



A Real Mosaic of Solutions to Respond to Loss and Damage from Climate Change

Early Warnings

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Introduction

This publication is part of a [series of briefs](#) unpacking the pieces of a fit for purpose “mosaic of solutions” to respond to loss and damage from climate change. This series expands on our earlier work which presented a five-year vision for Loss and Damage under the [United Nations Framework Convention on Climate Change](#) (UNFCCC) to look beyond the international climate regime at catalysing a wider mosaic of solutions.

In the [flagship paper](#) of the series, we unpack the pieces of the mosaic. In these thematic briefs we dive deeper into existing solutions and how they can be strengthened. We also consider any reforms needed and explore emerging solutions.

This brief unpacks the relationship between loss and damage responses and early warning systems. It provides a short introduction to the benefits of early warning systems, highlights the challenges that are limiting coverage and upkeep of early warning systems in developing countries, and how these challenges can be addressed.

What are early warning systems?

Early warning systems are integrated systems designed to provide timely and actionable warnings of impending hazards including extreme events (e.g. cyclones and earthquakes), risks to health (e.g. heatwaves and disease outbreaks), and food security threats (e.g. droughts). They are crucial tools for building resilience, safeguarding livelihoods, reducing loss of life and injury, minimising economic impacts, and protecting critical infrastructure.

Giving just 24 hours’ notice of an impending hazardous event can reduce damage by as much as 30 percent.¹ Investing just 800 million USD in early warning systems in developing countries could prevent losses of 3 to 16 billion USD annually.²

What is the problem?

Just 119 countries are covered by [multi-hazard early warning systems](#) (MHEWS).³ Developing countries—particularly the [Least Developed Countries](#) (LDCs) and [Small Island Developing States](#) (SIDS)—have the lowest level of coverage, with only 52 percent of LDCs and 43 percent of SIDS covered.⁴ Challenges include finance gaps, the need to innovate new technology,⁵ ensuring long term sustainability of systems, and the complexity of evolving climate risks.⁶

Significant systematic observation gaps also need to be closed, particularly in Africa, Asia and Latin America.⁷ This is key to ensuring that MHEWS have the data they need to issue advanced warnings. Although efforts to close these gaps are supported by the [World Meteorological Organization](#) (WMO), the [Global Climate Observing System](#) (GCOS), and the [Systematic Observations Financing Facility](#) (SOFF), all of these institutions face major funding challenges.^{8 9 10}

A persistent “digital divide” is also limiting the reach of new technologies in developing countries.¹¹ In particular, the online hosting of tools and databases which requires stable, high-bandwidth Internet connections and smartphones with sufficient data packages.¹² This is further compounded by a lack of connectivity in both urban and rural areas.¹³ Furthermore, much of the finance being provided to developing countries for MHEWS comes in the form of loans.¹⁴ This risks exacerbating existing debt crises.

What do we need to see?

Launched by the [United Nation's Secretary General](#), [Early Warning for All \(EW4All\)](#) aims to ensure universal coverage of MHEWS by the end of 2027.¹⁵ This is supported by financial mechanisms, including the [Climate Risk Early Warning Systems \(CREWS\)](#) initiative, which funds projects in LDCs and SIDS to establish risk-informed early warning services.¹⁶

Universal coverage of MHEWS must be achieved by the end of 2027 under the EW4All initiative.¹⁷ This requires an investment of at least 3.1 billion USD.¹⁸ CREWS requires at least 78.8 million USD in funding just to address the immediate needs of LDCs and SIDS and significantly scaled up funding thereafter.¹⁹ Sustained funding is also needed for the upkeep of MHEWS in developing countries.

At the same time, the WMO, GCOS, and SOFF must receive scaled up and sustained funding to close systematic observation gaps in developing countries.²⁰ New satellite technologies and powerful advances in data processing and artificial intelligence must also be harnessed to reshape systematic observation.²¹ Developed countries must close all of these finance gaps and ensure that technology is transferred. Table 1 provides greater detail on these existing solutions, the challenges they face, and what is required to close the gaps.

