United Nations Secretary-General António Guterres called for an urgent and concerted effort to enhance international cooperation to address extreme heat in four critical areas: caring for the vulnerable; protecting workers; boosting resilience of economies and societies using data and science; and limiting temperature rise to 1.5°C by phasing out fossil fuels and scaling up investment in renewable energy.

31 https://theconversation.com/climate-change-has-doubled-the-worlds-heatwaves-how-africa-is-affected-258594

32 https://www.research-collection.ethz.ch/server/api/core/bitstreams/4c6a24c8-212b-419f-b16a-8c915a738777/content

33 https://wmo.int/media/news/extreme-heat-impacts-millions-of-people

34 https://earthobservations.org/groups/global-heat-resilience-service

35 https://www.unccd.int/news-stories/stories/un-declares-2025-2034-decade-combating-sand-and-dust-storms

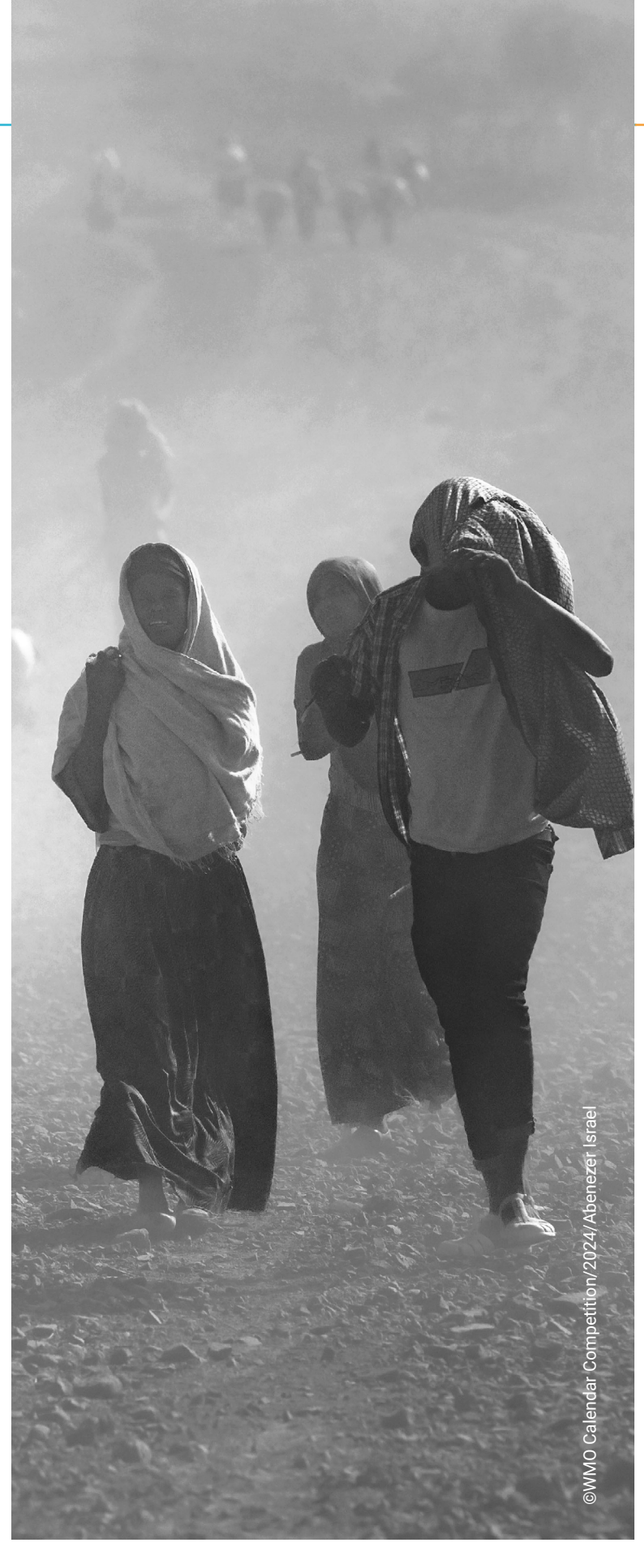
36 https://wmo.int/media/news/international-partnership-enhances-sand-and-dust-storms-early-warnings

37 https://earthobservatory.nasa.gov/images/154186/dust-storm-sweeps-through-iraq

38 https://wmo.int/media/news/international-partnership-enhances-sand-and-dust-storms-early-warnings

In support of the global efforts, the UNCCD hosts the SDS Toolbox,[39] which provides resources to help countries with observation, monitoring, modelling, forecasting and early warning, as well as risk and vulnerability assessments, source control and management, and impact mitigation. UNCCD also produced the Guideline on the Integration of Sand and Dust Storm Management into Key Policy Areas, which offers guidance on EWS, in addition to other areas (UNCCD and FAO, 2024). Enhancing EWS for SDS has remained a critical priority in the General Assembly resolutions on SDS in recent years. EWS for SDS risk reduction and management has also been addressed in the interregional dialogue series organized by the Economic and Social Commission for Asia and the Pacific (ESCAP) and United Nations Economic and Social Commission for Western Asia (ESCWA) in 2025, which resulted in a number of recommendations to advance EWS for SDS at the regional and national level.

Attempts to use AI to better predict SDS are underway, such as the "Dust Watcher", run by a team in Lanzhou University in China. They are developing forecast systems for North and East Asia, which reportedly made 13 per cent fewer errors than non-AI models when predicting where and how much dust is being picked up, as well as how the dust amounts change (Xiaoying, 2024). Clarifying the operational status of such systems – whether pilot, experimental or integrated into national EWS – would help assess their contribution to global forecasting capacity.[40]



©WMO Calendar Competition/2024/Abenezer Israel

39 https://www.unccd.int/land-and-life/sand-and-dust-storms/toolbox

40 UNDRR acknowledges the contribution of Carol Chouchani Cherfane, Niloofar Sadeghi Komjani and Mostafa Mohaghegh from the Arab Centre for Climate Change Policies, and Letizia Rossano from the United Nations Coalition on Combating Sand and Dust Storms towards the review of this section.

Box 2

Advancing EWS for SDS: Case studies from the Arabian Peninsula, Cameroon and Iraq

Since 2022, the increasing frequency and severity of SDS across Iraq, Kuwait and eastern Saudi Arabia have underscored the urgency of effective EWS for SDS. In response, both national and regional institutions have adopted integrated, multi-hazard approaches to forecasting SDS and disseminating forecasts and warnings. These activities have yielded tangible benefits for public health, institutional preparedness and early action.

In Iraq, the Iraqi Meteorological Organization and Seismology – supported by the United Nations Development Programme (UNDP) and WMO – launched a robust EWS combining satellite data, local observations and predictive models. Coordinated efforts with media, health authorities, and civil defence enabled timely dissemination of warnings through SMS, mobile apps and mass media, contributing to a 20 per cent reduction in respiratory-related emergency visits during SDS events. Schools and airports became more strategic in their response by closing facilities in advance. Improved inter-agency coordination also led to improved preparedness and response. Integration of SDS alerts into broader MHEWS platforms could further strengthen anticipatory action.

Meanwhile, on the Arabian Peninsula, real-time forecasts and advisories from the Sand and Dust Storm Regional Center empowered the Saudi National Center for Meteorology to issue proactive warnings ahead of severe storms, including one on 14 April 2025. Despite technical advances, the public's underestimation of SDS risk – especially among vulnerable groups – prompted awareness-raising campaigns via social media, official websites and government workshops. These efforts enabled institutions to suspend outdoor activities, notably protecting children from hazardous exposure.

Across both contexts, the integration of local knowledge with advanced data enhanced forecasting accuracy. Key enablers included strategic partnerships with media and health sectors for comprehensive outreach, and multi-stakeholder coordination for coherent response planning. However, reliance on manual alerts remains a limitation. There is a shared need for investment in automated, multilingual warning systems as well as reliable digital infrastructure and ongoing community engagement to ensure MHEWS lead to early action.

In Cameroon, the Department of National Meteorology at the Ministry of Transport creates a national weekly multi-hazard meteorological bulletin, which includes warnings for SDS. Written in simple language and accompanied by a map to show where the impact is expected to be greatest, it enables recipients of the bulletin to prepare for the impact of SDS.

Wildfires

Wildfires threaten human life and property and have serious negative impacts on health, economies and ecosystems that reach far beyond the areas of immediate destruction. Early warnings about dangerous conditions can prompt populations and practitioners to take actions that reduce the risk of wildfires starting, spreading or endangering people and property. Forecasting wildfire conditions has improved, reflecting a joint approach that includes not only consideration of high temperatures and lack of rain, but also compounding factors such as windspeed, wind direction and preceding seasonal conditions on vegetation. Early warnings are essential because once a fire has started and is spreading, it can be very challenging to issue timely warnings to affected areas due to a combination of fast-changing conditions, power outages and failure of communication infrastructure.

In January 2025, a combination of climatic factors fuelled intense, fast-spreading wildfires in Los Angeles, killing at least 30 people, displacing more than 200,000 residents and destroying over 18,000 structures.[41] With economic losses estimated between $28-54 billion, it is one of the most costly disasters in California's history (Los Angeles County Economic Development Corporation, 2025). An after-action review found that a series of weaknesses, including among communication, hampered the effectiveness of the response.[42]

Massive fires throughout 2024 drove record-breaking loss of tropical primary forests, destroying ecosystems critical for livelihoods, carbon storage, water provision and biodiversity. Losses were highest in Brazil, followed by Bolivia, the Democratic Republic of Congo, Indonesia and Peru (Goldman, Carter, and Sims, 2025). In June 2025, the Group of Seven (G7) leaders resolved to boost global cooperation to recover from, prevent and fight wildfires through the Kananaskis Wildfire Charter. It includes a pledge to leverage research tools and technology to provide early warnings when wildfire threatens inhabited areas and infrastructure.[43]

Weather and satellite data can enhance EWS through fire danger ratings, providing advance notice of severe conditions days and weeks ahead, and enabling the public and practitioners to detect threats and take early action.[44] Other technologies that are being deployed to improve wildfire EWS include cameras, drones, mobile phone signal movement, remote sensing and mobile Doppler radar.[45] Recently, AI has been employed to visualize wildfire data to facilitate decision-making for wildfire risk reduction (see box 3).

The first Global Fire Management Hub Plenary, based at the Food and Agriculture Organization of the UN (FAO), was held in June 2025 and explored early warning and fire danger rating systems for integrated fire management, among other issues.[46,47]

41 https://www.fire.ca.gov/incidents/2025
42 https://file.lacounty.gov/SDSInter/bos/supdocs/207915.pdf
43 https://g7.canada.ca/en/news-and-media/news/kananaskis-wildfire-charter/
44 https://gfmc.online/gwfews/overview.html
45 https://www.preventionweb.net/news/8-blazing-new-technologies-could-spark-change-wildfire-risk-reduction
46 https://www.fao.org/forestry/firemanagement/fire-hub-plenary-2025/en
47 UNDRR acknowledges the contribution of M. Conceição Colaço from the Centre for Applied Ecology "Prof. Baeta Neves" (CEABN), School of Agriculture within the University of Lisbon, InBIO (Research Network in Biodiversity and Evolutionary Biology) towards the review of this section.

Box 3

Translating data into interactive frameworks: California wildfire case studies using game engine and AI technologies

The data and information needed to determine risk often do exist, but not necessarily in the formats that enable practitioners to translate and use that information to understand risk or inform risk-reduction decision-making. Yet it is essential that scientific data and geospatial information are synthesized into actionable and usable content.

Navteca has been combining two emerging technology areas: immersive visualization using game engines and conversational AI. These technologies are combined to create an interactive visual framework for displaying 3D geospatial wildfire data as it relates to disaster risk and resilience. Both technologies enable humans to interact with data and information naturally and intuitively. In the case of immersive visualizations, while they can be viewed in a virtual reality headset, the more widespread approach is to distribute information as 360° content (images or videos that capture a full spherical view of a scene) using mobile devices, primarily cell phones or on the web.

Additionally, conversational AI – using the Navteca Voice Atlas[48, 49] – enables humans to use natural language rather than keywords and metadata tags to ask about the visualization and find answers to queries, making the data more open and accessible.

Navteca has developed several case studies, supported in part through grants from the National Aeronautics and Space Administration (NASA) Applied Sciences Program, Wildland Fire. These projects leverage previous research to combine the immersive game engine visual interface with data from NASA, the National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS). Meanwhile, the Voice Atlas AI component creates a robust, interactive visualization that utilizes conversational AI to answer questions and provide contextual information about the wildfires at Hermit's Peak[50] (New Mexico), Lahaina[51] (Hawaii), Eaton and Pacific Palisades (California).

The simulations "tell the story" of each wildfire, including modelling of complex wind vectors, smoke plumes, soil moisture, burn severity, fire radiative power, active fire points and others. Several of the immersive 3D visualizations were incorporated into documentaries produced by the Public Broadcasting Service (PBS) to explain the scientific aspect of destructive wind-driven fires in the western United States,[52] and a feature documentary about the devastating Los Angeles fires[53] that occurred in January 2025.

48 https://www.voiceatlas.com/
49 Responsible AI is a set of principles that help guide the design, development, deployment and use of AI – building trust in AI solutions that have the potential to empower organisations and their stakeholders. It involves consideration of the broader societal impact of AI systems and the measures required to align these technologies with stakeholder values, legal standards and ethical principles. Responsible AI aims to embed such ethical principles into AI applications and workflows to mitigate risks and negative outcomes associated with the use of AI, while maximizing positive outcomes.
50 https://www.navteca.com/wildfire.html
51 https://www.navteca.com/lahaina.html
52 https://www.youtube.com/watch?v=_uVdeK2nrrg
53 https://www.youtube.com/watch?v=PiX9t_wovEY

Glacial and related hazards

About 70 per cent of the world's fresh water is stored in glaciers, primarily in the Antarctic and Greenland ice sheets, while the over 275,000 mountain glaciers worldwide together account for less than 1 percent of global fresh water. Climate change is causing a rapid retreat of these glaciers, and 2022 to 2024 has seen the largest three-year loss of glacier mass on record.[54] This not only threatens water security but also poses multiple hazards such as GLOFs, avalanches, landslides, changes to river and sediment flow, and displacement waves when large sections of ice fall into lakes or oceans.

Glacier melting is accelerating due to climate change (Intergovernmental Panel on Climate Change [IPCC], 2021), endangering water security, ecosystems and human settlements downstream. In response, the United Nations launched the Decade of Action for Cryospheric Sciences,[55, 56] which calls for immediate action to monitor glacier loss, improve EWS and climate services in high-mountain regions, and integrate cryosphere risks into national adaptation plans.

Globally, 15 million people are exposed to impacts from potential GLOFs. In the High Mountain Asia region, people are the most exposed and on average live closest to glacial lakes, with approximately 1 million people living within 10 km of a glacial lake (Taylor, and others, 2023). In response, 2025 has been designated the "International Year of Glaciers' Preservation".[57] Coincidentally, the turn of the year saw multiple hazardous glacial events take place.

Despite Nepal housing 21 of the 47 dangerous glacial lakes in the region, only two have functioning EWS, leaving vast areas and communities exposed. The formation of supraglacial lakes and accelerating thermokarst activity further increase risks, yet remain largely unmonitored. GLOFs in the Hindu Kush Himalayan region are intensifying due to climate change, with multiple destructive events occurring within short intervals in the first half of 2025 alone. A major takeaway from this growing pattern of GLOFs is the urgent need for stronger transboundary collaboration on EWS. More attention is needed not only to traditionally-monitored glacial lakes but also to supraglacial lakes and permafrost thaws that increase the instability of mountain slopes, as these are emerging drivers of massive GLOFs. On the community front, EWS must be backed by well-informed local knowledge about safer zones and activities to ensure that communities are equipped to respond.[58]

In northern Juneau, Alaska, a GLOF from the Mendenhall Glacier caused major flooding of homes and roads in August 2024. Although such outbursts have occurred annually since 2011, this event was noteworthy for the amount of water released and because the basin continued to refill with meltwater, with the area experiencing additional releases later in the year. To mitigate the risks of GLOFs in the region, scientists are trying to improve monitoring and forecasting to anticipate future events more accurately.[59]

In eastern Greenland, one of the world's largest ever GLOF occurred, releasing more than 3,000 billion litres of meltwater in two weeks between September and October 2024. Fortunately, no human deaths were reported due to the sparsely populated area. Such an event has never been captured live before, but satellite imagery and favourable conditions enabled scientists to observe, monitor and measure the event in real time.[60]

The Alpine town of Blatten, Switzerland was destroyed in May 2025 when the Birch glacier collapsed and buried the area in ice, water and debris. One resident was reported as missing since the event, while approximately 300 residents were saved due to pre-emptive evacuations. The EWS and early action was praised as a success, yet it was recognized that such systems are not nearly as effective in lower-income countries where glaciers are prevalent.[61] For example, in the Indian Himalayas, the state of Sikkim suffered a GLOF in 2023, which killed 55 people and destroyed a hydropower dam.[62] The Government of India has since approved the National GLOF Risk Mitigation Project, which aims to reduce the risks associated with GLOFs, including by strengthening the early warning and monitoring capacities.[63, 64]

Box 4

Call for actions to improve EWS for glacial-related hazards

Just weeks after the event in Blatten, a special thematic Session on glacial-related hazards and the EW4All initiative was organized by UNDRR, WMO and the Government of Switzerland at the High-level International Conference on Glaciers' Preservation in Dushanbe, Tajikistan.

Participants called for several actions[65] to improve EWS for glacial-related hazards:

- Launch public awareness raising that visually and narratively portrays the escalating risks of glacier-related hazards, emphasizing localized impacts.
- Identify glacier and other cryosphere-related disaster loss data within national loss and risk assessments, in order to drive evidence-based policy, if possible, in a harmonized way that facilitates international data exchanges and comparisons.
- Enhance national risk governance mechanisms by inclusion of glacier hazard expertise and the integration of monitoring into risk management strategies.
- Utilize the EW4All framework to foster broader engagement of governments and stakeholders in addressing glacier-related hazards, ensuring that EWS are duly prioritized and effectively reach vulnerable communities.
- Support developing transboundary EWS within the EW4All at the subregional level, prioritising the collaborative monitoring and dissemination of alerts for glacier-related hazards.
- Initiate a collaborative, multi-stakeholder effort to produce comprehensive global and regional project proposals, outlining actionable strategies and plans for glacier hazard DRR.

54 https://wmo.int/news/media-centre/glacier-melt-will-unleash-avalanche-of-cascading-impacts
55 https://docs.un.org/en/A/RES/78/321
56 https://www.un-cryosphere.org/en
57 https://wmo.int/news/media-centre/unesco-and-wmo-launch-international-year-of-glaciers-preservation-2025
58 https://www.icimod.org/initiative/himap/
59 https://www.climate.gov/news-features/event-tracker/2024-glacial-outburst-flood-near-juneau-sets-record-second-year-row
60 https://news.ku.dk/all_news/2024/12/one-of-worlds-largest-glacier-floods-triggered-in-greenland/
61 https://blogs.egu.eu/divisions/nh/2025/06/11/the-blatten-landslide-in-switzerland/
62 https://www.carbonbrief.org/catastrophic-2023-lake-outburst-in-india-driven-by-glacial-melt-and-permafrost-thaw/
63 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2117268
64 UNDRR acknowledges the contribution of Neera Shrestha Pradhan from the International Centre for Integrated Mountain Development (ICIMOD) towards the review of this section.
65 https://www.undrr.org/news/high-level-call-action-glacier-hazards-and-early-warnings-all

Box 5

Mitigating GLOFs in the Himalayan region

The approach taken by India to mitigate GLOFs in the Indian Himalayan region has shifted from reactive relief to proactive resilience. Catalysed by major GLOF events in 2013 and 2023, the National Disaster Management Authority (NDMA) established the National GLOF Risk Mitigation Programme, anchoring national efforts in scientific evidence, advanced technology and multi-agency collaboration. Through coordinated work under the Committee on Disaster Risk Reduction, the government has created a dynamic risk inventory of 195 high-risk glacial lakes out of a broader set of 28,000 identified in the Himalayas – 7,500 within India. Key milestones include targeted field expeditions to 45 lakes, installation of solar-powered automatic weather stations at sites more than 5,000 m above sea level, and deployment of unmanned aerial vehicles and remote sensing for localized hazard mapping.

From mid-2023 to mid-2025, NDMA has streamlined risk assessments, standardized mitigation frameworks and expanded MHEWS capabilities in high-altitude terrains. Structural solutions like lake drawdowns, bunding and siphoning are complemented by capacity-building through workshops, the development and implementation of emergency protocols and community planning activities. The NDMA's real-time coordination with states and experts encourages operational viability and scientific standards.

Box 6

Volcano EWS workshop

In line with its multi-hazard approach, the EW4All initiative is helping advance multi-disciplinary understanding and application of volcanic hazards, their impacts and EWS. A workshop on Volcano EWS, supported by CREWS, was held in the margins of the International Association of Volcanology and Chemistry of the Earth's Interior in July 2025. It brought together over 100 participants from volcano observatories, national and regional disaster risk agencies, EW4All pillar lead organizations and international organizations as well as scientists and civil society representatives. Recommendations included further integration of the volcanology community within international EWS coordination and legislative governance mechanisms and increased support for cross-pillar engagement of in-country volcano authorities in the development of EW4All or national implementation plans.

Volcanic eruptions

Ten percent of the world's population live in areas susceptible to volcanic eruptions, which can trigger other hazardous events. Small-scale eruptions can present major issues for local communities, while large-scale events can cause disruption across wide areas. In rare cases, extreme events can have climate impacts (Brown, and others, 2017).

In November 2024, eruptions from Mount Lewotobi Laki-laki volcano in Indonesia killed at least 10 people and put more than 10,000 people in temporary shelters. Meanwhile, populations faced flash floods and lahars (dangerous mudflows comprised of volcanic debris). In July 2025, further eruptions prompted evacuations for over 4,000 people, shortages of clean drinking water and flight cancellations.

Volcanic hazard, exposure, vulnerability, and risk assessments have advanced significantly in recent years, driven by progress in probabilistic modelling, remote sensing and interdisciplinary research. Hazard assessments are now better able to capture complex volcanic processes across varying timeframes and spatial scales, providing valuable insights for both emergency response and long-term planning.

However, important gaps remain. Many volcanoes, particularly in low-income countries, lack sufficient monitoring, while historical records are often incomplete, limiting confidence in hazard assessments and maps. While exposure mapping has improved through high-resolution imagery and local data sources, challenges persist in capturing dynamic population movements and understanding systemic interdependencies. Vulnerability assessments in volcanic contexts also remain underdeveloped, with limited data and methodologies for quantifying social, economic and institutional factors.

Promising innovations in monitoring volcanic activity include transdisciplinary approaches by volcanologists and ecologists. These include the use of NASA satellite images to approximate magma-generated carbon dioxide by observing tree leaf colour around volcanoes. Greener tree cover forewarns of an impending eruption at a much longer lead time than conventional methods.[66]

©Shutterstock/Avatas

66 https://www.nasa.gov/earth/natural-disasters/volcanoes/nasa-satellites-provide-early-volcano-warnings/

Recommended reading

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2

Global Status of MHEWS

Image Source: ©WMO/Mika Pakarinen

2. Global Status of MHEWS

This chapter of the report provides a snapshot of the global status of MHEWS, drawing on a range of datasets (see section 1.3.3). The analysis starts with an examination of MHEWS coverage across countries and regions, and then considers the comprehensiveness of MHEWS[67] capabilities through the lens of each of the four MHEWS pillars.[68] Advances in each pillar are then analysed in depth, followed by reflections on cross-cutting topics.

2.1 MHEWS coverage and comprehensiveness

2.1.1 Progress in MHEWS coverage

Global coverage of MHEWS is assessed using the average scores of MHEWS (Sendai Framework indicator G-1), which aggregates scores from the four MHEWS pillars (through indicators G-2 to G-5).[69] Details about monitoring the Sendai Framework in relation to increasing the availability of and access to MHEWS (Target G) are available on the UNDRR website.[70]

The total number of countries reporting the existence of MHEWS[71] has increased each year since 2015, from 56 in 2015, to 119 in 2024 (see figure 2; map 1). This reflects a 113 per cent increase over the past 10 years. Despite the encouraging progress made, close to 40 per cent of countries (76 in total) have not reported having MHEWS.

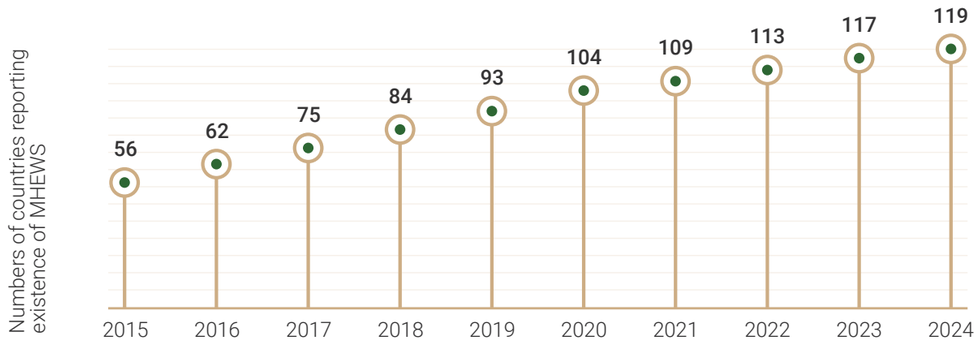


Figure 2. Cumulative number of countries reporting the existence of MHEWS (non-zero score) globally, with 119 countries reporting the existence of MHEWS (i.e. SFM indicator G-1 score greater than zero) (source: SFM, data as of March 2025)

67 The report uses "coverage" to denote the availability of and access to MHEWS in countries", while "comprehensiveness" implies the quality of MHEWS measures through the scores across its four pillars.

68 The four pillars of single EWS and MHEWS were originally proposed in 2006 and remain a central concept, mirrored by the structure of the EW4All initiative.

69 Sendai Framework indicator G-5 aligns with Pillar 1 (disaster risk knowledge), G-2 with Pillar 2 (detection, observation, monitoring, analysis and forecasting of hazards), G-3 with Pillar 3 (warning dissemination and communication), and G-4 with Pillar 4 (preparedness and response capabilities); SFM (www.undrr.org/sfm).

70 https://www.undrr.org/implementing-sendai-framework/monitoring-sendai-framework

71 Using the SFM tools, national governments report against the indicators of the Sendai Framework, including those for Target G. SFM reporting is coordinated by the government institution that is responsible for DRM, with data provided by different ministries, departments and agencies in line with their mandates and areas of expertise. The scores are self-assessed based on the technical guidance provided by UNDRR. Countries may retroactively submit or update the data on the coverage or comprehensiveness of their MHEWS for any given year. Therefore, the increase in the cumulative number of countries reporting the existence of MHEWS (i.e. positive or non-zero scores) can indicate a country either reporting MHEWS capability for the first time, even though it pre-existed, or a recently developed capability.

2.1.1.1 Variations in coverage, by region

The existence of MHEWS increased in every region compared to last year and, for the first time, over half of the countries in each region now report the existence of MHEWS. Coverage still varies by region (see figure 3 and table 2) with Asia and Pacific having the highest coverage of countries with MHEWS in the region, at close to three quarters. This is followed by Arab States (68 per cent), and Europe and Central Asia (64 per cent). MHEWS exist in more than half of the countries in the Africa region now, and also half of the countries in the Americas and Caribbean region, where four new countries have started to report the existence of MHEWS in the last year.

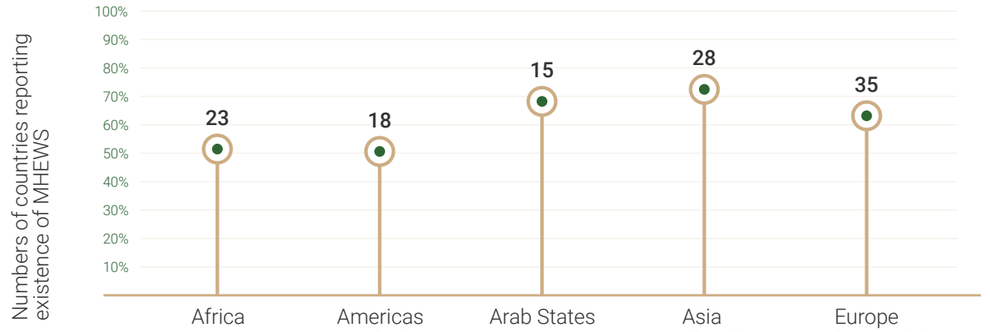
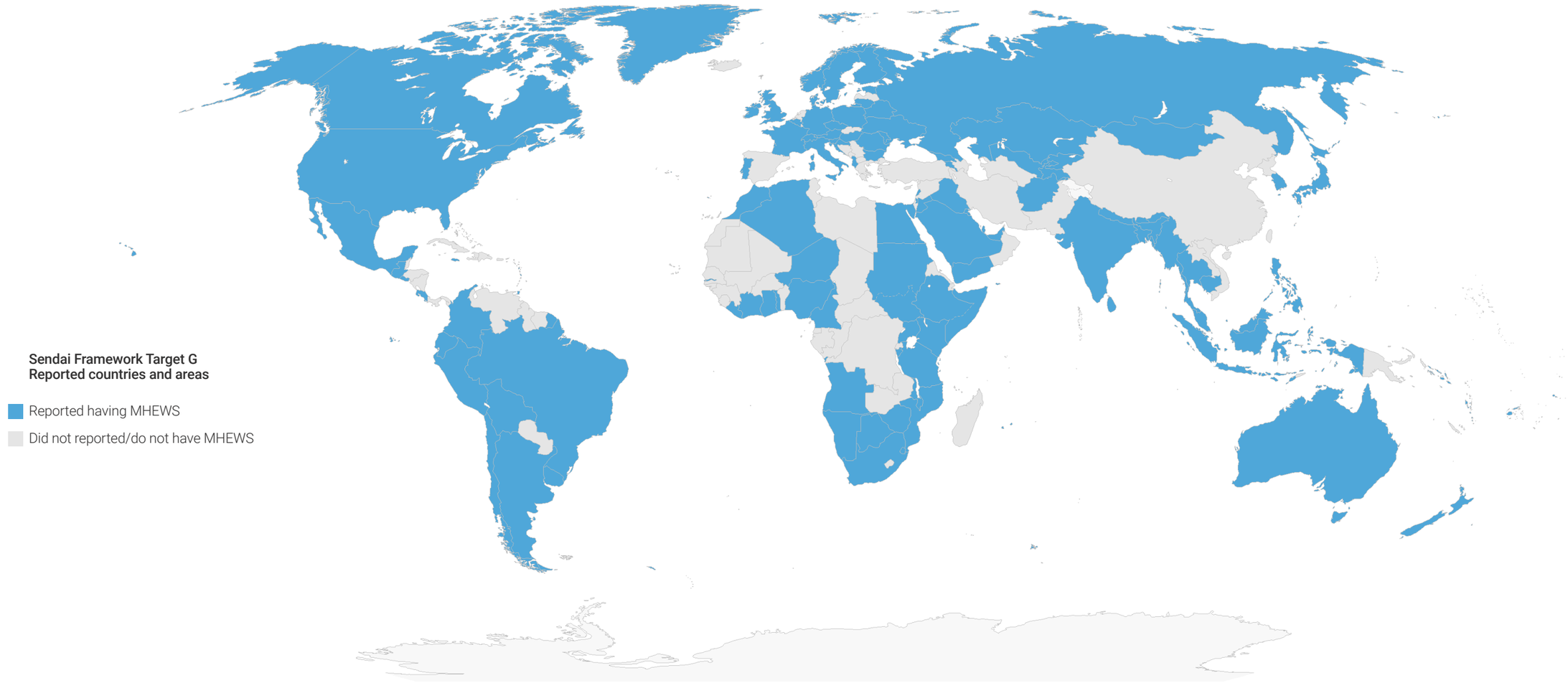


Figure 3. Proportion and number of countries reporting MHEWS by region; bars showing the percentage of reporting countries, numbers within bars showing the number of reporting countries (source: SFM, data as of March 2025)

Map 1. The 119 countries (in blue) that have reported the existence of MHEWS
(i.e. SFM indicator G-1 score greater than zero) (source: SFM, data as of March 2025)



Data source: Sendai Framework Monitor, as of April 2025.

The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.
Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan.
The final status of Jammu and Kashmir has not yet been agreed upon by the parties.
A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

Table 2. Numbers and percentage of countries reporting MHEWS by UNDRR region (source: SFM, data as of March 2025)

UNDRR Regions	Africa	Americas and the Caribbean	Arab States	Asia and Pacific	Europe and Central Asia
Reported having MHEWS (SFM G-1)	23	18	15	28	35
Total number of countries	44	35	22	39	55
Percentage of countries reporting	52%	51%	68%	72%	64%

2.1.1.2 Variations in coverage, by country group

MHEWS are crucial for countries in special situations[72] – Least Developed Countries (LDCs), Small Island Developing States (SIDS), and Landlocked Developing Countries (LLDCs) – because they are disproportionately vulnerable to climate-related disasters and often have limited resources and capacity to cope with the impacts. A large percentage of these countries are also affected by fragility, conflict or violence,[73] making the development and implementation of MHEWS simultaneously more challenging and more important.

The reporting of MHEWS increased by about 5 per cent over the last year for both LDCs and SIDS, continuing the positive trend since monitoring began in 2015. The existence of MHEWS has been reported by 52 per cent of all the LDCs (23 countries). The percentage of LLDCs reporting MHEWS (63 per cent) is higher than that of SIDS (43 per cent, 16 countries) and LDCs, yet remained the same as last year, with a total of 20 countries.

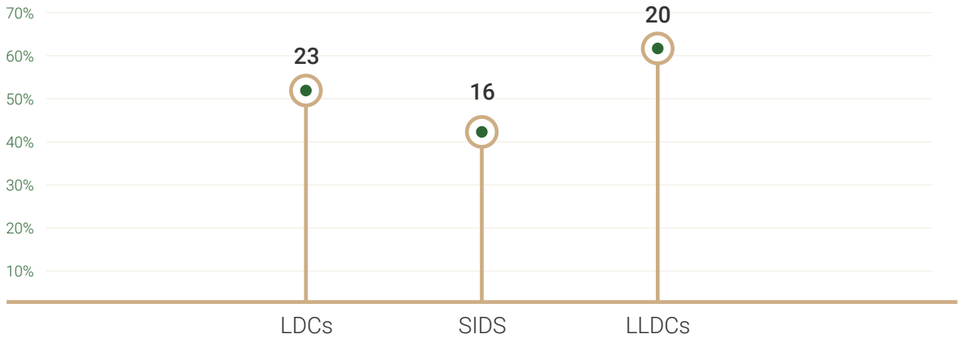


Figure 4. Status of MHEWS in LDCs, SIDS and LLDCs; bars showing percentage, and numbers inside bars showing the number of reporting countries within each country group (source: SFM, data as of March 2025)

72 UNDRR follows the official United Nations Member States designations and memberships of LDCs, LLDCs and SIDS, published by the Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (OHRLLS). Note that in 2024, São Tomé and Príncipe graduated from the LDCs category and, as a result, the total number of LDCs is now 44. Note also that some countries appear in more than one list. List of LDCs: https://www.un.org/ohrlls/content/list-ldcs; list of LLDCs: https://www.un.org/ohrlls/content/list-lldcs; list of SIDS: https://www.un.org/ohrlls/content/list-sids.

73 World Bank Group classification of fragile and conflict-affected situations: https://www.worldbank.org/en/topic/fragilityconflictviolence/brief/classification-of-fragile-and-conflict-affected-situations.

Table 3. Numbers and percentage of LDCs, SIDS and LLDCs with MHEWS (source: SFM, data as of March 2025)

Country group	LDCs	SIDS	LLDCs
Reported having MHEWS (SFM G-1)	23	16	20
Total number of countries	44	37	31
Percentage of countries reporting	52%	43%	63%

2.1.1.3 Variations in coverage, by pillar

There is considerable disparity in coverage among the four MHEWS pillars. Pillar 3 – dissemination and communication – has the greatest coverage globally, with 105 countries indicating some level of coverage for dissemination and communication of warnings. This is up by 3 countries from last year; however, with 119 total countries reporting the existence of MHEWS overall, not every reporting country has the ability to communicate and disseminate early warnings. Given that every pillar – and interconnection – needs to function properly for MHEWS to work, a lack of capability in any pillar means that the effectiveness of the whole "chain" is at risk.

Many countries have reported some capabilities in terms of responding to warnings (Pillar 4), which is the second-most-reported pillar of MHEWS (see figure 5). Fewer countries reported the existence of capabilities for detection, observations, monitoring, analysis and forecasting (Pillar 2), yet the data for Pillar 2 still reveals an improvement, with two additional countries reporting capabilities over the last year. Notably, Pillar 1 continues to trail, with less than a third of all countries reporting having accessible, understandable, usable and relevant disaster risk information and assessment available. Still, this area shows improvement over the last year, increasing from 54 to 56 countries with risk knowledge.

