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Designing Inclusive, Accessible Early Warning Systems: Good Practices and Entry Points

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Acronyms

CAP	Common Alerting Protocol
DARAJA	Developing Risk Awareness through Joint Action
DRM	Disaster risk management
DRR	Disaster risk reduction
EWS	Early warning system
GFDRR	Global Facility for Disaster Reduction and Recovery
MHEWS	Multi-hazard early warning systems
NGO	Non-Governmental Organization
UCL	University College London
UN	United Nations
WCAG	Web Content Accessibility Guidelines
WMO	World Meteorological Organization

Photo: D. Talukdar | istock

1. Purpose, Audience, and Methodology

This report presents key lessons and areas of good practice from specific examples, along with recommendations and entry points for inclusive, accessible early warning systems (EWS). It is aimed at development practitioners, especially World Bank staff, working with communities and governments to provide evidence-based approaches to enhance inclusion of different social groups in EWS, depending on the local context. It is not intended to be a comprehensive overview of a robust, effective EWS, but rather to highlight entry points for the inclusivity components of multi-hazard impact-based EWS.[1] The report builds on the premise that adopting pragmatic, contextually tailored approaches to design and implementation of EWS produces better, more effective and inclusive outcomes and reaches more-diverse populations than one-size-fits-all models.

Over the past 20 years, the World Bank has invested close to US$1.5 billion in hydrometeorological systems and EWS globally (Grimes et al. 2022) with GFDRR providing technical assistance, capacity building and global knowledge to support these investments. From fiscal years 2017 to 2022, GFDRR provided approximately US$93 million in grant funding for projects related to EWS. GFDRR prioritizes inclusion in its portfolio, including in EWS activities, as highlighted in its 2021-25 Strategy. This note draws upon evidence and good practice from its grant portfolio and other sources to support expansion of inclusive approaches across EWS investment programs.

The report also benefited from a desk review, consultations with several stakeholders, and reviews of previous and ongoing World Bank– and Global Facility for Disaster Reduction and Recovery (GFDRR)–financed projects. Consultations were held with World Bank personnel, industry professionals, academics, and subject matter experts from the University College London Warning Research Centre network.[2] A complementary literature review of scientific publications and organizational reports was simultaneously conducted to inform the work.

[1] For more information on how to develop a robust EWS, refer to Anticipation Hub (2020).

[2] These included World Bank team leaders, independent consultants (government agencies and non-governmental organizations), academics from various global institutions, international non-governmental organization personnel, and individuals from the private sector.

2. Background

2.1. Inclusive EWS as a Development Priority

Disasters do not affect populations equally and often disproportionately affect the world's most economically and socially vulnerable populations. Disasters can disrupt livelihoods, education, and economic growth and harm health and social prosperity. Short-term recovery can be hindered, and long-term development impeded. Gendered differences in disaster outcomes tend to reinforce existing inequalities across and livelihoods, including human capital, economic opportunities, voice, and agency (Erman et al. 2021). These inequalities can affect different people's capacity to manage and recover from shocks. Similarly, the impacts of disasters and climate change disproportionately affect persons with disabilities given attitudinal, physical, environmental, and economic barriers to access to services and participation in public life. Available data indicate that persons with disabilities are up to four times as likely to die in a disaster as those without (UN-ESCAP 2015). Globally, it is estimated that more than 1 billion people, or approximately 15 percent of the world's population, have a disability (World Bank 2016).

As a key element of disaster risk management (DRM), early warning systems (EWS) are the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss (UNISDR Terminology on Disaster Risk Reduction, 2009). EWS play a crucial role in promoting sustainable development by mitigating the negative impacts of disasters and other hazards. EWS can facilitate the integration of disaster risk reduction and climate change adaptation into development planning. By identifying and addressing risks early on, EWS can help to ensure that development efforts are more resilient and sustainable over the long term.

Designing and implementing inclusive EWS requires careful consideration of the distinct needs and abilities of diverse groups to prepare for and respond to disasters. Exclusion of certain groups from the early warning notification process can result in adverse consequences, particularly for marginalized communities, which may already be at heightened risk during disasters or emergencies. For example, persons with disabilities require notifications in accessible formats, such as through audio or visual alerts or assistive technologies. Similarly, addressing the needs of women and girls requires safe spaces for women, trained responders' gender-based violence and gender-sensitive notification. By promoting equity and mitigating vulnerability, inclusive EWS can help to safeguard lives, decrease the impact of disasters on communities, and foster long-term resilience.

2.2. Institutional Framework for Inclusive EWS

The Sendai Framework for Disaster Risk Reduction 2015-2030 recognizes the importance of multi-hazard early warning systems (MHEWS) in supporting disaster risk reduction (DRR) efforts. It includes commitments to investing in and strengthening people-centered MHEWS, disaster risk communication mechanisms, and hazard-monitoring telecommunications systems—emphasizing a participatory and gender-inclusive approach. Specifically, Target G of the Sendai Framework aims to "substantially increase the availability of and access to

multi-hazard early-warning systems and disaster risk information and assessments to the people by 2030."

Despite significant progress in addressing disaster risk on a global scale, approximately one-third of the world's population still lacks access to a warning system (World Meteorological Organization, 2022). In response, the United Nations Office for Disaster Risk Reduction, the World Meteorological Organization, the International Federation of Red Cross and Red Crescent Societies, and the International Telecommunication Union collaborated to launch the Early Warnings for All initiative (EW4All) during COP27. The initiative aims to provide universal access to early warning systems within the next five years to ensure the protection of all individuals. Furthermore, the 2022 International Day for Disaster Risk Reduction focused on the importance of EWS in reducing disaster destruction. Effective EWS can play a significant role in driving development, reducing economic losses by an estimated US$35 billion per year (ILO, 2022) and lowering global mortality and morbidity rates. However, despite their importance, only 4.1 percent of total official overseas development assistance was invested in disaster preparedness, of which warnings are a central element, between 2010 and 2019 (UNDRR, 2021).

Contributing to this global agenda, the World Bank uses various approaches to ensure inclusion of groups that are often excluded or disadvantaged based on gender, disability, sexual orientation, and a variety of factors. These frameworks and strategies guide how World Bank task teams approach development policy dialogue and investment programs with partner countries, including in EWS, and set out methodologies for considering inclusion across sectors. For instance, the Strategic Framework for Mainstreaming Citizen Engagement in World Bank Group Operations (WBG 2014) and the Disability Inclusion and Accountability Framework (Mcclain-Nhlapo et al. 2022) have been developed for systematic mainstreaming of citizen engagement and disability into World Bank–financed operations and policy dialogue. In addition, the World Bank Group Gender Strategy FY16–23 (WBG 2015)[3] was adopted in the context of the Sustainable Development Goals—specifically Sustainable Development Goal 5, which focuses on achievement of gender equality and empowerment of women and girls.

2.3. Definition and Key Elements of EWS

Warning systems are processes that attempt to translate hazard and risk information, such as the strength of an approaching tropical cyclone or the dangers of living on the bank of a ravine prone to excessive flooding, into timely decisions and actions among populations receiving the warnings via a range of stakeholders. The intention is to prompt behavior that safeguards lives and livelihoods as much as possible, accounting for all potential needs and capabilities in a society. Scientific data and information must be recorded, analyzed, and translated into a meaningful message before being broadcast to its intended audience.[4]

Generally, more frequently updated, more-detailed data can help build a clearer picture of dynamic hazards, but too much information risks is overwhelming, so the content must be tailored to the audience. Warnings should not be unidirectional, with one-way lines of communication that only send information from scientists, forecasters, and governments to individuals and communities; instead, they should be continual, multidirectional forms of

[3] The World Bank Gender Strategy is being updated for 2024 to 2030.