Table 1 : Existing early warning and systematic observation solutions that must be strengthened.

CURRENT SOLUTIONS	HOW DOES IT WORK?	WHAT ARE THE ISSUES?	WHAT NEEDS TO CHANGE?
Early Warning for All (EW4All)	EW4All is built on four pillars: 1. Disaster risk knowledge, led by United Nations Office for Disaster Risk Reduction (UNDRR); 2. Detection, observation, monitoring, analysis, and forecasting, led by the WMO; 3. Warning dissemination, and communication, led by the International Telecommunication Union (ITU); and 4. Preparedness and response capabilities, led by the International Federation of Red Cross and Red Crescent Societies (IFRC).	EW4All required a total of 3.1 billion USD in targeted investments between 2023 and 2027. Gaps remain in financing²² and much of the finance being provided as loans (69 percent).²³ This will exacerbate debt crises in developing countries.	Developed countries must close the funding gap, with new and additional grant based finance.

CURRENT SOLUTIONS	HOW DOES IT WORK?	WHAT ARE THE ISSUES?	WHAT NEEDS TO CHANGE?
Climate Risk Early Warning Systems (CREWS)	CREWS works directly with countries to increase the availability of, and access to, early warning systems. Country and regional projects are implemented by countries with the support of UNDRR, the World Bank Global Facility for Disaster Reduction and Recovery (GFDRR), and the WMO. ²⁴	Progress is being made under CREWS. Since 2015, 397.6 million people living in LDCs and SIDS have gained access to forecasts and early warnings developed or improved with CREWS support.	CREWS needs an additional 78.8 million USD in funding to address immediate demand. ²⁵ Developed countries must close the funding gap, with new and additional grant based finance.
The Global Climate Observing System (GCOS)	GCOS is a long-term, user-driven program that coordinates and improves global monitoring of the atmosphere, oceans, and land to provide comprehensive data for climate science.	GCOS faces funding challenges that threaten the sustainability and continuity of long-term climate data records. A small number of institutions are responsible for maintaining key data records. ²⁶	Developed countries must equip GCOS with the funding it needs to ensure the sustainability and continuity of long-term climate data records. With sustained and increased funding, the GSOS will be able to help fast track the role out of new satellite technologies and powerful advances in data processing and artificial intelligence. ²⁷ This will enhance the accuracy of predictions, analysis of complex climate scenarios, and refine models to better understand current and projected loss and damage, leading to more accurate and timely early warning systems.
World Meteorological Organization (WMO)	The WMO coordinates, standardises, and supports systematic observation to provide reliable data for weather forecasting, climate monitoring, and early warning systems.	The WMO faces challenges in including funding shortfalls, and significant gaps in global observing networks, particularly in developing countries. ²⁸	Financial support of the WMO must increase alongside sustained support to developing countries to increase observation networks in regions where data are lacking. ²⁹ Developed countries must ensure that the WMO has the funding it needs.

CURRENT SOLUTIONS	HOW DOES IT WORK?	WHAT ARE THE ISSUES?	WHAT NEEDS TO CHANGE?
Systematic Observations Financing Facility (SOFF)	The SOFF is a financing mechanism that supports countries to close the basic weather and climate observations data gap. SOFF prioritises LDCs and SIDS, providing long-term financial and technical assistance.	Nearly 90 percent of the basic weather and climate data required from the 77 LDCs and SIDS is missing. ³⁰ Closing this gap requires approximately 500 million USD for observation infrastructure and human capacity, plus an estimated 50 million USD per year to sustain operations. ³¹	SOFF has launched the innovative source of finance the Systematic Observation Impact Bond , which seeks to mobilise 200 million USD from investors backed by public and private donors. ³² However, there is a risk that the impact bond could result in high transaction and administrative costs. ³³ Therefore, grant based finance from developed countries should be prioritised.