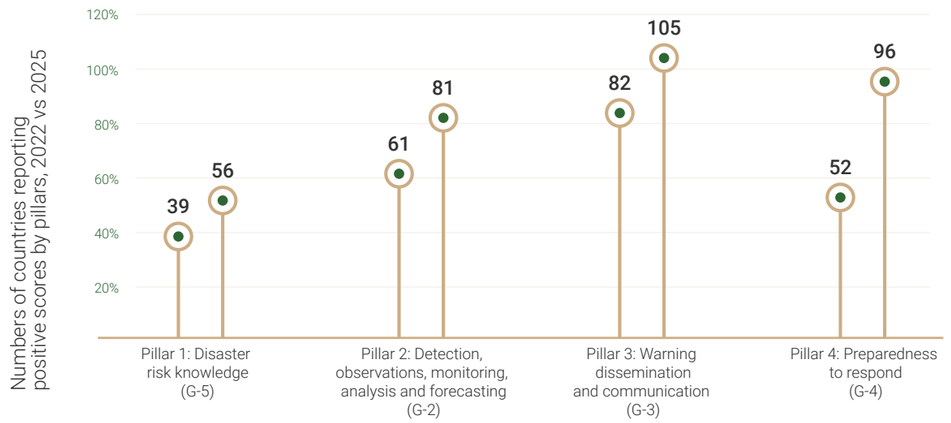


Figure 5. Number of countries reporting positive scores by pillars (G-2 to G-5), comparing 2022 (left bars) and 2025 (right bars) (source: SFM)

Box 7

EWS coverage during conflict: Case study from Sudan

When conflict erupted in Sudan in April 2023, the national weather agency lost nearly all forecasting capability. Staff were displaced, infrastructure was damaged and communication systems collapsed.

The rapid deployment of cloud-hosted infrastructure supported by WMO and CREWS enabled the Sudan Meteorological Authority (SMA) to resume critical operations and disseminate warnings despite the displacement of a substantial portion of its personnel who began working remotely from Port Sudan, Cairo and Nairobi. In August 2024, SMA was able to issue a flood warning through a new website[74] and social media channels, demonstrating that EWS can be operated remotely by staff in exile.[75]

Yet a nationwide study, led by the Sudan Urban Development Think Tank (SUDTT) in late 2024, surveyed over 2,389 households across all 18 states in Sudan and revealed that while 67 per cent faced climate disasters (primarily flooding), only 39 per cent had access to weather information.

The Daraja Sudan Emergency Weather and Early Warning Service was set up at the outset of the conflict to provide forecasts and warnings to affected populations – including farmers, pastoralists and emergency responders – with a focus on humanitarian hotspots to combat the severe food crisis. Led by Resurgence – in partnership with the SMA, SUDTT and the Intergovernmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC) – the initiative convened communities and institutions in co-production workshops to engage openly to build trust and sustained momentum for service delivery under complex operating conditions. Through partnerships with local non-governmental organizations (NGOs) and global aid agencies, Daraja Sudan is set to deliver forecasts and warnings to 24 communities across 7 states through SMS, radio, community networks and other channels.

In 2025, WMO supported training for SMA operational forecasters on severe weather and IBF and early warning services through its Severe Weather Forecasting Programme (SWFP) Eastern Africa and Regional Specialized Meteorological Centres (RSMCs).

Despite the challenging context, early warning early action (EWEA) actors are redesigning and implementing anticipatory action frameworks in Sudan. In November, a localized, child-centred early action protocol was activated in Blue Nile State to address the risks posed by multiple hazards – disease outbreaks/epidemics and flash floods.[76] It was coordinated by Save the Children Sudan and implemented alongside Raise for Development and Humanitarian Aid and SoS Sahel Sudan, with the Ministry of Health, the Ministry of Urban planning and SMA, funded by the German Federal Foreign Office. This is one of just 10 of the listed frameworks that address multiple hazards.[77] Reaching 173,010 people, anticipatory actions included capacity-building, early warning, flood prevention, and interventions relating to health, livestock and gender inclusion. This is one of two active frameworks in Sudan, the other focusing on drought and led by the WFP.[78]

Sudanese stakeholders are also committed to the development of DRR strategies, with a group participating in gender and disability DRR training in November 2024. At the workshop, which was implemented by UNDRR and supported by CREWS, Sudanese participants committed to forming a national working group and advocating for budget allocations supporting inclusive disaster preparedness.[79]

74 https://meteosudan.sd/alerts/

75 https://wmo.int/media/project-update/resilience-and-innovation-advancing-early-warnings-sudan-and-south-sudan

76 https://www.anticipation-hub.org/download/file-4998

77 Of 154 active frameworks in 2024, 10 are focused on multi-hazards: https://www.anticipation-hub.org/download/file-4999.

78 https://www.anticipation-hub.org/download/file-4999

79 Gender-responsive – empowering women and girls, example from Somalia and Sudan: https://crews-initiative.org/reports/annual-report-2024/crews-values-in-action/.

2.1.2 Progress in MHEWS comprehensiveness

The comprehensiveness of MHEWS capabilities in each country is determined from national governments' self-assessments of progress against the four MHEWS pillars.[80]

At the global level, Pillar 3, warning dissemination and communication has the highest score (see figure 6), closely followed by Pillar 2 and Pillar 4, which indicate capabilities that are comprehensive or very nearly so. While there has been an improvement in the scores across all the pillars since reporting began, the score of Pillar 1 (disaster risk knowledge) continues to be the lowest. However, it reflects that the countries that have reported on Pillar 1 have substantial capabilities, on average.

Globally, the average increase was 45 per cent over initial reporting scores, indicating strong and steady progress, with the average of MHEWS capabilities being substantial. In particular, since March 2022, Pillar 1 on disaster risk knowledge has seen a high increase of over 16 per cent, while the other pillars have also seen a marginal increase. Despite notable progress, disaster risk knowledge remains at a lower level compared to other pillars.

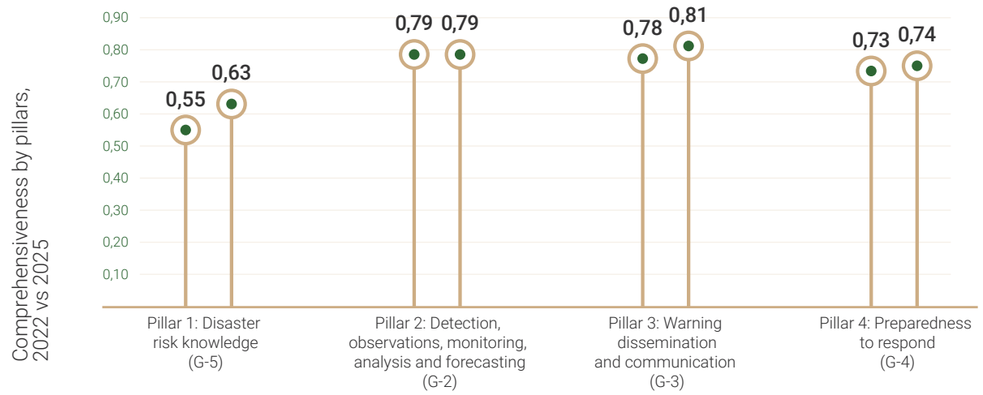


Figure 6. Average comprehensiveness by pillars (G-2 to G-5), comparing 2022 (left bars) and 2025 (right bars), computed for countries that reported for that pillar (source: SFM)

80 In terms of comprehensiveness, a positive score under 0.25 indicates "limited" capability, 0.25 to 0.49 is "moderate", 0.50 to 0.74 is "substantial", and over 0.75 is a "comprehensive" capability. This applies to the scores for MHEWS overall and for the individual pillars.

2.1.2.1 Variations in comprehensiveness by region

As of the end of March 2025, Africa has seen the greatest progress since 2015, with a 72 per cent increase in the comprehensiveness of MHEWS capabilities since national governments reported their initial scores (see footnote 62). This increase brings Africa closer to the global average. The Arab States saw a modest increase of 40 per cent and are now at the high edge of moderate capability.

Since reporting began in 2015, Asia and Pacific region saw the second largest increase in comprehensiveness with an overall MHEWS score (G-1) up by 64 per cent, the highest among all regions. The comprehensiveness of MHEWS capabilities in Europe and Central Asia has improved by about half that amount (29 per cent) in the last decade, closing the gap with Asia and Pacific.

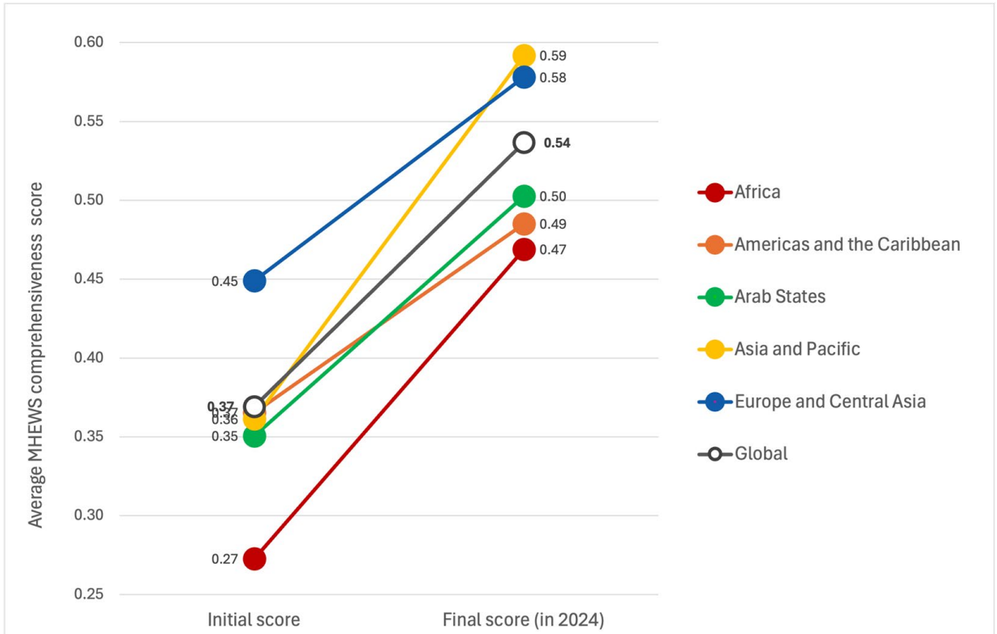


Figure 7. Average initial and final MHEWS (G-1) scores and percentage increase globally and by region, computed for countries as average of all pillars (source: SFM, data as of March 2025)

2.1.2.2 Variations in comprehensiveness by country group

LDCs have seen their overall MHEWS comprehensiveness score (G-1) increase by 95 per cent, from their initial reporting to the latest score held in 2025; however, the final score for LDCs is still the lowest of the three country groups. The improvement in scores for LLDCs is 82 per cent since reporting began. The overall MHEWS score of SIDS increased by a more moderate 53 per cent from the first reporting score to present, but the SIDS started from a more advanced position, and their final score exceeds the global average.

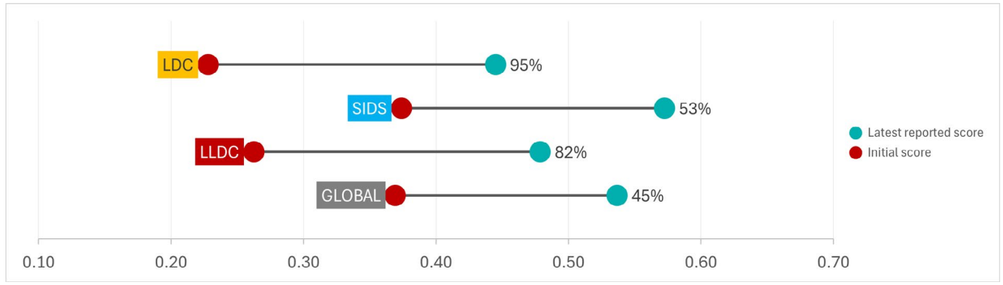
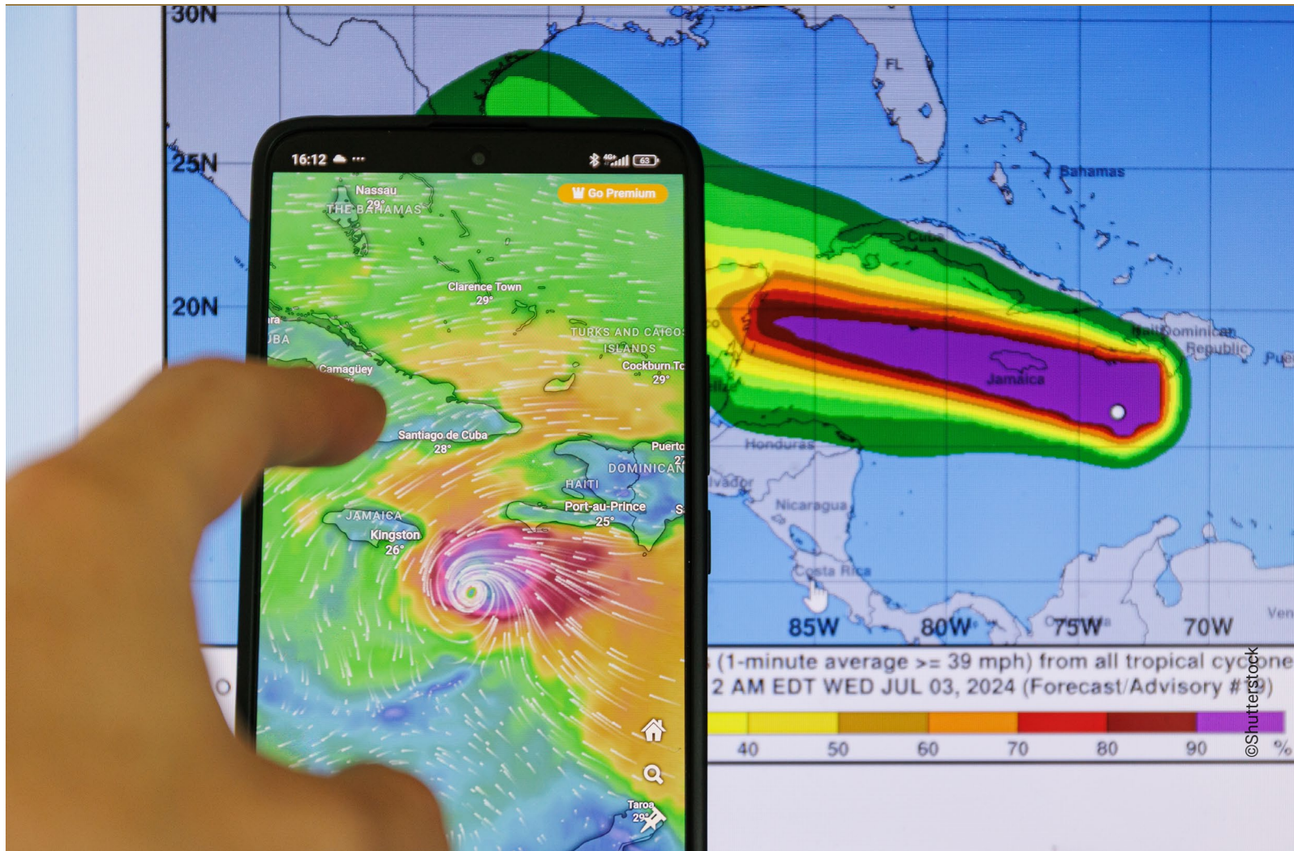


Figure 8. Average initial and final MHEWS (SFM G-1) scores and percent increase globally and by country group, computed for countries as average of the four pillars (source: SFM, data as of March 2025)



2.2 Disaster risk knowledge

Previous reports have indicated a lag in disaster risk knowledge capabilities which, in turn, has increased focus on support for risk knowledge production, access and application. A stronger understanding of capabilities through the indicators tracked under EW4All has also increased the recognition of technical innovations and good practices in this segment of the MHEWS value chain.

Compared to other regions, the Asia-Pacific region has considerably more countries (44 per cent total) reporting having disaster risk knowledge systems. The Europe and Central Asia region and Arab States come in at a distant second with 27 per cent. The Americas and the Caribbean region and the Africa region follow with 23 per cent. However, in the Americas and the Caribbean region, most of the reporting countries have either substantial or comprehensive capabilities to generate accessible, understandable, useable and relevant disaster risk knowledge. In contrast, in the Africa region, no countries are reporting comprehensive systems (i.e. Pillar 1 score reported to be over 0.75).

Only five countries across three regions are reporting having limited Pillar 1 capabilities (i.e. lower than 0.25). While this remains a concern, it is a significant improvement over the past two years. Two regions no longer have countries reporting limited capabilities (Americas and the Caribbean and Arab States). Africa halved the number of countries with limited capabilities (from four to two), and the proportion of countries with limited capabilities in the Asia-Pacific region is down from three to two countries. Within Europe and Central Asia, only one country is reporting limited capability. However, the limited levels of risk knowledge still call for greater investments in improving capabilities – for example, by providing more complete and disaggregated disaster risk information ahead of the onset of hazardous events, to inform decisions that will save lives and minimize impacts.

In addition to the indicators used for G-5 within the Sendai Framework, Pillar 1 of the EW4All initiative tracks capabilities and effectiveness through key processes of risk knowledge: production, access, and application (along with the monitoring and reporting of coverage and effectiveness). Three factors are also considered within these key processes: collaboration, integration of ILK, and the use of technology and innovation. Strengthening the production, accessibility and use of such risk information supports not only preparedness and early action planning but also broader, risk-informed development.

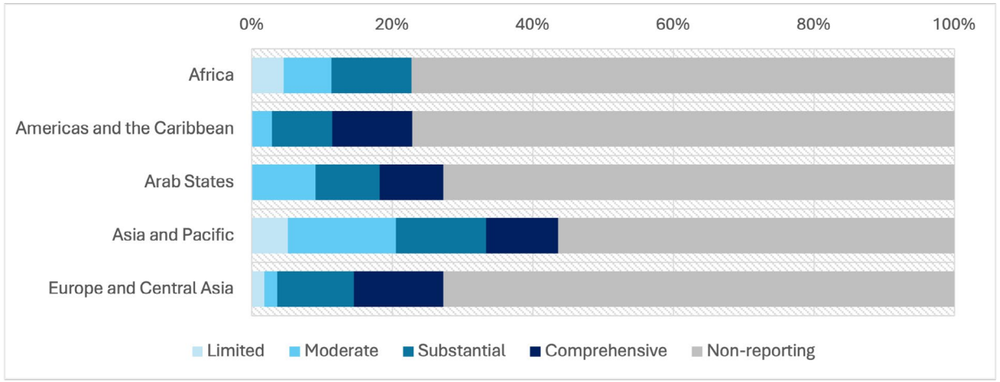


Figure 9. Coverage and comprehensiveness of disaster risk knowledge (Pillar 1, SFM G-5) (source: SFM, data as of March 2025)

2.2.1 Production of disaster risk knowledge

As MHEWS evolve from hazard detection to IBF and anticipatory action, the need for robust, disaggregated and context-specific disaster risk information becomes increasingly critical. Disaster risk knowledge capabilities encompass a range of interrelated components that together support the understanding and use of disaster risk information. These include the systematic collection and analysis of hazard, exposure and vulnerability data; the development of risk assessments that are multi-hazard, dynamic and context-specific; and the integration of traditional, scientific and locally generated knowledge. Equally important are the institutional arrangements that enable coordination among actors, the technical infrastructure for data management and dissemination, and the human and financial resources needed to sustain these efforts.

2.2.1.1. Better data and statistical standards

UNDRR and the International Science Council (ISC) have updated the hazard classifications and the associated Hazard Information Profiles (HIPs) to ensure they remain functional and usable in support of the multi-hazard approach of the Sendai Framework (ISC, and UNDRR, 2025). HIPs provide a common set of hazard definitions for governments and stakeholders to assess risk and monitor hazard impacts, informing DRR and management strategies and actions. From the 302 hazards first published in 2021,[81] the 2025 update has streamlined the list to 281 hazards.[82] This update includes an enhanced section on drivers, a new section on multi-hazard context and revised descriptions of expected outcomes. The multi-hazard context section now highlights the interconnectedness of hazards, and it maps triggers and downstream effects, facilitating better tracking and understanding of cascading and compound events. This reorganization helps practitioners to assess risk and monitor impacts more comprehensively, enabling more effective disaster risk management (DRM) and planning. It also ensures that HIPs remain a robust resource for a wide range of stakeholders, including policymakers, researchers and DRM professionals.

Under the United Nations Statistical Commission, an Inter-Agency and Expert Group has been established to develop a common statistical framework for disaster-related data. Currently under development, the framework will cover key statistical domains such as disaster occurrence, human and economic impacts, and disaster risk drivers, and will promote the integration of these statistics into national statistical systems.[83] It will also encourage the use of the internationally agreed definitions, classifications and methodologies, and will provide guidance on data sources, institutional arrangements and capacity-building strategies. Once in place, the statistical framework will greatly strengthen the quality of disaster-related statistics, especially relevant to the risk knowledge pillar, and enhance the collaboration with national statistical offices on data related to early warnings.

2.2.1.2 Disaster tracking system

Having data relating to hazardous events and disaster impacts is an essential basis for understanding the risks and impacts associated with disasters. To date, 113 countries have reported having some form of system for tracking the impacts of disasters. However, now, *DELTA Resilience*,[84] an enhanced disaster tracking system for hazardous events and associated losses and damages – developed by UNDRR with UNDP and WMO – is available for deployment.[85] *DELTA Resilience* is an open-source system and is both more comprehensive and more interoperable than the existing DesInventar Sendai system.[86] *DELTA Resilience* is offered to United Nations Member States to help them establish their respective country-owned, institutionalized and contextualized national tracking system for losses and damages. The system integrates the WMO methodology for the cataloguing of hazardous events, which enables countries to record and link the hazardous events to the effects they trigger in both vulnerable and exposed systems – whether human or natural.

81 https://www.undrr.org/quick/12955
82 https://www.undrr.org/quick/94808
83 https://www.undrr.org/DRS
84 Disaster and hazardous events, losses and damages tracking and analysis system
85 https://www.undrr.org/L-DTracking
86 https://www.DesInventar.net

The country-focused toolkit includes resources to diagnose data ecosystem maturity to address persistent challenges spanning the methodological evolution of loss and damage and impact assessments. The toolkit also includes advice on the interoperability of systems, data governance and how their use can be institutionalized. Further, guidance is offered on identifying pathways and concrete actions to support sustainability and enable democratized access to technological innovation in digital and data technologies.

DELTA Resilience supports new and traditional use cases, including MHEWS. UNDRR has published a review of existing applications and use cases to explore how improved loss and damage data collection and management could support better decision-making and inform development planning, climate change adaptation and DRR (UNDRR, 2025a). The published analysis is complemented by a live repository of case studies showcasing application areas and country examples.[87]

In May 2025, WMO published the Drought Impact Monitoring: Baseline Review of Practices report as part of the Integrated Drought Management Programme. The report outlines operational guidelines to help countries establish or refine their drought monitoring systems, and it encourages cross-sector collaboration, open databases and tools to improve data accessibility, and tailored systems that can be adapted to local needs.

2.2.1.3 Innovation and technology for advancing risk knowledge

At COP29 in Baku, the United Nations Framework Convention on Climate Change (UNFCCC) Technology Executive Committee (TEC) and GEO launched the policy brief, Realising Early Warnings for All: Innovation and Technology in Support of Risk-Informed Climate Resilience Policy and Action. The brief aims to highlight the transformative role of technologies – from Earth observation satellites, to the use of mobile networks and AI – in supporting global climate resilience and disaster preparedness efforts through MHEWS (UNFCCC, and GEO, 2024).

The policy brief underscores the need to mainstream MHEWS across national planning frameworks – such as NDCs, NAPs and technology needs assessments – while calling for increased investment in interoperable technologies that address multiple risks. It emphasized the importance of global cooperation through international initiatives and public–private partnerships, alongside the promotion of community-driven innovation embedded in local projects. To ensure inclusive and sustained impact, the brief advocated for building technical capacity in developing countries and leveraging global scientific expertise to shape data-informed, forward-looking resilience strategies.

TEC has since emphasized the importance of integrating technologies into projects to enhance local stakeholder engagement. This integration should ensure that both low- and high-tech solutions support the generation and use of risk knowledge for MHEWS by the local communities, including Indigenous people and youth.

2.2.1.4 Indigenous and local knowledge

The systematic integration of ILK into risk knowledge production is still the exception rather than the norm. While there are good examples of the application of ILK within MHEWS for various hazards across the world, these have been mostly isolated cases or anecdotal model practices from project interventions. However, there are a handful of countries that have begun to institutionalize the integration of ILK within DRR frameworks and climate change adaptation plans – often through laws, policies or government-mandated programmes and services.

In the Philippines, the importance of ILK systems is explicitly acknowledged in its DRR policy and plan. This is not only established at the national level but has trickled down to some local government units that have ordinances requiring the inclusion of ILK in village-level risk assessments. This has led the hydrometeorology and geological services to partner with communities to validate traditional signs for hazards such as flooding and earthquakes (Morath, and others, 2021).

In New Zealand, the Resource Management Act mandates consideration of Māori perspectives and knowledge in environmental risk decisions. Te Ao Māori (Māori worldviews) are formally integrated into disaster planning via agencies like the National Emergency Management Agency (Rout, and others, 2024).

In Kenya, the National Drought Management Authority has institutionalized Indigenous early warning indicators – such as livestock behaviour and plant phenology – as part of the national drought monitoring system (Konrad-Adenauer-Stiftungand UoN-ADIS, 2016).

In Vanuatu, traditional knowledge is being integrated into contemporary technologies such as the ClimateWatch app. Local civil society organizations are using the app alongside provincial traditional knowledge calendars to collect valuable environmental data. Through this initiative, communities systematically document and monitor traditional indicators – including animal behaviour, plant changes and celestial signs – to enhance MHEWS capabilities.

Even where ILK is being integrated, its contribution to risk knowledge production is not yet given proportionate consideration in the knowledge-building systems, nor in either policy or funding decisions. There is still a lack of standardized methods for documenting and validating ILK across sectors, which further inhibits systematic tracking of its usefulness in MHEWS. This suggests a gap that might be the focus of future research for multidisciplinary teams with the aim of developing best practice guidance for countries to use when coproducing – co-designing, developing and implementing – effective MHEWS with their local communities and technical experts.

87 https://www.undrr.org/building-risk-knowledge/disaster-data

Box 8

Guidance and tools to strengthen risk knowledge capacities for MHEWS[88]

Training curricula: For multi-hazard risk assessment
The multi-hazard risk assessment (MHRA) training is designed to strengthen national capacities for developing risk profiles that are essential for early warning early action (EWEA). It begins with a three-day in-person workshop engaging up to 25 stakeholders, including technical experts and decision-makers, to introduce key concepts of MHRA. Building on this foundation, an intensive 8- to 10-week virtual training course is provided for 10 technical professionals with GIS experience. The virtual training covers advanced methods and tools for hazard modelling and risk analysis using freely available data and open-source software. The programme culminates in a final project, enabling participants to apply skills in developing national-level products (i.e. hazard, exposure, vulnerability and risk maps) to inform early warning and preparedness planning.

Technical guidance note and toolkit: Data Ecosystem Maturity Assessment Framework
Effective governance of risk and disaster data is crucial for DRR and MHEWS applications. To support this, a Data Ecosystem Maturity Assessment Framework has been developed, providing countries with a structured, holistic tool to diagnose and characterize the strengths and gaps in their national data ecosystems. The framework examines dimensions such as data governance, data value chains, stakeholder roles, infrastructure interoperability, and the alignment of data supply with evolving user needs and demands. It enables countries to evaluate their current state and identify ways for advancing through five maturity levels – from fragmented, ad hoc systems to fully integrated, state-of-the-art data ecosystems. The resource package includes a technical guidance note that outlines the framework's conceptual foundations and maturity levels, and a comprehensive toolkit that contains a pre-assessment guide, self-assessment process and guidance for post-assessment consolidation.

Technical guidance note: Exposure and vulnerability indicators
A technical guidance note has been developed to support countries in selecting hazard- and sector-specific exposure and vulnerability indicators that are essential for strengthening their EWEA systems. This resource package comprises two components. One is a conceptual guidance document that defines exposure and vulnerability and outlines the processes for selecting, ranking, weighting, aggregating, and quality-checking indicators. The other is an extensive bank of indicators, consolidated from established sources such as the Index for Risk Management (INFORM)[89] (see section 2.2.2.2) and the World Risk Index.[90]

Guidance on indicator selection is crucial as it enables countries to build risk assessments based on context-specific, reliable data, ensuring EWEA mechanisms are timely, targeted, and effective in reducing disaster impacts. Following the Methods for the Improvement of Vulnerability Assessment in Europe (MOVE) framework, the guidance note defines vulnerability as the susceptibility and fragility of societies to hazards, and is shaped by physical, ecological, social, economic, cultural, and institutional factors. It is assessed alongside capacities to anticipate, cope, and recover from disasters, highlighting both risks and resilience of communities.

Technical note: Cataloguing landslide hazardous events to better track associated impacts
This technical note aims to improve the cataloguing and impact recording of landslides. It provides insights for national organizations responsible for collecting and storing information on landslide occurrences and impacts. The note presents an efficient and feasible reporting framework that can be used to characterize and evaluate landslide databases in a coherent and consistent manner across countries.

88 https://www.undrr.org/building-risk-knowledge/early-warnings-for-all-risk-knowledge-resource-package
89 https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk
90 https://data.humdata.org/dataset/worldriskindex

2.2.2 Access to disaster risk knowledge

Enhancing access to disaster risk information and knowledge by all relevant actors is a priority intervention in MHEWS, with growing investment in risk information platforms, data-sharing networks and data collaboration initiatives. Improvements in disaster risk data management, sharing and access are supported by interactive tools and portals. Efforts to promote joint learning and the exchange of good practices have also gained increased attention, contributing to a broader base of shared knowledge. Efforts continue to ensure that knowledge platforms enable practitioners to create inclusive, accessible MHEWS for women, persons with disabilities and other marginalized groups, such as people with different levels of literacy or who speak non-dominant languages. This highlights the critical importance of designing platforms and processes that are responsive to, and inclusive of, diverse user needs.

2.2.2.1 Information and knowledge-sharing platforms and networks

The Asian and Pacific Centre for the Development of Disaster Information Management (APDIM) conducted an assessment of the current capacities, available services and needs for disaster risk information and risk data management in the Asia-Pacific region (APDIM, 2020) The analysis provides insights into the characteristics that a successful risk data-management platform should include. For example, it should offer standard-format datasets with sufficient metadata, clear licensing terms, a permanent URL and application programming interfaces (API) to enable the automatic transfer of data to other systems, including smartphone applications. The platforms should also be actively managed with regular updates and should be easy to navigate.

Several online platforms have been established to support data management and risk intelligence. Platforms, such as those in table 4, serve as shared data portals and decision-support systems that can have regional- and national-level instances customized to and managed by regional groups or countries themselves. While many countries typically develop their own risk intelligence systems, adopting or building upon proprietary technologies that have ready-made architectures, tested methodologies and sustained technical support from technology solutions providers has enabled more developing countries to catch up and accelerate the development of their EWS capabilities.

The Index for Risk Management (INFORM)[91] is a joint initiative of the Inter-Agency Standing Committee, the European Commission, and humanitarian and development organizations worldwide. The initiative has developed a suite of quantitative, analytical tools to support decision-making on humanitarian crises and disasters. INFORM Warning is an example of a tool that is in development which will "present reliable, quantified, multi-hazard information that warns about risk trends, forecasts, scenarios and events that could lead to crisis impacts in the next 12 months".92 The tool will be designed to complement the INFORM suite of analytical tools, which include INFORM Risk, INFORM Severity and INFORM Climate Change.

91 https://drmkc.jrc.ec.europa.eu/inform-index/
92 https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Warning

Table 4. Online platforms for data management and risk intelligence

Platform name	Creator/host organization	Countries/regions served	Link
DisasterAWARE	Pacific Disaster Center (PDC)	Asia-Pacific, Latin America, the Caribbean, parts of Africa and globally	pdc.org/disasteraware
Caribbean Risk Information System (CRIS)	Caribbean Disaster Emergency Management Agency (CDEMA)	Twenty Caribbean nations	cdema.org/cris
myDEWETRA-VOLTALARM	Italian Civil Protection Department, and partners	West Africa (Volta basin countries), Ethiopia and other African nations	mydewetra.world/ https://www.floodmanagement.info/three-day-training-workshop-on-mydewetra-voltalarm-ews-for-the-volta-basin-countries/
Disaster Risk Management Knowledge Centre (DRMKC)	European Commission Joint Research Centre (JRC)	European Union Member States and neighbouring countries	drmkc.jrc.ec.europa.eu
East Africa Hazards Watch	WMO	Africa (East Africa/ Greater Horn of Africa)	eahazardswatch.icpac.net/

Box 9

Incorporating exposure and vulnerability data to improve disaster risk knowledge and provide impact-based early warnings for flood and drought: Case studies from Ethiopia and Kenya

Existing hazard-based EWS do not always incorporate exposure and vulnerability data or provide impact-based information. In Kenya and Ethiopia, the EarlyWarning4IGAD project is piloting an approach for impact-based early warning for floods, concentrating on the impacts on crops and subsistence farmers, with the focus being on the impacts on people and drought. UNDRR commissioned the United Nations University (UNU) and partners to develop risk models for the flood and drought IBF pilots in Kenya and Ethiopia.

The project is being implemented using the East Africa Hazards Watch.[93] Enhanced data-sharing and risk analysis enabled by the platform will help emergency responders to identify vulnerable populations, support early flood evacuation, improve drought impact monitoring for agricultural decision-making, and strengthen coordination among governments and stakeholders to safeguard lives, food security and infrastructure.

Results will be validated by the NMHSs and national DRM communities of the IGAD Member States together with representatives from the humanitarian sector, the agricultural sector, policymakers' research, and academia.

Constraints on data at the national and regional level can be addressed by utilising global datasets to cover gaps in national datasets, with validation at the sub-county level (in Kenya) as far as practicable. Collaboration among partners can help advance their respective capacity for finding data sources and following procedures such as data cleaning and quality control.

93 https://eahazardswatch.icpac.net/mapviewer/

The application of disaster risk knowledge to support IBF, anticipatory action, early action planning, disaster preparedness and risk-informed development planning is steadily advancing and enabling more timely and targeted interventions. However, the consistent and systematic application of risk knowledge across sectors and levels remains uneven, potentially due to a lack of governance structures in some countries. These disparities underscore the need for continued capacity-building, coordination and innovation.

Box 10

A prototype hazard index to improve risk knowledge for displacement contexts, integrating data on multiple hazards: A case study

Globally, especially in Africa, climate change is exacerbating the hardships and risks of displaced people and host communities, especially in fragile and conflict-affected areas. This is due to increased exposure to extreme weather, limited access to climate-resilient services, and EWS being rendered inadequate for addressing cascading crises and repeated displacement.

The Consultative Group on International Agricultural Research (CGIAR) and the United Nations High Commissioner for Refugees (UNHCR) co-developed a prototype for a climate- and conflict-informed hazard index tailored to displacement contexts. The index integrates heat, drought, flood and conflict variables to enable multi-dimensional risk analysis and better assessment of the compounded impacts on vulnerable populations. The partnership has made progress on early and targeted interventions for at-risk communities by informing UNHCR's contingency planning, site risk screening and programme targeting in Africa. It has also supported the provision of climate risk insurance in refugee settlements, informed United Nations Security Council briefings, and shaped global dialogues at the Global Refugee Forum and Africa Climate Summit as well as through UNFCCC processes.

Box 11

Disaster loss and damage data assessment with multiple stakeholders: A case study from Timor-Leste

Timor-Leste – an LDC and SIDS – faces climate-exacerbated hazards like droughts, floods and landslides. This is compounded by limited technical, financial, and human capacity; weak disaster data systems; and gaps in coordination, risk information, and inclusive MHEWS for vulnerable populations.

UNDRR, with support from Portugal, led a comprehensive assessment of disaster loss and damage data-collection practices, involving over 50 stakeholders from both government and non-government sectors. Outcomes included the development of standard operating procedures, methodologies, guidelines and training for officials from the Civil Protection Authority.

The result of the assessment informed a methodology and procedural guidance for improved accounting for disaster loss and damage. This was applied in capacity strengthening work with the national government, with support from CREWS through its Accelerated Support Window (ASW).

Learning suggests that inter-agency and interministerial coordination takes sustained and dedicated effort and that active participation from vulnerable groups should be standard practice for equitable disaster preparedness.

2.3 Detection, observations, monitoring, analysis and forecasting

The second pillar of MHEWS focuses on observations and monitoring, and it is critical for enhancing preparedness. Of the 119 countries reporting the existence of MHEWS, over two thirds have reported on this pillar, with an average score of 0.79, indicating comprehensive capabilities (see figure 10).

Nearly 60 per cent of countries in the Asia and Pacific region report capabilities for detection, observations, monitoring, analysis and forecasting (Pillar 2), with about two thirds of these countries reporting comprehensive coverage. Arab States report the second highest coverage at 45 per cent, notably with all countries reporting substantial or comprehensive coverage. The other three regions report similar coverage at close to 35 per cent. It is noticeable that for all the countries reporting the capabilities in detection, observations, monitoring, analysis and forecasting (Pillar 2), two thirds of these countries (53 out of 81 countries) have assessed their capabilities as comprehensive, and with a high percentage (27 per cent) of moderate and substantial capabilities. Only six countries indicated limited capabilities for Pillar 2, four of which are LDCs.