[4] In some locations, traditional knowledge and local observations are used to provide community-level warnings of impending hazard events, but this note focuses on science-based approaches to EWS, because other approaches are based on more localized cultural systems that are outside the brief for this report.

communication wherein information is passed between everyone with a stake in protecting society.

2.4. Principles of Inclusive, Efficient EWS

As defined by the UN and WMO, the four major interrelated elements of an effective end-to-end early warning systems, include: (i) disaster risk knowledge, (ii) observations, monitoring, analysis, forecasting, (iii) warning dissemination and communication, and (iv) preparedness and response capability.

The nature of the intended audience should guide the creation and dissemination of alerts based on hazard and risk information. EWS should consider people's experiences with hazards and warning systems, their trust in science and authority, their access to media and channels through which warnings can be received, their abilities to understand the message, their abilities to hear or see a warning, and their abilities to respond in the desired ways. At each stage of the warning process, not accounting for these factors can render a warning ineffective.

To incorporate these factors into the process requires participatory approaches, and according to the findings from the recent evaluation of the World Bank's disaster risk reduction programs (World Bank, 2022), these were often key elements of success in implementing EWS and building trust with marginalized communities that must be able to understand and act upon a warning. An underlying factor of community trust and action is that the EWS infrastructure must be operational and well maintained; if an EWS is not functioning because sensors, radar, or weather stations, for example, are no longer operational, the system breaks down, and warnings (if even issued) are ignored.

To be inclusive and efficient, EWS must be:[5]

- **Integrated:** Bringing together needs and capabilities of multiple users, threats of multiple hazards, and key aspects of warnings. This can often be achieved through a single platform such as the Common Alerting Protocol (CAP), which allows warning alerts to be sent out with consistent messaging through multiple channels and in multiple formats. CAP supports inclusivity by enabling the message, channel, and format to be tailored to people with hearing or visual impairments or who speak a different language.

- **People centered:** Accounting for the needs, knowledge, and capabilities of warning receivers, enabling individuals and communities to prepare for and respond to emergencies in ways appropriate to them. This is often achieved via community based EWS.

- **Multi-hazard impact-based EWS:**[6] Covering all types of hazards and shocks, including secondary, cascading, and simultaneous hazards, wherein one hazard triggers further hazards (e.g., heavy rain and flooding causing landslides) or hazards occur at the same time, compounding the effects of both; forecasting what the weather will do, not just what the weather will be, enabling individuals and organizations to take action to mitigate the impacts of the hazard.

[5] These elements are building blocks for inclusive EWS, but multiple, additional elements are required for a successful EWS. See Anticipation Hub (2020) for more details.

[6] For the purposes of this report, the term "early warning system" will be used in place of the longer, more comprehensive term "multi-hazard impact-based early warning system."

- **Connected:** Linking the four key elements of an EWS. Often, warnings are less effective because too little attention is paid to the importance of the linkages between the elements of an EWS. Linkages are often the human factors that affect behavior as much as the elements of a warning themselves and can include previous hazard and disaster experience, social and family norms, understanding of risk and messaging, appreciation of scientific uncertainty, and perceived safety of evacuation sites. These additional considerations regarding key elements highlight how characteristics of populations at risk must ultimately shape how warnings are delivered, focusing on context and the vulnerabilities of communities, rather than on the hazards themselves.

Furthermore, seeing beyond a single characteristic and considering multiple cross-cutting factors. Involving key stakeholders in warnings requires consideration of an array of characteristics and abilities, including sex, gender, sexuality, age, race, ethnicity, caste, disabilities (e.g., physical, mental, sensory, cognitive), religion, languages, communication forms, and precarity (e.g., detained, undocumented, homeless, asylum status). Depending on a person's characteristics, they might not see or hear a warning, not be registered on a list to receive a warning, receive a warning but be unable to understand or respond, or have many other possible constraints. This approach is known as taking an intersectional perspective. Addressing intersectionality is a daily aspect of any development work with communities and individuals and does not necessarily mean breaking down every component of every person's identity and catering to each individually. Many warning mechanisms can be relevant to a multitude of people and needs. For example, bad lighting and poor privacy options are disincentives for women to evacuate to shelters. Improving both would increase safety for everyone, particularly women, gender-nonconforming people, men from ethnic minorities, and persons with a range of disabilities. When incorporating intersectionality, existing knowledge and evidence provide a helpful baseline.

For EWS, individuals' characteristics and abilities can, among other factors, enable people to receive and understand a warning or hinder them from doing so (e.g., if they have visual or hearing impairments or do not have the appropriate means or technology to receive a warning, such as access to the Internet, a cell phone, or a radio). Even if they receive a warning, they might be unable to respond given limited mobility, lack of resources, or other factors. Tailored approaches are essential to ensure that those receiving the warnings are contributing to the design and development of the EWS so that their needs are met.

3. Good Practices and Entry Points

This section provides entry points and good practices for designing more inclusive, accessible early warnings and is organized around the four key elements of effective end-to-end EWS. The entry points are supplemented with case studies and identification of gaps and actions that illustrate activities related to the EWS element.

3.1. Disaster Risk Knowledge

Risk assessments and information are the foundation of good DRM, yet to be effective and useful, risk assessments must consider the evolving nature of risks (e.g., hazards, exposure, vulnerability). This requires information that is up to date on the characteristics of the people and their location and an understanding of how these characteristics shift according to changing environmental and human conditions, such as urbanization and land use. Furthermore, as the Independent Evaluation Group has found, information is needed to provide understanding of the underlying vulnerability that person's most susceptible to disaster risks face, meaning that it is essential to develop qualitative information, in addition to quantitative data, and integrate it into risk assessments. Having this updated information can help authorities and early warning implementers understand their target audiences, including the diverse needs and capabilities of their communities, so that authorities and warning implementers can craft and tailor warnings to fit the communities. Interagency cooperation is important for making early warning systems more inclusive, as it improves access to inclusivity data, outreach to communities, and other relevant efforts.

Entry point: Participatory approaches to data generation and weather information

Early warning inclusivity begins with community-based, participatory risk reduction approaches, including co-production of disaster management knowledge and materials that inform warning design and generate public receptiveness. This community-based approach regarding data can encourage accessibility (via multimedia, open-source mechanisms) and enable various social groups with a vested interest in DRR to be (and stay) informed on how to protect themselves and their communities most appropriately. When prepared correctly, these approaches allow platforms for marginalized voices to inform warning processes on often missing and specific needs and considerations for a wide range of vulnerabilities.

These approaches can cultivate buy-in of populations that are less connected to and less trusting of warnings and can nurture leadership in typically marginalized groups. Co-production of risk information can enable incorporation of local culture, knowledge, and observation into EWS planning, which strengthens technological systems, making the warning infrastructure more appropriate to its location and acceptable to its people.

Open-source information on risks, hazards, and community needs enables more people to understand their own risk profiles and take action based on a comprehensive risk information picture. Developing participatory approaches to create open-access information enhances its efficacy; warnings are then not just top-down, unidirectional mechanisms, but also bottom-up, people-driven (ongoing) processes. Participatory approaches support warnings that,

through people-driven processes, are inextricably linked to relationships (e.g., family, friends, neighbors), perceptions (proximity to and familiarity with risk information), varying abilities, actions (e.g., evacuation possibilities), and infrastructure (e.g., emergency shelters).