Endnotes

- 1 International Federation of Red Cross and Red Crescent (2023). IFRC and UN scale up Early Warnings for All into action on the ground. *International Federation of Red Cross and Red Crescent*. Available [here](#).
- 2 Global Center on Adaptation (2019). Adapt now: a global call for leadership on climate resilience. *Global Center on Adaptation*. Available [here](#).
- 3 World Metrological Organisation (2025). Global Status of Multi-Hazard Early Warning Systems 2025. *World Metrological Organisation*. Available [here](#).
- 4 United Nations Office for Disaster Risk Reduction (2025). Global Status of Multi-Hazard Early Warning Systems 2025. *United Nations Office for Disaster Risk Reduction*. Available [here](#).
- 5 Institute for Water Education (2022). Early warning for all – six key challenges. *Institute for Water Education*. Available [here](#).
- 6 Ibid.
- 7 Ibid.
- 8 World Metrological Organisation (2026). Scientists and experts gather in the United Kingdom to shape the future of global climate observation. *World Metrological Organisation*. Available [here](#).
- 9 World Metrological Organisation (2025). Bulletin highlights successes, opportunities and challenges of WMO at 75. *World Metrological Organisation*. Available [here](#).
- 10 Systematic Observations Financing Facility. (2025). SOFF Action Report 2025 Time to scale up. *Systematic Observations Financing Facility*. Available [here](#).
- 11 World Metrological Organisation (2025). Global Status of Multi-Hazard Early Warning Systems 2025. *World Metrological Organisation*. Available [here](#).
- 12 Ibid.
- 13 Ibid.
- 14 World Metrological Organisation (2025). Global Observatory for EWS Investments. *World Metrological Organisation*. Available [here](#).
- 15 United Nations (no date given). Early Warnings for All. *United Nations*. Available [here](#).
- 16 World Metrological Organisation (no date given). Climate Risk & Early Warning Systems. *World Metrological Organisation*. Available [here](#).
- 17 United Nations (no date given). Early Warnings for All. *United Nations*. Available [here](#).
- 18 Ibid.
- 19 Climate Risk & Early Warning Systems (2024). CREWS Annual Report 2024. *Climate Risk & Early Warning Systems*. Available [here](#).
- 20 World Metrological Organisation (2025). World's first impact bond on weather and climate data opens for contributions. *World Metrological Organisation*. Available [here](#).
- 21 World Metrological Organisation (2026). Scientists and experts gather in the United Kingdom to shape the future of global climate observation. *World Metrological Organisation*. Available [here](#).
- 22 World Metrological Organisation (2025). Call to Action by the WMO Secretary-General on Accelerating the Implementation of the Early Warnings for All Initiative. *World Metrological Organisation*. Available [here](#).
- 23 Early Warnings for All (2025). Global Observatory for EWS Investments. *Early Warnings for All*. Available [here](#).
- 24 World Metrological Organisation (no date given). Climate Risk and Early Warning Systems (CREWS). *World Metrological Organisation*. Available [here](#).
- 25 Climate Risk and Early Warning Systems (2024). Annual Report 2024. *Climate Risk and Early Warning Systems*. Available [here](#).

- 26 World Metrological Organisation (2026). Scientists and experts gather in the United Kingdom to shape the future of global climate observation. *World Metrological Organisation*. Available [here](#).
- 27 Ibid.
- 28 World Metrological Organisation (2025). Bulletin highlights successes, opportunities and challenges of WMO at 75. *World Metrological Organisation*. Available [here](#).
- 29 World Metrological Organisation (2025). World's first impact bond on weather and climate data opens for contributions. *World Metrological Organisation*. Available [here](#).
- 30 Systematic Observations Financing Facility (2025). SOFF Action Report 2025: Time to scale up. *Systematic Observations Financing Facility*. Available [here](#).
- 31 Ibid.
- 32 Ibid.
- 33 Savell, S., Heady, L. (2016). Evaluating Impact Bonds. *Social Finance*. Available [here](#).