In the last year, concerted efforts have driven substantial progress on detection, observations, monitoring, analysis and forecasting. Pillar 2 saw encouraging momentum in both reach and scale. However, major gaps in capacity and access persist – particularly among LDCs and SIDS and especially in the Africa region and the Americas and the Caribbean – reinforcing the urgency of continued investment, coordination and innovation.

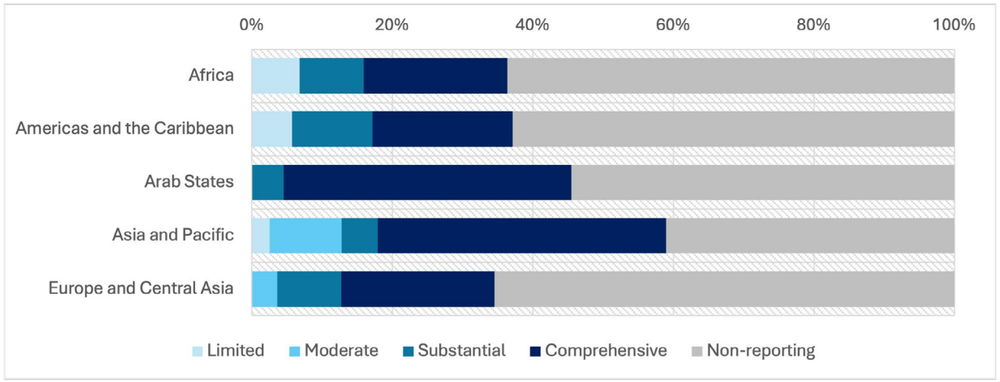


Figure 10. Coverage and comprehensiveness of detection, observations, monitoring, analysis and forecasting (Pillar 2, SFM Indicator G-2) by region (source: SFM, data as of March 2025)

2.3.1 Detection, observations and monitoring

2.3.1.1 Observational infrastructure

The Global Basic Observing Network (GBON), which sets mandatory requirements for spatial and temporal coverage of surface and upper-air stations, continues to serve as the definition of the observational infrastructure needed to support accurate and timely forecasts. As of the second quarter of 2025, just 18 WMO Members – roughly 10 per cent – achieved full compliance with GBON requirements across both surface and upper-air observations. When disaggregated, 29 per cent of Members met standards for surface-based observations, while 12 per cent fulfilled upper-air criteria. No LDC had reached full compliance, consistent with data from the previous year. However, the total number of GBON-compliant stations operating in LDCs rose over two-fold, from 21 in May 2023 to 71 by May 2025, indicating meaningful progress in enhancing foundational capacity in vulnerable contexts.

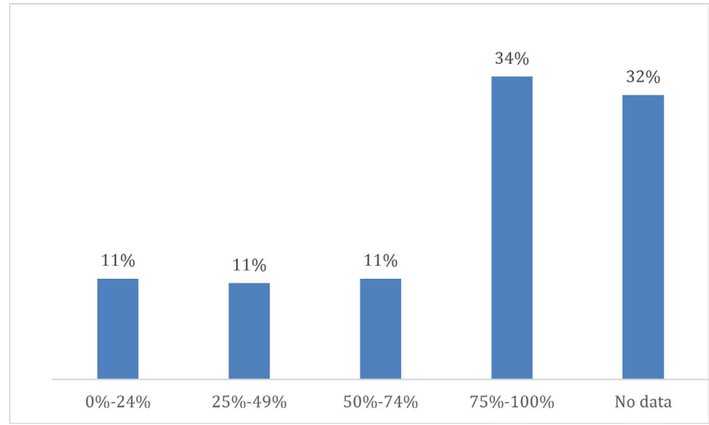


Figure 11. Percentage of National Meteorological and Hydrological Services (NMHSs) observing network automation

Automating observational stations is critical to delivering early warning, as it improves data quality, frequency, and timeliness, while simultaneously reducing operational burdens and enabling broader, more efficient network coverage. Significant progress has been made in this respect through the adoption of Automatic Weather Systems (AWS). As of June 2025, one third of WMO Members have automated their infrastructure networks (i.e. more than 75 per cent of their observing stations). AWS enable more frequent measurements, including continuous night-time observations – an important step towards achieving GBON compliance – while reducing the labour intensity of network operations and cost-effectively expanding coverage and efficiency.

Driving much of this advancement is the Systematic Observations Financing Facility (SOFF), which continued to scale its "readiness" and "investment" phases across an expanding number of countries (see section 2.6.4 and section 4.1.2). SOFF – alongside other interventions, which include the installation and improvement of hydrometeorological infrastructure – is actively enabling countries to establish GBON-compliant observation stations and integrate them into the global data exchange system through the WMO Integrated Global Observing System (WIGOS). Among those countries that have completed their readiness work, in total, 60 GBON National Gap Analyses, 47 National GBON Contribution Plans, and 56 Country Hydrometeorological Diagnostics have been finalized. These outputs are helping countries articulate their needs, build investment pipelines and engage with development partners and donors more effectively. The progress made is evidenced in a landmark study[94] by the European Centre for Medium-Range Weather Forecasts (ECMWF) in 2025, which provides the strongest scientific evidence to date that investments in data gaps in the global observing system dramatically improve forecast accuracy, both locally and globally.

94 https://www.ecmwf.int/en/about/media-centre/news/2025/impact-experiments-support-initiative-more-weather-observations

2.3.1.2 Data exchange

In 2025, the WMO Information System (WIS) 2.0 entered its operational phase, marking a historic milestone in global data sharing and initiating the replacement of the Global Telecommunication System, which had served as the backbone for WMO weather data exchange since 1971. WIS 2.0 is a cloud-ready, open-standards framework using Internet of Things (IoT) technologies to share real-time atmospheric, oceanic, hydrological and cryospheric data, as well as other environmental observations. Its cloud design removes the need for costly infrastructure, enabling LDCs and SIDS to fully join global data exchange. This rich flow of high-quality observational data underpins reliable forecasts and timely warnings that protect lives and livelihoods. The system's global infrastructure – operated jointly by 11 countries – ensures efficient access, seamless sharing and continuous monitoring around the globe.

There is good progress on WIS 2.0 implementation thanks to on-the-ground capacity development and tailored support. The open-source WIS 2.0 in a box (WIS2Box) software developed by WMO offers a simple and low-cost solution for establishing a WIS 2.0 node to connect and operate within the upgraded global data exchange. Adoption of WIS 2.0 has grown rapidly – the number of WMO Members sharing data via WIS 2.0 has more than doubled, from 30 in 2023 during its pre-operational phase to 67 by mid-2025, representing one third of the membership of WMO. Still, more resources are required to help NMHSs in low-income countries cross the digital divide and enable the modernization of their operations and services to protect lives and livelihoods.

Robust Internet connectivity is a critical enabler for NMHS operations, including WIS 2.0, data exchange, system integration and forecast production. Yet about one-fifth of WMO Members operate with unstable connections, experiencing frequent outages and large bandwidth fluctuations that prevent reliable access to external data and products. Of these 37 Members, 30 are LDCs, SIDS or LLDCs. Low bandwidth and connectivity limit the capacity of data exchange and the operational use of online resources in forecast production, underscoring the urgency of closing the digital divide.

Despite these challenges, WIS 2.0 is quickly enhancing the capabilities of NMHSs and plays a key role in enabling EW4All and robust MHEWS. By expanding access to timely, high-quality observation data, it strengthens countries' abilities to deliver timely, actionable and life-saving information to communities at risk, thereby strengthening resilience to extreme weather and climate-related hazards worldwide.

2.3.1.3 Implementation challenges

The sustainable financing of observation data collection and sharing, especially across institutions and ministries, remains a challenge to MHEWS implementation. While investments in observation hardware – including installation and operational acceptance – help countries to achieve GBON compliance, the benefits of GBON are only achieved if the ongoing costs of operations and maintenance are met, enabling data collection and sharing to be sustained. Although national governments might be expected to meet these ongoing running costs, this is not always possible. SOFF addresses this by contributing to operational costs subject to sustained data exchange. However, other financial mechanisms may not be able to fund this expenditure or the training required to ensure that new equipment is used to its full potential. This challenge can be overcome through coordination between development partners with different funding models and by some projects or programmes recognizing that countries may need additional financial support to sustain operations, especially in the first years. The benefits obtained from the continued operation of observing networks – at all levels, local to global – are seen to provide the evidence that NMHSs need to make the case for increased operational budgets and the transition to a sustainable model.

Institutional arrangements present another challenge. While national legislation often gives NMHSs broad authority to monitor, forecast and issue warnings, the precise division of roles and responsibilities across agencies is often unclear. Just over half of WMO Members (54 per cent) have adopted a law, decree or similar instrument addressing MHEWS, yet only about a third (35 per cent) set out comprehensive mandates that clearly define institutional responsibilities for generating and disseminating warnings across hazards. Effective forecasting in a multi-hazard context requires integration across the whole Earth system – including meteorological, hydrological, marine and coastal data. However, these responsibilities are often fragmented, which makes effective coordination challenging. For example, in many countries, the provision of meteorological and hydrological services is often separated into different institutions and may also be hosted by different ministries. Addressing this will require national reforms to enable routine and reciprocal operational data exchange across ministries and sectors. The development and institutionalization of open data-sharing frameworks must be a top priority to unlock the full potential of IBF and integrated MHEWS.

2.3.2 Analysis and forecasting systems and approaches

2.3.2.1 Prediction systems and forecasting services

In order for all NMHSs to reliably issue forecasts and warnings, it is essential that they have access to the forecast products that underpin them. To this end, the WMO Integrated Processing and Prediction System (WIPPS) – which consists of over 150 operational numerical prediction centres – provides WMO Members and partner organizations with essential products and services for weather, climate, hydrology, ocean and environmental applications.

Progress has been made in this space with 76 per cent of WMO Members using forecasts and data from WIPPS centres to support the delivery of their operational services. This widespread uptake highlights the vital role of WIPPS in strengthening operational forecasting and related services across weather, climate and hydrology. The WMO-SWFP makes efficient use of the WIPPS Designated Centres to provide severe weather forecasting products and guidance to NMHSs worldwide. In 2025, SWFP reached 85 Members, up from 82 the previous year, and plans to reach 13 more countries – possibly by the end of 2025 – through new Regional Forecast Support Centres (RFSC) in the South-East Asia-Oceania and Central America subregions. In 2025, over 80 operational forecasters from NMHSs of WMO Members in East Africa, Horn of Africa, West Africa, Central Africa, South-East Asia and the Caribbean were trained through specialized SWFP training workshops on the interpretation and use of products available from the relevant WIPPS centres contributing to SWFP.

NMHSs are further strengthening their operational capacity to use WIPPS centres' data and products: as of the first quarter of 2025, 91 Members (47 per cent) reported having an integrated system for analysis, weather forecasting and visualization. This represents a modest increase from 86 the year before. The gap among LDCs and SIDS remains substantial: only 27 per cent of countries in these groups had such systems, while 37 per cent lacked them entirely, and data remained unavailable for 36 per cent.

2.3.2.2 Impact-based forecasting for early warning services

Early warning services are a core function of NMHSs, providing timely alerts that help safeguard lives, livelihoods and property from hazardous weather, climate and water-related events. Some NMHSs also provide warnings of geophysical events. In effect, the vast majority of WMO Members deliver early warning services (see figure 12).

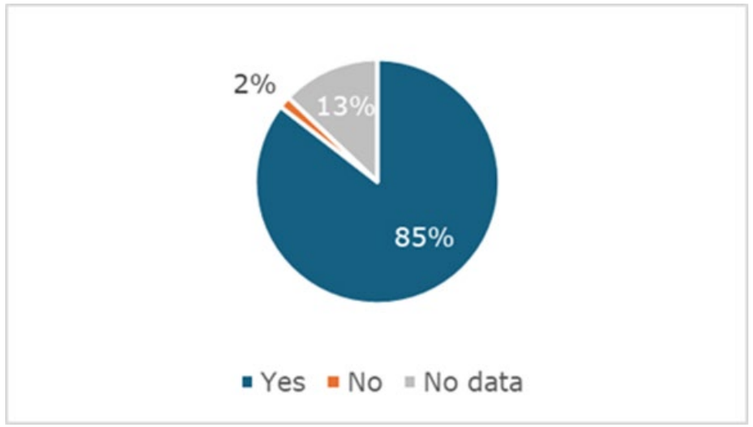


Figure 12. Percentage of NMHSs providing early warning services (source: WMO)

By monitoring evolving threats, assessing potential impacts and delivering actionable information, NMHSs serve as the backbone of national DRR. Their role is central to advancing the objectives of the EW4All initiative, ensuring that warnings are timely and trusted and that they effectively reach those at risk.

In this context, IBF represents a paradigm shift where forecasters draw upon risk knowledge (from a range of stakeholders, including sector experts) to predict not just "what the weather will be" but "what the weather will do". It is an important component of a multi-hazard approach, noting that the impact of a hazard is a function of dynamic changes to vulnerability and exposure that may result from compounding and cascading hazards or other events, such as conflict or displacement.

However, the very nature of IBF means that implementing it presents a multidimensional challenge. It requires NMHSs to be equipped with trained forecasters and context-specific modelling tools, as well as advanced software and hardware systems. In addition, IBF depends on access to detailed datasets – such as historical information on disaster impacts and hazardous events, exposure profiles and vulnerability maps – that are often held outside the meteorological community. Yet cooperation between national agencies remains weak, and decision-support tools are lacking in many countries. Indeed, the Hydromet Gap Report 2024 found that in half of the countries assessed, NMHSs receive no observational data from other institutions, and in the other half, data sharing is partial or infrequent at best. The absence of integrated data-sharing policies limits the ability of NMHSs to generate timely and location-specific warnings based on expected impacts. IBF is also most effective when local populations and other users are involved in IBF processes from the outset, defining what kind of impacts are most relevant and useful for their own decision-making. This approach is consistent with best practice for people-centred MHEWS (see section 2.6.2.1).

Part of the data-related challenges in IBF can be addressed by enhancing collaboration between the entities that are responsive for the first two MHEWS pillars, among others. However, aside from data sharing, there are also gaps in IBF capabilities. According to data from Pillar 2 Rapid Assessments published on the EW4All Dashboard, the majority of the countries that were surveyed up until June 2025 continue to exhibit weak or non-existent IBF capabilities. Out of 59 countries assessed in relation to EW4All Pillar 2,[95] 43 have IBF readiness of less than 21 per cent, 10 have limited capabilities and six have partial capabilities.

2.3.2.3 WMO Coordination Mechanism

The WMO Coordination Mechanism (WCM) makes an important contribution by supporting crisis-prone and conflict-affected regions with timely expert advice and situational awareness. WCM provides co-designed and tailored solutions for United Nations and humanitarian agencies to curate authoritative weather, climate, and water information from WMO Members and RSMCs to advance early action, enhance preparedness efforts and provide crisis support.

Developed collaboratively with WMO stakeholders and humanitarian partners, WCM services include both regular and ad hoc products, as well as capacity-building through training and guidance.

Some products include weekly hydrometeorological scans at global and regional levels, ad hoc tropical cyclone scans that provide event-specific information, monthly global climate outlook briefings, quarterly regional and subregional climate outlooks, and ad hoc seasonal climate outlook scans. WCM is also developing hazard calendars, including a tropical cyclone calendar and a rainy season calendar.

Since its inception, WCM has delivered nearly 500 products to organizations such as UNHCR, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), IFRC, Save the Children, and Start Network to foster the protection of lives and livelihoods in fragile contexts worldwide.

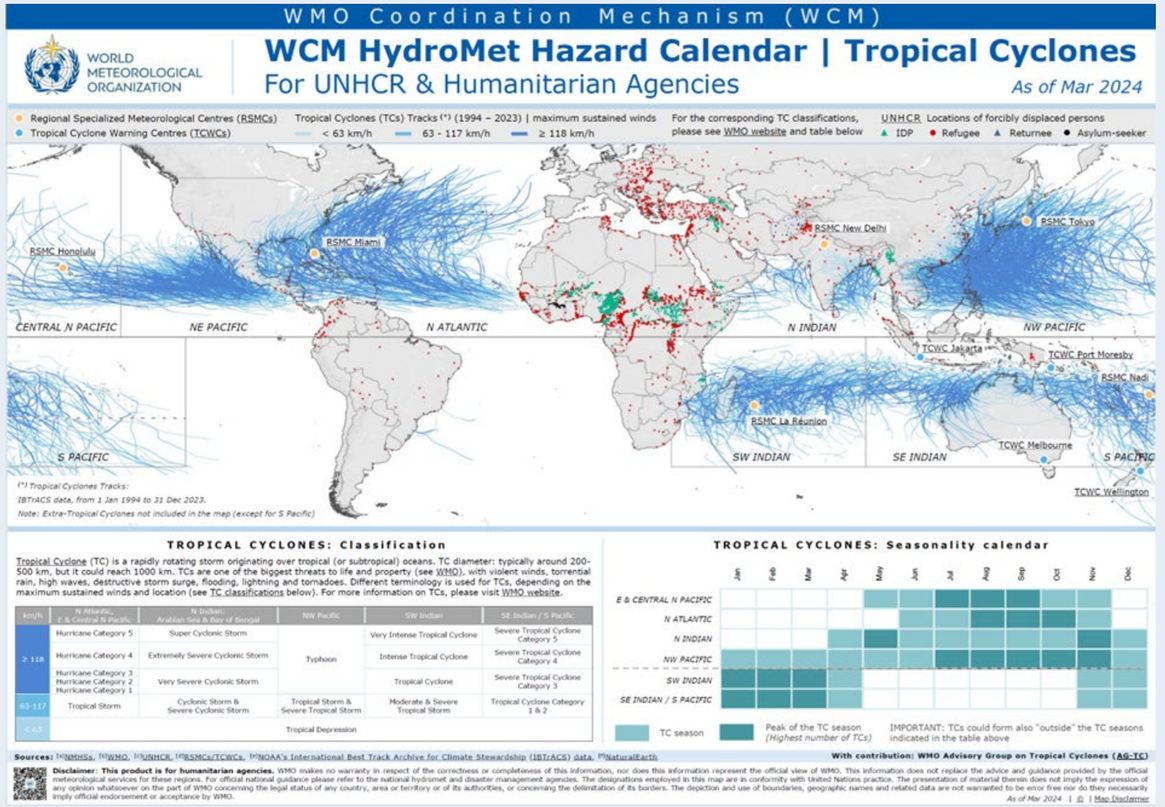


Figure 13. Examples of the WCM HydroMet hazard calendar for tropical cyclones (source: WMO)

95 The assessed countries are those listed on page 5 of the EW4All Dashboard: https://earlywarningsforall.org/site/early-warnings-all/dashboards/early-warnings-all-dashboard.

2.3.3 Specialist forecasting systems for flooding and flash flooding

Hydrological forecasting and flood early warning capabilities are expanding steadily.

Through the Early Warning Systems for Floods (EWS-F) initiative, under WMO leadership, 27 countries have completed structured assessments so far using the National Capacity Assessment Tool (NCAT), which focuses on end-to-end flood forecasting and EWS. This comprehensive diagnostic landscape has strengthened the global evidence base on MHEWS functionality, enabling more tailored support, especially for hazard-specific applications such as flooding.

These assessments provide detailed diagnostics of national hydrological services and inform investment needs, and offer targeted support around model set-up, institutional mandates, data digitization and technical workflows.

The Flash Flood Guidance System (FFGS), led by WMO and partners, is operational in over 70countries. The system leverages satellite-derived rainfall estimates, soil moisture modelling and weather forecasts to deliver real-time, location-specific guidance for flood risk. It supports immediate decision-making while fostering better coordination between national and regional agencies. More than 1,000 technical staff have been trained through FFGS to date, and regional centres continue to provide peer support and capacity development. Recently, concerns about the long-term sustainability of the system have been raised. In response, WMO has developed a concept note on a flood forecasting framework, aimed at empowering Members and ensuring the sustainability not only of FFGS but also of other flood forecasting systems led by WMO.

Together, EWS-F, FFGS and Water at the Heart of Climate Action (WHCA) (covered in section 4.2.2) represent a structured and scalable model for building flood forecasting capability aligned with national strategies and the EW4All universal coverage goal.

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Box 12

Technology driving innovations for locally tailored tools, real-time data transmission and interoperable systems for climate resilience and disaster response: Case studies from Chad, the Maldives, the Philippines and Rwanda

In Rwanda, the SOFF-funded deployment of upgraded surface weather stations and an upper-air observation site in Huye District is bolstering national capability to generate and exchange meteorological data in compliance with GBON requirements. Integrated with WHCA, this effort strengthens regional forecasting and MHEWS capabilities. The success in Rwanda also lies in extensive capacity-building led by WMO and Finnish experts, and in sustaining the advances made through these initiatives thanks to allocations within national budgets and favourable policy.

In Chad, SOFF investments have rehabilitated and expanded the country's meteorological network to GBON-compliant operations, including 34 stations – 2 of which are upper-air – and satellite data transmission systems for remote areas. Technical support from GeoSphere Austria and coordination with WFP and UNDP have improved both infrastructure and human resource capacity. These advances are directly improving forecasts for floods, droughts, locust invasions and agricultural planning while enhancing anticipatory humanitarian action.

The Philippines demonstrates how decentralized and community-embedded technologies can make MHEWS more inclusive. The national Strengthening Resilience through Early Action and Impact Mitigation–Early Warning System (STREAM-EWS) initiative in Mindanao deployed calibrated flood sensors and telemetered weather stations across 12 municipalities. Aligned with existing Philippine Atmospheric, Geophysical and Astronomical Services Administration standards relating to observations, this infrastructure bridges gaps in local river basin monitoring, enhances forecast accuracy, and improves coordination among municipalities for evacuations and emergency actions. In San Miguel, Surigao del Sur, where traditional river monitoring involved manual inspection, the STREAM-EWS system now automatically triggers SMS alerts based on water-level thresholds, directly notifying local government units and communities in real time. The project's human-centred design extended beyond hardware: local officials and communities received training and conducted simulation exercises that improved real-time decision-making and strengthened preparedness. For budget-constrained local government units (LGU), affordable and maintainable technologies combined with capacity-building activities have made the system sustainable with the ability to adapt it if required to meet changes in local needs.

The Maldives Meteorological Service (MMS) received support from SOFF to enhance technical, human and institutional capacity for weather and climate data provision, with UNEP leading implementation. In collaboration with MMS and the Regional Integrated Multi-Hazard Early Warning System (RIMES), UNEP aims to close critical data gaps, aligning with the GBON. While this work is focused on Pillar 2, UNEP is exploring how to expand efforts across the full MHEWS value chain, covering marine observations, technical training, IBF, and enhanced stakeholder collaboration and communication, especially with vulnerable groups.

Common success indicators across the four case studies include increased GBON-compliant station functionality, real-time data generation and sharing through national and international platforms, enhanced forecast accuracy and lead time, qualitative feedback from communities and authorities on improved disaster response, and institutionalized capacity-building that includes gender-inclusive training programmes.

Learning points from across the case studies include highlighting that technology must be adaptable to local contexts, especially where fiscal and connectivity constraints exist, and that real-time monitoring tools save lives only when paired with robust dissemination systems and local training.

Box 13

Youth-led, community-centred technology: Case Studies from Libya and Malawi

In climate-vulnerable regions like Malawi and Libya, community-based monitoring initiatives are driving improvements in EWS capabilities.

In northern Malawi, the African Drone and Data Academy (ADDA) – established by the United Nations Children's Fund (UNICEF) in partnership with local and international academic institutions – has equipped over 1,400 young people (60 per cent women) from 25 countries with skills in drone operations, geospatial data and disaster risk analysis (UNICEF Malawi, n.d.). ADDA graduates are actively capturing aerial imagery, analysing flood-prone areas and supporting the country's Department of Disaster Management Affairs with risk mapping, forecasting and rapid response. Notably, their contributions to a new flood risk mapping and forecasting system now serve over 236,000 residents. With science, technology, engineering and mathematics (STEM) training and real-world disaster applications, the programme empowers youth to co-design solutions for community resilience.

In Libya, with UNICEF support, the youth-led Roaya Foundation is scaling up Libya Mozn, the country's first real-time EWS. The system launched in 2022, one year before the catastrophic floods in 2023 that affected nearly 1.5 million people. After the floods, Roaya intensified efforts to collect data and provide more accurate early warnings. Using data from 45 weather stations, which was updated every two seconds, Libya Mozn monitors a range of hazards including heatwaves, floods and dust storms. Young community members are trained as climate monitors and technicians, ensuring sustained local ownership. Mozn's visibility is also growing. More than 50,000 users of the Roaya Mozn smartphone app receive alerts and safety guidance. Roaya's Facebook page amplifies EWS alerts with 909,000 followers and reaches more than 3 million people overall (93.7 per cent from Libya; 46 per cent women), with most high-engagement posts coming from Mozn updates. A related Facebook group with 100,000 active members regularly shares local weather reports, photos and videos.[96]

These cases illustrate how community-based approaches can dramatically improve hazard detection and response by combining local knowledge with real-time technologies for more accurate forecasting. They also support long-term sustainability by strengthening youth engagement and capacity through inclusive STEM education, fostering co-ownership between communities and institutions, and embedding monitoring tools within digital and social platforms to enhance reach and impact.

Box 14

Regional coordination for detection, observations, monitoring, analysis and forecasting: A case study from South-East Europe

The South-East Europe Multi-Hazard Early Warning Advisory System addresses fragmented forecasting capacities and limited transboundary coordination across 17 countries. Led by WMO – with support from ECMWF, the United States Administration for International Development (USAID), the World Bank, and European Union partners – the initiative established a harmonized, region-wide platform for hazard detection, monitoring, analysis and forecasting.

A key achievement is the common information platform, which enables forecasters to access and visualize shared observational data, high-resolution numerical models and hydrological forecasting tools. With more than 26,000 daily reports exchanged by the participating countries and supporting international partners, the system improves lead times, operational readiness and decision-making across borders. A regional forecast verification process also enhances trust and consistency in outputs.

Despite challenges in resourcing and stakeholder participation, the project has strengthened coordination and laid the foundation for more responsive, interoperable MHEWS. Future efforts aim to expand user engagement and decision-support capabilities to increase local relevance and impact.

96 https://www.unicef.org/documents/stories-of-impact

2.4 Warning dissemination and communication

2.4.1 Coverage and comprehensiveness in warning dissemination and communication

The vast majority of the 119 countries (89 per cent) that have reported the existence of MHEWS have reported some capability in warning dissemination and communication (see figure 14). Capability comprehensiveness is also advanced for this pillar, with an average score of 0.81, with more than half of the countries in every region reporting that their Pillar 3 capability is comprehensive. In the Europe and Central Asia region, nearly 90 percent (28 out of 32 reporting countries) have reported comprehensive capacities for dissemination and communication. Meanwhile, two thirds (67 per cent) of all countries in the Asia-Pacific region have reported some capability for warning dissemination and communication (Pillar 3).

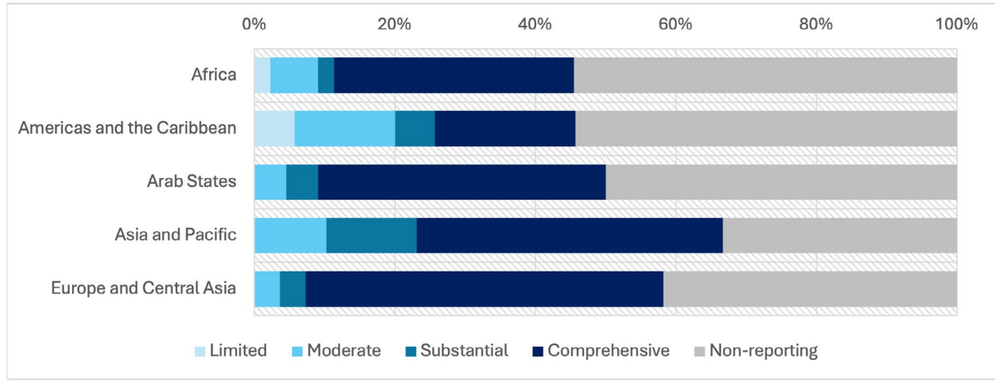


Figure 14. Coverage and comprehensiveness of warning dissemination and communication (Pillar 3, SFM G-3) by region (source: SFM, data as of March 2025)

2.4.1.1 Multichannel, multi-direction

An effective MHEWS must reach everyone at risk, anywhere. Pillar 3 of EW4All focuses on ensuring that warnings are not only issued quickly and at scale, but also reach everyone at risk in a way that is trusted, understandable and actionable. This requires a multichannel approach – from advanced mobile technologies like cell broadcast (CB) and location-based SMS (LB-SMS), to traditional media, radio, sirens and community networks – so that no single point of failure can disrupt the provision of life-saving alerts.

At the same time, effective warning dissemination must be people-centred and inclusive, addressing gaps linked to geography, gender, disability, language and digital access. Building trust and ensuring clarity of messages is as vital as the technology itself. Ultimately, the ethos of Pillar 3 is to combine innovative, interoperable systems with locally grounded communication practices, ensuring that early warnings are delivered reliably, equitably and in ways that enable timely action.

Only a multichannel approach – raising the alert by radio, television, billboards, mobile applications, social media, sirens, etc. – can properly address these gaps and include the diversity of communities at risk, increasing the effectiveness of an alert. The population at risk includes people in urban and remote areas, those with or without access to telecommunication networks, people with disabilities, roamers and people speaking different languages, to name just a few (Gray, and Grangeat, 2023).

While the terms early warning dissemination and early warning communication are often used interchangeably, this can overlook the important distinction between sending information one-way compared to the two-way or multi-way exchange of information and related dialogue among multiple stakeholders. While information dissemination provides official warnings to specialized agencies and the general public, those messages are only part of the breadth of information that individuals share and receive at a given time, with differing levels of trust and understanding based on circumstances.

The global emphasis remains on dissemination, but communication holds potential to surface local insights that complement science-based knowledge, promote public and private dialogue about shared responsibilities and feasible actions, hold stakeholders to account, develop trust, challenge harmful risk perceptions, support deliberation, innovation, decision-making, and ultimately lead to early action (see section 2.6.3). The trust and credibility of warnings are as critical as the technology itself. Risk perception strongly shapes how people respond to alerts; therefore, messages must be clear, actionable and delivered by institutions and voices that communities recognize and trust.

2.4.1.2 Adopting an "all of society" approach

Building an effective MHEWS not only involves technological choices but also requires stakeholders to come and work together. It is therefore important to promote continuous and efficient communication, coordination and cooperation between all stakeholders involved in the development and implementation of MHEWS. At the national level, this means bringing together all persons and institutions participating in DRM; authorities at all levels of government; representatives of local communities; and public and private persons, including media professionals and institutions from the information and communications technology (ICT)sector, among other relevant actors.

Media outlets and telecommunications companies often form the backbone of risk communication, but they can be taken for granted. They frequently operate under highly constrained budgets and time pressures, especially small-scale local media (e.g. radio), which often hold the highest levels of trust with populations. These outlets are frequently vulnerable to the same impacts their audiences are facing. Practitioners who can create impactful media content on MHEWS – especially well before approaching hazards – require investment in training, production and time. They also require easy access to often scarce "media-ready" experts and officials who have the skills and remit to talk about MHEWS in everyday language.

2.4.1.3 Physical and technological environment

The integrity and resilience of communication systems – infrastructure, institutions and interactions – will ultimately determine the operational success or failure of the MHEWS implemented.

The physical and technological environment also plays an essential role. In geographically isolated or hazard-prone areas, communities require consistent access to reliable communication systems. Ensuring the resilience of FM radio operations, mobile networks and undersea cables can help populations remain connected through different stages of interruption to operations. For instance, FM towers designed to withstand common hazards and business continuity plans for local stations can provide ongoing broadcasts to populations with battery or solar-powered receivers. Mobile networks that are equipped to last through extended power outages can enable populations to receive and share information when it is most needed. This reinforces both the importance of robust infrastructure and the adoption of a multichannel approach, which includes dissemination channels that are less dependent on power or connectivity – including no- and low-tech solutions like flags, loudhailers and sirens.

Looking forward, early warning dissemination and communication will increasingly rely on interoperable, AI-enabled and people-centred communication strategies. Combining advanced digital platforms with trusted local networks will ensure that warnings are not only issued rapidly but are also tailored to meet the needs of local audiences – especially in terms of language – to ensure that they are understood, trusted and acted upon.

2.4.1.4 Policy and regulation

Robust policy and regulation that strengthen the ability of media and communication companies to play their roles demonstrate good risk governance. This requires arrangements that recognize the public–private overlap in operations. When successfully implemented, this can strengthen business continuity for the dissemination of warnings widely and equitably, while also promoting public dialogue around risk governance, fostering greater engagement and trust in the long-term. Robust regulatory frameworks and public–private partnerships are key enablers of effective dissemination. For example, the European Union's directive on mobile alerts, has accelerated uptake of CB at the regional level, while at the national level, collaboration with telecom operators, broadcasters and technology providers ensures both compliance and innovation.

National Emergency Telecommunications Plans (NETP) are a key tool for strengthening disaster management and risk reduction through ICT. While technologies are central to enabling preparedness and response, NETPs ensure that their development and implementation is embedded in strong national strategies, coordinated governance, and robust legal and regulatory frameworks. They outline the activities and actions required across all phases of DRM, prioritize MHEWS implementation, and guide stakeholders in defining clear roles and responsibilities through multi-stakeholder collaboration. By going beyond the ICT sector, NETPs foster a holistic, whole-of-society approach to emergency telecommunications.

To date, ITU has supported the development of 41 NETPs worldwide, including 11 in LDCs and 10 in SIDS. In addition, ITU has supported the development of two regional frameworks in Africa – one for Southern African Development Community countries and one for English-speaking countries. These efforts are helping governments to enhance coordination, strengthen governance and leverage ICTs more effectively to protect lives and livelihoods in times of crisis.

The Government of Chile has a comprehensive regulation for its CB system, which operates in close partnership with mobile network operators (MNO).[97] Policies cover MNO roles in relation to infrastructure maintenance, message dissemination, testing, compatibility with handsets and more. A recent report published by GSMA examines how the system that Chile has developed has evolved over 10 years and what countries can learn from the country's experience.

97 https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/gsma_resources/chiles-emergency-alert-system-the-role-of-mobile-network-operators-in-early-warning-systems/

Box 15

A memorandum of understanding between government and media organizations for early warning communication: A case study from Barbados

Barbados is frequently subject to severe weather events, which can develop with very short notice. Communicating timely warnings that resonate with the population is critical, but also challenging, especially when power outages limit the reach of online and mobile-based communication. Meanwhile, many within the population underestimate the impact of forecasted threats and can be slow to act.

To support public dialogue about hazards and EWS, facilitate mass communication during hazardous events, and ensure the timely dissemination of critical information, the Barbados DEM formalized nine memorandums of understanding (MoUs) with major broadcasting networks, representing 18 radio stations.

The MoUs acknowledge the critical role that media organizations can play in reaching audiences with trusted information before and during times of crisis and seek to support greater collaboration for improved warning communication. Specifically, the MoUs sought to promote:

- A spirit of collaboration between media organizations and the DEM
- An exchange of expertise and skills between the government and media
- Strengthened capacity of both parties
- An understanding of how the infrastructure – as well as the human, physical and financial resources of both the DEM and media organizations – may be used in support of each other's objectives.

In June 2024, representatives from the DEM, the Barbados Meteorological Services and media organizations convened to further explore how they could collaborate, within the remits and resource limitations of their organizations, to jointly improve public communication for early warnings. As a result, they agreed to meet regularly about the execution of the MoU protocols and a broader risk communication plan for the country.

2.4.2 Common Alerting Protocol

The Common Alerting Protocol (CAP) is a digital format for exchanging emergency alerts, which allows for a consistent alert message to be disseminated simultaneously over multiple communications pathways. The digital nature of CAP messages also enables the automation of responses, where devices like sirens or highway signs can be triggered to disseminate alerts, further enhancing the speed and effectiveness of alerting systems.

Of the 193 WMO Members, 122 (63 per cent) have completed CAP training and have technically "adopted" CAP, while 39 (20 per cent) are in the process of developing and testing. A smaller proportion of countries, 32 (16 per cent), have yet to start implementation.[98] However, there is an important distinction to make between adopting CAP – receiving training and registering alerting authorities – and embedding CAP within standard operational procedures for sustained dissemination of warnings. The latest data reveals that only a third (65 WMO Members) are sustaining CAP messaging, as monitored by the WMO Severe Weather Information Centre.[99] There are 44 WMO Members (23 per cent) that are using CAP but not at a sustained level, and 84 WMO Members (44 per cent) that have yet to issue a CAP warning. The picture is also incomplete; while data exists for the raising of CAP alerts by NMHSs, as yet, there is no data on the downstream dissemination of these messages through different channels.