Integration of civil society groups, local leaders, and community-based organizations can increase the inclusivity of warnings. Understanding where these groups and individuals are and ensuring their involvement from the beginning of the EWS design stage is important for establishing multiway communication channels and factoring in feedback loops as early as possible, as the Developing Risk Awareness through Joint Action (DARAJA) project (Case Study 1) demonstrates. Trusted groups link decision makers with people, providing a channel through which information about local capabilities and requirements can be communicated.

CASE STUDY 1

Country: Kenya and Tanzania

Initiative: Developing Risk Awareness through Joint Action (DARAJA)—The Inclusive City–Community Forecasting and Early Warning Service

DARAJA is a project under the Weather and Climate Information Services for Africa (WISER) East Africa program that works on a co-design basis to improve weather and climate information services. A focus of the program is early warnings for extreme weather, targeting urban users in rapidly growing informal settlements and prioritizing the most vulnerable populations (e.g., women, elderly, persons with disabilities). Resurgence, Kounkuey Design Initiative, and Centre for Community Initiatives implement the project in partnership with the Kenya Meteorological Department and the Tanzania Meteorological Authority.

Key lessons and best practices:

- Including community leaders, radio presenters and journalists, the Kenya Red Cross, and other stakeholders in Nairobi enabled wider reach to audiences and informed them of the value of understanding weather-related risk.
- Training on understanding the terminology of weather forecasts and how to communicate these concepts better to a wide range of audiences and listeners meant that more people received and understood the forecasts.
- Dedicated segments on local radio on weather and climate information reach a wide audience.
- Community actions (e.g., drain clean-up before the rains) demonstrate how warnings and early action are connected, showing the importance of warnings. People now listen to, and trust, forecast information.

Key success factors:

- Program design was based on qualitative and quantitative research, including household surveys, key informant interviews, community focus groups, information ecosystem mapping (how information flows through a community and which channels are preferred), and mass media tracking.
- Co-designing interfaces brings together weather and climate information producers (e.g., National Meteorological Service) and those who use the information services to make decisions (often through intermediaries).
- The initiative serves as a bridge to create and maintain operational partnerships between the actors who are critical to the co-design of the products, dissemination channels, and feedback loops for weather forecasts and extreme weather alerts.

This case study is also connected to the third EWS, "warning dissemination and communication."

Source: DARAJA n.d.

Several methodologies have been effective in promoting the voices of marginalized populations in ways that value their lived experiences, which can be useful in the project preparation phases of EWS design. The Missing Voices Approach is designed to capture first-person perspectives that can better inform DRM from a marginalized perspective, and a civil society–government coalition in the Philippines has revised its DRM manual to incorporate the needs of people with disabilities. Titled "Lahat Handa" (meaning "Everybody Ready"), this train-the-trainers program has trained predominantly persons with disabilities, including many women with disabilities, as master trainers and is widely used in community-based disaster-preparedness projects that involve development of inclusive local EWS. The Oxfam Australia project Down by the River (Dwyer and Woolf 2018) prioritizes storytelling of Fijian sexual and gender minorities, challenges the jargon of the development and humanitarian sectors, and informs elements of the UN cluster system[7].

Understanding the target audiences of the EWS, including their needs and abilities, is essential; data (if available) about these groups and their characteristics can help inform the design of inclusive EWS. Using existing digital tools and guidance can help development practitioners and task teams work with disaggregated data that support inclusive development. Warning-related projects can harness and apply these proven tools quickly and relatively easily.

To further illustrate how to formulate inclusive interventions, Table 1 provides examples of gaps and actions captured through a review of World Bank–financed EWS project documents and international experiences. The list is not meant to be exhaustive but to guide formulation of results chains (see indicators related to each action in Annex 1) and improve the overall design of inclusive EWS.

[7] The UN cluster system is a coordination mechanism used by the United Nations to ensure effective humanitarian responses during emergencies and disasters. The system is based on clusters or groups of humanitarian organizations that focus on specific areas of humanitarian assistance such as shelter, health, nutrition, water and sanitation, logistics, and protection. The UN cluster system is designed to improve the predictability, timeliness, and effectiveness of humanitarian responses by ensuring that all stakeholders have a clear understanding of their roles and responsibilities, and by promoting coordination and collaboration among different organizations. The cluster system was established in 2005, following the humanitarian response to the Indian Ocean tsunami in 2004.

Table 1 Gaps and Actions—Disaster Risk Knowledge

Gaps	Actions
○ No or insufficient data disaggregated by sex, gender, disability status, age, and other characteristics relevant to vulnerable groups	○ Systematically collect disaggregated data on marginalized and vulnerable groups, such as women, children, elderly, persons with disabilities, and various minority groups.
○ Lack of central standardized repositories for disaggregated demographic data and storage and management of disaster events or data and risk information	○ Identify or establish central standardized repositories for disaggregated demographic data and storage and management of event or data and risk information (including a geographic information system).
○ No or insufficient integration of inclusion considerations into disaster risk assessments	○ Incorporate vulnerability data disaggregated by type and degree of functional disability, age, gender, and geographic location when assessing population dynamics and vulnerable community sectors.
○ Limited data sharing and lack of interoperability of disaster-related information systems and social protection databases	○ Ensure interoperability between disaster risk information systems and social protection databases (e.g., by developing, adopting, and implementing a data governance framework with a set of principles, procedures, and responsibilities for data management).
○ Insufficient use of community-based participatory risk-reduction approaches, including co-production of disaster risk knowledge	○ Apply community-based participatory risk-reduction approaches, including developing an up-to-date social registry of vulnerable people with contact information, location, and specific needs and designing multi-hazard impact-based forecasting EWS.
○ No or limited understanding of specific needs and capabilities of vulnerable groups related to EWS	○ Increase share of women as heads of community early-warning committees.
○ Unequal access for persons with disabilities to disaster risk knowledge because accessible formats are unavailable	○ Make information supporting disaster risk knowledge accessible using multimedia open-source mechanisms and compliance with Web Content Accessibility Guidelines (WCAG) 2.1. (Annex 2).

3.2. Detection, Observation, Monitoring, Analysis, and Forecasting

Accurate, continuously generated data are critical for monitoring hazards, their changing parameters, and the risk they pose to a community at any given time. These data provide a sound scientific basis for forecasting and the ability to generate timely, accurate messaging that will enable people to better prepare for emergencies. As mentioned previously, it is essential that EWS be technically operational and well maintained, with sustainable funding for equipment and human resources, to be able to make them inclusive. It is critical that monitoring and warnings be an ongoing and evolving process of information updates, spread across as many institutions as possible for shared awareness and coordination and not one-time events.

Entry point: Diversity, collaboration, and commitment

Digital information can be adapted to different forms of technology (e.g., older mobile phone operating systems as well as newer smartphones) and to suit people with varying abilities, such as vision or hearing difficulties. Digitizing information also allows weather information to be received and synthesized efficiently and accurately so that it can, for example, feed into locally appropriate forecasting. As a result of these processes, digital information can also be stored and protected appropriately and

used in a greater variety of ways, including to support analyses of gender inequality and how to overcome exclusion of marginalized groups

Local knowledge is critical in integrating hazard observations into an EWS. As a key element of local knowledge integration, elevating the roles and responsibilities of underrepresented groups such as young people, women, and marginalized populations can increase inclusion practices. Inclusion of women often facilitates inclusion of minority groups; women have been found to understand the varying needs of all in their communities, often have greater access to typically overlooked groups, and can offer solutions for better accommodating all needs and requirements. The citizen science campaign regarding flooding in Brazil (Case Study 2)

CASE STUDY 2

Country: Brazil

Initiative: Dados à Prova d'Água (Waterproof Data Project)

A citizen science project in Brazil engaged with local stakeholders, including students from public schools, to produce flood risk data. Teachers, students, the Civil Defense, and residents in more than 20 municipalities across five states tested the tool, which engaged intergenerational groups of citizens to provide community knowledge and memory from a variety of age and experience perspectives. Brazil's National Center for Monitoring and Warning of Natural Disasters uses the data to generate warnings.

