WARNINGS
BRIEFING NOTE

MULTI-HAZARD EARLY WARNING SYSTEMS

Building warnings for multiple hazards (MHEWS)

Key Points

- For warning systems to be most comprehensive they need to be multi-hazard
- MHEWS must operate across many stakeholders to integrate hazard / risk knowledge
- There is a risk of too many differing and contradictory EWSs causing confusion

State of the Art

Multi-Hazard Early Warning Systems (MHEWS) can be defined as warning systems that 'address several hazards and/or impacts of similar or different type in contexts where hazardous events may occur alone, simultaneously, cascadingly, or cumulatively over time, and taking into account the potential interrelated effects' (UN, 2017).

In practice MHEWS can be challenging to implement, as working across different hazards presents challenges to monitoring and responding agencies. These agencies have to make sense of what to do when new data is issued, often in isolation to other hazards, with lots of uncertainty, and frequently requiring conflicting actions. For example, during the COVID-19 pandemic in East Africa, restrictions suggested that vulnerable populations to remain isolated, while severe flood warnings urged vulnerable populations to evacuate their homes and seek alternative shelter. Developing MHEWS is made more challenging by increasing levels of public warning solutions (e.g. CAP/Cell Broadcasting), the vulnerability of electricity to support communication during a crisis, and misinformation as a result of social media, all of which can have security issues.

Core Needs

MHEWS attempt to overcome the challenges of issuing multiple hazard warnings and preparing for the negative/contradicting, or positive/reinforcing actions that can emerge via:

- The ability to warn of one or more hazards that increases the efficiency and consistency of warnings through co-ordinated and compatible mechanisms and capacities.
- Warnings require integration across different vulnerabilities to help responders take the appropriate actions.
- Developing integrated and coordinated warnings across differing silos to enable broader, more diverse overviews of any single situation or multiple crises, working across numerous organisations and disciplines.

Yet, more analysis of MHEW is needed to understand how to design and implement MHEWS more effectively

Recommendations / Guidance

- For MHEWS to operate effectively, national, regional, and local governments and vulnerable groups should create an integrated comprehensive framework to clarify roles, responsibilities and relationships (see fig. 1).
- MHEWS require integration across different vulnerabilities for anticipatory action, preparedness, and responding to multiple hazards and events. This can be best achieved via simulations and drills to explore differing scenarios [1], bringing together stakeholders to establish issues to be resolved prior to crises.
- Design warnings to be flexible, simple, and facilitate multi-directional feedback in the face of emerging hazards / risks. Numerous systems can result in confusion leading to a loss of trust or credibility [2].
- Examine and share knowledge of warning design that addresses practices, and lessons identified.

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Operationalising Multi-Hazard Early Warning Systems: Icelandic Volcanic Hazards

Volcanoes often generate multiple hazards that occur at the same time, affecting different locations. An excellent example is Eyjafjallajökull volcano that erupted in Iceland during 2010. The Icelandic Meteorological Office (IMO) worked with Icelandic and global scientists along with the Department of Civil Protection and Emergency Management to manage the local hazards (e.g. lava flow and ash), alongside the secondary impacts (e.g. agriculture and tourism). Volcanic ash created transport and logistical chaos as airspace closed for an unprecedent five days. Warnings were issued by the IMO, London Volcanic Ash Advisory Centre, World to the International Civil Aviation Organization (ICAO), who collectively managed the ash risk to aircraft all over Europe, requiring collaboration across numerous national borders and jurisdictions on local, regional, and national levels.

Such a complex MHEW was built upon well established relationships, that had been tested via simulation scenarios, and took advantage of local and national networks to provide effective warnings [3]. Key lessons from the volcano community on how to operationalise MHEW include:

- Translation (e.g. language, terminology, and technology) along with multi-way communication are required to ensure that all involved in using MHEWSs understand what information is credible and relevant for each hazard.
- All stakeholders are required to work across different silos whether of different disciplines, organisations, geographies, social contexts, and hazards and threats.
- Consider the different understandings of uncertainty / risk for decision-making across the hazards.
- Whilst standardisation of warning systems is vital to convey information to a wide range of stakeholders, standardisation is difficult to implement due to the diversity and uncertain nature of multiple hazards.
- To be effective, inclusive and accessible, MHEWSs should integrate local and traditional knowledge, drawing on the wealth of local disaster risk knowledge to enhance the overall effectiveness of MHEWS.

A MHEWS Framework

The WMO produced a checklist for MHEW in 2018 [4] that brings together the main components and actions to develop and evaluate MHEWSs.

Fig. 1 highlights the work needed beyond a single hazards warning system via multiple vulnerability, risk, sector approaches that require significant levels of feedback and interaction to coordinate warnings and generate appropriate actions.

However, there is still no comprehensive design manual that provides insights into how to actually 'DO' MHEWS.

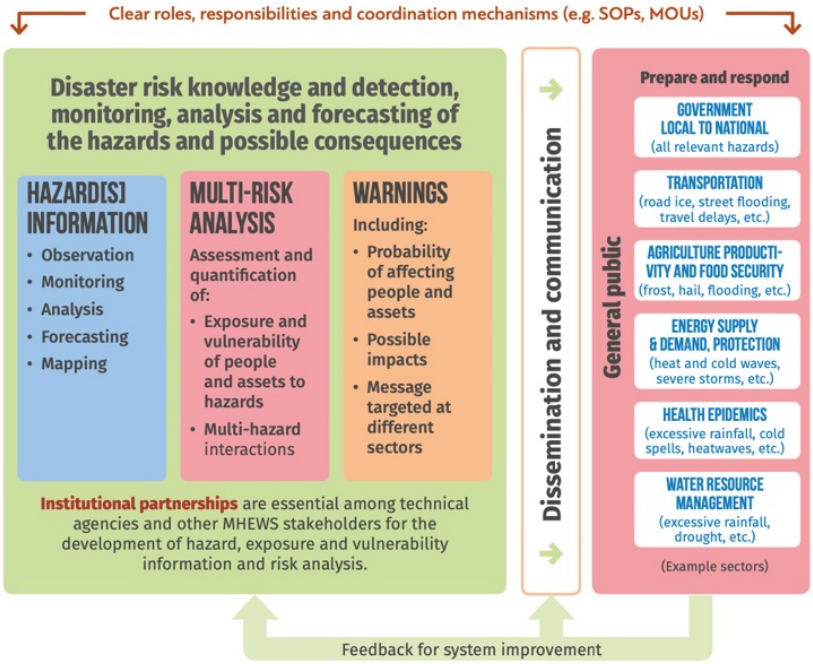

Figure 1: Schematic of a multi-hazard early warning systems [4]

References

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[2] Fearnley, C. J., & Dixon, D. (2020). Early warning systems for pandemics: Lessons learned from natural hazards. *International Journal of Disaster Risk Reduction*, *49*, 101674.

[3] Day, S *et al*. (2010). Volcanic Hazard from Iceland: analysis and implications of the Eyjafjallajokull eruption, UCL

[4] World Meteorological Organization (2018) Multi-Hazard Early Warning Systems: A Checklist. 1-20.

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