98 https://earlywarningsforall.org/site/early-warnings-all/dashboards/early-warnings-all-dashboard
99 https://severeweather.wmo.int/

The inclusion of actionable messages in the instruction field of CAP alerts is critical for enabling anticipatory action. By embedding clear, concise and actionable instructions within the CAP message, such as "find safe shelter right until the storm passes", authorities can guide the public on specific steps to take to protect themselves. This transforms an alert from a simple warning into a direct enabler of proactive protective measures, enabling individuals and communities to move from a state of passive awareness to active preparation, thereby mitigating potential harm and building resilience to impending threats.

National Meteorological and Hydrological Services (NMHSs) sustaining CAP alerts by sharing them through SWIC 2.0

Source: WMO Monitoring System, 2025 / Scope: 193 WMO Members

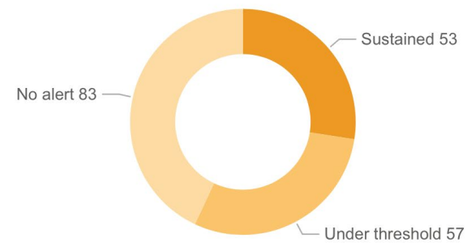
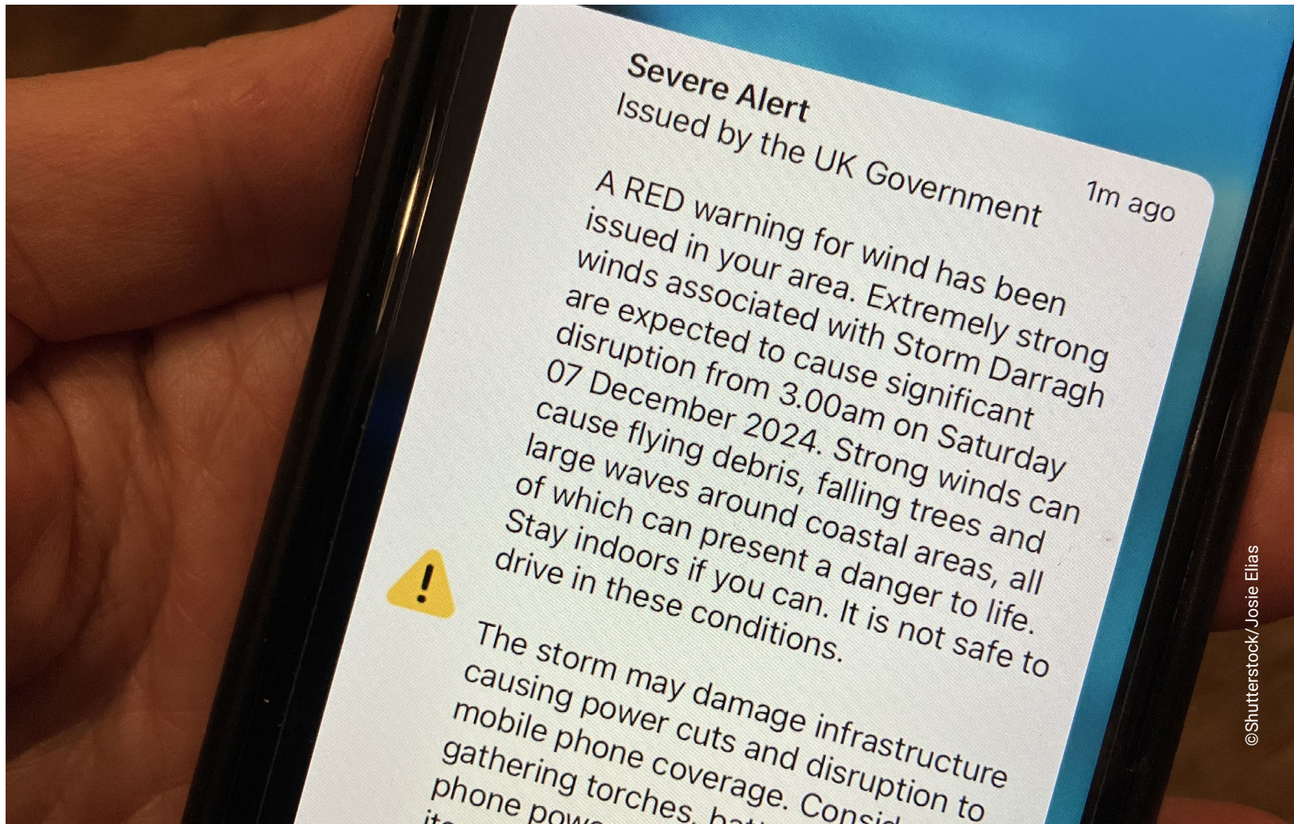


Figure 15. NMHSs sustaining CAP alerts by sharing them through the Severe Weather Information Centre 2.0



©Shutterstock/Josie Elias

Box 16

CAP: Case studies

Recent developments around the CAP reflect growing global momentum to standardize and strengthen early warning communication. CAP – a digital format for delivering consistent, multichannel alerts – is central to platforms like the IFRC Alert Hub, which helps communities act early by broadening access to official alerts published by government agencies.

The IFRC Alert Hub has now built a sizable database of CAP alerts, collecting approximately 5 million every quarter from WMO-recognized authorities.[100]

Researchers are analysing this data to evaluate coverage in disaster-prone areas, language inclusivity, clarity of recommended actions and opportunities for public feedback. The results are being shared with alerting authorities and provide guidance for increasing the quality and impact of their alerts.

Country-level efforts underscore the adaptability and impact of CAP. In Ghana, the Meteorological Agency scaled up CAP-based dissemination in 2024 across WhatsApp, Telegram, social media and forecast platforms. More broadly, the scale-up of CAP messaging has been enabled by the roll-out of the ClimWeb package (supported by CREWS and the Norwegian Refugee Council's Norwegian Capacity, NORCAP), which includes an upgraded CAP-enabled interface that delivers image-rich, multilingual alerts in real time via radio, social media and web dashboards. By the end of 2024, ClimWeb was rolled out to 19 African nations, providing professional and user-friendly online platforms that integrate CAP alerting and improve public visibility of CAP alerts issued by NMHSs in Africa. Enabled by ClimWeb, between February 2024 and 31 July 2025, Agence Nationale de la Météorologie du Togo (the NMHS) issued 47 CAP alerts,[101] and Guinea-Bissau issued 9 in June and July 2025 alone.[102]

The IFRC Global Disaster Preparedness Center supported CAP expansion in Togo, Burundi, Burkina Faso and Eswatini, tailoring strategies to national priorities through workshops and MHEWS assessments. Using the IFRC Public Awareness and Public Education messages for DRR, the development of contextualized sets of actionable messages for key hazards was prioritized. The agreed-upon sets of messages can be included in official CAP alerts and distributed across different media platforms.

Together, these initiatives show that CAP is becoming a cornerstone for digital MHEWS – enabling faster, more inclusive alerts while supporting anticipatory action and local engagement.

100 https://alerthub.ifrc.org/historical-alerts
101 https://meteotogo.tg/api/cap/rss.xml
102 https://meteoguinebissau.gw/api/cap/rss.xml

2.4.3. Mobile-enabled EWS

MHEWS Pillar 3 promotes the development and implementation of inclusive mobile-enabled early warning dissemination systems, such as CB and LB-SMS. Among other advantages, these technologies can target the warnings to reach only people located in an at-risk area, can allow for warnings that are adaptable to specific requirements (such as a user's language), and can reach a high percentage of the population. As of 2024, for instance, 94.6 per cent of the world's population had an active mobile broadband subscription, and close to 79.7 per cent own a mobile phone.[103]

CB technology enables a single order to trigger the broadcasting of a specific message that will be displayed on all mobile phones that are attached to the specified cell location. This can be done regardless of network congestion, and at near-real-time speed, in a matter of seconds. LB-SMS is a normal SMS sent to a subset of all mobile devices operating under the mobile operator network within a particular geographical area.

As of July 2025, 44 countries have adopted an inclusive MHEWS based on CB or LB-SMS. Of these, 28 countries have adopted a CB solution, while 10 countries rely on LB-SMS, and 6 countries have both technologies available for disseminating alerts to their population. There are several factors that are driving the adoption of CB or LB-SMS, especially in the last 5 years. One example is European Union legislation from 2018, which required all European Union countries to set up systems for sending alerts via mobile networks by 2022.[104] The development and adoption of CB and/or LB-SMS has also been encouraged by different organizations and initiatives worldwide, not least EW4All. Apart from those 44 countries, at least 13 others are developing a CB or LB-SMS system, with the aim of implementing these solutions before the end of 2026.

Technology enables MHEWS to operate at speed and scale, but its impact depends on adaptation to diverse local contexts. From AI and LB-SMS to megaphones and traditional knowledge sharing, effective deployment must align with local realities to ensure that MHEWS are actionable and inclusive. CB technology has proven to be an effective tool for the rapid and secure massive dissemination of early warnings to targeted areas, ensuring that alerts reach at-risk communities faster. To date, 34 countries report using CB. While most of the countries that have implemented CB are those with high-income economies (Gray, 2025), ITU works to bring CB technology to LDCs and SIDS. Under EW4All, ITU is currently supporting Somalia, Mauritius, Guatemala, all Eastern Caribbean Telecommunications Authority countries and others to prepare for and implement CB.

As the reach of this mobile technology expands to new countries, barriers to populations accessing the technology and the opportunities it provides persist, particularly for marginalized communities. Financial barriers, language and social exclusion can all contribute.[105]

Figure 16. Number of countries with CB or LB-SMS (cumulative) (source: ITU Research – work in progress)

103 https://datahub.itu.int/data/?e=701
104 European Electronic Communications Code (EECC), Article 110.
105 https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/wp-content/uploads/2024/06/EnhancingInclusionInMobileEnabledRiskCommunications_Final_1.pdf

Box 17

Mobile technology expanding inclusive early warning communication: Case studies from Brazil, Cambodia, India and the Solomon Islands

CB and LB-SMS are technologies that enable mobile network infrastructure to send messages to handsets. LB-SMS can send SMS messages to devices within a defined geographic area. CB can send instant, loud, distinctive alerts to millions of devices in seconds, also within a defined geographic area. Countries like Brazil, the Solomon Islands and Cambodia are strengthening MHEWS through mobile-based strategies tailored to local contexts and resource realities.

In Brazil, the integration of CB technology into the national public alert dissemination interface has significantly broadened the reach of emergency messages. CB allows geotargeted alerts to be sent instantly to all mobile phones within a hazard zone – without requiring prior registration or Internet access. Led by the National Secretariat for Civil Protection and Defence, in collaboration with Anatel and mobile operators, this approach improved warning speed and coverage, particularly in flood-prone regions, while addressing structural inequalities in access to lifesaving information.

A similar CB approach was piloted in the Solomon Islands in 2025, supported by GSMA, the Pacific Islands Telecommunications Association and OmniTouch. By delivering real-time warnings to all mobile devices, including those without credit or registration, this system complements alerts that are already being disseminated by limited SMS, mass media, social media and traditional channels. Hosted within the Solomon Islands Government ICT services (SIG-ICT) office and integrated with the outputs from multiple warning agencies, this successful pilot has paved the way for the regional roll-out of this CB-based solution while also demonstrating the importance of stakeholder training and strong local ownership.

In contrast, EWS1294 in Cambodia showcases how a subscription-based, low-cost model can still yield substantial preparedness gains. Built by People in Need in collaboration with national disaster authorities, EWS1294 delivers flood alerts via interactive voice response calls, public loudspeakers, Telegram groups, radio broadcasts and SMS. In Siem Reap, a local disaster officer's outreach helped register over 25,000 residents, resulting in improved response, reduced damage and a strong multiplier effect – nearly 80 per cent of those alerted helped inform others. While effective, the post-event assessments revealed gaps in coverage, particularly among remote populations, which spurred efforts to expand awareness and launch broader SMS broadcasting with telecom partners.

The National Disaster Alert Portal in India – SACHET[106, 107] – was piloted in Tamil Nadu from 2019 to 2021 and is now operational nationwide. It was developed to address longstanding challenges in delivering timely, inclusive and geotargeted disaster alerts to over a billion people at risk. Led by NDMA and the Centre for Development of Telematics – and integrated with all 36 states, union territories and major mobile operators – the CAP-based platform combines LB-SMS and CB (still undergoing testing) to deliver multilingual alerts in 23 languages, with accessibility features for persons with disabilities. It incorporates real-time dashboards, GIS targeting, automated workflows, and multichannel dissemination across phones, sirens, broadcast media, and display boards. With over 44 billion alerts issued across 30,000 hazardous events, the system has improved speed, reach and public trust. Challenges such as device compatibility and over-alerting were addressed through training, standard operating procedures and public awareness efforts, positioning SACHET as a scalable model for digital risk communication.

106 https://sachet.ndma.gov.in

107 https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/gsma_resources/indias-sachet-public-warning-system/

Box 18

High tech, low tech, and no tech: Case studies on technology and innovation for accessibility, collaboration and local leadership in Ecuador, Haiti and India

Under the CREWS Haiti programme, Haitian authorities tackled a longstanding gap in risk communication by developing 41 visually engaging hazard awareness boards in Haitian Creole. These boards – created in collaboration with UNDP, WMO, and the Haiti Hydrometeorological Unit – illustrate key hazards such as cyclones, droughts and flooding in ways that are accessible and culturally relevant.[108] The boards were first showcased during the inauguration of the civil protection agency's crisis room and the launch of the 2024 hurricane season. The materials are now central to national preparedness campaigns and are being distributed to regional departments. By shifting from technical, top-down messaging to locally tailored communication, this initiative aimed to make early warnings more understandable, inclusive and actionable.

In Ecuador, in the Simón Bolívar neighbourhood in Quito, a community-based MHEWS was implemented to address recurring flood risks from the Caupicho river. The initiative combined technology, collaboration and local leadership to strengthen risk communication and coordination. Municipal authorities installed surveillance cameras, a water-level gauge and a public megaphone while creating a WhatsApp communication channel between the emergency operations centre and residents. Alerts were issued in three categories –preventive, evacuation and active event – and a trained local response group supported evacuation and first aid. Crucially, residents activated alarms themselves based on official updates, demonstrating autonomous community leadership. Despite challenges aligning municipal coordination with community action, particularly in urban neighbourhoods, the initiative improved response times and highlights the value of co-designed systems and strong community–government collaboration.

In India, the Smart Access to Marine Users for Ocean Data Resources and Advisories (SAMUDRA) mobile app – launched by the Indian National Centre for Ocean Information Services in August 2023 – strengthens MHEWS by delivering real-time, geotargeted alerts for ocean hazards like tsunamis and cyclones. With colour-coded warnings and regional language support, it enhances last-mile communication for coastal communities. Integrated with satellite-based GEMINI devices, it ensures offshore users also receive timely updates. Recognized with a 2024 Geospatial World Excellence Award, SAMUDRA shows how inclusive, tech-driven design can make EWS more effective and accessible.

108 https://storymaps.arcgis.com/stories/89d297e269ba4ab78412de4ecc0a301d

2.5 Preparedness and response capabilities

2.5.1 Coverage and comprehensiveness of preparedness to respond

MHEWS can only be considered effective if people and institutions are ready to act once alerts are issued. Over 80 per cent of the countries reporting the existence of MHEWS have reported preparedness and response capabilities – that is, to act on the early warnings when issued.

However, there is variation among countries reporting on the level of their preparedness and response capabilities. For the Arab States, Europe and Central Asia, and the Asia-Pacific regions, over 50 per cent of all countries have local plans to act on early warnings.

Furthermore, 25 of the 30 countries in Europe and Central Asia that reported the existence of MHEWS have indicated having comprehensive capabilities in terms of local governments that are prepared to respond and act on early warnings. Meanwhile, the countries in the Asia-Pacific region have the highest overall level (61 per cent of all countries), over 60 per cent of which report comprehensive capabilities. The Americas and Caribbean region and the Africa region need considerable attention, as less than 40 per cent of the countries report preparedness and response capabilities, with only half of those countries reporting a comprehensive capability.

It is important to note that the SFM does not specify if these plans are operational, linked to anticipatory actions (before a hazard occurs or its most acute impacts are felt), or mainly focused on traditional preparedness and rapid response after impact.

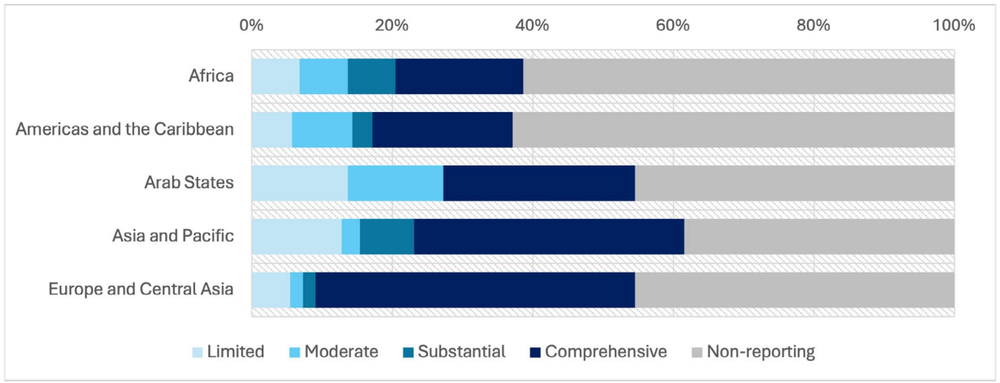


Figure 17. Coverage and comprehensiveness of preparedness to respond (Pillar 4, SFM G-4) by region (source: SFM, data as of March 2025)

2.5.1.1 Anticipatory action

Early warnings alone do not always lead to timely and effective action. Many of the most devastating and costly hydrometeorological disasters of this century were in fact predicted, yet the forecasts did not trigger adequate preparedness or response (Finnish Red Cross, 2024). For warnings to save lives and reduce loss, anticipatory action – pre-planned measures taken before a hazard, based on forecasts – has become increasingly recognized as essential.

Anticipatory action is a faster, more cost-effective and more dignified response compared to traditional reactive approaches. It works best when the following three core components are in place:

- Pre-agreed plans or frameworks clarifying the actions to be taken in response to warnings and the specific roles of each stakeholder
- Threshold levels that are used to trigger the actions and release funds
- Tied to pre-arranged financing to ensure actions can be implemented quickly, optimizing the window of time before the hazard occurs[109]

These components are underscored by a thorough understanding of risk and the required institutional and technical capacities to act.

Over the past year, the global momentum for anticipatory action has continued to see remarkable growth, as reflected by the increased adoption of these approaches across countries and sectors, highlighted in the sections that follow.

Box 19

Guidance and tools to strengthen preparedness to respond to warnings

Training curricula for anticipatory action[110]
The Anticipation Hub provides comprehensive training curricula designed to build capacity for anticipatory action in humanitarian and DRM contexts. The curricula are particularly relevant for government officials, offering them the tools and knowledge needed to integrate anticipatory approaches into national and local disaster preparedness strategies. It consists of two main courses: "Foundations of anticipatory action", which introduces key concepts and global case studies through four concise modules, and "Getting ready for anticipatory action", which delivers guidance across five in-depth modules, covering operational readiness, financing, IBF, monitoring and preparedness planning. The training is available in multiple languages and formats, including self-paced e-learning as well as materials for facilitated workshops. It is tailored to a broad audience, but places particular emphasis on enabling public sector actors to lead and coordinate anticipatory action effectively.

Toolkit: "Anticipatory action in fragile, conflict- and violence-affected settings"[111]
Implementing anticipatory action in fragile, conflict-affected and violent (FCV) contexts is critical to mitigating the impact of hazards on vulnerable populations and reducing strain on overstretched disaster response systems. Despite growing interest, anticipatory action remains limited in these settings due to challenges such as insecurity, weak governance, damaged infrastructure and socioeconomic hardship. These factors contribute to complex multi-risk environments that complicate hazard prediction and response planning. Nevertheless, with a deep understanding of local contexts and vulnerabilities, anticipatory action frameworks can be tailored to enable effective, conflict-sensitive interventions. To support this, a dedicated toolkit offers resources for designing and implementing anticipatory action in places affected by FCV settings, including areas affected by displacement. It complements existing guidance by integrating emerging lessons and best practices, and addressing persistent knowledge gaps. The toolkit was developed by the Red Cross Red Crescent Climate Centre (RCRCCC), the Anticipation Hub and the International Water Management Institute (IWMI), under the CGIAR Fragility, Conflict and Migration initiative and in close collaboration with the Anticipation Hub working groups on conflict and multi-risk.

Technical guidance and toolkit: "Protection, gender and inclusion (PGI) in anticipatory action"[112]
Anticipatory action presents a vital opportunity to address the vulnerabilities of diverse at-risk groups, such as women, children, persons with disabilities and marginalized communities. However, despite growing recognition, PGI considerations are not consistently mainstreamed across anticipatory action programming due to gaps in capacity, data, funding and policy frameworks. To address these challenges, a comprehensive guide and toolkit have been developed, offering context-adaptable resources for stakeholders to embed PGI principles, dignity, access, participation and safety into MHEWS, planning, operations, financing and monitoring. This resource supports inclusive, conflict-sensitive anticipatory action across humanitarian and development settings, encouraging collaboration and continuous learning to strengthen outcomes for those most at risk. The guidance and toolkit have been co-developed by Plan International, IFRC, Humanity & Inclusion, Practical Action, United Nations Population Fund (UNFPA), UNICEF and Start Network.

109 https://www.anticipation-hub.org/about/what-is-anticipatory-action

110 https://www.anticipation-hub.org/learn/learning-resources/learning-modules

111 https://preparecenter.org/resource/toolkit-for-anticipatory-action-in-fragile-conflict-and-violence-affected-settings/

112 https://www.anticipation-hub.org/Documents/Manuals_and_Guidelines/PLAN-PGI_in_AA_Toolkit-Full-v2.pdf

2.5.1.2 Institutionalization and government ownership of anticipatory action

Governments are increasingly recognizing the value of anticipatory action to reduce disaster impacts. While government leadership of anticipatory action is not yet the norm (REAP, 2024a), governments are increasingly engaging with anticipatory action frameworks, often spurred by deliberate efforts from humanitarian actors to collaborate and align with state actors.

In practice, many governments are already taking early measures such as pre-emptive evacuations, even in the absence of formal frameworks. However, these actions can be ad hoc and do not fully exploit the critical window of time between forecasts and disaster impacts. Institutionalizing anticipatory action through policies, plans and financing is key for using this window more systematically (IFRC, 2025).

At the 34th International Conference of the Red Cross and Red Crescent in October 2024, 196 Member States – together with the International Red Cross and Red Crescent Movement components[113] – adopted the resolution, "Protecting people from the humanitarian impacts of extreme climate and weather events: Working together to strengthen anticipatory action".[114] This marked a significant milestone in demonstrating government commitment to embed anticipatory action in their national DRM systems.

The extent to which the institutionalization of anticipatory action is practiced worldwide is not yet fully documented. However, reporting from 46 countries suggests meaningful progress has been made (Anticipation Hub, 2025). Among these, 24 have established at least one key building block – such as a designated government authority, a national technical working group (TWG) or a national roadmap – while another 15 are in the process of putting similar measures in place. An additional 15 countries are working towards having at least one of those in place.[115]

Collaboration between governments, the United Nations, the IFRC network and NGOs has been essential to progress. National Red Cross and Red Crescent Societies, as auxiliaries to public authorities, have played a unique role in linking anticipatory action to the local government and community levels.

2.5.2 Legal and policy frameworks

Legal and policy frameworks create the enabling environment for anticipatory action, determining whether it is formally recognized, resourced and coordinated. Laws define institutional responsibilities of these authorities, establish coordination and financing mechanisms and carry binding authority. Policies and plans complement these laws by setting national priorities and guiding operationalization.

Anticipatory action can be integrated across a range of legislative and policy areas, including DRM, climate change adaptation, disaster risk financing, social protection, telecommunications and data governance.[116] Dedicated legal instruments specifically addressing anticipatory action can also be developed.

Research by IFRC has identified at least seven countries where governments have revised DRM laws or policies to enable anticipatory action: Bangladesh, the Philippines, Mongolia, Mozambique, Ecuador, Sierra Leone and Fiji (IFRC, 2025). Notable progress in 2024 includes the following:

- The Government of Ecuador passed the 2024 Law on Integrated Disaster Risk Management[117] that mandates national, sectoral and local authorities to integrate anticipatory actions.
- The Government of Sierra Leone included anticipatory action in its Disaster Risk Financing Strategy and Implementation Plan 2024–2029,[118] tasking government and non-government actors with identifying funding for anticipatory action.
- The Government of Fiji enacted the National Disaster Risk Management Bill 2024,[119] authorising the National Disaster Management Office to use "government resources in anticipation of a potential emergency".

113 The International Red Cross and Red Crescent Movement is made up of three independent parts: IFRC, ICRC and 191 National Societies.
114 https://rcrcconference.org/app/uploads/2024/11/34IC_R5-Anticipatory-Action-EN-1.pdf
115 https://www.anticipation-hub.org/download/file-4995
116 https://disasterlaw.ifrc.org/media/4255
117 https://procuraduria.utpl.edu.ec/NormativaExterna/LEY%20ORGÁNICA%20PARA%20LA%20GESTIÓN%20INTEGRAL%20DEL%20RIESGO%20DE%20DESASTRES.pdf
118 https://mof.gov.sl/wp-content/uploads/2024/03/SL_DRFS-FINAL-_compressed.pdf
119 https://www.parliament.gov.fj/wp-content/uploads/2024/06/Bill-No.-6-National-Disaster-Risk-Management-Bill-2024-.pdf

2.5.3 Operational mechanisms and planning

Anticipatory action requires shifting much of the regular decision-making ahead of hazardous events – for example, decisions on funding, actions, and targeting caseloads and criteria (IFRC, 2025). Because it depends on robust preparedness and coordination, enhancing DRM systems to adopt a proactive approach can improve efficiency across the entire DRM cycle (WFP, 2025).

2.5.3.1 Anticipatory action frameworks supported by humanitarian organizations

The number of active anticipatory action frameworks, or pre-agreed plans that enable actions in anticipation of a hazard, has increased by nearly 50 per cent in the last year – from 107 in 2023 to 154 in 2024, covering 48 countries,[120] with pre-arranged financing in place worth $248 million (Scherer and Shumba, 2025). With only one country developing plans for the first time, most of this growth comes from countries implementing plans for additional hazards. An additional 197 frameworks were being developed in 76 countries.

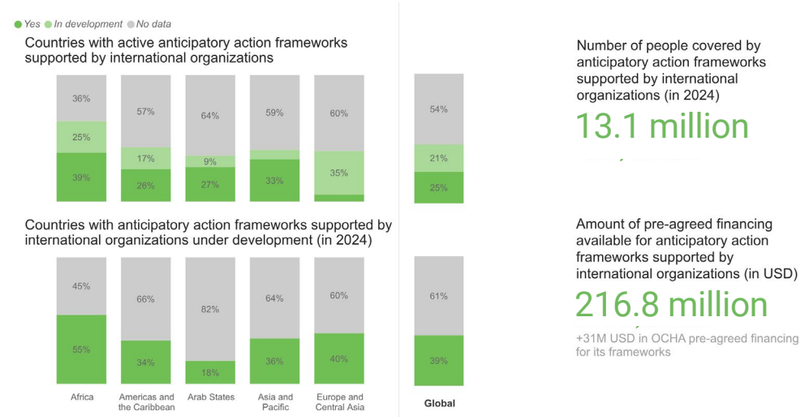


Figure 18. Countries with active anticipatory action frameworks supported by international organizations (source: EW4All Dashboard; Anticipation Hub, 2025)

2.5.3.2 Integration of anticipatory action in state-owned DRM plans or protocols

There was an increase in the institutionalization of anticipatory action into government systems during 2024, noting that 24 countries have now designated a lead authority, formed national TWGs and established national strategies to support implementation (Anticipation Hub, 2025).

In addition to integrating anticipatory action into state-owned DRM plans or protocols (see section 2.5.2), some governments have gone further. For example, both Mozambique and Mongolia have developed dedicated anticipatory action plans for specific hazards, with pre-agreed actions, triggers and financing (IFRC, 2025). In addition, Mozambique has developed a national manual to guide the design of drought-specific anticipatory action frameworks, which was used in nine districts ahead of the 2024 drought.

Other governments, including Honduras, Bangladesh, Madagascar, Nepal and the Philippines, have embedded anticipatory action into existing contingency plans (IFRC, 2025). In Nepal, for example, local authorities introduced anticipatory action thresholds for floods (e.g. danger level over 0.85 m) that trigger anticipatory action plans. In Madagascar, the government updated its national contingency plans for floods and cyclones to include a distinct "anticipation phase" between the preparedness and response phases.

120 Each anticipatory action framework covers a particular hazard. Therefore, one country can have multiple active frameworks.

2.5.4 Financing preparedness and anticipatory action

Anticipatory action needs both "build" and "fuel" funding. Build funding refers to the structural funds needed to establish and strengthen anticipatory action systems – such as enhancing institutional capacity, improving data and forecasting for anticipatory action, developing anticipatory action frameworks, and integrating anticipatory action into national policies and plans. In contrast, fuel funding refers to the pre-arranged funds that are released once pre-defined triggers for a hazard are met, enabling the timely implementation of pre-agreed actions ahead of disasters.

In December 2024, the "Grand Bargain Caucus on Scaling Up Anticipatory Action" – bringing together donors, United Nations organizations; the International Red Cross and Red Crescent Movement; and international, national and local NGOs – adopted an outcome document.[121] This committed signatories – including Germany, the European Union, Sweden, the United Kingdom and the United States – to substantially increase funding for anticipatory action, especially fuel funding; track both fuel and build funding; and improve coordination. Donors were encouraged to spend at least 5 per cent of humanitarian funding on anticipatory action.

The Anticipation Hub has been mandated to collect and consolidate this data in the yearly Global Overview report on anticipatory action. It will build on previous efforts within the G7 and other existing initiatives to track anticipatory action funding – for example, the Global Observatory (see section 3.5) – ensuring consistency and avoiding duplication. Going forward, it will be important to ensure clarity of investments from across humanitarian, development and climate funds for preparedness and response capabilities, including build and fuel funding for anticipatory action.

2.5.4.1 Financing the implementation of anticipatory action

Despite its proven benefits, funding for the implementation of anticipatory action (fuel funding) remains underfunded, receiving only 0.8 per cent of total crisis financing (Plichta, and Poole, 2024). Current funding relies heavily on a few donors – notably Germany, the United Kingdom and the European Union – and humanitarian contingency-financing mechanisms such as the following:

- The IFRC Disaster Response Emergency Fund (DREF), which provides rapid, flexible funding to National Red Cross and Red Crescent Societies, including for anticipatory action
- The OCHA Central Emergency Response Fund (CERF), which includes a window to finance anticipatory action for UN agencies
- The Start Fund and Start Ready fund, which enable NGOs to implement anticipatory action based on early warnings.

While these mechanisms have demonstrated proof of concept, they remain small relative to needs, and their reliance on humanitarian channels constrains sustainability (Scherer and Shumba, 2025).

In 2024, pre-arranged funding reached $248 million, an increase of over one third from approximately $180 million in 2023 (Anticipation Hub, 2025). However, a review by the Asia-Pacific Technical Working Group on Anticipatory Action (TWGAA) found that many frameworks in the region were either dormant or suspended (Asia-Pacific TWGAA, 2024). This was often linked to insufficient resources for maintaining and updating systems (build funding) or for triggering actions once thresholds were met (fuel funding).

121 https://interagencystandingcommittee.org/sites/default/files/2024-02/Caucus_AA%20Problem%20definition%20and%20strategy_final%20version.pdf

2.5.4.2 Using sovereign funding for anticipatory action

Some governments are beginning to use domestic resources for anticipatory action, though this shift is still in early stages, and most initiatives remain donor-funded (IFRC, 2025). Notably, there are two known cases where sovereign funds have been released ahead of disasters to conduct anticipatory actions beyond pre-emptive evacuations:

- In the Philippines, LGUs have started using government funds to finance anticipatory actions, with support from the Philippine Red Cross (IFRC, 2025). The Provincial Disaster Risk Reduction and Management Offices in western Samar and southern Leyte have signed agreements with the Red Cross outlining when and how local funds can be used for anticipatory actions. At the national level, the government also passed Memorandum Order No. 60, allowing LGUs to access up to 30 per cent of their Quick Response Funds if forecasts predict that 15 per cent of the local population could be impacted by an impending disaster.[122]
- In Mongolia, during the 2022/2023 winter, the central government released fodder and hay reserves at subsidized prices based on early warnings of a dzud. This was the first time the government invested in anticipatory action, with the Ministry of Finance matching the cost of the 50 per cent discount from the government reserve fund. Local governments complemented this by covering the remaining costs through their own reserves (FAO, 2024).

In countries such as Madagascar, Nepal and Mozambique, NDMAs have collaborated with finance ministries to review their disaster fund guidelines to enable anticipatory action (IFRC, 2025). In 2024, the Government of Madagascar tested the release of national contingency funds for anticipatory action ahead of a cyclone during a simulation exercise, though application in actual disaster contexts has not yet taken place.

2.5.4.3 Linking anticipatory action to social safety nets

Another emerging pathway is integrating anticipatory action into social protection systems. In several countries, linkages have been piloted and developed, and have even seen "activations". Two models are evolving (WFP, 2023b):

- Using existing social protection systems – such as coordination platforms, targeting, payment and delivery mechanisms – to implement anticipatory actions (e.g. in Nepal[123])
- Adapting social protection systems to integrate core components of anticipatory action, such as forecast-based triggers to decide when to provide anticipatory cash transfers (e.g. in Haiti[124])

Examples of such linkages exist in Haiti, Fiji, Somalia, Dominican Republic, Mozambique, Ethiopia, Kenya and Nepal (Baade, and Sibande, 2024; Secades, and Shafee, 2024) . Support from multilateral development banks has been a key enabler, with the World Bank helping governments establish shock-responsive social protection systems that now underpin anticipatory linkages (World Bank, 2013; IIED, 2023).

122 https://www.anticipation-hub.org/Documents/Case_Studies/Case-Study-Philippines_Nov_2021.pdf
123 https://www.anticipation-hub.org/news/linking-nepals-social-protection-programmes-with-anticipatory-action
124 https://www.wfp.org/publications/linking-anticipatory-action-and-social-protection-fragile-and-conflict-affected

2.5.5 Coordination and partnerships

A key trend is the increasing coordinating role played by NDMAs – for instance, by chairing TWGs and supporting line ministries in developing sector-specific anticipatory actions (IFRC, 2025).

According to IFRC research, of the 47 countries with anticipatory action frameworks in 2023, 21 per cent had TWGs for anticipatory action led by government institutions – Madagascar, Sri Lanka, Mongolia, Ethiopia, Lesotho, Mozambique, Bangladesh, the Philippines, Pakistan and Nepal (IFRC, 2025) – and it is likely other cases exist. Most were co-chaired with a humanitarian partner, while in a few cases, TWGs were fully embedded within government coordination systems, including most recently in Sri Lanka in 2025.[125]

Regional intergovernmental organizations are increasingly engaging with anticipatory action (IFRC, 2025). Regional TWGs for anticipatory action exist in several regions, often led by humanitarian agencies but with active participation from regional intergovernmental organizations.[126] For example, in Eastern Africa, the IGAD co-chairs the regional TWG with WFP.

Regional roadmaps have been developed by these TWGs to guide the scale-up of anticipatory action in Asia-Pacific (including a dedicated roadmap for the Pacific), Southern Africa, Eastern Africa, the Middle East and North Africa (MENA), and Latin America and the Caribbean. Most emphasize government leadership as central to scaling. In 2024, IFRC and WFP founded the MENA Anticipatory Action Community of Practice, which seeks to strengthen coordination for anticipatory action in the region and includes NMHSs, and developed the (unpublished) "MENA Roadmap for Anticipatory Action (2024–2029)".

By the close of 2024, OCHA had facilitated 17 multi-partner anticipatory action frameworks, almost twice as many as the year before, with an additional three in progress (Scherer and Shumba, 2025). These frameworks were backed by $123 million in pre-arranged financing from the CERF, while five of them also benefited from complementary funding of up to $17.5 million from other sources to broaden the scope of anticipatory interventions. This reflects progress towards more coordinated approaches and collective financing, though further diversification of funding sources remains an important objective.

2.5.6 Implementing anticipatory action

The number of activations of anticipatory action frameworks (meaning either the release of financing or the implementation of anticipatory actions) also continued to rise in 2024. A total of 121 activations were recorded across 45 countries, compared to 98 activations the previous year, marking a 24 per cent increase and reaching an estimated 17 million people.

This anticipatory action was enabled by the 154 active frameworks, which together mobilized $248 million in pre-arranged financing. With momentum building for anticipatory action, many countries are developing more frameworks, with an additional 197 frameworks under development in 2024.