Key lessons and best practices:

- Technology designed and developed collaboratively with intended users has enabled buy-in, audience-appropriate design, and use of local materials.
- A learning guide for students on production of data and knowledge on disasters caused by excess water or lack of urban drainage in their neighborhoods provided an educational element regarding use of data and the importance of appropriate methods of risk management.
- Connecting to Brazil's National Center for Monitoring and Warning of Natural Disasters Education Program provides sustainability and relevance and ultimately builds trust of local stakeholders.
- Involving students leads to a more inclusive DRR process and contributes to ownership, buy-in, and trust of the data of the students, which can trickle up to their parents and communities.
- Relatively straightforward technological upgrades can enhance development of a web control panel and potential national reach.

Key success factors:

- The initiative rethinks how flood data produced and alters how the data typically flow, creating innovative methods regarding data practices that transfer leadership and responsibility to citizens. Normally, data flows from local levels to specialist centers of expertise, and then warnings and alerts are disseminated back to local actors and citizens. This method enables new types of data to be generated at the local level, involving citizens in production of interfaces that collect and communicate flood-related information.
- As a result of innovative methods, new governance arrangements have been made between citizens, governments, and flood specialists, leading to integration of citizen data with other sources and greater community empowerment and urban resilience of vulnerable populations.

This case study is also connected to the first EWS element, "disaster risk knowledge."

Sources: FGV EAESP n.d.; Marchezini et al. 2022.

harnesses the power of students and school children, leveraging the support of Brazil's National Center for Monitoring and Warning of Natural Disasters Education Program to maintain momentum and provide continuity.

To further illustrate how to formulate inclusive interventions, Table 2 includes examples of gaps and actions captured through a review of World Bank–financed EWS project documents and international experiences. The list is not meant to be exhaustive but to guide formulation of results chains (see indicators related to each action in Annex 1) and improve the overall design of inclusive EWS.

Table 2 Gaps and Actions—Detection, Observation, Monitoring, Analysis, and Forecasting

Gaps	Actions
○ No or insufficient involvement of women and other vulnerable groups in design and implementation of EWS	○ Include vulnerable populations in participatory planning and implementation of DRR projects and EWS.
○ Limited cooperation between agencies responsible for establishing operational frameworks for implementing multi-hazard impact-based EWS and developing warning processes and agencies responsible for gender mainstreaming, disability, and other inclusivity types	○ Make EWS more inclusive by strengthening multisector coordination, through interagency protocols, to ensure consistency of warning language and communication responsibilities. ○ Encourage digitization of data for accuracy, record keeping, and cross-sector sharing.
○ Institutional capacity constraints undermining government's ability to monitor gender-responsive public spending	○ Establish procedures for monitoring gender-related public spending on inclusive DRM and EWS by local governments and integrate gender-responsive budgeting into financial management information systems to monitor gender indicators. ○ Conduct capacity development, training, and outreach and awareness campaigns on early warnings and community mobilization tailored to the intended audience, (e.g., women, girls, persons with disabilities).
○ Insufficient training of vulnerable groups on early warnings and community mobilization	○ Support connections between early warning committee members and government officials to enable advocacy for the community's needs regarding early warning.
○ Lack of ways to assess and/or improve inclusivity of EWS	○ Develop robust methodologies and guidelines for assessing and subsequently enhancing inclusivity of EWS.

3.3. Warning Dissemination and Communication

Hazard information must be converted to clear, consistent, relevant messaging for wide distribution and must be useful, relatable, understandable, and usable for all. If they are to be believed and followed, warnings often must connect national, regional, and local threats; consider the most appropriate actions at each level; and be issued by trustworthy sources. It is widely recognized that multiple channels of warning distribution are necessary for redundancy, inclusivity, and the widest possible reach, but these channels must promote a consistent message to maintain trust and clarity. Building in redundancy and robustness not just of communications channels (e.g., social media, community-alert messages), but also of telecommunications and electric power infrastructure makes emergency communications, including warning messages, more effective.

Entry point: Communications redundancy, adaptability, and creativity

Using multiple communication channels for disaster warnings was effective in ensuring that populations with uneven access to technologies could receive alerts. The World Bank financed project in India (Case Study 5), supported this approach by incorporating various communication channels, such as horns, radio warnings, cell broadcasts, and interactive voice-response technologies into a multichannel EWS. Haiti (Case Study 3) is an excellent example of how multiple channels can be used to provide redundancy and ensure that EWS messaging reaches marginalized communities.

The need for holistic approaches to DRM is seldom more evident than when analyzing warning communication and information dissemination campaigns. Making everyone a part of warnings encourages wide support for and willing participation in widespread, equitable risk management, which cultivates a risk-reduction environment in which top-down and bottom-up systems meet in the middle and complement each other.

Contextually appropriate communications material is also key to reaching populations with the appropriate intended messaging. It enables adapted material to be used and distributed to reach groups with different challenges and abilities. Ensuring that specialist, scientific, and technological information is communicated in simple non-technical language without losing its accuracy and explicitness is crucial to greater warning inclusion at all levels. Local experts, nongovernmental organizations, and government institutions are best placed to understand these aspects and to direct the design and implementation of such campaigns.

Redundancy in communication infrastructure is routinely stressed as a key element of maintaining a vital lifeline of information to people, especially during the most dangerous moments they may experience. Facilitating physical and social communication networks enhances the consistency of risk information and advice, particularly in the context of safeguarding vulnerable populations and in response to the dynamic nature of hazards.

Communicating consistent alert messaging through multiple channels can also be supported using tools such as the CAP, a digital format for the exchange of all-hazard public warnings over all networks used for alerts, which is being integrated into a project in Tunisia (Case Study 4). In addition to being able to accommodate modifications to enable greater compatibility with established EWS infrastructure, the CAP promotes inclusivity by allowing use of various media (e.g., photographs, maps, audio, video), being able to target geographically relevant

CASE STUDY 3

Country: Haiti

Initiative: Strengthening Haiti's resilience to multiple hazard risks in a fragile context

Haiti endures frequent hazard-related disasters that have significant human and economic impacts. The challenges inherent in instilling and maintaining effective DRM in such a volatile environment are amplified; severe exposure to hazards and political instability often impede viable strategies and a coordinated response. Support from the European Union and GFDRR has been crucial in increasing the institutional capacity of local disaster management officials and stakeholders and promoting sustainable, inclusive resilience practices. This project included components related to a public communications campaign, development of geospatial data collection, and improved shelter management recommendations. The public communications campaign targeted women (including elderly women and young girls) so that they could understand and heed early warnings and advocated for hurricane preparation. The campaign used a local female musician and local graphic designers and mobilized radio stations and social media platforms to connect with the target audience.

Key lessons and best practices:

- Open-access data platforms, such as HaitiData.org, make key information, including updated locations of emergency shelters, available to DRM experts and the public. Training Haitian officials on how to use the tool has significantly increased local inclusivity.
- Communication campaigns on early warnings and community mobilization are most successful if the campaign is tailored to the intended audience because the intended audience is more likely to receive and understand the warning.
- Behavioral science research should be used to determine barriers to target audiences receiving, understanding, and acting on warning messages.
- Exploring new methodologies to reach new households to include in protection programs can provide information regarding to whom and how to target early warning messages, provided the information is used appropriately and ethically.
- Creative communication tactics (e.g., music, art, humor) can help connect with populations more effectively.

Key success factors:

- Sustained investment and maintenance of strong partnerships (in this case between the European Union, World Bank, and government of Haiti) have been a key element of this approach to improve disaster risk management. This initiative has also built on the progress of previous established support mechanisms (e.g., technical assistance from the European Union's Caribbean Regional Resilience Building Facility).
- Supporting preparedness holistically (e.g., ensuring that good shelter facilities are available for evacuation) increased warning capabilities.
- Combining analysis of damage from previous disasters with technological advances enabled better data collection and management to inform resilience and preparedness regarding weather forecasting, response coordination, and building repair.
- Connecting to the culture made the campaign credible because the audience knew that it was tailored for them.
- Using messengers in the target demographic (e.g., young and female with a large online following) lent credibility to the message, reached that demographic, and reached a larger audience.

This case study is also connected to the first "disaster risk knowledge" and fourth "preparedness and response capability" EWS elements.

Sources: GFDRR and World Bank 2022; Llopis and Perge 2020; World Bank Group n.d.a.

CASE STUDY 4

Country: Tunisia

Initiative: Tunisia Integrated Disaster Resilience Program

Tunisia has experienced recurrent flash floods in recent years (e.g., the 2018 Nabeul floods), with climate change expected to decrease precipitation overall while increasing the frequency and severity of droughts and flooding. Disasters disproportionately affect women and girls, and limited access to education may hinder their ability to access early warning information. Tunisia's hydrometeorological services and early warning systems require more strengthening than in other countries in the region. The country has started piloting a tool for issuing weather alerts and warnings: Carte Vigilance. This World Bank–financed project is designed to build institutional capacity and modernize the hydrometeorological services, including by developing site-specific multi-hazard impact-based forecasting and EWS.

Key lessons and best practices:

- Appropriate channels for warning women must be used because women have limited access to public information. Those channels can best be identified and understood by specifically engaging with women, testing the EWS with them separately from men, and then addressing their needs.
- The CAP should be combined with existing tools.
- Disaggregating indicators by sex for the EWS component supports more equitable reach to women and men.
- By linking disbursement indicators to outcomes associated with inclusive early warning systems, projects and programs have the potential to improve their results (e.g., in year 5, test warnings in pilot sites with women and vulnerable groups to ensure that their needs are addressed).
- Pilots should be used to monitor the efficacy and desired outcomes of activities targeted at groups (e.g., women and vulnerable populations), using appropriate channels for warnings.

Key success factors:

- Identifying and investing in existing small-scale flood risk protection projects while supporting implementation of the National Flood Risk Management Plan built on efforts at the community level (supporting locally led initiatives), enabled national oversight, and connected top-down and bottom-up processes.
- Strong support was provided for development of long-term disaster risk reduction governance in key national institutions.
- A holistic approach to disaster risk was taken, including building provisions for adequate disaster risk financing mechanisms.
- Good (more and in greater detail) data were collected and disaggregated to reveal richer insights into vulnerable groups' needs and capabilities.

Source: World Bank Group n.d.b.

alerts to defined areas, and delivering messaging in multiple languages and in formats for persons with vision or hearing impairments.

The Web Content Accessibility Standards contain website design guidance designed to increase the functionality and usability of online information. The guidelines provide a common standard for web content accessibility and can be a valuable reference for agencies and organizations trying to create warning and preparedness information in widely accessible ways. When accounting for different languages, awareness of the limitations of automatic translation tools is important, as is the need to provide warnings in varying formats (e.g., written, visual, audio) in those different languages (see Figure 1).

Figure 1 Warnings in the Local Language and a Nonlocal but Common Language

Source: Photo by Ilan Kelman.
Note: Pictures are used to convey danger for those not able to read either language.

To further illustrate how to formulate inclusive interventions, Table 3 provides examples of gaps and actions captured in a review of World Bank–financed EWS project documents and international experience. The list is not meant to be exhaustive but to guide formulation of results chains (see indicators related to each action in Annex 1) and improve the overall design of inclusive EWS.

Table 3 Gaps and Actions for Early Warning Dissemination and Communication

Gaps	Actions
○ Lack of access of a significant share of vulnerable populations to disaster information and EWS necessary to make risk-informed decisions and take appropriate protective actions	○ Ensure that warning messages are communicated over various platforms (digital and non-digital; formal and informal networks) and through a variety of media, using the Common Alerting Protocol to ensure consistency and inclusivity.
○ Limited access of persons with disabilities and elderly face to information and communications technology–related services, including websites, media channels, and social media platforms, because of lack of compliance with WCAG 2.1, the internationally recognized accessibility standards	○ Establish mandatory technical standards for barrier-free access to all information and communications technology–related services, including websites, media channels, and social media platforms, based on WCAG 2.1, the internationally recognized accessibility standards. ○ Use technological advances that help translate messages, generate captions, and read text out loud, among other innovations that can increase inclusivity for people with disabilities and elderly.

Table 3 Gaps and Actions for Early Warning Dissemination and Communication (cont.)

○ Limited knowledge related to understanding of communication needs of vulnerable populations	○ Ensure thorough understanding of communication needs of vulnerable groups through surveys, focus groups, etc., and use this knowledge to inform a warning communication strategy, including through crafting fit-for-audience messages and effective use of appropriate channels and messengers.
○ Lack of ownership of mobile devices and limited access to the Internet of women and other disadvantaged groups, preventing them from using mobile phone applications designed for early warning dissemination	○ Eliminate access barriers to mobile phone applications designed for early warning dissemination. ○ Establish training, advocacy, and awareness-raising campaigns targeting vulnerable groups with limited literacy and digital skills.
○ Lack of literacy and digital skills of vulnerable groups, particularly in remote areas, preventing them from understanding and responding to notifications	○ Ensure that scientific information is communicated in simple non-technical language. ○ Train early warning committees to read the signs of extreme weather events and ensure representation of vulnerable groups on such committees. ○ Distribute test warnings with women and vulnerable groups in pilot sites to ensure that their needs are addressed.
○ No or limited training of government officials on inclusive, accessible communication policies, practices, and techniques	○ Train government officials on how to enhance the efficacy of warnings and targeting of audiences receiving, understanding, and acting on warning messages.

3.4. Preparedness and Response Capacity

Understanding individual and collective risk and how to respond to it with alert messaging is key to maintaining the ability to respond safely and appropriately to warnings. Effective disaster management planning, local awareness campaigns, information and advice on safe behavior, protection of homes and assets, and routine practice of, for example, evacuation drills can all help maintain a state of readiness among populations. However, projects with these downstream elements that do not include mechanisms to test whether preparedness activities will be effective in the face of a disaster, including for vulnerable populations, are liable to be unsuccessful in supporting warning response actions. Investments in EWS communication systems, shelters, and evacuation routes do little to reduce vulnerability if communities cannot react to warnings promptly.