2.5.6.1 Types of anticipatory actions

The types of actions most commonly used in 2024 remain cash and voucher assistance; water, sanitation, and hygiene (WASH) services; and early warning dissemination, supported by growing use of AI and machine learning to refine forecasts and triggers (Anticipation Hub, 2025a). Cash and voucher assistance (used in 73 per cent of active anticipatory action frameworks) has been particularly valuable, enabling people at risk to decide for themselves what they need to do to prepare – for example, avoiding distress sales of assets, securing evacuation costs, or protecting their homes, livelihoods, and health.[127]

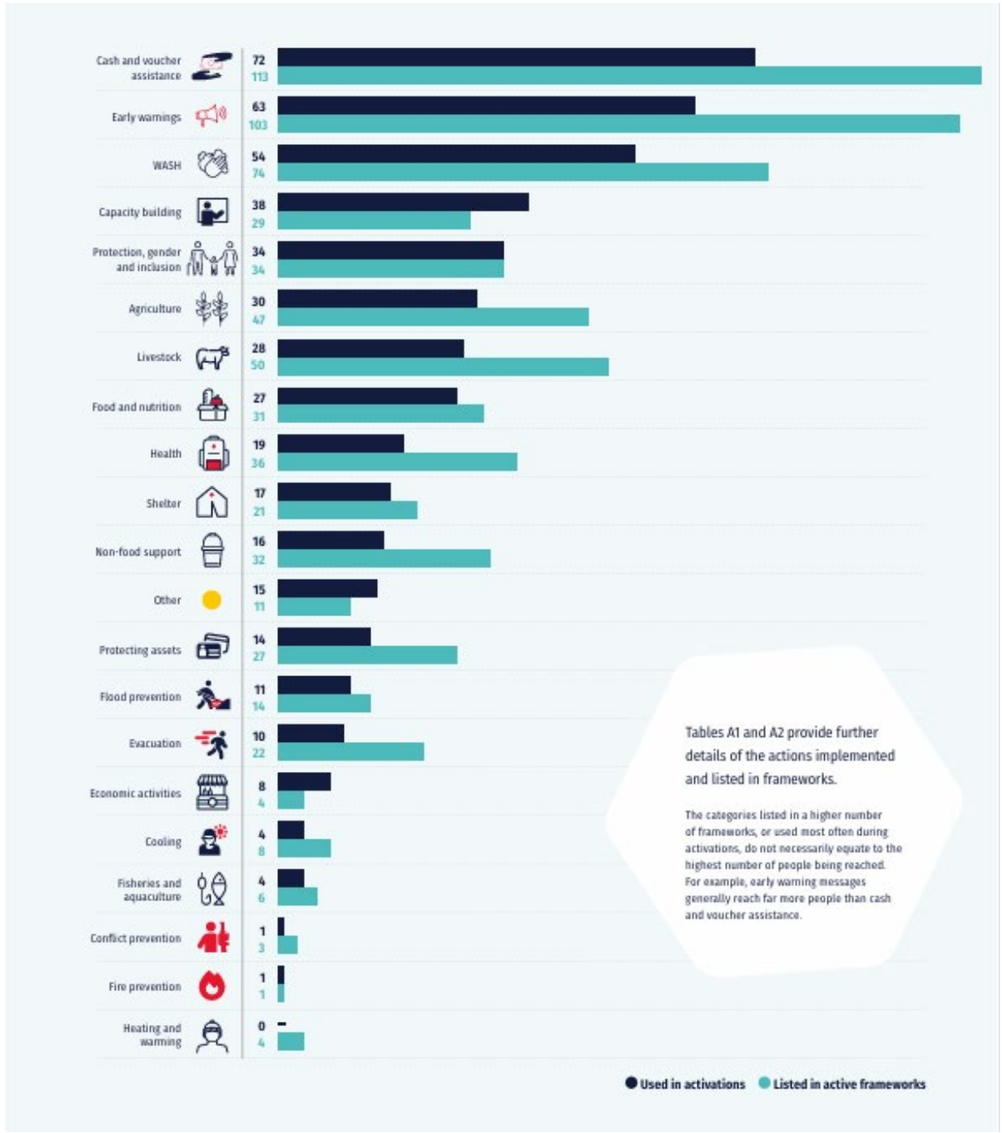


Figure 19. Anticipatory action in 2024: Types of actions (source: Anticipation Hub, 2025)

125 https://www.anticipation-hub.org/news/sri-lankas-government-convenes-the-first-meeting-of-the-national-anticipatory-action-working-group
126 https://www.anticipation-hub.org/exchange/working-groups/
127 https://cash-hub.org/

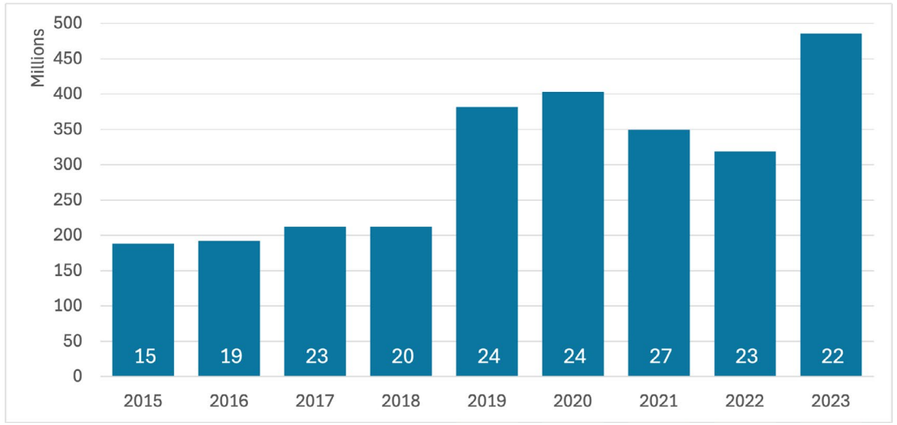


Figure 20. Number of people evacuated per year from 2015–2023; bar height representing the number of people (in millions) pre-emptively evacuated, numbers inside the bars representing the number of countries reporting (source: SFM, data as of March 2025)

Evacuation also remains an anticipatory action when taken in response to forecasts. It may become necessary to evacuate the population that is most at risk – either due to its location in relation to the approaching hazard (exposure) or its vulnerability, or a combination of the two. Globally, between 2015 and 2023, there were 2.7 billion instances of people being evacuated pre-emptively (see figure 20).

The figures relating to pre-emptive evacuation are highly disproportionate in terms of regional distribution. More than half of the people who have been protected through pre-emptive evacuations up to the end of 2023 have been located in the Asia-Pacific region, consistent with previous reports (see figure 21). The second largest number of evacuations took place in Europe and Central Asia, where the proportion was relatively similar to the data at the end of 2022 (as reported in last year's report). Meanwhile, in the Americas and the Caribbean, the number of people evacuated more than doubled: from 155 million in 2022 to 322 million by the end of 2023. Although the Arab States evacuated the smallest number of people overall, the number of people evacuated has increased from 1.4 million by the end of 2022, to 21 million by the end of 2023 – almost 15 times as many people were pre-emptively evacuated in the Arab States in 2023 as had been evacuated in the previous seven years.

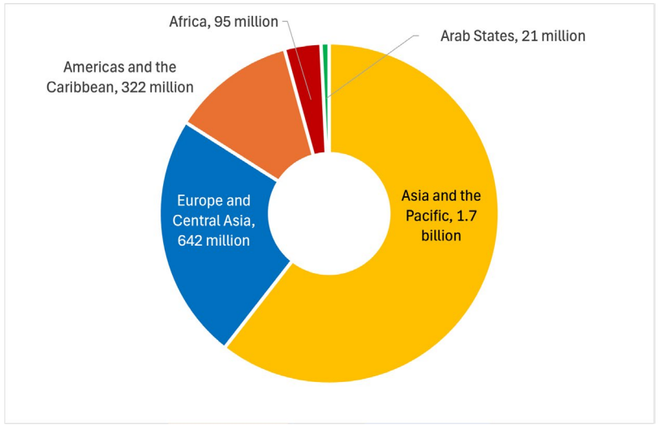


Figure 21. Number of people protected through evacuation from 2015–2023, by region (source: SFM, data as of March 2025)

2.5.6.2 Scaling up anticipatory action in fragile, conflict-affected and violent contexts

A significant research focus in 2024 was the feasibility and effectiveness of anticipatory action in complex and protracted crises, including FCV contexts. During the year, there was notable progress in FCV settings, where 33 activations were completed, proving the model's viability even in complex environments (Anticipation Hub, 2025). There was promising work on anticipatory action in protracted crises, including against floods in Kenya and Somaliland (Save the Children Fund, 2024) and for displaced people in South Sudan (Easton-Calabria, 2024).

To support practitioners implementing conflict-sensitive, effective and sustainable anticipatory action in FCV contexts, a toolkit for anticipatory action in FCV settings was created by RCRCCC, the Anticipation Hub and the IWMI, enabled by the CGIAR Fragility, Conflict and Migration Initiative (RCRCCC, and IWMI, 2024).

Box 20

Community-led approaches to anticipatory action: Case studies from Bangladesh, Ecuador and the Philippines

In the Philippines, Cox's Bazar (Bangladesh) and Ecuador, anticipatory action demonstrated how proactive, community-led approaches can save lives and strengthen resilience.

In the Philippines, the International Organization for Migration (IOM) developed a forecast-based MHEWS in typhoon-exposed regions like Bicol, Caraga and eastern Visayas. Using probabilistic forecasting and pre-agreed triggers – such as wind speeds exceeding 136 km an hour – the system activated early distribution of cash assistance and modular shelters before typhoon landfall, enabling dignified pre-evacuation. Complementing this, localized flood alerts were co-designed with LGUs and residents through participatory mapping and manual tracking for signal-poor areas. A key element was the Risk Index for Climate Displacement, which overlays vulnerability and hazard data to predict displacement and guide local planning, and is now integrated into climate funding processes.

In Cox's Bazar, Bangladesh – home to the world's largest refugee settlement – IOM tailored a camp-level MHEWS for landslides, floods and cyclones, where terrain degradation and dense informal shelters posed extreme risks. Over 1,600 volunteers (50 per cent women) formed disaster management units to issue warnings via sirens, megaphones and radio networks. Anticipatory measures included relocating households from danger zones, implementing nature-based solutions like bamboo slope reinforcement and pre-positioning emergency supplies. Local coordination – including partnerships with government, host communities and "Camp-in-Charge" officers – enabled drainage improvements and awareness campaigns, reducing fatalities and expanding EWS coverage to over 500,000 residents.

The coastal city of Manta in Ecuador has advanced its tsunami preparedness through a community-led approach, combining technical innovation with local engagement. Partnering with the Japan International Cooperation Agency (JICA), the Manta municipal government introduced visible communication tools in flood-prone public spaces, including "totems" with QR [Quick Response]-linked web maps showing evacuation routes and 23 designated safe zones. These efforts were bolstered by in-person outreach and social media campaigns designed to build public awareness and autonomy in disaster response. Community participation has steadily grown, with evacuation drills in 2023 and 2025 showing marked improvements in responsiveness. By 2025, 4,000 residents and 60 institutions took part, voluntarily initiating evacuation upon siren activation and effectively navigating routes using locally understood signage. This demonstrated a shift from reliance on officials to empowered self-protective action. Having experienced the benefits of this approach, the municipal government doubled its preparedness budget and expanded coverage of visual alerts. Evacuation speeds remain a challenge, requiring ongoing work with communities.

2.6 Cross-cutting enablers and principles

The EW4All logic model highlights the importance of an enabling environment for the effective delivery of MHEWS and identifies a series of cross-cutting "enablers" and "principles" that underpin the success of MHEWS.[128] Under this, five enablers have been identified:

- Strong governance through clear institutional, policy and legislation frameworks in place for the development and implementation of EWS
- Effective coordination between relevant agencies and stakeholders
- Targeted communication, outreach and advocacy to promote the benefits of MHEWS at national and local levels
- Plans for the development and implementation of MHEWS – developed, financed and operationalized
- A global mechanism in place for monitoring countries' MHEWS capacities

Together, these enablers ensure that MHEWS are inclusive, actionable and sustainable.

The EW4All logic model also identifies eight guiding principles: (a) people-focused; (b) accountability; (c) inclusiveness; (d) collaboration and integration; (e) multi-hazard and multifunctional; (f) relevance and context; (g) technology, innovation, and forward-looking; and (h) sustainability.

In this section, we address selected enablers and principles to highlight prominent and emerging themes.

Box 21

Enabling a national EWS: A case study from Mozambique

Mozambique has faced a sharp rise in climate-related disasters in recent years, prompting the government – supported by various United Nations agencies – to develop a national integrated MHEWS. Key actions included the development of climate risk profiles, the provision of technical support to meteorological institutions, the introduction of localized SMS alerts and coordination across sectors. Forecast-based financing pilots and anticipatory action protocols have been used ahead of storms like Cyclones Freddy and Jude to trigger early evacuations, pre-position supplies and protect livelihoods. United Nations agencies have also worked with community-based committees to support public outreach and preparedness, while investing in infrastructure through initiatives like the SOFF-funded weather station expansion.

While these efforts have helped increase early warning coverage and link national plans to community response, challenges persist. Gaps in observational data, limited digital access and constraints in local capability still hinder the system's full effectiveness. Although significant populations received alerts and some anticipatory responses were activated, long-term sustainability will depend on integrating these systems into broader development policies, maintaining infrastructure and ensuring inclusive governance across remote and high-risk areas.

128 https://wmo.int/sites/default/files/2023-11/Theory-of-Change_EW4All_FINAL.pdf

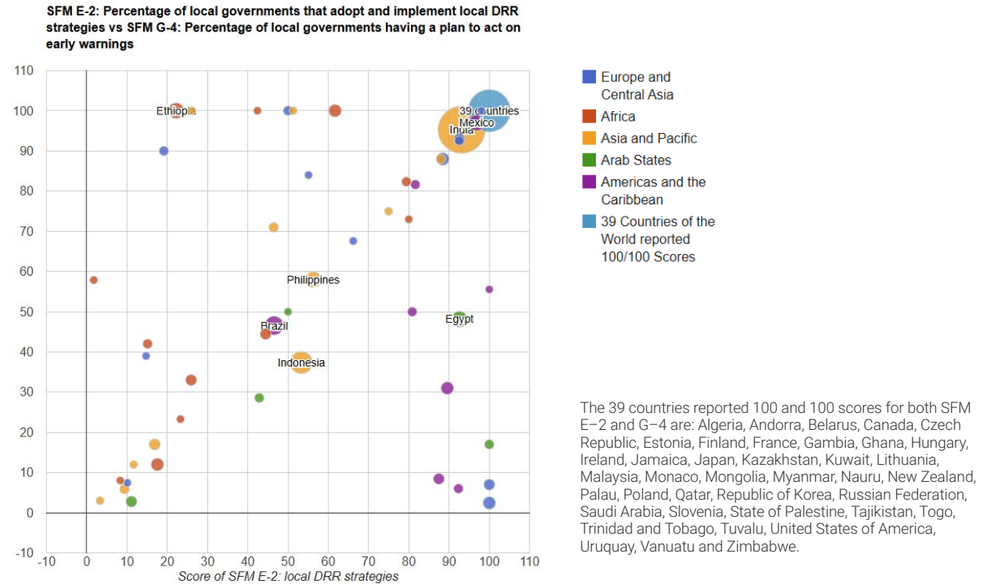
2.6.1 Governance

Governance plays a critical role in the effectiveness, sustainability and inclusiveness of MHEWS, ensuring strategic coordination and policy frameworks. Among the 119 countries that have reported having MHEWS, 112 of them (94 per cent) also reported having a national DRR strategy in alignment with the Sendai Framework. A moderate positive correlation is also observed between the establishment of a national DRR strategy (SFM indicator E-1 scores) and the existence of MHEWS (SFM indicator G-1 scores).

Section 1.4 highlighted how MHEWS has emerged as a unifying basis for the global agendas. This is also seen at the national level, where MHEWS prominently gets reflected as a key action area in both DRR strategies and NAPs. Countries are increasingly applying a comprehensive risk management approach to the integrated implementation of NAPs and DRR strategies.[129]

More importantly, countries with more comprehensive DRR strategies (that is, higher scores), tend to have more comprehensive MHEWS. For instance, for countries with a low score for DRR strategies (below 0.5), only 3 out of 101 countries reported capability in all four pillars; however, this increased to 31 countries when it came to countries with a higher score for DRR strategies (above 0.5). Consistent with this finding, the average score of comprehensiveness of DRR strategies is 0.64 for countries reporting on only one MHEWS pillar, increasing to 0.77 for countries reporting on all four pillars.

At the local level, 88 countries have indicated the proportion of their local governments that have a plan to act on early warnings (Pillar 4, and SFM G-4), as well as established local DRR strategies and plans (SFM E-2). Figure 22 shows a moderate correlation between the coverage of local DRR plans and local plans to act on early warnings (Pearson's coefficient at ρ = 0.60). Among the 88 countries reporting on both indicators G-4 and E-2, 39 countries have reported that all of their local governments have preparedness plans to respond to early warnings, and local DRR strategies or plans. This suggests that a coherent and well-supported approach to local planning – both for early warning response and DRR plans – is not only possible but may enhance integrated policies, resilience and resource optimization.



The 39 countries reported 100 and 100 scores for both SFM E–2 and G–4 are: Algeria, Andorra, Belarus, Canada, Czech Republic, Estonia, Finland, France, Gambia, Ghana, Hungary, Ireland, Jamaica, Japan, Kazakhstan, Kuwait, Lithuania, Malaysia, Monaco, Mongolia, Myanmar, Nauru, New Zealand, Palau, Poland, Qatar, Republic of Korea, Russian Federation, Saudi Arabia, Slovenia, State of Palestine, Tajikistan, Togo, Trinidad and Tobago, Tuvalu, United States of America, Uruquay, Vanuatu and Zimbabwe.

Figure 22. Correlation of G-4 (coverage of local governments with a plan to act on early warnings) and E-2 (local DRR strategies and plans) (source: SFM, data as of March 2025)

129 www.undrr.org/crm and https://www.early-action-reap.org/resources-comprehensive-risk-management

Box 22

Governance for MHEWS: Case studies from different levels

Examples of strong risk governance for MHEWS were seen in Latin American and the Caribbean this year.

Regional governance for MHEWS in the Caribbean
In collaboration with regional and international partners, the Caribbean Disaster Emergency Management Agency (CDEMA) established the Regional Early Warning System Consortium (REWSC) in 2019 as a strategic governance mechanism for MHEWS. Rooted in the region's comprehensive disaster management strategy and aligned with the Caribbean Community (CARICOM) Resilience Pathway, REWSC offers policy coherence, oversight and coordination across the MHEWS value chain – from risk identification to response. Informed by the findings of a 2016 EWS study (Collymore, 2016) and stakeholder consultations, REWSC integrates expertise from national agencies, academia and development partners to ensure institutional sustainability and has been endorsed by CDEMA. It has facilitated region-wide adoption of key operational tools, while advancing strategic instruments like the MHEWS checklist and model policy guide. REWSC also addresses challenges such as financial and human resource constraints through capacity development and resource mobilization. Data governance and interoperability issues are tackled through alignment with the CARICOM Strategic Framework for Regional Digital Resilience. High-level advocacy continues to reinforce institutional reforms, and phased implementation ensures resilience amid resource limitations.

National governance for MHEWS in Barbados
In 2024, Hurricane Beryl became the first ever category 5 hurricane to form in June,[130] highlighting an unprecedented early-season intensity in the Caribbean. While it had a devastating impact on multiple countries, fewer people died compared to similar hurricanes in the past. This has been attributed to government-led investments at the national and regional level, as well as coordinated efforts among the private sector, community organizations and the government. In Barbados, the national policy on MHEWS – which was developed with support from CREWS – proved effective in establishing clear roles and sustainable financing for the system. Proactive measures were also effectively taken by governments in other countries, such as Grenada and Saint Vincent and the Grenadines.

Municipal governance for MHEWS in Quito, Ecuador
In response to heavy rainfall and a mudflow in El Tejado ravine on 2 April 2024, municipal authorities in Quito demonstrated strong risk governance by swiftly supporting 48 affected families and deploying an inclusive, locally empowered MHEWS. The system included video surveillance, community sirens, flow-level monitoring in La Gasca and real-time alerts through WhatsApp, with messages categorized to guide public action: preventive, evacuation or event-in-progress. The response was made effective because of community-led activations, where trained local groups acting under the oversight of the local community risk management committee responded rapidly with evacuation support and first aid. Humanitarian aid reached 15 families, and 17 more received security kits, reflecting responsive service delivery.

Governance successes demonstrated by these three examples included empowering citizens with knowledge and autonomy, integrating local structures with technical systems and sustaining engagement through shared platforms. Challenges in urban cohesion, institutional coordination and message integration were overcome by innovations like community groups and phased system implementation. The case highlights how decentralized, transparent collaboration between government and citizens can build resilience and improve disaster response at the local level.

130 https://www.weather.gov/lch/2024Beryl

2.6.2 Coordination and stakeholder engagement

MHEWS work best with national and regional governments leading, but it is the end user – represented across multiple stakeholder groups – whom the systems must ultimately benefit and be tailored for. Making sure that the systems are most effective requires at-risk communities and sectors to co-develop and co-own them with clear roles and responsibilities, ensuring trust, timely action and long-term sustainability. Tailoring early warnings to user needs and capabilities through a participatory approach empowers recipients to make informed decisions and take early action based on their specific risks, priorities and capacities.

MHEWS rely on information flows among various actors, spanning governments, technical institutions, organizations, communities and individuals. To be effective, MHEWS need to be timely and universally accessible to all, addressing barriers such as language, literacy, trust, infrastructure limitations and disability-specific needs. They must also fully leverage the reach of the media and the power of technology, including traditional knowledge and local communication channels. To achieve this, science must connect with communities, and partnerships must be expanded – taking advantage of each stakeholder group's strengths and capacities.

The United Nations Plan of Action on Disaster Risk Reduction includes a priority on maximizing efforts around strengthening MHEWS. The 2024 progress report indicated that 141 of the 152 programme countries were supported on EWS by 17 United Nations organizations: 85 were supported through global early warning mechanisms, 122 through national mechanisms and 98 through regional ones.[131]

2.6.2.1 People-centred and inclusive

Despite increased investments, MHEWS often fall short of serving the people they are meant to protect. While efforts to broaden participation have improved, real-world implementation often lags behind stated commitments towards inclusive approaches.
As a result, these systems may fail to effectively reach, engage and meet the needs of diverse groups (Budimir, and others, 2025). It should be acknowledged that even in the absence of advanced infrastructure, community-based systems – including those using traditional monitoring and prediction techniques together with informal communication networks – can deliver timely and meaningful warnings and may be better received. Therefore, for MHEWS to be truly effective, at-risk communities and sectors must co-develop and co-own them within an institutionalized chain of responsibility – ensuring trust, timely action and long-term sustainability. Tailoring early warnings to user needs and capabilities through participatory approaches empowers recipients to make informed decisions and take early action based on their specific risks, priorities and capacities.

MHEWS must also recognize how hazards interact – triggering, cascading, amplifying or occurring simultaneously – and how vulnerabilities evolve dynamically across time and events in response. EWS that focus on single hazards can overlook these complexities, leading to contradictory or ineffective guidance. For example, during compound events like simultaneous floods and tornadoes, conflicting guidance can endanger lives. People-centred MHEWS include the use of IBF, tailoring communication to diverse audiences and ensuring preparedness actions do not inadvertently increase risk from other hazards. Three cross-cutting components essential for people-centred MHEWS involve: inclusive governance, community involvement, and attention to gender and equity. Communities, including marginalized groups, must be involved in every stage – from identifying relevant hazards to co-designing response protocols. Systems must also account for differentiated vulnerabilities, such as those based on gender, disability, disability or Indigenous identity, as well as other vulnerable groups, including migrants, non-native language speakers and visitors. Community networks, the adaptation of single-hazard systems to multi-hazard contexts, and the use of qualitative methods where data is scarce all offer opportunities for improvement (Budimir, and others, 2025).

131 https://www.preventionweb.net/sendai-framework/united-nations-plan-action-drr-resilience

©IFRC

Box 23

Understanding people: Case studies

Localising MHEWS fosters community ownership, which builds trust in warning institutions, thus increasing the likelihood of timely and effective response. The Community Trust Index for EWS, developed by the IFRC, is an evidence-based tool designed to measure and strengthen community trust in MHEWS, the actors behind them, and the information and alerts they provide. The tool is grounded in a people-centred approach, drawing directly from community voices and lived experiences. It was recently piloted in Mozambique and Nepal. Preliminary findings from pilots there reveal strong trust drivers – such as risk understanding and knowledge – but also point to concerns regarding transparency, inclusiveness and participation. Monitoring these gaps in trust drivers is essential for decision-makers to improve MHEWS from the perspective of local communities and to advance the effectiveness of MHEWS.

The government of the Lao People's Democratic Republic, through the Department of Meteorology and Hydrology, conducted a national EWS perception survey under CREWS and WFP with support from UNDRR, WMO and the Asian Disaster Preparedness Center. This assessment surveyed over 1,700 households across nine provinces and included focus group discussions with groups disproportionately affected by disasters – such as women, persons with disabilities, ethnic minorities, youth and older persons. The results indicated a high level of awareness and trust but also demonstrated the need to improve access for populations in isolated or risk-prone settings. Key recommendations included investing in localized, accessible and tailored information to ensure that early warnings are timely, understandable and actionable to all.

Box 24

Accessible and inclusive MHEWS: Case studies from diverse contexts

Evidence on inclusive approaches in MHEWS is growing, signalling increased momentum across diverse regions. Initiatives in Mali, Sudan, Cambodia, and Latin America and the Caribbean demonstrate how equity-driven strategies can strengthen MHEWS.

In Mali, with support from a CREWS project, over 2,100 individuals – including 393 women leaders – were trained to coordinate food security and disseminate early warnings in flood-prone areas. Their leadership during the 2024 floods helped embed gender-responsive governance into local disaster planning.

In Sudan, a 2024 Training of Trainers workshop convened with CREWS support brought together policymakers and civil society actors to integrate gender and disability inclusion into DRR frameworks. Despite conflict-related barriers, participants co-developed national roadmaps and inclusive early action tools, supported by regional collaboration with Somalia.

In Cambodia, the EWS1294 system was assessed for inclusivity between 2022 and 2025, leading to national guidance on mainstreaming gender equality and social inclusion in DRM. Community workshops and post-flood evaluations that were undertaken with CREWS support helped tailor alerts to the needs of women, children, older persons and persons with disabilities.

Complementing these efforts, the Latin American and Caribbean Women's Network for Disaster Risk Reduction – supported by UNDRR, the Global Network of Civil Society Organisations for Disaster Reduction (GNDR) and United Nations Women – has documented 43 regional best practices that leverage science, technology and innovation to empower women and girls in DRR (Latin American and Caribbean Women's Network for Disaster Risk Reduction, 2023). Their work emphasizes intersectional leadership and community-based risk communication, reinforcing Pillars 1 and 3 of MHEWS.

Together, these examples show that inclusive MHEWS can transform disaster preparedness into a more equitable, effective and people-centred process if the MHEWS is grounded in local leadership, with commitment from all of the institutions involved and supported through meaningful cross-sector collaboration.

2.6.2.2 Catalysing business engagement in MHEWS

Enhancing coordination with the private sector is a key part of an "all of society" approach to closing the MHEWS coverage gap. The participation of the private sector through both individual initiatives and public–private partnerships supports accelerated infrastructure development and brings innovative technological expertise.

Stronger engagement of the private sector is required more than ever. Clear roles and responsibilities are important for ensuring cohesive approaches, as defined in the CREWS operational procedures for private sector engagement (CREWS, 2023), which describe how businesses can engage in the four MHEWS pillars.

Adding to the guidance on engaging with business – including a report on the roles of state and non-state actors (REAP, 2024b) in 2025 – WMO and the World Economic Forum (WEF), in collaboration with the Australian National University, published a framework for understanding the roles that businesses can play in the MHEWS ecosystem, identifying challenges and recommendations (WEF, and WMO, 2025). Examples of how businesses relate to the risk knowledge segment are shown in figure 23.

Businesses as users: Users rely on MHEWS data to identify and assess risks, enabling proactive measures such as adjusting operations in high-risk areas. They also use this data to develop products and services to help others mitigate risks.	**Businesses as vendors:** Vendors provide advanced analytics platforms, including tools powered by AI and non-traditional data sources that enhance the ability to collect and process risk data more efficiently than traditional methods.
Businesses as partners: Businesses collaborate with public agencies by sharing data and co-developing tools that enhance collective risk knowledge.	**Businesses as innovators:** Innovators create cutting-edge tools, like AI-driven models and predictive analytics that offer faster and more accurate risk assessment.

Figure 23. Business engagement in risk knowledge

Box 25

Wildfire EWS involving the private sector: A case study from Guatemala

In Guatemala, NaturAceites a member of the ARISE and CentraRSE[132] networks for the private sector in DRR has been using satellite technology through a certified third-party provider to deliver real-time information on deforestation and potential fires in the area. The information is used to coordinate rapid response teams to contain risks. The satellite monitoring area covers a radius of 50 km around each point in the NaturAceites supply chain. Since its implementation in 2015, all incidents identified have been successfully contained.[133]

Box 26

Coordination for MHEWS: Case studies illustrating diverse contexts

Efforts in Cambodia, Central Asia, Costa Rica, Democratic Republic of the Congo, Nepal and Panama exemplify the growing emphasis on coordinated, people-centred MHEWS tailored to complex risk contexts.

In Nepal, local emergency operations centres, using tailored standard operating procedures, enabled anticipatory action ahead of the 2024 monsoon floods, which resulted in improved evacuation outcomes and showcased the value of collective municipal leadership and grass-roots coordination. The project has strengthened inclusive preparedness through locally led planning, early warning protocols and community engagement in remote districts like Panchthar.

Across five transboundary river basins in Central Asia, the Center for Emergency Situations and Disaster Risk Reduction along with national hydrometeorological services, supported by the German Agency for International Cooperation (GIZ), are advancing cross-border flood preparedness through harmonized data-sharing protocols. Despite challenges in basin selection and stakeholder trust, trilateral meetings and standardized formats are laying the groundwork for collaborative forecasting and upstream-downstream risk mitigation.

In the transboundary Sixaola River basin shared by Costa Rica and Panama, an initiative strengthened joint watershed governance and hazard management through a bi-national EWS. Emphasizing community empowerment, gender equity and women's empowerment, and Indigenous knowledge, the project responded to limited hydrometeorological infrastructure – just one weather station across 146 km – and mounting environmental pressures. By engaging 30 institutions and representatives from seven Indigenous territories, it improved risk knowledge and forecasting capability via new stations, sensors, predictive models and climate-responsive floodplain mapping. Participatory validation and community emergency committees connected 88 communities with national authorities, enabling inclusive DRR planning. Outreach strategies featured multilingual messaging, digital resources and local radio, while governance was formalized through MoUs and bi-national protocols. The initiative not only enhanced disaster preparedness but also restored ecosystems, strengthened social protection and livelihoods, and demonstrated that when meaningful cross-border collaboration puts people first, geographic and institutional boundaries can be bridged.

In Cambodia, a nationwide initiative under the CREWS project developed the EW4All roadmap and introduced IBF in three river basins. Partnerships with national agencies, NGOs and civil society have enabled community-based flood management, gender-responsive training and subnational emergency planning. The leadership of Cambodia in coordinated MHEWS is now recognized at international DRR forums.

In South Kivu and Maniema provinces of the Democratic Republic of the Congo, anticipatory action led by Humanitarian Action for Africa has improved early warning coverage for floods and landslides in rural communities that previously had no warning infrastructure. Local volunteers conducted seasonal awareness campaigns and monitoring activities, reducing disaster impacts by advising communities to take low-cost, scalable anticipatory actions like roof reinforcement and pre-emptive evacuation. Linking community alerts to governance systems enhanced trust and responsiveness, despite limited resources.

Together, these initiatives demonstrate that successful coordination in MHEWS requires multilevel partnerships, locally adapted strategies, and efforts to bridge institutional gaps and geographic divides. Whether through cross-border information exchange, subnational alignment or village-based alert networks, the integration of scientific tools and community voices is key to safeguarding lives and livelihoods under increasingly unpredictable risk conditions.

132 RSE is the Spanish acronym for corporate social responsibility (responsabilidad social empresarial).

133 https://www.undrr.org/media/104498/download?startDownload=20250907

2.6.3 Communication, outreach and advocacy

Communication to disseminate early warnings to at-risk populations is covered by Pillar 3 of MHEWS (see section 2.4). However, the EW4All cross-cutting enabler, communication, outreach and advocacy, is framed around the need to influence and promote stakeholders to support MHEWS.

Communication can be used to achieve greater change by shaping how society understands risk and MHEWS (not just alerts), shifting knowledge about threats, challenging risk perceptions, sparking innovation for local actions, supporting informed debates and holding decision-makers to account.

There is growing recognition that media, and communication more generally, plays a pivotal role in risk reduction and MHEWS. The first ever dedicated thematic session on risk communication was held at the Global Platform for DRR in 2025, and the call to strengthen communication systems was reiterated throughout other sessions, urging governments to engage with media channels long before disasters happen and to meet with them regularly to build relationships. Presentations and discussions in other sessions also emphasized that populations should be viewed as active participants in risk reduction and MHEWS, not passive recipients of warnings.[134]

Communicating with people about Indigenous and local insights can enhance risk knowledge for all stakeholders involved, and it is important for valuing traditional knowledge and its custodians. Public discussions not only expand people's understanding of risk, but can also increase their willingness to consider scientific approaches alongside traditional or religious beliefs. When communication supports more advanced understanding of observation, monitoring and forecasting processes, and outreach involves communities in an active dialogue about these activities, people can become more trusting of advice based on science and more forgiving of "false alarms". When dissemination of alerts occurs, publics that are well-informed about and trusting of MHEWS will share alerts with hard-to-reach and vulnerable populations, expanding the reach and impact of alerts. Engagement with communities about preparedness to act can help highlight local barriers, identify the needs of vulnerable groups, "crowdsource" innovative solutions and encourage an "all of society" approach to risk reduction. People who are involved, informed, enabled and confident to act will be better placed to make well-judged decisions when warnings are issued.

Despite the potential for communication to serve as a cross-cutting enabler of MHEWS, it is rare for countries to have long-term, evidence-based communication strategies to enhance public dialogue and decision-making that ultimately improve MHEWS and public action. Integrating such communication strategies into DRM and MHEWS plans offers untapped potential for change at scale.

2.6.4 Finance

Last year's report highlighted the critical need for sustainable and sufficient funding to build, maintain and operate MHEWS. MHEWS are often financed through national budgets, public–private partnerships, and bilateral and multilateral financing, including via loans or grants. Yet many countries, especially LDCs and SIDS, continue to face challenges in securing long-term operational resources.

2.6.4.1 Global Observatory

A significant milestone in the understanding of MHEWS financing was achieved this year, with the release of a common taxonomy for MHEWS financing and the launch of the Global Observatory for EWS Investments,[135] forming key outputs of EW4All (see section 3.5). These two resources offer a critical window into the evolving landscape of investments in MHEWS.

The Global Observatory continues to serve as the central mechanism for tracking MHEWS investment, drawing on project-level reporting. In its 2025 reporting cycle, it shows nine funding institutions financing 365 active MHEWS projects in 131 countries, up from 329 projects the previous year. While Africa and Asia are the two main regions benefiting from these projects[136] – 34 and 35 per cent of all projects respectively – all continents are represented (see figure 24). Low- and middle-income countries account for 56 per cent of investments, and LDCs for 35 per cent.

134 https://www.undrr.org/news/global-platform-elevates-risk-communication-essential-disaster-risk-reduction

135 The organizations involved in the Global Observatory are: the Adaptation Fund, the African Development Bank Group, the Asian Development Bank, CREWS, the Global Environment Facility, GFDRR, the Green Climate Fund (GCF), the Inter-American Development Bank, the SOFF, and the World Bank.

136 Regions for the Global Observatory are grouped slightly differently from UNDRR regions, reflecting a grouping more similar to WMO regions.

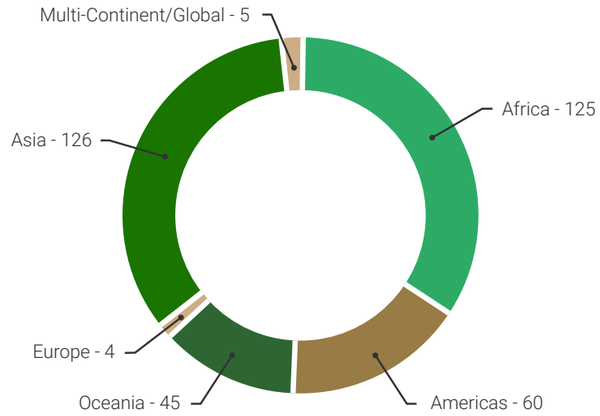


Figure 24. Regional distribution of EWS-related projects (source: UNDRR and WMO Global Observatory, 2025).

The latest reported figures for 2024 reveal that $4.04 billion in funding has been approved for MHEWS. One of the most striking insights from the latest data is that 41 per cent of all national-level MHEWS investments are concentrated in just four countries, due to the significant loans in these countries focused on EWS (see figure 25). There is a marginal reduction in the geographic concentration of MHEWS investments from the previous cycle.