For example, in 2018, when Tropical Cyclone Gita hit Tonga, affecting approximately 80,000 people, or 80 percent of Tonga's population, and causing widespread damage to infrastructure and housing and disrupting public services, although it was difficult for many Tongans, people living with disabilities were hit the hardest. With limited access to warnings and information about the storm, many were reluctant to evacuate because emergency shelters lacked facilities to address their needs, such as ramps to use bathrooms. Situations like these not only compromised their immediate safety, but also added unnecessary anxiety and stress (Global Shelter Cluster 2018).

Entry point: Enhancing EWS by building on national and local systems

The key to inclusive warnings is promotion of good practices at the national and local government levels.[8] Building on current national and local systems can not only reduce duplication and waste, but can also build an initial foundation of national and local suitability, appropriateness, and acceptability. Funding and political mandates for continuing training, outreach, and engagement must be ensured, because populations, technology, best practices, and hazards change over time. This also supports longer-term assumption by communities of elements of their own risk management and ensures that marginalized groups are continually involved. Closing the gap between government and communities can be challenging; when attempting to connect with minority and marginalized populations, it is often most effective to utilize community groups as intermediaries and mediators due to their reputation for trustworthiness, and efficacy. Building leadership from within communities also requires a growing culture of collective and inclusive responsibility for DRM.

Bolstering preparedness and response capabilities inclusively involves training for all social groups in a given population. World Bank and GFDRR inclusive community resilience efforts in India (Case Study 5) encapsulate several best practices for creating village-level disaster management task forces with strong female representation, including minority groups, and comprehensively engaging youth. This training should contain regular emergency drills, a practice in many cases found to be effective in maintaining a sense of preparedness, and familiarization with how to respond to a warning that becomes almost akin to an everyday activity. This also enables new people moving into a community to understand that community's risks and practice the appropriate response before a crisis arises.

Diverse stakeholder networks of varying sizes are a common feature of effective EWS. Multiway channels of communication within the stakeholder network and an iterative design and implementation process help ensure that every perspective is heard and incorporated as the strategy evolves. This level of stakeholder engagement is challenging and perhaps not always replicable but can be possible when guided by champions at the local and national government levels, with support from development partners. An example is the National Climate Resilience Investment Plan in Belize;[9] similar collaborative lessons can be drawn from Sri Lanka's Climate Resilience Multi-Phase Programmatic Approach project.

To further illustrate how to formulate inclusive interventions, Table 4 provides examples of gaps and actions captured in a review of World Bank–financed EWS project documents and international experiences. The list is not meant to be exhaustive but to guide formulation of results chains (see indicators related to each action in Annex 1) and improve the overall design of inclusive EWS.

[8] See Anticipation Hub (2020) for a comprehensive overview of good early warning practices.
[9] See https://www.gfdrr.org/sites/default/files/Belize%20SOI.pdf.

CASE STUDY 5

Country: India

Initiative: National Cyclone Risk Mitigation Project II

India's growing population is exposed to a wide range of environmental hazards. Coupled with poor economic and social conditions, fragile human settlements, unsafe building practices, and lack of awareness, this leaves many populations vulnerable to disaster risk and climate impacts. Approximately 5,700 km of India's 7,500-km coastline is exposed to regular cyclones, and an estimated 40 percent of the population lives within 100 km of the coast. To expand DRM efforts in these areas, GFDRR and the World Bank have supported the National Cyclone Risk Mitigation Project and the Tamil Nadu and Puducherry Coastal Disaster Risk Reduction Project, which are designed to reduce vulnerability to disaster risk by bolstering DRM capacity and encouraging participation of women in disaster planning. Gender awareness has been integrated into capacity building, EWS, and risk mitigation initiatives.

Key lessons and best practices:

- A network of disaster management village volunteers and task forces with equal female representation should be created.
- Community collaboration with local governments regarding DRM, including female and minority groups, should be supported.
- Youth should be involved in early warnings, search and rescue, first aid, shelter management, and evacuation activities.
- The entire community should be involved in risk identification and management to enable gender-equitable, generally inclusive disaster preparedness and plans and provide a sense of collective responsibility for mitigating vulnerability and risk. Such actions enable the community' to respond when an event occurs.

Key success factors:

- Providing appropriate resources and expertise during the evolution of the country's disaster risk management strategy (e.g., from a response to resilience strategy).
- Encouraging a holistic approach to disaster risk management that encompasses augmented early warning capabilities; greater connection between state, regional and local efforts; better sheltering and evacuation options; and enhanced community capacity for self-mobilized disaster management activities.

Source: WBG n.d.d.

Table 4 Gaps and Actions for Preparedness and Response Capacity

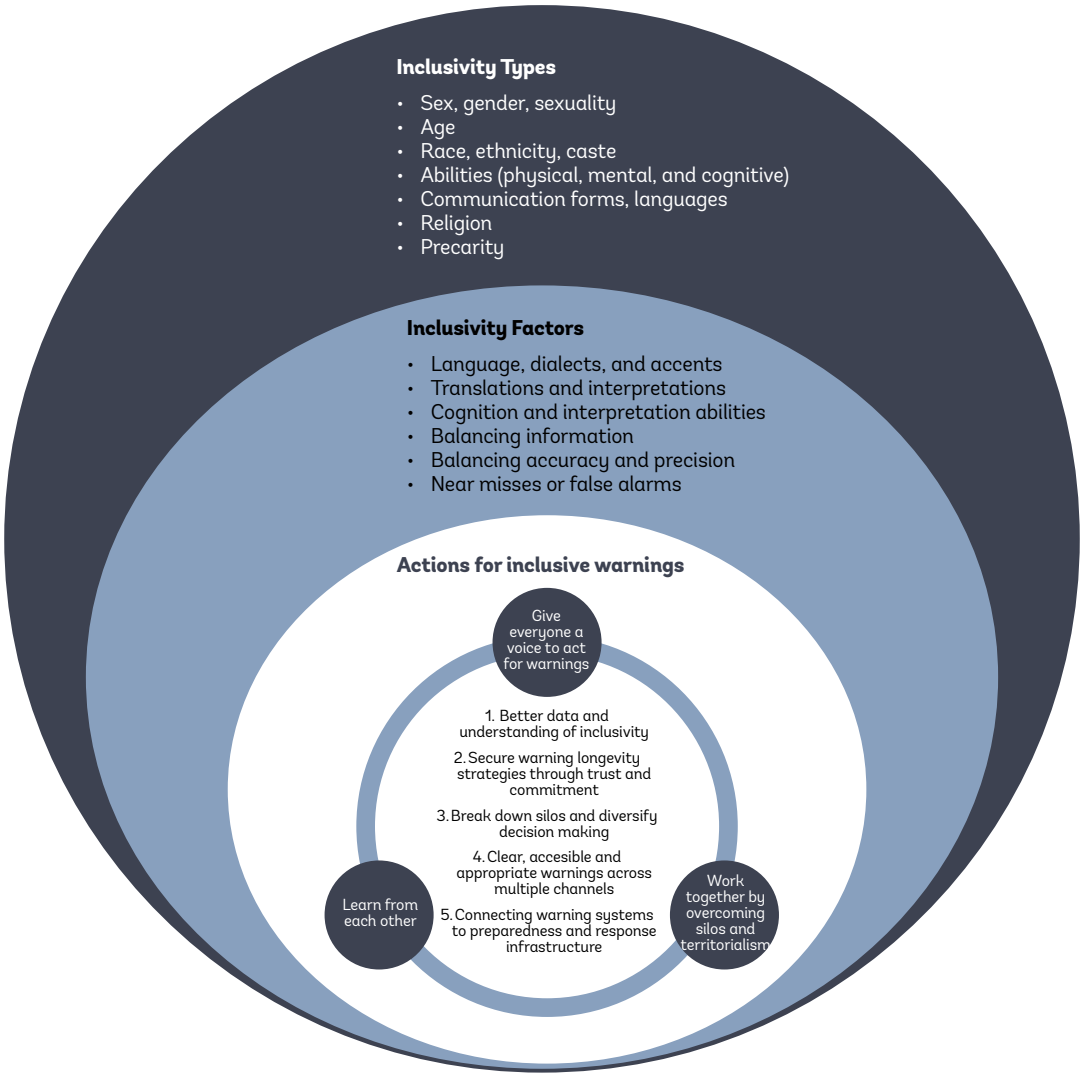
Gaps	Actions
○ No or insufficient employment of women and persons with disabilities by DRM agencies and other entities	○ Develop DRM agencies' capacity to support employment of marginalized and vulnerable individuals, including women and persons with disabilities.
○ Lack of women in DRM-related decision-making positions	○ Increase share of women in decision-making positions in relevant bodies.
○ Insufficient attention paid to special needs of vulnerable groups in design and implementation of disaster preparedness measures	○ Involve minority and excluded groups in risk identification and management for gender-equitable, more-inclusive disaster preparedness and plans and provide a sense of collective responsibility for mitigating vulnerability and risk. ○ Tailor disaster preparedness measures, including plans and standard operating procedures, to needs of people with different degrees of vulnerability.
○ Lack of appropriate infrastructure to accommodate special needs of women, persons with disabilities, and other disadvantaged groups	○ Use universal design in all aspects of EWS and disaster management design as a standard. ○ Involve minority and excluded groups in warning initiatives to support more-inclusive infrastructure, (e.g., safe evacuation routes, accessible shelters).
○ Limited guidelines designed to keep vulnerable groups engaged and able to make informed decisions and take informed actions in emergency situations to minimize their losses	○ Create a network of disaster management community volunteers and task forces with equal female and male representation.
○ Limited capacity of vulnerable and marginalized groups to prepare for and respond to emergency situations effectively, including because of insufficient training and limited collaboration with local government	○ Conduct drills and other training specifically for vulnerable groups. ○ Support community collaboration with local governments regarding DRM, including female and minority groups.

Note: DRM, disaster risk management.

3.5. Integrating Inclusivity into All Elements of an EWS

Although there are different entry points within each EWS element, it is ideal to integrate inclusivity into all elements. There are multiple different inclusivity types to consider and a variety of inclusivity factors (Figure 2).

Figure 2 Inclusive EWS Framework



The case of Sri Lanka (Case Study 6) illustrates how to integrate inclusivity into each of the four EWS elements. The World Bank project in Sri Lanka is considering multiple different types of inclusivity factors, such as gender, disability, age, ethnoreligious identity, and poverty, in developing the EWS and examining how to better incorporate intersectionality into the project.

CASE STUDY 6

Country: Sri Lanka

Initiative: Climate Resilience Multi-Phase Programmatic Approach

Sri Lanka is highly prone to extreme weather events, with an increasing trend of flooding, and an estimated 87 percent of the population lives in areas prone to moderate to severe flooding. By 2050, it is projected that climate change will result in a 1.2 percent loss in annual gross domestic product. This World Bank–financed project is designed, among other objectives, to enhance the country's capacity to deliver climate and weather information, including by improving EWS. This project has integrated inclusivity into each of the four EWS elements.

Key lessons and best practices:

- Establishing a community early warning committee can help determine the needs of specific people, particularly those traditionally difficult to reach.
- Committees should be trained to read the signs of impending extreme weather events (e.g., rising water levels), and these committees should represent vulnerable groups. Connections between committee members and government officials should be encouraged to enable advocacy of the community's needs for early warning.
- Multiple types of channels should be used to deliver warning messages, including television, social media, and text messages. Technological advances that can help translate messages, generate captions, and read text out loud should be used, among other innovations that can increase inclusivity.
- Community members should be trained to understand, use, and respond to warnings. Capacity-building workshops should be tailored to the needs of various vulnerable community groups. Drills and other training should be conducted specifically for vulnerable groups, as well as the wider public.

Key success factors:

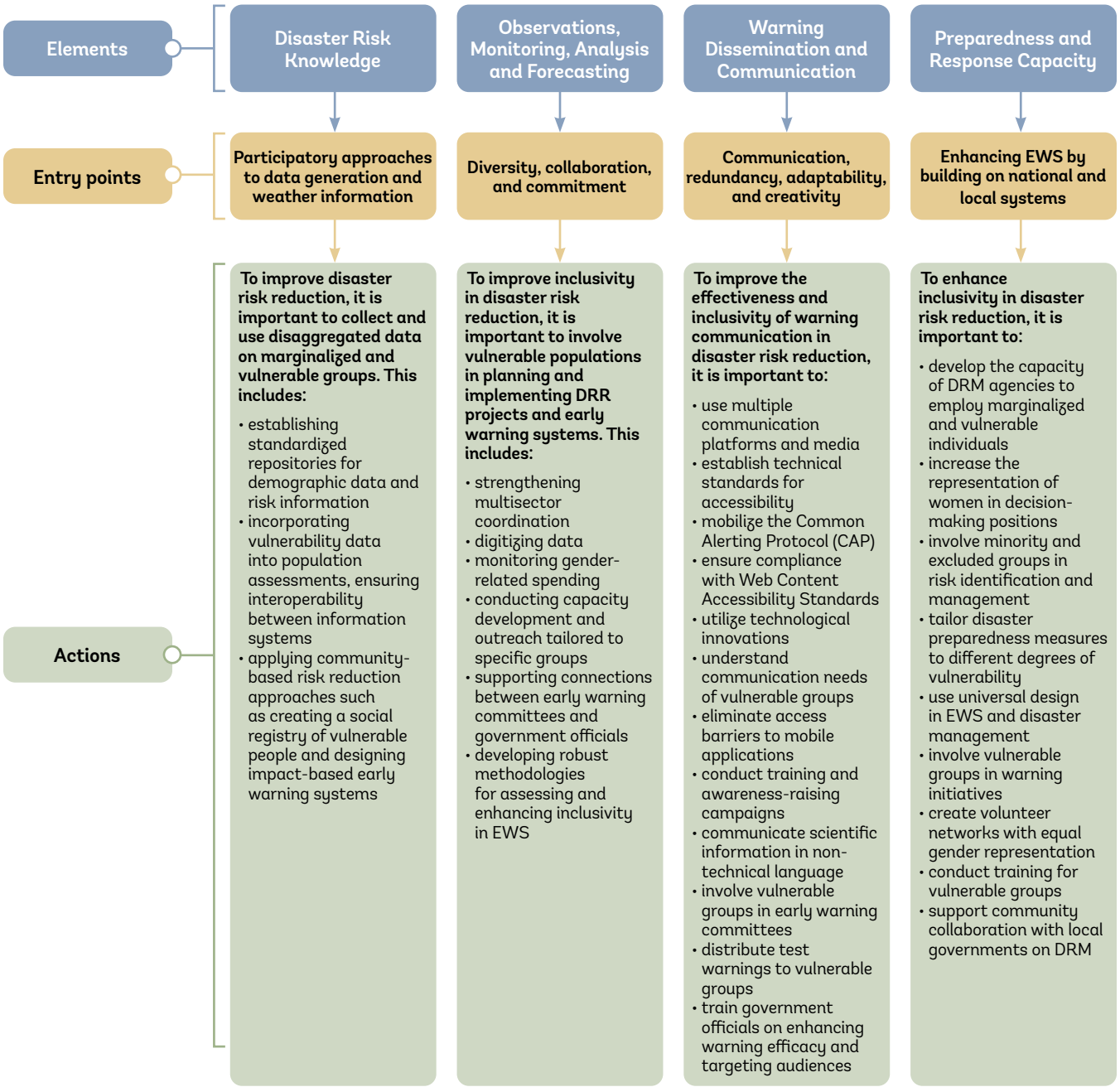
- Developing an up-to-date, secure social registry of vulnerable people, including contact information, location, and specific needs that can be shared appropriately with multiple types of organizations (e.g., local government agencies, NGO organizations, first responders) is critical, although strict ethical standards must be adhered to when handling sensitive information, particularly when certain groups may be subject to discrimination or insecurity.
- Engaging the Multi-Phase Programmatic Approach that enables a nation to divide a complex project into a set of smaller, consecutive operations (or phases), under one program also provides space for learning and adaptation, with each phase incorporating lessons from the last and ensuring program responsiveness to changing country circumstances
- The initiative should be aligned with the medium- and long-term development objectives of the government to ensure its commitment to the program and to the overall DRM and resilience agenda.