While this statistic is not adjusted for population size, risk exposure or the baseline cost of achieving full MHEWS coverage, it nonetheless enables funders and implementers to review current investment trends. It also bears noting that this statistic does not include regional and global projects – which are featured separately in the Global Observatory – because regional investments cannot reliably be attributed to a single country.

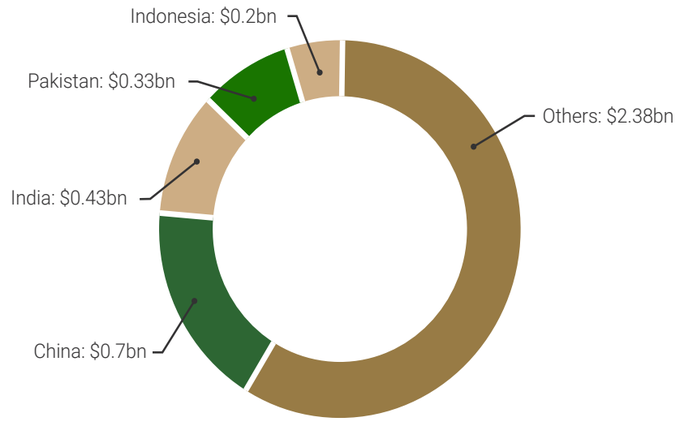


Figure 25. MHEWS funding by country national projects (source: UNDRR and WMO Global Observatory, 2025)

In terms of multilateral financial flows, the Green Climate Fund (GCF) leads in this year's dataset as the top financier of MHEWS to date, with $2.21 billion invested. It is followed by the Asian Development Bank and the World Bank, which have committed $1.46 billion and $1.06 billion, respectively. This demonstrates the growing role of climate finance in supporting adaptation measures, such as MHEWS, and the potential to scale up resources for countries with the right enabling conditions.

Similar to geographic concentration, the share of projects utilizing loan or credit modalities dropped from 75 to 69 per cent, due to the increased role of GCF in this space. However, across the portfolio of reported projects, loans and credits remain the dominate modalities, accounting for 44 per cent and 25 per cent of investments, respectively (see figure 26). Loan financing has important implications for countries with limited fiscal space, many of which face debt distress. These nations often struggle to take on additional borrowing – even for high-return investments like MHEWS that reduce future disaster losses. Therefore, it is especially significant that a third of investments are grant-based, offering a critical financing pathway to develop MHEWS capabilities without exacerbating fiscal risk. Increasing the share of concessional or blended finance, including results-based grants, could therefore be a strategic focus for both donors and implementers.

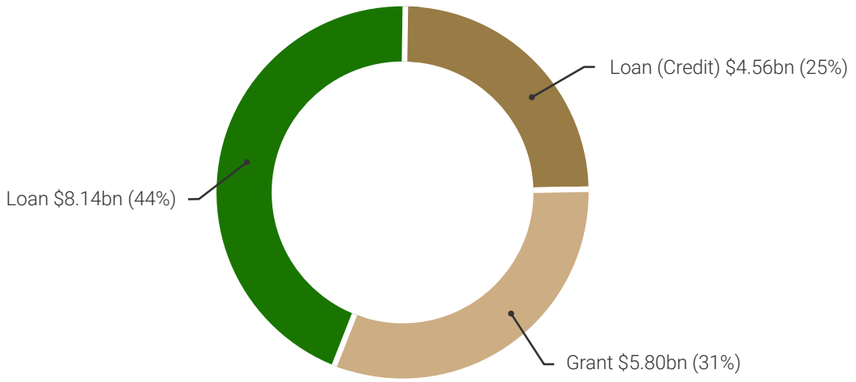


Figure 26. This graph illustrates the financial breakdown of 365 active projects, totalling $18.5 billion, comprised of grants, loans, and credits. Notably, only 22 per cent of the total funding ($4.04 billion) is allocated to EWS. (source: UNDRR and WMO Global Observatory, 2025)

More specifically, in national-level projects, LDCs predominantly receive MHEWS investments in the form of grants (95 per cent), similarly to countries in the SIDS category (68 per cent), while low- and middle-income countries access funding mostly through loans (45 per cent compared to 24 per cent for grants). This reflects that the MHEWS financing instruments available to countries are largely suited to their fiscal contexts.

In terms of Organisation for Economic Co-operation and Development (OECD) tracked bilateral investments in MHEWS, 23 donor countries have reported contributing over $923 million to MHEWS efforts in 99 recipient countries, using grant modalities. Recipient countries are predominantly located in Africa, with a mix of both national- and regional-level interventions. This trend reflects both humanitarian priorities and an increasing recognition of the Africa region's vulnerability to multi-hazard risks, including floods, droughts and food insecurity, where timely and localized warnings are most critical.

The taxonomy of the Global Observatory – designed to align with the EW4All four-pillar framework – enables disaggregation of financing by MHEWS component. The analysis reveals that funding is most strongly associated with Pillar 1 (disaster risk knowledge) and Pillar 2 (detection, observations, monitoring, analysis and forecasting) (see figure 27), underscoring a continued emphasis on technical and data infrastructure. However, the taxonomy also shows that more than a third of projects span across all pillars, which indicates a growing trend towards integrated and cross-sectoral MHEWS programming. These multi-pillar projects represent an important shift towards end-to-end MHEWS – those that not only generate risk data but also ensure that communities receive, understand and act on timely warnings.

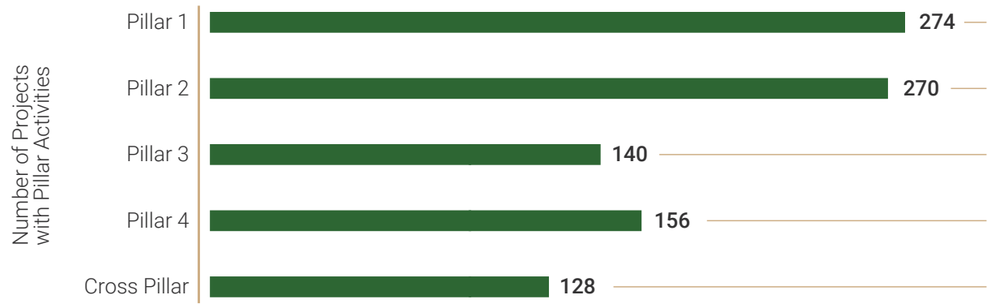


Figure 27. Number of projects with activities focused on each pillar (source: UNDRR and WMO Global Observatory, 2025)

2.6.4.2 Financial mechanisms that support MHEWS

Significant funding mechanisms focused on supporting the scale-up of MHEWS are outlined in this section.

The CREWS initiative is an operations-led funding initiative that is dedicated to supporting action on MHEWS in LDCs and SIDS. The CREWS portfolio totals $139.5 million in MHEWS financing through 11 national and 8 regional active programmes, with additional funds approved for new phases of existing programmes for the Pacific SIDS and in South-East Asia. ASW continues to expand as a rapid technical support mechanism, providing up to $250,000 for a maximum of 12 months, with 16 approved technical assistance grants. Six countries have transitioned to scaled-up projects through the GCF-CREWS Simplified Approval Process, which provides fast-track access to up to $25 million in GCF finance. For example, Togo was approved in February 2025 for $27 million, including co-financing across 10 years, with two more proposals expected to be approved in 2025 and 15 more in the pipeline for the period of 2025 to 2027 (see section 4.1.1).

SOFF has mobilized $100 million to support 61 countries approved for readiness phase funding, with a focus on LDCs and SIDS. This includes $9.2 million in short-term phase-one readiness funding for publicly available hydrometeorological diagnostics to inform national planning and further investment, alongside $90.8 million in long-term phase-two investment financing approved for 15 countries transitioning from the readiness phase, with 14 more in the pipeline. The third phase, compliance, will offer results-based payments to countries sharing GBON data – an important development in the financing of models to address the challenge of sustaining operations and maintenance activities. The SOFF Framework for Collaboration ensures that investment benefits are disseminated throughout the MHEWS value chain (see section 4.1.2).

Through its climate information and EWS portfolio, GCF funds numerous projects that are aligned with the global ambition of MHEWS scale-ups. To date, GCF has invested close to $933 million in MHEWS projects, consisting of 62 projects – 42 in LDCs and 35 in SIDS[137] – and early warning initiatives such as CREWS. GCF recently approved over $114.6 million for a multi-year project to accelerate access to global and regional technical and operational support for the development of comprehensive MHEWS and to address policy gaps, strengthen inter-agency coordination and strategies, build technical and scientific capacities, and promote effective local action.[138] The available roadmaps developed through the EW4All initiative directly guided the prioritization of activities and financial support. The project will be implemented by the governments of Antigua and Barbuda, Chad, Cambodia, Ecuador, Ethiopia, Fiji, and Somalia with the support of UNDP and the four EW4All pillar leads.

137 https://www.greenclimate.fund/theme/early-warning-systems
138 https://wmo.int/media/news/green-climate-fund-grants-boost-early-warnings-all

Embedding MHEWS within national systems requires sustained financing through long-term stakeholder engagement and co-ownership. The Zurich Climate Resilience Alliance, Practical Action and REAP published a policy brief, Enhancing Finance for People-Centred Early Warning Systems (Mall, and others, 2025), which offers actionable recommendations to reorient MHEWS financing towards systems that are inclusive, locally owned and integrated across government and humanitarian-development sectors. Accelerating domestic capacity-building and multi-stakeholder engagement is essential for sustained national MHEWS financing and for the delivery of effective EWS and anticipatory action services. In Togo, following approval under the GCF Simplified Approval Process for CREWS Scale-Up, collaboration between Togolese authorities and various organizations – including GCF, UNDRR, WMO, ITU, IFRC, the West African Development Bank and EW4All partners – saw the strengthening of stakeholder capacity under the project based on national priorities. Similar efforts are now being considered for replication in other countries and regions.

2.6.5 Monitoring and evaluation

EW4All has a robust monitoring and evaluation (M&E) framework and process (see section 3.2), yet efforts to evaluate the effectiveness of MHEWS remain uneven and underdeveloped, particularly when viewed against the full set of effectiveness dimensions outlined in emerging global frameworks and in the MHEWS Effectiveness Index (see box 31). While technical aspects such as accuracy and timeliness are more readily measurable – often through automated verification processes or comparisons between forecast and observed events – other critical indicators (including relevance, accessibility, actionability and responsiveness) remain poorly assessed in most contexts.

These latter dimensions require a deeper understanding of how different communities experience and interact with warnings: whether the messages are tailored to their needs, conveyed in trusted formats and languages, understood clearly and ultimately acted upon in ways that reduce harm. This kind of evaluation demands investment in both qualitative and quantitative methodologies – from surveys and interviews to behaviour-tracking studies and community feedback mechanisms. Yet, many DRM agencies, particularly in resource-constrained settings, lack the technical expertise, funding and institutional mandate to undertake such evaluative work on a routine basis. Furthermore, these essential M&E activities are not always factored into the design of projects and programmes, even if it is best practice to do this from the outset.

The absence of consistent measurement practices leads to critical knowledge gaps: we often know that a warning was issued, but not whether it led to timely action or whether it reached the people most at risk. Moreover, without structured mechanisms to capture and share lessons learned, progress remains localized and best practices fail to inform system improvements elsewhere.

There is an urgent need for global guidance on how to evaluate MHEWS comprehensively – drawing from both scientific and user-centred approaches – and for platforms to share this learning across countries and sectors. It is also desirable for the M&E frameworks of projects and programmes to align more closely with existing targets – including Sendai in terms of "access" to MHEWS, and EW4All in terms of "global coverage". Such collective efforts would strengthen accountability, promote innovation and ensure that MHEWS not only function technically but fulfil their primary objective: protecting lives and livelihoods in the face of escalating climate and disaster risks.

2.6.5.1 After-event review methodology

In the context of evaluating MHEWS effectiveness in an applied operational setting, EW4All has developed an after-event review (AER) methodology as a structured approach to assessing the performance of an MHEWS following a disaster or hazardous event.

The AER conceptually aligns with the six dimensions of effectiveness: relevance, timeliness, accuracy, accessibility, actionability and responsiveness. It guides users on how to conduct a comprehensive review of the entire MHEWS process, including how hazards were detected, how forecasts were produced, how warnings were issued and disseminated, and how effectively stakeholders and communities understood and acted on those warnings. It also examines stakeholder coordination and the capacity of the system to enable timely and appropriate responses. By analysing these aspects, the AER identifies key lessons learned, offering actionable recommendations for strengthening MHEWS and building greater resilience for future hazards.

This methodology is flexible and adaptable to a wide range of hazards and scalable for small incidents as well as major disasters. It can also be used in post-disaster evaluations, near misses, close calls and false alarms, supporting continuous improvement of MHEWS.

Box 27

Measuring the impact of community-led EWS: Case study from Uganda

In the flood-prone settlement of Bwaise, Kampala, the Daraja project has demonstrated how community-led EWS can meaningfully strengthen climate resilience when impact measurement is prioritized from the outset. Launched in April 2023, the initiative brought together residents, the Uganda National Meteorological Authority, ACTogether and other city stakeholders to co-design weather and climate information tailored to local needs.

From the initial design stage, M&E (and learning and accountability) was embedded in the project, which developed a participatory action research framework to track the access to, comprehension of, and actions taken in response to received forecasts and warnings by 35 community members. This deliberate method revealed notable improvements as a result of project interventions: access to climate information rose from 59 per cent to 100 per cent, understanding of forecasts increased from 44 per cent to 63 per cent, and implementation of early actions based on warnings reached full coverage. These metrics – collected through real-time feedback loops, interviews and visual documentation – validated the effectiveness of the Daraja model and ensured it remained adaptive to community realities. By emphasizing impact measurement not just as a reporting tool but as a mechanism for learning and accountability, Daraja offers a model for scaling EWS that are trusted and transformative.

2.6.6 Technology and innovation

Technology is improving MHEWS by enabling faster, more accurate and more actionable information for decision-making. For example, fibre-sensing technologies can be used to advance EWS for volcanic activity by measuring underground movement more precisely and quickly than conventional sensors, giving the public between 30 minutes to several hours of advance notice.[139]

A UNFCCC and GEO policy briefing on how innovation and technology can improve risk knowledge is covered in section 2.1.1.3. A United Nations Special Report on the use of technology for DRR (UNDRR, 2025b) highlighted challenges and recommendations for the use of technology in MHEWS. The key findings were that data collection and security require advanced storage and processing capabilities, especially for large volumes; poor interoperability between different systems and platforms can hinder efficiency; and the co-design, scalability, adaptability, and sustainability can be limited by geographies and demographics. Recommendations that can optimize information flows for MHEWS include using internationally recognized standards for providing forecasts and natural hazard monitoring data; regularly updating staff capabilities across multiple hazards and related social issues; and establishing governance models that include a wide range of stakeholders in MHEWS (UNDRR, 2025b).

139 https://www.caltech.edu/about/news/fiber-sensing-technology-can-provide-early-warning-for-volcanic-eruptions

Box 28

New – and old – technologies help scale up EWS: A case study from Chile

In Chile, mobile phone applications are enabling people to report adverse events, which can enhance hazard awareness and strengthen community capacity to detect them through community monitoring. The National Service for Disaster Prevention and Response (SENAPRED, by its Spanish acronym), with the Red de Informantes Mercalli (Mercalli Informants Network), uses such an app. After an earthquake, local populations report their perception of the intensity and damage to authorities through official channels using standardized information and protocols, based on training they receive from SENAPRED. Such initiatives can be implemented through communication systems with low connectivity and technological requirements that are able to reach much of the population, such as walkie-talkies and mobile phones (UNDRR, 2025b).

Box 29

Non-technical innovations also enable MHEWS

While technology and innovation are often used synonymously, there is a subtle difference. Innovations are not limited to technology and may include ways of working, including the development of new operational procedures – for example, the new operational procedure by CREWS for FCV contexts – or the development of new funding models, such as SOFF. Communities of practice are another mechanism for surfacing and sharing new innovations, such as the MENA Community of Practice developed in 2024 by IFRC and WFP (see section 2.5.5).

2.6.6.1 Artificial intelligence applications for MHEWS

AI, including deep learning and machine learning, is already transforming the MHEWS space – both overall and within the pillars. This has been especially evident in the case of observations and forecasting. Where previously, huge teams of experts and massive supercomputers were needed to produce forecasts, AI models can now be run on a laptop and present results within minutes. At the other end of the scale, several major technology companies and academics have released AI-based weather forecasting systems in recent years.[140] AI is being used across the meteorological value chain, starting with the processing of observations – including data quality control and bias correction[141] – through to the production and dissemination of tailored forecasts. Beyond its potential for predicting future hazard conditions, a recent study (Camps-Valls, and others, 2025) suggests that AI can also be a tool for understanding extreme climate events on nature and people's lives, estimating their impacts and effectively communicating risks. More recently, AI has been used for immersive visualization to create an interactive visual framework for displaying 3D geospatial wildfire data as it relates to disaster risk and resilience (see box 3). Remote sensing is able to provide up-to-date population estimates, and AI can process mobile big data to understand population shifts and allocate resources appropriately. Other MHEWS-related applications of AI have also been highlighted in recent reports (see box 29).

140 https://e360.yale.edu:8443/features/artificial-intelligence-weather-forecasting

141 https://www.ecmwf.int/en/newsletter/167/meteorology/data-assimilation-or-machine-learning

Box 30

Artificial intelligence: The potential for MHEWS

Over the past year, concerns about the viability of AI gave way to a surge in practical applications among organizations (Singla, and others, 2024). Yet concerns remain over how to ensure AI works for everyone. UNU outlines a series of potential applications, along with their risks (UNU-EHS):

- Advance disaster risk knowledge by gathering and analysing vulnerability and exposure data, which is particularly useful in areas where data is scarce. However, ensuring that AI models do not misinterpret or overlook the nuances of marginalized groups is crucial for ensuring people-centred principles.
- Accelerate hazard detection and monitoring through improved predictive analytics and real-time data assessments. The WMO Severe Weather Information Centre[142] uses AI to consolidate and disseminate severe weather information. However, this is reliant on significant resources and data, which may not be available in many countries.
- Improve communication and dissemination by optimizing when, where and how alerts are sent. AI can also translate alerts into multiple languages and customize information to highlight context-specific, impact-based alerts. Equally, AI can generate false and misleading information that spreads at speed and scale. Therefore, this requires stronger policies, professional skills and media literacy levels to maintain healthy communication ecosystems.
- Simulate emergency scenarios that boost preparedness and response. AI can present complex scenarios based on data, overriding our own limitations that prevent us from imagining certain events and how they may unfold. AI can also aid in preparing for scenarios, refining contingency plans, and allocating resources through real-time assessments. However, relying on untested AI methods for decision-making during fast-moving events with real-life consequences requires great care.

Recognizing the potential for AI to improve MHEWS, the AI for EW4ALL subgroup has been established[143] and is working with partners and key stakeholders to develop strategies to scale EW4All with AI applications.

The 2025 AI for Good Global Summit, organized by ITU in partnership with over 40 United Nations agencies and the Government of Switzerland, explored how advanced AI can surface early warning knowledge from fragmented data and how it can identify and quantify populations lacking connectivity to improve early warning dissemination. A hackathon on AI for EW4All[144] was hosted to explore solutions to address critical gaps in EWS for disasters and extreme weather events.

An inter-agency working group on AI, co-led by ITU and United Nations Educational, Scientific, and Cultural Organization (UNESCO), brings together United Nations system expertise on AI in support of the United Nations System Chief Executives Board and the United Nations High-Level Committee on Programmes.

142 https://severeweather.wmo.int/

143 The AI for EW4All subgroup is a partnership among ITU, UNDRR, WMO, IFRC, UNDP, UNFCCC, the ITU-WMO-UNEP Focus Group on AI for Natural Disaster Management, Google, Microsoft, GSMA, and GEO: https://www.itu.int/itu-d/sites/digital-impact-unlocked/enhancing-early-warning-systems-with-artificial-intelligence/.

144 https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Events/2025/AI-EW4All-Innovation-Challenge.aspx

Box 31

AI helps identify mobile connectivity “cold spots” for inclusion: A case study

While mobile networks are increasingly recognized as a critical channel for disseminating early warnings, a significant proportion of the world’s most vulnerable populations still live in areas with limited or no mobile connectivity. The problem worsens in the wake of disasters when infrastructure is damaged or destroyed. Without accurate, up-to-date information on where these connectivity “cold spots” are located, governments are unable to design equitable and effective alerting strategies.

The ITU, as part of the EW4All initiative, developed the Early Warning Connectivity Map (EWCM) together with Microsoft AI for Good Lab, GSMA, Planet Labs, and the Institute for Health Metrics and Evaluation at the University of Washington. The core challenge to solving the problem is threefold: determining which populations can be reached through available messaging channels; quantifying how many people are offline and therefore unable to receive alerts; and understanding how connectivity levels – and the capability to deliver warnings – change during and after disaster events. To address this challenge, ITU and partners developed the EWCM, which uses an AI-powered methodology[145] that integrates satellite imagery and advanced analytics to generate high-resolution, time-enabled population density maps. Overlaying this information with mobile network coverage data could then further identify areas in need of connectivity and inform decisions around rural network expansion. This AI-powered approach enables EWCM to provide a detailed and continuously updated view of connectivity gaps – crucial for planning EWS that truly leave no one behind.

The EWCM was first piloted in Fiji, Tonga and Vanuatu. Following the success of these initial deployments, the approach has since been scaled to 30 more countries, the majority being supported as part of the EW4All initiative. It has helped identify major coverage gaps where mobile early warning messages would fail to reach communities, which has strengthened national strategies for last-mile coverage and inclusion.

Data variability and patchy network coverage from mobile operators posed challenges in ensuring consistency. To mitigate this, EWCM aggregates nine distinct connectivity datasets and supplements them with real-time, crowd-sourced data. Ongoing validation with ITU Member States and continuous improvement of AI tools helps address data quality concerns. Supporting technical innovation with capacity-building efforts is important, ensuring that national authorities not only have access to high-quality data, but also possess the skills and tools necessary to interpret and apply it effectively in decision-making.

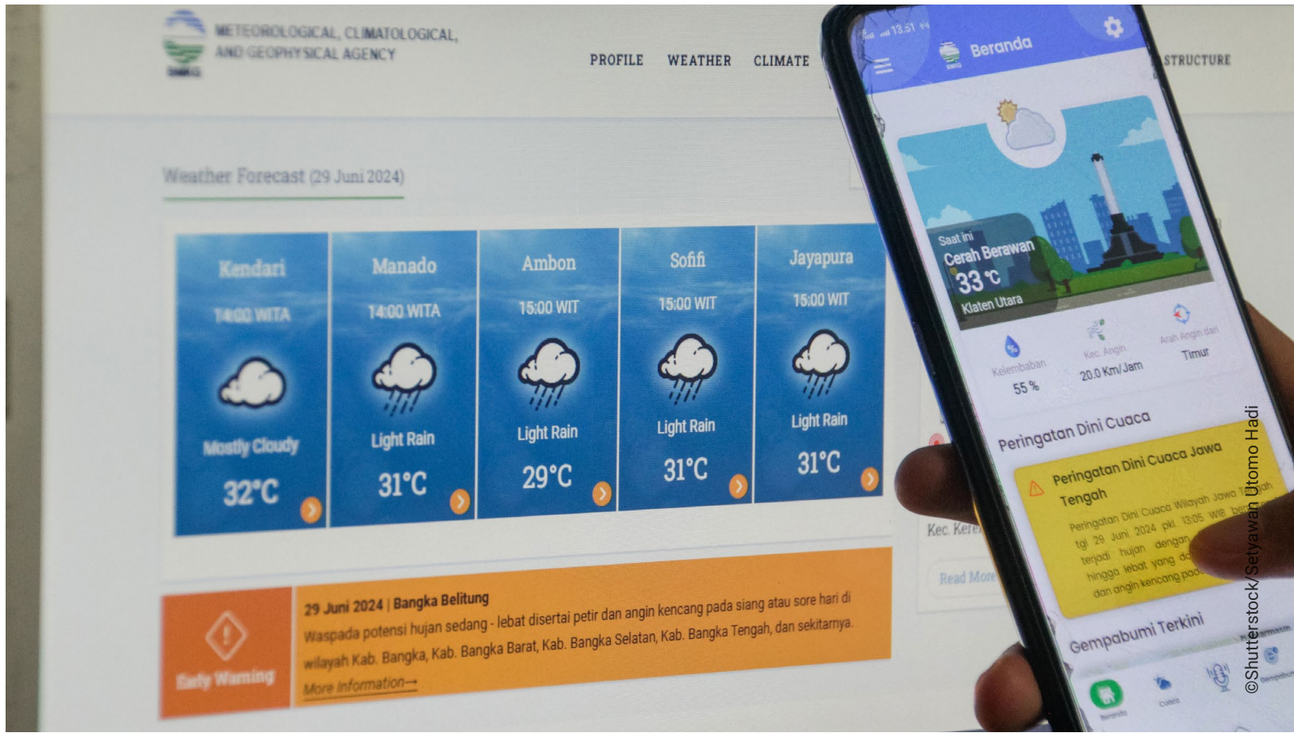
145 https://www.planet.com/pulse/ihme-microsoft-and-planet-collaborate-to-map-climate-vulnerable-populations-in-unprecedented-detail/

2.6.6.2 Digital tools that enable MHEWS

Across all parts of MHEWS, digital tools are enabling MHEWS and strengthening pillar capabilities. Across Africa, the roll-out of ClimWeb is bringing forecasting tools and CAP-enabled dissemination systems to NMHSs (see section 2.4.2).

In relation to Pillar 4, digital tools like AccessRC[146] are enabling more effective anticipatory action by transforming forecasts into fast, targeted and inclusive responses. With real-time self-enrolment, geotargeting, automated communication and multilingual accessibility, AccessRC enables vulnerable communities to pre-register and stay connected with their local National Society before, during and after disasters. This dramatically shortens the mobilization window, enabling cash and voucher assistance (CVA) to be deployed proactively – rather than reactively – and empowering people with the resources they need to take early, effective action. This is being tested now in the Caribbean with seven National Societies (Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, and Saint Vincent and the Grenadines) as part of readiness efforts for the 2025 hurricane season.

A resource for National Societies and local actors looking to strengthen their anticipatory capacity is the “CVA as anticipatory action” workshop package – developed by the IFRC, Anticipation Hub and partners – which links CVA preparedness directly into EAP development. It offers guidance, tools and learning to operationalize CVA as a proactive, agile modality for early action.



©Shutterstock/Setyawan Utomo Hadi

146 https://accessrc.org/

3

Progress in the Early Warnings for All Initiative

Image Source: ©UNDRR/Grandidier

3. Progress in the Early Warnings for All Initiative

Section 1.4 summarizes the growing recognition of MHEWS globally, with the most prominent initiative to date being EW4All. This chapter provides progress on this initiative in depth.

In 2022, the United Nations Secretary-General António Guterres launched EW4All with a clear and urgent goal: to ensure that everyone on Earth is protected by life-saving MHEWS. This global effort is a direct response to the growing risks posed by climate-related hazards, and it supports the achievement of Target G of the Sendai Framework.

3.1 Stakeholder involvement

The initiative is co-led by UNDRR and WMO, in partnership with ITU and IFRC. Each of these organizations leads one of the four core EW4All pillars: disaster risk knowledge (UNDRR); detection, observation, monitoring, analysis and forecasting (WMO); warning dissemination and communication (ITU); and preparedness and response capabilities (IFRC).

While national authorities are responsible for putting MHEWS into action, EW4All draws from a broad range of partners to offer technical support and policy guidance and to help coordinate efforts across regions and sectors. Partners from across the United Nations system, the humanitarian sector, civil society, international financial institutions (IFI), bilateral donors, the private sector, and academia are contributing their expertise and implementing activities that are building on decades of work to advance the effectiveness of MHEWS, and all are essential to the initiative's success. Following the United Nations development system reforms in 2018, the revitalized United Nations Resident Coordinators are playing a central role in mobilizing this breadth of stakeholders at the national level, and ensuring there is alignment of MHEWS with policy, financing, and capacity-building efforts on all aspects of sustainable development.

The United Nations Secretary-General established the EW4All Advisory Panel, co-chaired by the UNDRR Special Representative of the United Nations Secretary-General for DRR and the WMO Secretary-General. Convening bi-annually, the panel brings together leaders from international organizations, financial institutions, civil society and the private sector to: help shape strategy; monitor progress; share success stories, good practices and challenges; and keep MHEWS high on the global agenda. Regular global coordination meetings serve as a forum for partners to both receive updates on the strategic direction of the EW4All initiative as well as share progress, surface challenges, and align activities through the initiative's coordination mechanisms and governance structures. Member State briefings co-chaired by the UNDRR Secretary-General for DRR and the WMO Secretary-General provide strategic updates to Members, communicating opportunities to donors to fill gaps in implementation. These coordination mechanisms are essential for advancing a unified and inclusive approach to MHEWS for all and by all.

The meetings are informed by outputs from the EW4All M&E working group, supported by the EW4All Dashboard. The working group, composed of EW4All initiative partners, is developing a capacity baseline assessment to support country snapshots. These snapshots will present country-level data for all nations reporting to the SFM, highlighting capacities and effectiveness by pillar based on the EW4All Maturity Index. This information is in process and will be added to the dashboard to support monitoring, evaluation and resource mobilization.

3.2 Monitoring and evaluation of EW4All

The EW4All M&E strategy follows a twin-track approach of monitoring global progress and success on MHEWS coverage and effectiveness, and monitoring progress of the implementation of catalytic interventions. The initiative tracks results at three levels through complementary methods and reports, using a variety of key M&E tools (see table 5).

Table 5. EW4All approach to monitoring

Level of monitoring		Measurement approach
1. Global	Impact	SFM
2. National	Outcomes	MHEWS Maturity Index • Capability • Effectiveness
3. Initiative	Implementation	EW4All M&E Framework • Progress (outputs) • Success (outcomes)

3.2.1 Monitoring the impact of MHEWS at the global level

Progress at the global level is shared through the EW4All Dashboard,[147] which provides monitoring and annual reports that are updated regularly, offering a periodic stocktake.

The EW4All dashboard is a centralized online data portal and the key monitoring tool for the EW4All initiative. Specifically, it is a portal where data for the four EW4All pillars, the DRR strategies, and cross-cutting enablers are monitored and visualized. It aims to facilitate information sharing, enhance coordination, strengthen accountability, track progress of the initiative, inform decision-making and measure success.

The dashboard comprises data from partners, and it presents selected monitoring indicators structured along three categories:

a. Global indicators: These are metrics that capturthe initiative's impact on the availability of end-to-end, people-centred MHEWS. The data is based on official reporting mechanisms, such as the SFM, and information from the WMO Monitoring and Evaluation system.

b. Implementation indicators: These are metrics based on the initiative's M&E framework, along with the cross-cutting indicators on the enabling environment.

c. Country capability indicators: This includes baseline data on the MHEWS capability of featured countries. The current focus is on hazard monitoring and forecasting (Pillar 2), with the aim of expanding coverage to all four pillars. The approach piloted by WMO for Pillar 2 is expected to inform the development of the EW4All Maturity Index.

147 https://earlywarningsforall.org/site/early-warnings-all/dashboards/early-warnings-all-dashboard

The annual reports on the global status of MHEWS – including the present report – provide periodic stocktakes and analyses of the implementation of EW4All.[148] The EW4All Dashboard serves as the central data repository for the annual reports. A capacity baseline assessment is also being conducted to support the development of country snapshots being added to the Dashboard. These snapshots will present country-level data for all nations reporting to the SFM, highlighting capacities and effectiveness by pillar based on the EW4All Maturity Index. This information is in process, and it will be added to the dashboard to support monitoring, evaluation and resource mobilization.

3.2.2 Monitoring MHEWS at the national level

To monitor outcomes at the national level, a Maturity Index is being developed under EW4All. It is a comprehensive measurement framework for assessing the capability and performance of countries' MHEWS, comprising the following:

a. The capability sub-index, which measures vertical maturity of early warning pillars based on indicators adapted from the globally used MHEWS checklist and the EW4All M&E framework

b. The Effectiveness Index, which measures performance along the six dimensions of effectiveness (see box 31)

©WMO

148 Link to previous annual reports: 2022 (https://www.undrr.org/quick/74257), 2023 (https://www.undrr.org/reports/global-status-MHEWS-2023), and 2024 (https://www.undrr.org/reports/global-status-MHEWS-2024). In addition, a thematic report focusing on LDCs was released in 2024: https://www.un.org/ohrlls/sites/www.un.org.ohrlls/files/mhews_in_ldcs.pdf.

Box 32

EWS Effectiveness Index

Understanding the degree of development of a country's capability for each EWS pillar is essential for identifying its strengths, gaps, and needs, and for both setting and achieving key milestones linked to establishing the main components of an EWS. However, such data alone may not provide sufficient evidence that the system as a whole is effective in performing its function. As such, EW4All is looking beyond the comprehensiveness of individual pillars and into indicators of effectiveness to signal the overall performance of EWS – as a system, not just the component parts.

The EWS Effectiveness Index is envisioned to provide comprehensive, data-driven insights into the operational performance and effectiveness of MHEWS implementation at the national level. Its primary objectives include to:

- Generate authoritative, evidence-based analysis of country EWS effectiveness, harnessing and integrating the data of countries and partners, covering all pillars of MHEWS.
- Evaluate and measure the effectiveness of the country, identifying both areas of strength and critical gaps.
- Support national policy decision-making, particularly on aspects related to the development and improvement of EWS and related institutions.
- Inform investment prioritization and decision-making by providing data-driven insights for governments, development partners, financial institutions, etc.
- Raise awareness and advocacy among policy makers, programme planners and other stakeholders to ensure that sufficient priority is given to EWEA.

The EWS Effectiveness Index is based on six key dimensions:

- Relevance: Ensures warnings are tailored to the needs of at-risk populations through participatory design and feedback
- Timeliness: Measures whether warnings are delivered with enough lead time to support action
- Accuracy: Reflects the reliability of forecasts and their predicted impacts
- Accessibility: Gauges whether alerts reach users through trusted and appropriate channels
- Actionability: Determines if users understand and respond effectively to the warnings
- Responsiveness: Considers whether plans and resources are in place to enable those early actions

3.3 Progress at the national level

Protecting populations through MHEWS relies on national leadership, coordination and collaboration to encourage and translate national commitments into action. National governments designate various authorities in their countries to implement MHEWS in accordance with nationally defined roles and responsibilities. National governments are uniquely equipped to do this. They manage the infrastructure required to implement the pillars of the MHEWS and coordinate the flow of information both vertically – across national, regional and local levels of government – and horizontally – across government agencies, non-governmental organizations (NGOs – international, national and local), the private sector, academia and local communities. This allows for a consolidated effort with clearly defined roles and an institutionalized chain of responsibility, reducing duplication of costs and efforts while also building public trust in MHEWS. Because national governments oversee coordination efforts, they are well positioned to promote data sharing, which is particularly important to maintain the accuracy of MHEWS and thereby preventing, minimising or mitigating the socioeconomic impacts of shocks, extreme weather events and disasters. National governments can also mobilize large-scale development and domestic financing to support MHEWS including through a resilience dividends approach, in which a share of the losses avoided by MHEWS is re-invested to strengthen and sustain them.

The EW4All initiative supports national governments in scaling MHEWS by broadening local and international partnerships, offering technical support and normative guidance, and facilitating finance and cooperation mechanisms to help countries build domestic systems for sustained local capacity. One of the primary approaches involves collaborating with national governments that have historically lacked the minimum capability for MHEWS, particularly LDCs, LLDCs and SIDS. Integrating MHEWS into legislative and regulatory frameworks is essential to institutionalize the participation of populations and sectors at risk within existing nationally led implementation mechanisms. Therefore, an important initial focus for EW4All is to support national governments as they create, strengthen and ratify national implementation plans that prioritize short-, medium- and long-term interventions to improve the operation and effectiveness of national MHEWS.

Initiation of EW4All at the national level entails five phases:

- Stakeholder mapping, including designation of focal points
- National consultations to establish or verify coordination mechanisms across sectors and levels, inviting government representatives, intergovernmental organizations (IGO), NGOs (international, national and local), academia, the private sector, donors, local communities and other representatives of groups disproportionately impacted by disasters
- Gap analysis
- Development of a national implementation plan where time-bound actions across multiple ministries, departments and agencies are consolidated into a costed roadmap to close gaps in MHEWS performance, to be ratified or otherwise recognized by the national government
- Implementation, monitoring and reporting

In many countries, the EW4All initiative is effectively harnessing the convening role of United Nations Resident Coordinators to support governments in undertaking this work.

The EW4All Implementation Toolkit[149] is being refreshed to provide resources for mapping MHEWS stakeholders, allocating roles and responsibilities, and holding national meetings, workshops, and consultations, with a launch date planned for later this year. Using this guidance, stakeholder mapping, national consultative workshops (including the establishment or verification of a national coordination mechanism) and gap analyses have been completed in 41 countries, 13 of which were finalized since the publication of last year's report. National implementation plans have been completed in 17 countries – an increase of 5 countries since last year's report. Many of the national consultation workshops or launches of national MHEWS roadmaps were attended by Heads of State, reflecting strong political commitment and national ownership.

National implementation plans guided by costed roadmaps support structured dialogues to help allocate financing for MHEWS, such as country-led roundtables, regional dialogues and global peer-to-peer learning events. They also help build a shared understanding and vision for a country's MHEWS investment priorities. These roadmaps reflect strong country ownership, highlight complementary efforts across sectors and ensure that investments are sustainable and aligned with national priorities. In many countries, roadmaps are the cornerstone of collaborative discussions between donors and implementing partners, bringing together actors to enable complementarity and reduce duplication of efforts. For instance, the five-year CREWS South-West Indian Ocean Programme has taken national costed roadmaps into consideration as a core part of its M&E framework. As a significant share of MHEWS investment occurs at the local level, roadmaps also bridge internal financing mechanisms such as domestic private-sector contributions with public investment managed through ministries of finance, fostering more integrated and strategic funding approaches.

Beyond providing support for national implementation plans, the Interpillar Technical Coordination Group (ITCG) – comprising of UNDRR, WMO, ITU and IFRC – has active joint projects in 17 countries, and broader support from partners extends additional technical assistance to over 100 countries (UNDRR and WMO Global Observatory, 2025). In 2025, national authorities in Somalia, the United Republic of Tanzania, and Uganda carried out simulation exercises under the EW4All initiative. The exercises provided participants with a controlled environment within which to apply their knowledge, test operational procedures and coordinate decisions under simulated real-time conditions. Simulation exercises focused on clarifying institutional roles while fostering stronger collaboration across agencies and between national, local and community actors.

Work has also been undertaken to strengthen the MHEWS pillars. For example, an operational framework for risk knowledge generation and use within MHEWS was piloted in Mozambique to enable risk-informed decision-making. Meanwhile, with support from CREWS, in the Maldives, risk communications products were developed in partnership with the Maldives Red Crescent Society and the NDMA as part of their risk communication campaign to address hazards that the population feels least prepared for, according to a risk knowledge survey. These products were also made accessible to people with visual and hearing impairments. A further development relates to Pillar 2, where staff in more than 23 countries have been trained in support of the national implementation of the CAP, leading to the use of the standard doubling in 15 African countries over the past year. Efforts in over 10 countries have improved the institutionalization of anticipatory action through coordination with local government and communities, as well as advocacy for a greater evidence base, thereby fostering alignment of anticipatory action frameworks with national DRM systems.

Box 33

Horizontal and vertical coordination: A case study from China

One example of the benefits of horizontal and vertical coordination has come from China, where the three-in-one disaster prevention and mitigation command platform integrates operational systems and county-level data from 10 departments, including meteorology, emergency response, urban management, natural resources, hydrology and transportation.

Focusing on the severe weather warnings from the China Meteorological Administration, the platform enables joint consultations to inform coordinated early action measures. In Shangluo, a city of 2.3 million in Shaanxi province, data from the platform informed the evacuation of 20,807 people during a period of heavy rain in July 2024.[150] The platform has since been enshrined in national policy through the country's Action Plan on Early Warning for Climate Change Adaptation (2025-2027), which was launched in support of the EW4All initiative.

149 https://earlywarningsforall.org/site/early-warnings-all/early-warnings-all-programmatic-framework-country-level-implementation/implementation-toolkit

150 https://www.cma.gov.cn/en/highlights/202505/t20250507_7049302.html

3.4 Progress at the regional level

Disasters driven by natural phenomena do not respect national borders, and as such, the effectiveness of MHEWS depends on collaboration beyond the national level. Countries in the same region often face similar hazards and systemic vulnerabilities, making coordinated systems crucial to streamlining strategies and pooling resources and technical expertise.

The EW4All initiative has contributed to the development and strengthening of regional coordination mechanisms that facilitate the sharing of experiences and good practices, and in turn support joint planning, data sharing and policy alignment. It has also supported transboundary governance through peer-to-peer exchanges that enable local capacity-building. This approach uses regional expertise and resources, positioning external support as additional and complementary rather than the main driver. This results in MHEWS that are locally owned, contextualized, trusted, and thus sustainable.

A range of regionally coordinated mechanisms support this locally driven approach by aligning efforts and fostering shared learning. These include TWGs, regional programmes, joint strategies, South-South and triangular cooperation, and twinning programmes.

In the first half of 2025, a Pacific regional MHEWS-TWG was established by the Pacific Community and other partners of the EW4All initiative. Its purpose is to strengthen collaboration and coordination across the region, ensuring that the implementation of EW4All is effectively aligned with the Weather Ready Pacific (WRP) programme. The WRP programme is the regionally endorsed mechanism for delivering EW4All objectives in the Pacific, creating a unified approach to enhancing climate resilience in the region.

During 2024, the SWFP began taking steps to expand coverage to Central America (i.e. Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama) and, in early 2025, to South-East Asia-Oceania (i.e. Brunei Darussalam, Indonesia, Malaysia, Papua New Guinea, and Timor-Leste). The programme is an enabler of the EW4All initiative as it aims to strengthen the capability of NMHSs to deliver improved forecasts and warnings of severe weather by providing tools and guidance products as well as opportunities for cross-regional learning. The programme also includes capacity-building for staff delivering IBF and warning services. These services incorporate information on the potential consequences of hazardous events alongside guidance on appropriate actions to be taken to mitigate associated risks. To do this, they include information about the potential impacts and how the public can mitigate against them.

In May 2025, the Coordination Centre for the Prevention of Disasters in Central America and the Dominican Republic (CEPREDENAC) worked with CDEMA to develop a joint strategy to reduce the impact of the 2025 hurricane season in Central American and the Caribbean Member States. This strategy includes the regional activation of MHEWS and the standardization of emergency response protocols, as well as communication procedures and resource-sharing mechanisms to ensure a more efficient and unified disaster response across the region.

South-South and triangular cooperation – in which two or more developing countries collaborate with or without support from an external partner – is an effective mechanism to coordinate peer-to-peer learning, enable the exchange of data and foster knowledge sharing. Arranged through the Africa Network of Centres of Excellence for DRR, in September 2024, Mozambique joined a study visit to Italy focusing on MHEWS and risk data management. This was followed by a peer exchange between the NDMAs of Mozambique and United Republic of Tanzania, facilitating the sharing of good practices on risk data systems, transboundary DRM and EW4All implementation. Key outcomes included co-developing an open-source platform and forecasting tools, and adapting technical expertise to refurbish the national situation room of Mozambique under the African Union programme, Africa Multi-Hazard Early Warning and Early Action System (AMHEWAS).

Twinning is a collaboration mechanism in which a more experienced organization supports the capacity development of a partner institution. In Panama, the National Civil Protection System (SINAPROC) – with the support of WMO, UNDRR, ITU, IFRC, and the Institute of Meteorology and Hydrology of Panama – collaborated with key trainers from Ecuador and Chile to build on the capacities of CAP for multi-hazard alerting. Meanwhile, as part of SOFF (see section 4.1.2), 20 NMHSs with strong expertise in data collection and standardization offer technical advice and analytical support to 62 beneficiary countries through the SOFF peer advisor programme. WMO is also developing an engagement framework to better enable transparent, inclusive, and country-driven peer-to-peer support between NMHSs facilitated through WMO projects, as well as technical assistance to development partners – prioritising south-south and triangular twinning. Within CREWS programmes, the peer-to-peer approach has been used to good effect and is now integrated into programme development documentation and M&E cycles.

Open-source Earth observation data offers a cost-effective means to improve regional cooperation and data sharing, particularly in LDCs where conventional data collection is constrained by limited infrastructure and resources. The Space for Early Warning in Africa project was launched in 2025 as part of the Africa-EU Space Partnership Programme to enhance continental capability to produce and deliver Earth observation services, applications, data and information for MHEWS. The project is expected to improve continental access to space-based data and services, develop IBF tools, foster institutional dialogue and coordination, establish regional centres to co-develop and operate country-tailored satellite-based nowcasting products, and build resident capacity through trainings and fellowships.

Box 34

Regional coordination: A case study from the Americas and the Caribbean

The Americas and the Caribbean Regional Coordination Mechanism was established in 2024, bringing together IGOs, United Nations agencies, regional specialized organizations, academia, IFIs and representatives from regional thematic networks. This includes women, Indigenous peoples, youth, persons with disabilities, science and technology, the private sector, civil society, and media. The mechanism seeks to provide technical and strategic guidance for the regional implementation of the EW4All initiative. Acting as an intermediary advisory and coordination body between global and national EW4All structures, it aims to ensure alignment of efforts, foster political momentum, enhance synergies with existing regional initiatives, and facilitate regional mapping and guidance on financing opportunities and capacity gaps.

Box 35

Advancing EW4All through multi-stakeholder engagement: A case study

Regional forums: Laying the groundwork for global action

To promote more people-centred and community-anchored early warning and anticipatory action, UNDRR and WMO – working alongside ITU, IFRC and partners – organized a series of regional multi-stakeholder forums (MSFs) throughout 2024 and early 2025. These were held in Montenegro (Europe and Central Asia), Namibia (Africa), the Philippines (Asia and Pacific), Saint Kitts and Nevis (Americas and the Caribbean), and Kuwait (Arab States). The MSFs convened a wide range of participants, from government agencies and civil society to academia and the private sector. Critical challenges – such as gaps in governance and financing – were identified, while also showcasing innovative solutions in technology and anticipatory action.

A whole-of-society approach emerged as a cornerstone of effective disaster preparedness, emphasizing the need for deep collaboration among sectors. Each MSF also served as a platform to showcase good practices from Member States, illustrating the socioeconomic benefits of robust MHEWS and the role of public–private partnerships in maintaining them.

The 2025 Global MSF: A pivotal moment

In June 2025, the first Global EW4All MSF[151] brought together over 450 in-person participants (and many more online) representing governments, civil society, the private sector and grass-roots organizations.

With over 70 speakers and strong representation from women, youth, persons with disabilities and Indigenous peoples, discussions emphasized that early warnings are no longer the sole domain of meteorologists and disaster risk managers. From farmers and educators to local officials and mobile operators, the message was clear: early warnings must be developed by all, not merely delivered for all.

Participants reaffirmed their commitment to the EW4All initiative, especially critical at a time when multilateralism and investments are being questioned. MSF discussions reflected a call for broader and more inclusive partnerships, deeper engagement across sectors and communities for inclusive MHEWS, and a substantial increase in financing to accelerate the implementation of the EW4All initiative.

This call to action was echoed in the Geneva Call for Disaster Risk Reduction,[152] where scaling up MHEWS was identified as one of eight core recommendations.

151 https://globalplatform.undrr.org/2025/preparatory-days/global-ew4all-multi-stakeholder-forum
152 https://www.undrr.org/publication/global-platform-2025-co-chairs-summary-geneva-call-disaster-risk-reduction

3.5 Financing EW4All

The EW4All initiative has galvanized new funding for MHEWS, and the number of bilateral and multilateral investments affiliated with the initiative has continued to grow as initiative results emerge, increasing funding for all pillars of the MHEWS value chain. Details of financing for MHEWS are in section 2.6.4.

The Global Observatory for Early Warning Systems Investments[153] is a collaborative platform led by UNDRR, WMO, nine IFIs, and the Friends of Early Warnings donor group. Launched in 2024, it brings together project-level data and uses a shared classification system based on the EW4All four pillars. Interventions are distinguished between structural (for example, equipment or infrastructure) and non-structural activities (such as training or planning), giving a clear view of how funding moves across stages of an MHEWS project.

Given the diverse contexts of SIDS and LDCs, the Global Observatory has also expanded its analytical capabilities by incorporating bilateral investments in EWS. Upcoming enhancements will enable users to explore disaggregated bilateral financing flows captured through the Creditor Reporting System – of the Development Assistant Committee (DAC) of the OECD – from 2015 to 2023. This new dimension will add critical granularity and will complement IFIs-focused data.

To manage the wide variety of reporting formats, the platform uses an AI-powered retrieval-augmented generation system. It retrieves relevant documents, reasons through their content, extracts financial data and flags entries for expert review.

The Global Observatory's growing evidence base is intended to help governments, donors and practitioners build solid investment cases, choose the right mix of loans and grants, and track progress towards universal MHEWS coverage by 2027. By revealing funding gaps and mapping where resources flow, it provides the insight needed to make MHEWS more inclusive, data-driven and effective.

To enable disaggregation of financing by MHEWS component, the Global Observatory has developed a taxonomy[154] that aligns with the EW4All M&E framework. Thus, it is possible to confirm that while more than a third of all projects (122 of 348) span across the four pillars, funding is most strongly associated with Pillars 1 and 2, underscoring a continued emphasis on technical and data infrastructure (see figure 27).

3.6 Partnerships and stakeholder engagement

Effective coordination is essential to the process of enabling inputs and contributions across different contexts and among actors with varied relationships, brought together by virtue of them all contributing critical information that supports decisions towards positive outcomes (WMO, 2024a). In this way, the goal of EW4All is to catalyse dialogues by bringing together actors from all sectors and all levels.

When considering stakeholders, there can be a focus on the public, private and academic sectors, leaving CSOs overlooked. However, CSOs occupy a critical space between communities and institutions, making them essential actors in the localization of MHEWS. In recognition of this role, the GNDR – supported by the British Red Cross, REAP, and the United Kingdom Foreign, Commonwealth and Development Office – has published its report Localising Early Warning Systems and Anticipatory Action Through Civil Society Organizations (GNDR, 2025). The report identifies existing barriers, challenges and good practices, drawing on survey responses from more than 400 CSOs across 88 countries. The report will feed into the development of the GNDR 10-year strategic roadmap for localizing early warnings and anticipatory action.

In Barbados in late 2023 – and under the aegis of EW4All – the GSMA, ITU and WFP co-convened a workshop to explore leveraging mobile technology for more effective, inclusive MHEWS across the Caribbean. MNOs in Somalia voiced strong support for the EW4All initiative during the GSMA Humanitarian Connectivity Charter (HCC) Africa June 2024 workshop. Building on the Somali operators' support at HCC Africa, the Somalia NETP Implementation Workshop was co-hosted by the GSMA and ITU in Nairobi in September 2024. ITU continues to lead discussions on integrating mobile technology, including CB, into Somalia's MHEWS.

Strengthening dissemination through tailored, inclusive and locally grounded strategies bridges the gap between forecasts and life-saving decisions. UNDRR piloted its "training of champions" model in the Seychelles, equipping a cohort of trained facilitators to deliver risk communication strategies tailored for EWEA – emphasizing inclusive, people-centred approaches to drive behavioural change and strengthen community preparedness. In Fiji, the Fijian Broadcasting Corporation became the first

153 https://earlywarningsforall.org/site/early-warnings-all/dashboards/global-observatory-ews-investments
154 https://www.preventionweb.net/media/101624

broadcaster in the South Pacific to develop a detailed disaster preparedness and response plan, outlining how early warning messages will be delivered to communities that are disproportionately impacted by disasters. UNDRR also launched a Disaster Risk Communication Hub to support practitioners in developing people-centred communication strategies that encourage informed decision-making among populations to ensure that early warnings translate into timely and appropriate action.

3.7 Scaling up EW4All through key tools and methodologies

At the midpoint of the EW4All initiative, it is clear that there has been a strategic shift as the global scale-up of MHEWS is gaining momentum. More than delivering EW4All, partners are aligning on the principle of systems that are co-developed by all. Crucially, national governments are in the lead, communities are engaged as active partners and international actors are providing targeted support to build and sustain domestic capability. Supported by science and technology – and strengthened by the integration of ILK – this inclusive approach is reflected in ongoing efforts to broaden the tent. The initiative is doing this by: expanding the range of implementing partners, reaching more people, mobilizing diverse financing sources and extending coverage to a wider set of hazards. It is also marked by the progress made in transitioning from single- to multi-hazard EWS. The long-term sustainability and effectiveness of these scale-up efforts depend on their embeddedness in national development plans, budgets and capacities. In this regard, the United Nations system is integrating EW4All and its tools and methodologies into the United Nations Sustainable Development Cooperation Frameworks, which is the basis of cooperation between the national government and the entire United Nations system in 162 programme countries and territories.

To sustain momentum in delivering technical support and normative guidance to national governments, the ITCG is adopting a twin-track approach that combines roadmap development with a priority intervention track. The track consists of a set of tools and methodologies that countries can use that mutually inform and reinforce each other to improve MHEWS effectiveness. Examples include guidance for conducting rapid assessments of MHEWS capability and performance, informed by disaster loss and damage data. These assessments can help countries to design and lead appropriate multi-stakeholder simulation exercises before a disaster occurs. Exercises like these enable countries to test the coordination and effectiveness of MHEWS and their enabling systems, both within and across technical pillars (see section 3.3). After a disaster, multi-stakeholder AERs are used to evaluate end-to-end MHEWS performance (see section 2.6.5). The findings from these activities guide national governments in conducting post-disaster needs assessments, identifying priority interventions, and planning for recovery and long-term resilience. These post-disaster insights then inform updated rapid assessments, restarting the cycle of continuous improvement.

Crucially, the inclusion of a “priority intervention” track ensures that national governments and supporting partners can focus their attention and resources on actions with the highest potential for impact. Because these priorities are identified through inclusive and evidence-based processes, they carry strong national ownership and local backing, enhancing countries’ abilities to mobilize bilateral and in-country funding. Risk knowledge products informing these processes include: a data ecosystem maturity assessment; and a guidance note on multi-hazard exposure and vulnerability indicators. In addition, an MHRA training curriculum is being developed by the Netherlands Red Cross and the Faculty of Geo-Information Science and Earth Observation at the University of Twente, in partnership with the ITCG.

Nearly one in five people worldwide are living within 5 km of an active conflict. Therefore, the development of MHEWS in settings affected by FCV is increasingly recognized as vital in achieving EW4All. A handbook on implementing MHEWS for displaced, migrant and refugee populations is being developed by UNDRR, IFRC, GCF, CREWS and IOM to inform the creation of normative guidance and tools. Also on this topic, in October 2024, a handbook was launched on Navigating Fragility, Conflict and Violence to Strengthen Community Resilience: A Handbook for DRR Practitioners (Sauerhammer, and others, 2024). Jointly developed by IFRC, ICRC, the German Red Cross, and RCRCCC, it aims to help navigate the challenges and uncertainties of FCV settings, avoid common shortcomings, and increase the chances of effectively reducing disaster risk.

Finally, in relation to specific hazard types, efforts are underway to strengthen MHEWS through transboundary coordination embedded in hazard-specific strategies and aligned with the principles of the EW4All initiative.

Thus, through greater stakeholder engagement, more robust governance, and close tracking of financing and progress in implementation, EW4All has driven national ownership, turning MHEWS into firm commitments that safeguard lives and development gains.

4

Implementation and mapping of initiatives

Image Source: ©Shutterstock/yanchi1984

4. Implementation and mapping of initiatives

This chapter identifies some key initiatives focused exclusively on MHEWS, operating at the global and regional levels. The initiatives featured are multi-stakeholder in nature, operating at varying durations of time.

4.1. Global

4.1.1 Climate Risk and Early Warning Systems

The CREWS initiative[155] is a financial mechanism that supports countries – in particular, LDCs and SIDS – to establish people-centred, risk-informed early warning services. It was launched in 2015 at COP21 as the first specialized funding mechanism solely focused on helping countries improve their access and capacities to effective MHEWS. The CREWS Steering Committee comprises 12 members: Australia, Austria, Canada (Chair from June 2025), Finland, France, Germany, Luxembourg, Monaco, the Kingdom of the Netherlands, Norway, Switzerland and United Kingdom. CREWS programmes are facilitated by its three implementing partners: WMO, World Bank Global Facility for Disaster Reduction and Recovery (GFDRR) and UNDRR, with ITU and IFRC in the process of being accredited as implementing partners.

Through the combined contributions of CREWS members, and under the guidance of the steering committee, CREWS has been able to expand its portfolio to support 19 ongoing programmes. To date, these programmes directly or indirectly supported over 397 million people – living in more than 70 LDCs and SIDS – to access and receive forecasts and early warning services.

At the national level, approximately 78 national plans, strategies and laws on early warning have been developed with support from CREWS. As such, supported countries have developed and implemented structured, costed, and budgeted investment plans for MHEWS, integrating them into broader climate resilience strategies and national development frameworks, and demonstrating strong national commitment to DRR. Additionally, through the CREWS programmes, 98 standard operating procedures – along with operational preparedness and anticipatory action plans linked to prediction and warning services – have been developed or updated. Furthermore, 147 forecasting and prediction products have been created or customized to meet local needs. These efforts have significantly strengthened MHEWS by enhancing the accessibility, relevance and responsiveness of forecasting services to better support risk-informed decision-making at the local level.

CREWS is guided by a set of core values, including "promoting coherence". An example of this value in action during 2024 was the time extension granted for the West Africa Programme (CREWS, 2025b). The extension was requested so that CREWS, with its strengths in technical assistance, could provide the technical training and support that countries need to maximize the benefits and full potential of hardware purchased by GCF. In addition to leveraging GCF investments, CREWS and GCF have embarked on a joint initiative: the GCF-SAP CREWS Scaling-up Framework, which aims to scale up and fast-track early warning financing that further amplifies the scope and impact of CREWS. Togo has led the way, receiving GCF approval in January 2025. CREWS has also supported countries through its ASW, which provides up to $250,000 for targeted interventions. Recent examples include the development of a smart weather app in Tonga and support for the implementation of CB in the Caribbean.

CREWS is continually learning and evolving its practices to meet demand and to adapt to changing environments, not least the contexts for countries affected by FCV. In 2024, CREWS supported 27 countries in FCV contexts, and drawing on the lessons from these programmes – together with lessons learned and best practice from elsewhere – CREWS is now finalising its "Operational procedures on programming in FCVs", reinforcing its commitment to enhance the delivery of people-centred MHEWS in FCV-affected LDCs and SIDS.

CREWS has an advanced framework for measuring the impact of its early warning financing (CREWS, 2025a). It also continuously adapts its indicators and methodologies based on practice and learning. Looking further ahead, CREWS is developing its 2030 strategy, outlining its vision where everyone – including those most at risk – is protected by timely, accurate, accessible, and actionable EWS that save lives, safeguard livelihoods, and strengthen climate resilience. The strategy focuses on ensuring reliable, equitable and sustainable MHEWS that meet community needs, strengthen national and regional capacities through sustained investment, and advance next-generation solutions through innovation.

4.1.2 Systematic Observations Financing Facility

Many LDCs and SIDS face systemic barriers in meeting the WMO-GBON standards. Outdated infrastructure, infrequent reporting, limited maintenance, and financial and technical constraints hinder their ability to collect and share high-quality weather data. These gaps weaken global forecasting and EWS.

To address this, SOFF[156] was launched in 2021 by WMO, UNEP and UNDP. SOFF provides grant-based finance and peer-to-peer technical assistance to modernize observation systems in LDCs and SIDS. Its phased model – readiness, investment and compliance – ensures long-term upgrades aligned with GBON standards. SOFF supports infrastructure modernization, staff training and sustained data-sharing, with a Gender Action Plan promoting women's empowerment in meteorology.

As of April 2025, SOFF has programmed support for 66 countries, primarily in Asia and Africa. It has approved $116.1 million in funding, including $9.2 million for readiness-phase activities in 61 countries and $90.8 million for investment-phase implementation in 15 countries. These efforts include deploying automatic weather stations, standardizing data protocols, and fostering partnerships among NMHSs, United Nations agencies, and multilateral development banks. Peer advisors from advanced meteorological services provide hands-on training, including South-South assistance, reducing technical dependencies and enhancing local capability.

SOFF's rapid scale-up – averaging 3.7 months for readiness approvals – has led to innovative solutions, especially in conflict-affected states. Outputs from the readiness phase inform subsequent investments and serve as resources for broader climate and hydrometeorological initiatives. An independent review affirmed SOFF as the "best viable option" for sustainable observation systems, citing its transparent grant model, technical support and alignment with GBON. With 88 per cent of funds going directly to country support, SOFF catalyses complementary investments from partners like the World Bank and WFP.

Success is measured through the SOFF Theory of Change and Work Programme, with targets including 75 countries in the "readiness phase" and 50 in the "investment phase". Indicators include gap analyses, contribution plans, diagnostics, staff training, consultations and infrastructure upgrades. Progress is tracked via verified documentation and a dedicated compliance application built on WMO monitoring systems.

Despite inflation and diverse country contexts, SOFF has maintained efficiency, with administrative costs at 12 per cent. It addresses operational challenges through a growing Community of Practice, webinars and a Moodle platform for continuous learning. Key lessons include the value of peer-to-peer support, phased funding and flexible cost planning – especially critical for SIDS and LDCs. SOFF continues to deliver impact through innovative financing and robust operational support, strengthening global resilience to climate risks.

155 https://crews-initiative.org/

156 https://www.un-soff.org/

4.1.3 Anticipation Hub

The Anticipation Hub is a global platform dedicated to advancing anticipatory action – an approach that enables communities and institutions to act ahead of forecast hazards and reduce predicted humanitarian impacts. It does this by systematically linking forecasts and/or early warnings with timely actions. Hosted by the German Red Cross – in cooperation with the IFRC and RCRCCC, with funding support from the German Federal Foreign Office – the Anticipation Hub connects practitioners, researchers, and policymakers to facilitate knowledge exchange, foster learning and innovation, and drive advocacy on anticipatory action.

The Anticipation Hub released its third *Global Overview* report (Anticipation Hub, 2025), highlighting substantial growth in both geographic reach and impact. Findings from the *Global Overview* report are shared in section 2.5. By compiling data on institutional uptake, financing and activation results, the Anticipation Hub continues to build an evidence base that supports broader adoption and alignment with climate resilience goals.

Young people are powerful partners in resilience, bringing fresh perspectives, technological fluency and a strong stake in long-term outcomes. Recognizing this, the Anticipation Hub has created the Future Leaders Network on Early Warning Early Action, which connects, inspires, and empowers early-career and young professionals across practice, science, and policy. The Network fosters collaboration across disciplines and geographies, enabling youth to act as change agents within their communities – co-creating solutions, driving anticipatory action and influencing policy processes.

4.1.4 Risk-Informed Early Action Partnership

REAP is a global initiative launched in 2019 to drive systemic shifts in DRM by embedding EWEA into policies, financing and practice. Its overarching goal is to make risk-informed early action a normative approach to mitigating the impacts of disasters, achieving scale by enhancing coordination among governments, United Nations agencies, NGOs and financial institutions. The goal is structured around four targets, each of which contributes to making 1 billion people safer from disaster by 2025.[157] Through REAP, over 100 organizations and governments regularly come together to build cross-sectoral communities of practice and develop shared knowledge to increase the impact of their collective endeavours.

Over the past year, REAP has actively supported work aligned with the four pillars of MHEWS:

- Pillar 1 (risk knowledge): Somalia and Nepal received support to integrate early action into national disaster risk strategies and plans.
- Pillar 2 (hazard monitoring and forecasting): A group of experts came together to identify the common features of effective EWEA systems.[158] They positioned hazard monitoring and forecasting within a broader EWEA value chain to bridge diverse practices, foster greater coherence across the pillars, and enable better use of climate and weather data for anticipatory decisions.
- Pillar 3 (warning dissemination and communication): REAP drew attention to the importance of inclusive alert systems that reach marginalized communities, and a dedicated working group on risk communication published a paper flagging five components for effective early warning communication. [159] The REAP partners also developed guidance on enhancing finance for people-centred EWS.[160]
- Pillar 4 (preparedness to respond): REAP continued to advance the body of knowledge on last-mile early action and provided an analysis of financing instruments that support early action.

In 2024, REAP also continued to focus on the institutional frameworks and political buy-in needed for effective early action. In its 2024 *State of Play* report,[161] REAP highlights notable progress in mainstreaming EWEA across national systems and global frameworks, marking the start of a transition from niche pilot projects to institutionalized strategies in multiple countries.

Recognizing the importance of risk governance for EWEA, REAP also published a guide on resources for comprehensive risk management, in collaboration with UNDRR as the co-chair of the REAP working group on its Target 1, helping governments to access key resources.[162] Finally, given the breadth of its membership, REAP also provides a space for sense-making and building bridges across the pillars. In 2024, its partners came together to review the role of different actors and the requirements for inclusive governance of EWEA.[163] It continues to support the EW4All M&E resources with an emphasis on cross-cutting indicators that ensure country-owned and multi-stakeholder EWS.

The experience of REAP in these areas has shaped a new 2030 strategy that will deepen country-led approaches and scale inclusive EWS, with a continued focus on the policy environment and the financing requirements. The updated REAP Monitoring, Evaluation and Learning framework reflects a shared commitment to interventions that are measurable, accountable and focused on long-term institutional impact.

4.2 Regional and transboundary

As mentioned in section 3.2, hazards can transcend national boundaries and impact multiple countries, which underscores the importance of coordinated approaches. This section provides examples of regional or transboundary approaches to MHEWS.

4.2.1 Regional Integrated Multi-Hazard Early Warning System

RIMES[164] is an IGO, aiming to address gaps in the end-to-end warning information value chain through technical support, strategic leadership and capacity strengthening. Member States are supported to establish and maintain EWS within a multi-hazard framework. RIMES also supports platforms for data sharing, risk communication, and multi-hazard research spanning climate, oceanic, hydrometeorological, and geohazards.

In 2025, RIMES reached a major milestone by fully operationalizing its Regional Multi-Hazard, Multi-Scale, Multi-Purpose Early Warning Center. This milestone marks the increased capability of RIMES to deliver end-to-end EWS from data acquisition to community-level action.

RIMES provided a diverse portfolio of services across its 22 Member States and 26 collaborating states. Key initiatives included the deployment of marine buoys in Seychelles and Timor-Leste, low-cost EWS in Pakistan and Sri Lanka, and enhanced data collection through mobile and sensor technologies in Bangladesh and Thailand.

Modelling and forecasting capabilities were significantly advanced in 2025. RIMES introduced enhanced flash flood guidance, operational lightning nowcasts and a specialized heatwave portal in Bangladesh. It developed ocean and climate models in Timor-Leste and refined flood forecasting in Nepal, Sri Lanka and Thailand. Landslide and disease forecasting tools were also initiated.

In 2025, RIMES published the *Impact Forecast Toolkit for Tropical Cyclones*[165], focusing on the South Asian countries to enable informed decisions based on the potential impact scenarios. The toolkit aims to serve as guidance for impact and IBF across the region.

Another major focus was the expansion of decision support systems across key sectors such as:

- Agriculture (e.g. Bangladesh Agro-Meteorological Information Service; Specialized Expert System for Agro-Meteorological Early Warning for Climate Resilient Agriculture)
- Livestock (e.g. National Livestock Advisory System)
- Health (e.g. Climate Risk Information System for Public Health)
- Transport (e.g. National Vehicular and Transport Resilience Gateway)
- Disaster management (e.g. System for Assessing, Tracking, and Alerting Risk; Integrated Forecast Dissemination Portal, Tamil Nadu System for Multi-hazard Potential Impact Assessment, Alert, Emergency Response Planning and Tracking and Rapid Portal)
- Ocean (e.g. Ocean State Forecasting and Advisory System)
- Water (e.g. enhanced Flood Forecasting and Warning Centre portal)
- Planning (e.g. Climate-informed Planning Decision Support)

157 https://www.early-action-reap.org/who-we-are
158 https://www.early-action-reap.org/reap-compendium-visualizations-early-warning-and-early-action
159 https://www.early-action-reap.org/five-components-effective-early-warning-communication
160 https://www.early-action-reap.org/policy-brief-enhancing-finance-people-centred-early-warning-systems
161 https://www.early-action-reap.org/early-action-state-play-2024-0
162 https://www.early-action-reap.org/resources-comprehensive-risk-management
163 https://www.early-action-reap.org/roles-state-and-non-state-actors-early-warning-and-early-action
164 https://rimes.int/
165 https://drive.google.com/file/d/1S7Vo95DaiZQjuoMD8Co1XVFkGMkr0nrJ/view

As Secretariat of the South Asia Hydromet Forum, RIMES facilitated its 4th Executive Council Meeting, which endorsed strategic priorities, including numerical weather prediction,

IBF, hydrology, and institutional sustainability. A sixth working group on climate services was established to improve data access and regional coordination.

4.2.2 Water at the Heart of Climate Action

This ambitious partnership between the IFRC, the Netherlands Red Cross, UNDRR, WMO and SOFF, and funded by the Kingdom of the Netherlands, aims to accelerate and scale up water action to reduce impacts of weather- and water-related risks exacerbated by climate change. Having completed a year of inception, the programme has moved into its implementation phase. The WHCA programme[166] is focused on supporting the countries of Ethiopia, Rwanda, South Sudan, Sudan and Uganda – which make up the Nile River basin – in establishing EWS for flood and drought hazards.

Firmly aligned to the interrelated work across the MHEWS value chain espoused by the EW4All initiative, the programme delivers on five technical focus areas, aligned with the four MHEWS pillars, plus collaboration, with the following outcomes:

- Weather and water-related disaster risk information systems inform decision-making.
- Climate, weather, and water observation, monitoring, and IBF products deliver warning services.
- Communities access water-related early warning messages that enable them to take actions.
- Preparedness to take anticipatory action and enhanced locally led water-related climate adaptation reduces water-related risks.
- Consortium partners' collaboration ensures interlinkages, quality, inclusion and learning.

Taking into consideration the diversity of national circumstances, programming in the five countries allows for country-specific activities and outputs that best cater to national priorities, existing capacities and ambitions. Meanwhile, WHCA elevates the work at the regional level by helping countries coordinate and jointly manage transboundary early warning concerns – from monitoring the situation to relaying warnings and addressing operational concerns on early action. Regional products such as interoperable platforms for risk information sharing – as well as platforms for learning, such as annual regional learning assemblies and joint training exercises – are developed alongside national products and include capacity-building activities.

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166 https://wmo.int/activities/projects/project-portfolio/water-heart-of-climate-action

5

Key findings and recommendations

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5. Key findings and recommendations

In this final chapter, the findings and recommendations from this latest global status report are presented. While largely based on the data and analysis presented in this report, these findings and recommendations also draw on the conclusions of the last three Global Status of Multi-Hazard Early Warning Systems reports (UNDRR, and WMO, 2022; 2023; 2024). Where there is evidence of recommendations being acted upon, this is highlighted.

In the third year since the global call for EW4All – to achieve universal coverage of EWS within five years – this year's report includes an update on the progress made by EW4All as well as the latest status of MHEWS, overall and by pillar. Thus, some of the findings and recommendations are presented from the perspective of EW4All – the progress that has been made and the gaps that remain.

Finding 1. Early warning systems are demonstrably saving lives.

Consistent with the findings of the last three global status reports, the latest data shows that countries with substantial to comprehensive MHEWS capabilities have a disaster-related mortality that is nearly six times lower than that of countries with limited to moderate comprehensive capabilities. A recent example is the earthquake in Kamchatka Peninsula, which triggered a tsunami alert for dozens of countries, resulting in the evacuation of millions and demonstrating the effectiveness of the tsunami EWS in the Pacific.

However, the number of disaster-affected people continues to grow, reflecting increasing exposure and vulnerability, especially in LDCs and SIDS. This continues to underscore the need for all countries to have more effective MHEWS. The discrepancy presents a challenge for defining success for MHEWS and measuring it effectively – for example, by confirming that messages are understood and are being acted upon. This highlights the importance of appropriate and effective M&E, and the extended version, MEAL: monitoring, evaluation, accountability and learning. Post-event analyses are also crucial for understanding how well MHEWS have worked, with a focus on any shortfalls and the lessons that need to be learned and shared through knowledge exchange and communities of practice.

Outlook:
The positive trend observed in previous years has been maintained, with lower mortality in countries with more comprehensive MHEWS capabilities. This trend is expected to continue but with the hope that as MHEWS capabilities, including for emerging hazards, improve globally – alongside other activities to improve community resilience and reduce the impact of disasters – mortality rates overall will also reduce.

Recommendations:
Countries and development partners should:

- Regularly update the status of MHEWS implementation and report related progress through appropriate mechanisms, disaggregating the data to enable detailed analysis, for example, by country categories (LDCs, SIDS, LLDCs) (see finding 2).
- Promptly carry out post-event analyses and take action to assess and evaluate the effectiveness of MHEWS, focusing on lessons that can be learned, sharing insights gained with MHEWS actors globally through forums and platforms for knowledge exchange and learning, including communities of practice.

Finding 2. More countries are developing, implementing and improving their MHEWS, but critical gaps remain, especially in Africa and Least Developed Countries.

At the halfway stage of the global call for EW4All, more than 60 per cent of all countries – and more than half of the countries in each region – have reported the existence of MHEWS. Progress on MHEWS implementation has been made within each country, each region and across every pillar.

In addition to improvements in coverage – evidenced by the increased number of countries reporting MHEWS – there has also been a significant improvement in the comprehensiveness of MHEWS capabilities across all regions. Globally, the average increase is 45 per cent over initial reporting scores.

At the regional level, Africa continues to show the greatest improvement since reporting began but started from the lowest baseline, with current MHEWS capabilities in Africa only slightly better than the level of comprehensiveness seen in the Europe and Central Asia region a decade ago. While much has been achieved in recent years in Africa, and elsewhere, persistent gaps remain in both technical and geographical areas, so momentum must not be lost if EW4All is to be achieved.

Within the country groups, the greatest improvement has been made by the LDCs, which conventionally have the least coverage and most limited capabilities, while the comprehensiveness of MHEWS capabilities is greatest in the SIDS, echoing the success seen in the Asia-Pacific region. However, all of the countries in these groups – LDCs, LLDCs and SIDS – are disproportionately vulnerable and often have limited resources or capacity to cope with impacts, so there is a moral imperative to prioritize support for these countries and enable them to develop effective and appropriate MHEWS to protect lives and livelihoods. Country-led plans are crucial for ensuring targeted and coherent investments, the benefits of which can be sustained in the longer term.

Outlook:
The positive trend observed in previous years has been sustained and is set to continue as country-led plans enable governments to benefit from targeted investments that are consistent with the ambition of EW4All. In the context of tightening fiscal space globally, such investments need careful planning and coordination to ensure coherence. In addition, effective M&E is crucial to maintain momentum and ensure effective, sustainable implementation.

Recommendations:
With support from development partners and EW4All, countries should:

- Leverage technical and financial support to improve MHEWS coverage and comprehensiveness – especially in the Africa region and among LDCs, LLDCs and SIDS – while encouraging greater coherence and complementarity across efforts.
- Develop and/or implement country-led EW4All roadmaps or national plans for MHEWS scale-up, broadening the scope of existing single-hazard systems by building on achievements to date while aligning with ongoing programmes and other national development and adaptation plans.
- Regularly update the status of MHEWS implementation and report related progress through appropriate mechanisms, including reporting through the SFM (in terms of coverage and comprehensiveness of MHEWS) and other M&E frameworks, taking opportunities to showcase success and demonstrate value for money.

Finding 3. People-centred, locally led approaches – underpinned by communication and dialogue – are enabling effective early action.

Warnings are only effective if they are received, understood, trusted and acted upon – by everyone. For this reason, people-centredness and inclusivity have always been important principles underpinning best practice for MHEWS design, development and implementation. Many of the case studies featured in this report provide evidence of people-centred approaches being mainstreamed – such as the IFRC Community Trust Index – and of people-centred actions becoming a focus for M&E frameworks, including for CREWS and EW4All.

Empowering local ownership – especially in marginalized and remote areas – enhances responsiveness and trust in warnings, enabling timely and anticipatory action. As noted in previous years' reports, local communities have a wealth of risk knowledge and expertise in reducing their risks.

There is growing evidence of people-centred approaches being mainstreamed, with local communities contributing their knowledge and experience. Community members often serve as informal weather observers and forecasters, while leaders – both formal and informal – play key roles in communication strategies that ensure warnings can reach even the hard-to-reach populations. Faith-based, youth and women's groups are especially effective in extending the reach of MHEWS information to those without access to conventional channels.

Local communities also play a central role in preparedness and response. Supported by local leaders, they help identify vulnerable populations and suggest practical actions during disasters. Activities like drills and desktop exercises reveal community priorities and resource gaps, while also helping experts understand how people make decisions after receiving warnings. This exchange fosters public dialogue around disaster risk, and it builds demand for MHEWS that are tailored to community needs.

Outlook:
The global scale-up of MHEWS must be supported by action at the grass roots, so renewed efforts are required to ensure that local actors and communities are at the heart of MHEWS designs and equipped to be active participants. The development of evidence-based communication strategies can engage populations across all aspects of MHEWS, advancing how people understand, trust, talk about and respond to warnings. This principle can be kept central to MHEWS through M&E frameworks that have indicators measuring the extent to which every aspect of MHEWS design, development, implementation and evaluation is people-centred and inclusive.

Recommendations:
With support from development and humanitarian partners and EW4All, countries should:

- Adopt a people-centred, locally led approach by ensuring that local actors and communities – including women, youth and other underrepresented groups – are at the heart of MHEWS design, development, implementation, evaluation, improvement and operation.
- Leverage technology to optimize MHEWS and ensure all sections of society are reached, including marginalized groups and persons with disabilities.
- Develop, enhance and implement local and national DRR plans and MHEWS frameworks to ensure alignment with the requirements of MHEWS and clarify the roles and responsibilities of all MHEWS stakeholders, including non-state actors.
- Develop evidence-based communication strategies that engage diverse populations across all aspects of MHEWS, ensuring that gender perspectives and the needs of all groups are meaningfully reflected.
- Initiate and sustain public dialogue about disaster risk, anticipatory action and response.
- Embrace civil society and the media as key stakeholders in MHEWS roll-out.
- Develop, enhance and implement M&E frameworks to ensure that MHEWS – and all related activities – are demonstrably inclusive and people-centred.

Finding 4. Comprehensive local and national governance is facilitating effective MHEWS.

MHEWS function best when they are embedded within a country's disaster risk governance, including DRR strategies and plans. Encouragingly, the number of countries reporting DRR strategies and local plans for early warnings has increased year-on-year, as have the numbers of country-led plans for MHEWS and related legislative enablers.

While MHEWS are a common implementation area in both DRR strategies and NAPs, there is evidence of MHEWS capabilities being more comprehensive where DRR strategies are also more developed. These achievements are born out of a coherent, holistic approach that is locally led, especially one which provides clarity over the roles and responsibilities that different parts of society – the public, private, civil and academic sectors – can play and how they should interact.

Many countries have national legislation and frameworks that can support MHEWS, or are continuing to make progress in developing, updating and adopting frameworks. At the national level, examples include comprehensive regulation on the role of MNOs in MHEWS, including infrastructure standards for emergencies, and ensuring public devices are compatible with message dissemination systems. IFRC has also found that at least seven countries have revised their DRM laws and policies to enable anticipatory action. MHEWS implementation and operation are also enabled by national legislation for establishing MHEWS and/or an NMHS, which exists in more than half of all WMO Members. Frameworks are also being developed and implemented at the continental (e.g. African Union) and regional levels, and are especially relevant for managing transboundary hazards and impacts. A recent example is the Regional EWS Consortium that has been developed in the Caribbean.

Comprehensive and inclusive governance is also crucial for long-term sustainability under national or local leadership, including transitioning away from anticipatory action led by international NGOs or other actors, including organizations within the United Nations system. Evidence of effective governance – with accountability – may also be a prerequisite for accessing the funds needed to implement countries' national plans for MHEWS and EW4All roadmaps.

Outlook:
Through the development and implementation of governance frameworks and MHEWS plans, the foundations are being set for holistic, multisectoral MHEWS approaches that operate both vertically and horizontally. Entry points include pre-existing mechanisms, such as laws that set out the mandates of key agencies, through to technical or thematic working groups that bring together sector specialists to address complex, cross-cutting issues such as DRR. Importantly, clear roles and responsibilities in these frameworks enable non-state actors – including the private sector – to contribute to MHEWS scaling up.

Recommendations:
With support from development and humanitarian partners and EW4All, countries should:

- Recognize EW4All as a unifying agenda for integrated planning – for understanding and reducing disaster and climate risk, and for improving resilience – across global goals including the Sendai Framework for DRR, the 2030 Agenda for Sustainable Development and the Paris Agreement.
- Ensure that DRR policies and institutional frameworks more explicitly support MHEWS at all levels, with clear roles and responsibilities for all stakeholders and directives that promote and enable coordination and collaboration, especially for data sharing.
- Take advantage of opportunities and support to ensure that MHEWS are aligned with DRR strategies and other plans at every level – from local to continental and including the United Nations Sustainable Development Cooperation Frameworks.

Finding 5. Effective stakeholder engagement and data sharing are supporting collaboration and coordination for MHEWS implementation.

Effective data sharing, collaboration and coordination – within and across all pillars, at all levels (global, regional, national and local) and across all economic sectors – are essential for delivering MHEWS at scale. They are especially important in the context of transboundary hazards and impacts, as exemplified by the work of international governmental organizations like RIMES, multilateral initiatives like CREWS and by targeted programmes like WHCA.

The collection, management and sharing of timely, quality-controlled data from different sectors and disciplines is important to many aspects of MHEWS. This is especially important for IBF, which requires knowledge of hazards, vulnerability, exposure and potential impacts that vary by sector, location and community, and are informed by analysis of past events. While good progress has been made – especially within the hydrometeorological community and as indicated by the improved quantity and quality of data being reported into the SFM – there remains room for improvement. In particular, it is essential to address data-sharing constraints that arise from institutional arrangements and structures. Only if good quality data is made available for MHEWS can we collectively harness the potential benefits of AI to deliver EW4All.

Collaborative working is most effectively enabled by strong governance frameworks (see finding 4) that include clear roles and responsibilities for all actors, including the private sector, together with effective communication and dialogue, especially with local communities. Engaging positively with all of these stakeholders – and maximizing their contributions – requires careful management and sustained effort.

Effective collaboration is also enabled by a shared language and opportunities to bring stakeholders together through platforms that operate at different scales. Examples include the EW4All MSFs at global and regional levels, regional hydrometeorological forums and platforms, and the Climate Outlook Forums, which are held at regional and national levels. Communities of practice also provide opportunities for knowledge exchange and learning, and are being developed by several initiatives and groups – including SOFF and the IFRC with partners (e.g. WFP), and TWGs at national and regional levels. At the national level, these efforts are further supported by United Nations Resident Coordinators, and they leverage the United Nations Sustainable Development Cooperation Frameworks.

Outlook:
Governments are increasingly working collaboratively with a range of MHEWS stakeholders, developing frameworks to enable effective data sharing and implementing plans for MHEWS scale-up. These trends are set to continue, supported by the development of communities of practice and the hosting of stakeholder forums that enable countries and their stakeholders to share their experiences in support of the goal of EW4All.

Recommendations:
With support from development and humanitarian partners and EW4All, countries should:

- Ensure an "all of society" approach to MHEWS with clear governance that enables all actors – including non-state actors – to contribute.
- Strengthen institutional arrangements for data exchange within and between MHEWS actors, adopting open-data frameworks wherever possible.
- Establish and maintain forums, mechanisms, and tools for dialogue, coordination, and alignment within and across countries, including MSFs and TWGs.
- Develop, use and contribute to the improvement of MHEWS tools and guidance.
- Develop, sustain and actively participate in MHEWS-related communities of practice relating to MHEWS, facilitating – or taking advantage of – opportunities for peer-to-peer support, mentoring, and twinning across countries, disciplines, and sectors.

Finding 6. Financial mechanisms are investing in MHEWS, but funding must be targeted and sustained.

Finance is an enabler, but it needs to be the right type, at the right time and for the right duration. Through EW4All, momentum is building for the global scale-up of MHEWS, with more funding becoming available as multiple initiatives and funds pledge their alignment and support. However, the mobilized resources need to match the ambition of EW4All.

While many financial mechanisms can invest in infrastructure, equipment and capacity-building, fewer are able to fund recurrent training, on-the-job coaching or make provisions for the ongoing costs associated with operations and maintenance – yet all are required if the benefits of investments in infrastructure, systems and equipment are to be fully realized. For example, in relation to observation and monitoring (within Pillar 2), the lack of funding for ongoing running costs has been recognized as a key reason for the persistent gaps in global observing networks. To address this, in addition to providing technical guidance and training, SOFF is expressly designed to support operational costs using a results-based funding mechanism during the final "compliance phase". Other funding entities like CREWS are able to support operational costs during programme implementation. If international support can be continued for running costs in the short term, evidence of the benefits arising can be used by NMHSs to make the case to their government for enhanced annual operational budgets that will sustainably support the delivery of MHEWS in the long term. If other financial instruments could adopt a similar approach, technical infrastructure will be used more effectively and for longer – delivering better outcomes for everyone, everywhere, as well as improved returns on investment for funders.

National strategies and EW4All roadmaps help coordinate funding and scale-up of MHEWS, while monitoring frameworks track progress. This alignment enables programmes to complement each other, as seen in 2024 when CREWS extended its West Africa Programme to match a GCF project timeline, funding training for effective use of new infrastructure. Initiatives like WMO Partner Coordination Mechanism also support international collaboration around national priorities. The Global Observatory provides a way to monitor progress on financing MHEWS scale-up. Launched in 2024, data from nine IFIs is now included. While Africa and Asia are each receiving more than a third of the total investments, all continents are represented.

More than half of the MHEWS investments are for low- and middle-income countries, and more than a third of the projects focus on LDCs. Over a third of all projects span across the four pillars, but funding is most strongly associated with Pillars 1 and 2, underscoring a continued emphasis on technical and data infrastructure. Yet for MHEWS to be effective on the ground, funds are also required to support participatory approaches that enable meaningful dialogues with MHEWS stakeholders – including public outreach and co-production activities – to inform the design and delivery of locally appropriate MHEWS.

Most anticipatory actions remain externally funded, although some governments have started to mobilize domestic resources. Despite growing interest, governments often lack the policies, resources and mechanisms to trigger early disbursement of public funds, and "fuel" funding for anticipatory action remains less than 1 per cent of total crisis funding. However, as part of their commitment to scale up anticipatory action under the Grand Bargain, leading donors have agreed to track and report funding of both "build" and "fuel" funding for anticipatory action. Progress will be monitored by the Anticipation Hub and reported annually within the annual Global Overview report on anticipatory action.

Outlook:
Momentum is building through the EW4All initiative, programmes and funds that have pledged their support. Investments to date – such as through CREWS, SOFF, GCF and the Adaptation Fund, among others – are all contributing to achieving the global goal.

Recommendations:
With support from development partners and EW4All, countries should:

- Develop costed national MHEWS implementation plans that enable and encourage coordination and coherence across financial mechanisms, development partners, and the activities they support.
- Review existing funding and business models pertaining to MHEWS capabilities.
- Sustain and continuously improve efforts to track investments in MHEWS and anticipatory action.

Finding 7. Innovation and new technology bring opportunities to scale up MHEWS, yet the digital divide remains.

Globally, and across all of the pillars, advances and innovations in all aspects of MHEWS – including non-technical innovations in ways of working and collaborating – are playing an important part in meeting the goal of EW4All.

Within risk knowledge (Pillar 1), this is seen through the development of DELTA Resilience, an enhanced disaster tracking system for hazardous events and losses and damages, and the roll-out of other platforms like myDEWETRA, which has APIs to enable its data to be integrated into other systems, including smartphone applications. Meanwhile, for Pillar 2, the roll-out of the package of digital tools in ClimWeb is building forecasting and warning dissemination capabilities across Africa, and WIS2Box is improving the exchange of hydrometeorological data globally. In the case of preparedness and response capabilities (Pillar 4), innovation and technology are supporting anticipatory action – for example, through digital tools that help vulnerable communities to pre-register and stay connected with their National Society before, during, and after disasters. Efforts also enable the timely and proactive deployment of cash and voucher assistance. The impact of innovations and new technology is perhaps most evident in relation to the communication and dissemination of warnings (Pillar 3) and is a driver of the high coverage and comprehensiveness scores achieved for this pillar.

This year, we are also starting to see AI transform the MHEWS space. While AI, including deep learning and machine learning, is already used in many sectors – including data quality control, assimilation and modelling applications in meteorology – its use is yet to be mainstreamed. Nonetheless, AI's potential is significant, from the analysis of vast datasets to the dissemination of tailored warning messages in a range of languages.

For some countries, a persistent digital divide hampers their adoption of new approaches and technologies, especially if they are dependent on strong Internet with sufficient bandwidth. While preferential to the proliferation of standalone systems that was seen in the past, the online hosting of tools and databases – and the development of mobile applications – requires stable Internet and smartphones with sufficient data packages (see finding 10).

Outlook:
Advances and innovations in science – for example, within forecasting – and technology have led, and will continue to lead, to improvements in MHEWS across all pillars. In the coming years, rapid advances are expected as the use of data and AI tools and approaches transform the MHEWS space. It is expected to bring huge efficiencies in the way that we analyse large datasets – including non-traditional data, such as from social media – and enabling warning messages to be quickly translated into multiple languages and be tailored to meet individual needs. Innovations in how stakeholders work together to maximize these new technologies will remain critical for realizing their full potential.

Recommendations:
With support from development partners and EW4All, countries should:

- Enhance investments in data availability and access – understanding past disaster impacts, tracking ongoing hazardous events, and predicting future risks are critical to the design and development of MHEWS and for ensuring that MHEWS are meaningful and informed.
- Leverage advances in science and technology – as well as innovations in ways of working and softer skills – to improve MHEWS capabilities, for example, in terms of new sensors, automated data quality control and improved forecasting systems.
- Explore how AI can be used to its greatest effect in the context of MHEWS.

Finding 8. The extent and depth of risk knowledge are improving but need further strengthening.

Traditionally the least advanced of the four pillars in terms of coverage and the comprehensiveness of capabilities, data suggests that disaster risk knowledge (Pillar 1) is seeing an increase in its scores. However, while countries are starting to reap the benefits of focused work to improve disaster risk knowledge, only a third of all countries are reporting capabilities in Pillar 1. This is concerning as disaster risk knowledge is foundational to the implementation of appropriate, effective MHEWS – from the requirements for observations and forecasting systems through to the design of anticipatory action frameworks. Disaster risk knowledge also informs strategies for communicating about hazards.

The comprehensiveness of Pillar 1 capabilities in the Africa region is significantly lower than elsewhere, with no countries reporting comprehensive capabilities. However, there have been significant improvements in the last year, with the number of countries reporting only limited capabilities reducing from 13 to five. The recent launch of DELTA Resilience is expected to drive this trend further, providing more complete and disaggregated disaster information that can be used before the onset of hazardous events to plan interventions that save lives and minimize impacts.

Strengthening the production, accessibility and use of risk information supports not only preparedness and early action planning but also broader risk-informed development. The limited level and coverage of risk knowledge – especially in the Africa region – calls for continued investment to roll out disaster risk knowledge systems and associated best practices for the collection, analysis and use of disaster risk information. In this regard, it is encouraging to see from the financial data in the Global Observatory that Pillar 1 is receiving the most funding.

Outlook:
Improvements in disaster risk knowledge so far, and into the future, have been supported by the development of a range of tools and the sharing of good practices. This trend is set to endure with continued investment in Pillar 1 activities that encourage the uptake of technology solutions and innovations – both high-tech and low-tech – that support the development and use of risk knowledge across every aspect of MHEWS design and implementation.

Recommendations:
With support from development partners and EW4All, countries should:

- Implement and fully utilize systems to support the timely collection, quality control and sharing of disaster risk knowledge – disaggregated by gender, age, disability and other relevant factors.
- Expand the knowledge base by fully integrating ILK and related approaches to ensure that MHEWS are relevant to local communities and build on their collective knowledge of hazards, vulnerability and exposure, especially in dynamic contexts.
- Utilize all available data sources and embrace innovations in data collection, management and analysis, including the potential use of AI to analyse data (see finding 7).

Finding 9. Observing and forecasting skills are improving, but comprehensive capabilities are not widespread, and emerging hazards bring additional challenges.

Pillar 2 has seen major improvements in observing and forecasting capabilities, driven by technological advances like meteorological satellites, new research and better access to historical data. Despite this progress, gaps remain as new hazards such as GLOFs and transboundary SDS emerge. Forecasting methods for these are still evolving, though initiatives (like the global partnership for combating SDS) show proactive steps. As systems develop, public understanding of risks and appropriate responses is crucial – especially for sudden or hard-to-track hazards like earthquakes, volcanic eruptions and landslides.

Globally, just over a third of all countries officially reported that they have multi-hazard monitoring and forecasting systems, and two thirds of these countries have comprehensive capabilities. In 2025, only six countries are reporting limited capabilities, but four of these countries are in the LDCs group, where a lack of operational systems and infrastructure continues to hamper the delivery and scale-up of MHEWS. The lack of integrated forecasting systems is most evident in the Africa region and in the Americas and the Caribbean, reinforcing the urgency of continued investment, coordination and innovation. Despite this, the vast majority of NMHSs are providing early warnings that enable early action.

Most countries benefit significantly from the global products provided by WIPPS centres, which serve as the essential foundation for forecasting and early warning services at the national level. However, while invaluable, WIPPS data and products are not always available at the spatial resolution required to produce detailed predictions at the local level.

Many of the gaps in observations that were highlighted in last year's report persist, with less than a tenth of WMO Members – and no LDCs – complying fully with the requirements of GBON, which are essential for running the global models that predict weather and climate. However, the number of compliant stations in LDCs has increased threefold in two years (to May 2025). This improvement has been driven by NMHS efforts and is further supported by investments in hydrometeorological infrastructure, including those backed by CREWS and SOFF. With funding models that permit some operational costs, it is clear that SOFF and CREWS are crucial vehicles for achieving sustained GBON compliance, with both initiatives providing technical support to countries. SOFF is also developing a Community of Practice (see finding 5).

The automation of observation networks improves data quality, frequency and timeliness, while reducing operational burdens. Currently, about a third of WMO Members have fully automated their observation networks, marking important progress in modernization. At the same time, the number of Members sharing data through WIS 2.0 has more than doubled in the past two years, ensuring that data is not just collected but shared. Many of the systems that NMHSs use for daily operations and service delivery – including WIPPS and WIS 2.0 – need stable, high-bandwidth Internet connections. However, a fifth of WMO Members – mainly LDCs and SIDS – do not have sufficiently robust Internet infrastructure.

Regional centres and flagship programmes (e.g. SWFP) have an important role to play in supporting MHEWS, especially for LDCs, LLDCs and SIDS. In the last year, SWFP has expanded to cover 85 countries, but the technical capacity for IBF still remains weak. The cross-sector data sharing that is fundamental to IBF – to understand the vulnerability and exposure of communities and assets – is also insufficient (see finding 5).

Outlook:
The foundational work completed in recent years is bearing fruit, with global initiatives (e.g. CREWS and SOFF) and programmes (e.g. SWFP) gaining momentum and scaling up. Meanwhile, other initiatives are building forecasting capabilities (e.g. the African Union ClimSA programme), which should improve the capabilities of NMHSs in the coming years.

Recommendations:
With support from development partners and EW4All, countries should:

- Seek financial support – for investment and running costs – to improve and sustain the availability of data from observation networks, thereby closing the GBON gap.
- Engage with regional centres and flagship programmes like SWFP to build forecasting capabilities, especially for IBF.
- Strengthen risk information and observation data for emerging hazards – including extreme heat, GLOFs and SDS – while simultaneously developing expertise and sharing best practice at appropriate forums.

Finding 10. Enabled by improvements in digital infrastructure, warnings are reaching more people but need to be sustained.

Pillar 3, communication and dissemination, remains the most developed pillar in terms of coverage (more than half of all countries) and comprehensiveness. More than half of the counties in each region report a comprehensive capability.

A recent highlight is the roll-out of CB and LB-SMS, now operational in 44 countries. There has also been progress in terms of agreements that enable warning dissemination. Regulatory mandates, such as the European Union's directive on mobile alerts, have accelerated uptake of CB (at the regional level), while collaboration with telecom operators, broadcasters, and technology providers ensures both compliance and innovation. The forming of NETPs – including roles and responsibilities for the media and private sector actors – is also supporting the development of this pillar at the national level. In addition to these technical advances, the potential of AI to enhance communication and dissemination is significant, with early examples demonstrating how warning messages can be tailored to meet user preferences for content and language.

Improvements in the availability, accessibility and affordability of the Internet and mobile broadband – as well as increased ownership of mobile phones – provide opportunities for the collection of data as well as the dissemination of warnings and alerts. Similarly, the continued adoption of the CAP standard ensures the dissemination of consistent messages across multiple platforms. In Africa, CAP adoption has been accelerated through the roll-out of the ClimWeb package, supported by CREWS and NORCAP. However, the data suggests that the use of CAP messaging is still not widespread – and even where CAP training has been completed, its use is not being sustained, with close to half of all WMO Members yet to issue a CAP alert.

Despite the advances made as a result of technology, some communities (especially marginalized groups) remain hard to reach, and inequalities persist – particularly in rural parts of developing countries. Therefore, it remains crucial for MHEWS communication and dissemination strategies to adopt a multichannel approach that is supported by clear, consistent warnings – and advice – from a single authoritative voice. To ensure no one is left behind, digital tools need to complement rather than replace traditional systems. This means that, while embracing the latest developments, countries must ensure that their MHEWS include basic forms of warning dissemination (e.g. sirens and flags), integrate traditional and local knowledge, involve local leaders, and use community-based participatory approaches and community dialogue, building trust in MHEWS.

Outlook:
With continued improvement expected in the coverage, accessibility and affordability of mobile communication – as well as the roll-out of CB and LB-SMS – dissemination of warnings by mobile phone will continue to transform the warning space, along with advances in satellite communication. However, if warnings are to reach everyone, a multichannel approach is needed with low-tech and no-tech dissemination mechanisms playing an equally important role.

Recommendations:
With support from development partners and EW4All, countries should:

- Ensure that communication and dissemination plans align with good practices in terms of a multichannel approach with consistent messaging from authoritative sources.
- Develop appropriate plans, regulations, and frameworks to support the expansion and improvement of availability and access to mobile broadband.
- Work with communities to address systemic issues linked to access radio and mobile phones.
- Encourage the sustained implementation of CAP messaging through the integration of the CAP standard within operational procedures for warning dissemination.
- Support the scale-up of CB and LB-SMS, and ensure the mobile industry is actively involved in the process.
- Take action to improve the stability and bandwidth of Internet connections, especially for key MHEWS actors.
- Consider how to use AI approaches to enhance MHEWS across all pillars, especially for data collection and analysis, and for messaging.

Finding 11. Momentum is building for anticipatory action and planned responses that save lives, but plans need to be embedded and keep pace with the growing complexity of risk.

Where preparedness and response plans exist and are activated, lives and livelihoods can be saved. Therefore, it is encouraging to see a dramatic increase in the number of countries reporting some capability in this pillar – now half of all countries.

When taken in response to forecasts, pre-emptive evacuation is an example of an anticipatory action. Globally, there were 2.7 billion instances of people being pre-emptively evacuated between 2015 and 2023, more than half of these taking place in the Asia-Pacific region. However, comparing the number of people evacuated from 2015 to 2022 to the data for 2023, the number doubled in the Americas and the Caribbean region and increased nearly 15-fold in the Arab States. This indicates that, in these regions in particular, a higher proportion of countries – and communities – are taking pre-emptive action in the face of a hazard.

Consistent with the data on pre-emptive evacuations, the Asia-Pacific region has the highest overall coverage for Pillar 4, and a third of reporting countries in this region have comprehensive capabilities. Coverage and comprehensiveness remain lower in the Americas and Caribbean and across the Africa region, yet there has still been a significant improvement. In the last year alone, the number of countries reporting preparedness and response capabilities has nearly doubled in the Africa region and increased by a third in the Americas and the Caribbean region.

Early warnings alone do not always lead to timely and effective action. Rather, effective early action and response are dependent on the development and activation of plans, together with both the mindset and resources needed to act. It is therefore encouraging to see that while they are far from widespread, the number of active anticipatory action frameworks has increased by half in the last year. There has also been an increase in the number of plans under development – nearly 200 in 2024, an increase of a third compared to the last year.

The growth in awareness and implementation of anticipatory action plans is in part thanks to the new tools, guidance and training that are available to participants, much of which has been co-developed by the IFRC and other humanitarian actors. This includes a new toolkit for implementing anticipatory action in FCV settings.

Significantly, a third of the 121 anticipatory actions in 2024 took place in countries affected by fragility, conflict and violence – proving that anticipatory action can be implemented in challenging, dynamic situations. Yet only a quarter of all countries have anticipatory action plans, leaving many communities vulnerable.

Another positive trend is that governments are playing an increasingly central role in driving anticipatory action at the national level, with the designation of government authorities for anticipatory action and the formalization of pre-existing, ad hoc arrangements. Inter-agency collaboration is also improving and, as auxiliaries to public authorities, the National Red Cross and Red Crescent Societies have played a unique role in linking anticipatory action to the activities of local government and communities. However, anticipatory action is not happening at the scale required or for all hazards, and many frameworks focus on single hazards (mainly drought), rather than taking a multi-hazard approach.

To turn early warnings into timely, life-saving measures, governments must integrate anticipatory action into DRM and related sectors like climate, health and social protection. This involves embedding it in laws, policies, forecasting, financing and preparedness plans to ensure swift, coordinated response before disasters strike.

Outlook:
With many countries developing anticipatory action frameworks in recent years and national governments seeing the benefits that they bring, there is an expectation that the number of active frameworks – and activations – will continue to increase in future years.

Recommendations:
With support from development partners and EW4All, countries should:

- Take advantage of technical assistance and shared learning from other countries and actors to start, continue to develop, or enhance anticipatory action plans for priority hazards, expanding to a multi-hazard approach wherever possible and supporting broader coverage, including in fragile and conflict-affected contexts.

- Transition towards local leadership of anticipatory action frameworks and plans where local and national governments have the technical and financial resources to do so.
- Regularly review and update plans – testing them through scenarios, simulations and exercises – with public outreach to improve knowledge of risks and understanding of how to respond.

Finding 12. EW4All continues to stimulate MHEWS scale-up.

The evidence from the data in this report and the examples cited underscore the need for early warnings – for everyone, everywhere – and why this has become a unifying agenda for adaptation and resilience. Early warnings are mentioned – and measured – in multiple initiatives and calls for action, not least the Sendai Framework for DRR, the 2030 Agenda for Sustainable Development, the Paris Agreement and, most recently, among targets of the UAE Framework for Global Climate Resilience under the GGA. Thus, momentum is gathering around the global scale-up of MHEWS with initiatives and programmes – both pre-existing and new – aligning with the goal of EW4All.

At national, regional and global levels, EW4All is bringing together key stakeholders and supporting the development of country-led plans to achieve the goal of universal MHEWS – for example, through a series of MSFs held at regional and global levels.

The data presented in this report provides clear evidence of the continued progress being made in terms of improvements in coverage and comprehensiveness of MHEWS within and across each pillar, region and country group. Pre-existing programmes and initiatives are aligning their activities with the goal of EW4All and, as evidenced by the data held in the Global Observatory, funding is being made available for MHEWS.

At the national level, countries have identified their key stakeholders, assessed the status of pillars and developed country-led plans to introduce or improve MHEWS. Regionally, EW4All partners and pillar leads are establishing coordination mechanisms and expanding the coverage of flagship programmes like SWFP. EW4All is also catalysing or supporting other peer-to-peer exchanges that will enable global scale-up, including South-South and triangular cooperation and twinning.

Evidence to track progress is increasing through a robust EW4All M&E system steered by an active M&E working group, with progress shared through the EW4All Dashboard and periodically through the annual global status reports. Meanwhile, and in collaboration with numerous partners, the initiative's ITCG oversees the provision of guidance and tools to countries to support them in the implementation of MHEWS. It has also provided technical assistance to more than 100 countries since the start of EW4All.

EW4All has catalysed many activities – including consultations with stakeholders nationally and through the regional and global MSFs – and has provided tools and guidance to support MHEWS scale-up. However, many challenges remain. While newly developed or adopted country-led plans and EW4All Roadmaps are key to addressing the persistent gaps in MHEWS, many countries – especially LDCs and SIDS – have insufficient funds to implement these plans without targeted support for implementing EW4All.

Outlook:
Momentum is gathering around EW4All and the global scale-up of MHEWS, catalysed by EW4All. Pre-existing and new initiatives and programmes are aligning with EW4All, and the demand for support is increasing as governments seek to improve outcomes for their populations. Over the coming months and years, more countries will complete the development of their national plans and move towards implementation. However, as the initiative reaches the halfway stage in 2025, while progress is tangible, there remains a lot of work to do before its goal can be achieved.

Recommendations:
With support from development partners and EW4All, countries should:

- Utilize the tools, guidance and technical support from EW4All to support the national scale-up of MHEWS through a collaborative approach with all of society.
- Regularly update the status of MHEWS implementation and report related progress through appropriate mechanisms (see finding 2).
- Engage with regional institutions, TWGs, and related projects, programmes, initiatives, and communities of practice to develop MHEWS capabilities and learn from the experiences of others.


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Annex A. Members of the EW4All Advisory Panel

The Advisory Panel of the Early Warnings for All initiative was established by UN Secretary-General António Guterres to ensure the effective execution and strategic coherence of the initiative, with the goal of ensuring that every person on Earth is safeguarded by Multi-Hazard Early Warning Systems by 2027. The composition of the Panel is deliberately diverse, aiming to actively engage all stakeholders in the implementation process.

The Panel is charged with assessing initiative progress in alignment with its established goals and targets, cultivating political and broader support for initiative, offering comprehensive recommendations for the mobilisation of resources and monitoring advancements in scientific and technical aspects related to EWS.


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Celeste Saulo, Secretary-General, World Meteorological Organization


Jagan Chapagain, Chief Executive Officer and Secretary General of the International Federation of Red Cross and Red Crescent Societies


Selwin Hart, Special Adviser to the UN Secretary-General on Climate Action and Just Transition


Inger Andersen, Executive Director of the United Nations Environment Programme


Rabab Fatima, Under Secretary-General and High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States


Tom Fletcher, Under-Secretary-General for Humanitarian Affairs and Emergency Relief Coordinator


Kamal Kishore, Special Representative of the United Nations Secretary-General for Disaster Risk Reduction


Doreen Bogdan-Martin, Secretary-General of the International Telecommunication Union


Haoliang Xu, Acting Administrator of the United Nations Development Programme


Sima Bahous, Executive Director of the United Nations Entity for Gender Equality and the Empowerment of Women


Oscar Fernández-Taranco, Assistant Secretary-General for Development Coordination


Catherine Russell, Executive Director of UNICEF


Mafalda Duarte, Executive Director of the Green Climate Fund


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Francis Pigeon, Chair of the Climate Risk & Early Warning Systems (CREWS) Initiative


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Mukhtar Babayev, President of the twenty-ninth United Nations Climate Change Conference


Ilan Goldfajn, President of Inter American Development Bank (IDB)


Brad Smith, Vice Chair and President of Microsoft


Michel Liès, Chair of the Insurance Development Forum Steering Committee


Willem van de Voorde, Special Envoy for Climate and Environment of the Kingdom of Belgium


Mwanahamisi Singano, Director of Policy at the Women's Environment & Development Organization


Ana Toni, Chief Executive Officer of the thirtieth United Nations Climate Change Conference

Annex B. Overview of data used in the report

A combination of data sources has been used in this report to assess progress towards the Sendai Framework's Target on MHEWS (Target G) and the EW4All initiative. The data gathering and analysis for the report is collaborative and multi-faceted, combining official reporting, surveys, contributions from partners, and in-depth case studies to provide a comprehensive picture of the global MHEWS landscape and guide efforts towards building more effective and people-centred early warning system. Sources include:

- Official Reports from UN Member States: Countries report on the status of their MHEWS through the Sendai Framework Monitor. This data includes information on the existence and comprehensiveness of their MHEWS, often measured through indicators G2-G5 which map to the four pillars of MHEWS.

- WMO Surveys: The World Meteorological Organization (WMO) conducts surveys to gather additional data on Members' MHEWS capabilities. This complements other official reporting from United Nations Member States.

- ITU Facts and Figures

- IFRC Anticipation Hub and reports on Anticipatory Action

- Case Studies and Consultations: An open call was launched for case studies that highlight successes and challenges in MHEWS implementation. These offer qualitative data and contextual understanding to complement the quantitative information. Contributors included:

  - Anticipation Hub
  - Caribbean Disaster Emergency Management Agency
  - CGIAR
  - China Meteorological Administration
  - CREWS Secretariat
  - Department of National Meteorology, Cameroon
  - EW4All
  - Finnish Red Cross
  - GIZ
  - Global Disaster Preparedness Center
  - Government of Barbados, Department of Emergency Management
  - Government of Benin, Meteo Benin
  - Government of Brazil, National Center for Risk and Disaster Management (CENAD)
  - Government of Chile, SENAPRED and Red de Informantes Mercalli
  - Government of Ghana, Ghana Meteorological Agency (GMet)
  - Government of India, Indian National Centre for Ocean Information Services (INCOIS), Ministry of Earth Sciences
  - Government of Iraq, Ministry of Environment
  - Government of Lao PDR, through the Department of Meteorology and Hydrology
  - Government of Switzerland
  - GSMA
  - Humanitarian Action for Africa
  - IFRC
  - ITU
  - Metropolitan Risk Management Department, Ecuador
  - Municipality of Manta, Ecuador
  - NaturAceites
  - Navteca
  - People In Need
  - Resurgence
  - Sand and Dust Storm Regional Centre / National Centre for Meteorology
  - SOFF Secretariat, WMO
  - UN - The Resident Coordinator's Office in Mozambique
  - UN IOM
  - UNDRR
  - UNEP
  - UNICEF
  - United Nations University - Institute for Environment and Human Security
  - WMO

Annex C. Country mapping by region

An exploratory mapping of MHEWS-relevant programmes and initiatives has been done and can be accessed here: www.preventionweb.net/media/100380.

This mapping, done per country by region, provides an overview of the coverage of MHEWS programmes, and will be updated regularly.

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Global Status of Multi-Hazard Early Warning Systems

2025

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UNDRR
UN Office for Disaster Risk Reduction

Early Warnings for All

WORLD METEOROLOGICAL ORGANIZATION