Sources: World Bank 2021

4. Conclusions and Recommendations

The four elements of an EWS, as defined by the UN and WMO are combined in Figure 3 with good practice entry points and a summary of actions for achieving greater inclusivity according to research findings.

Figure 3 Early warning system elements, identified entry points and potential actions



Source: original figure for this publication.

Overarching Recommendations

Inclusive, accessible EWS have characteristics that are consistent across the case studies presented in the report. They:

- Are long-term social processes.
- Use multiple channels, modes, and messages that are clear, transparent, consistent, and credible.
- Are relevant to everyone, covering a range of timeframes and geographic coverage
- Connect all governance levels, including local, national, and international.
- Require including the needs of different social groups to respond to multiple hazards, sequences, and cascading events.
- Extend beyond warning dissemination to include damage prevention, mitigation actions, and response conditions to ensure capacity to act.
- Facilitate early and anticipatory action, which also reduces inequalities and inequities regardless of the hazard.

Engage diverse communities and stakeholders from the beginning

Involvement of communities, especially minority and excluded groups, from the initial stages of project planning and warning design is vital for an iterative approach to development. Connecting implementers and communities, including through feedback loops via civil society organizations, can capture nuances that support development of an appropriate EWS for all. Some additional actions that can substantially improve the design of interventions include:

- Ensuring that minority and marginalized groups are included in community DRR taskforces and response initiatives.
- Working with community-based organizations with trusted relationships with marginalized populations to open multiway communication channels and create feedback loops in warning planning phases. Stakeholder mapping exercises can identify organizations and excluded groups that should be involved in participatory methods and warning co-production.
- Encouraging governments to bring all their relevant departments into the DRR planning process. For example, at the national level, disaster management and emergency preparedness and response units should plan warnings with social, health, and economic ministry expert input.
- Bringing private sector actors and NGOs to the planning table from the outset. This enables familiarity to be developed regarding one another's language, practices, constraints, mandates, and interests.
- Ensuring regular meetings of these groups to create familiarity and work through design, implementation, monitoring, evaluation, and adjustment together.

Integrate iteration and adaptive learning

A fully inclusive system would require iteration and adaptation every 6 to 12 months to ensure that groups that were initially not included can be identified and integrated into the system. In designing inclusive systems, a steep learning curve will be experienced in the first few years, requiring multiple interactions and adjustments to ensure inclusion of most groups, including:

- Regularly assessing how the EWS is working to determine how groups are included from the beginning and adapting as needed.
- Adapting and expanding coverage of interventions as needed.

Support initiatives and activities that create an enabling environment

Inclusion in EWS is likely to be most successful when there is an enabling environment that provides a foundation for inclusion. Policies or legislation designed to anchor gender and community inclusion provide a solid institutional environment, and resource allocation for inclusive actions during design and implementation of EWS interventions not only improves the overall quality of the interventions, but also enhances capacity to reach out to marginal and vulnerable groups. Other measures that can be taken to build an enabling environment include:

- Assessing the existing regulatory and institutional framework to identify opportunities and barriers to inclusion.
- Incorporating measures to address any shortcomings of regulatory and institutional frameworks in design of EWS interventions.
- Ensuring that resources are allocated for implementation of inclusive actions during EWS design and implementation.

Disaster Risk Knowledge: Data and open-access information

Support development of better data and understanding of inclusivity

Seeking good-quality, comprehensive data supports top-down approaches to warnings, as well as bottom-up initiatives. Authorities need data to understand the needs and capabilities of populations, and populations need data to better understand hazards, forecasting, risk, and how best to protect themselves.

As mentioned earlier, addressing intersectionality does not necessarily require dissecting every person's identity and catering to each one individually. Many simple adaptations to warning mechanisms can be relevant to many people, for example, using multimedia messaging can include a variety of populations, and modifying evacuation routes and emergency shelters can make them more accessible to people facing an array of challenges. Having representatives of different gender groups, vulnerable groups, and community members is critical. Lack of representation can lead to gaps in designing and delivering warnings, which can hamper delivery of interventions. Community knowledge and capacity should be used to facilitate data collection and design. Other measures that can be taken to increase access to data and increase understanding of inclusivity include:

- Using guidelines such as those that the United Nations, World Bank, GFDRR, other development partners, and prominent inclusivity working groups publish, including DRR Dynamics (see Annex 1), to fill in data gaps on marginalized populations.
- Ensuring that data collection includes information on vulnerable groups as well as descriptive information to understand the underlying aspects of vulnerability that persons most susceptible to disaster risks face.
- Considering storytelling methodologies that community-based organizations use to include marginalized voices and inform early warning planning.

- Supporting creation of open-source platforms and widely accessible information maintained by national, regional, and local stakeholders.
- Providing education opportunities for women, community groups and leaders, and other marginalized communities on understanding weather and climate.
- Advocating for open access to information and use of multiple channels of warning dissemination, including multimedia messaging and formats such as the CAP.

Detections, Observations, Monitoring, Analysis, and Forecasting: Diversity, collaboration, and commitment

Secure long-term commitment to warnings through trust and funding

Stakeholder networks that connect scientists, governments, scholars, civil society organizations, and communities are important to promote awareness and understanding of the role of each stakeholder community at all phases of a warning (pre-warning, during a warning, responding to a warning).

The consistent allocation of funds from national, regional, and municipal governments and partnerships enables long-term planning for EWS, particularly when modernization is required. Technology can also be a powerful tool to draw populations into the data creation and analysis processes and support reliable record keeping and open-access platforms. Digitizing data as a fundamental element of EWS can significantly enhance their inclusivity when done in context-appropriate ways. Other actions that can be taken to secure long-term commitment to warnings include:

- Modernizing early warning infrastructure, including digitizing data.
- Proving funding for inclusive warnings to ensure long-term continuity, regardless of political (e.g., change of government), environmental (e.g., change in hazards), social (e.g., movement of people and changing community demographics), and livelihood changes.

Warning Dissemination and Communication: Redundancy, familiarity, and adaptability

Ensure that clear, accessible, consistent, appropriate warnings are provided through multiple channels and platforms

Multiple channels and platforms should be leveraged for maximum reach of warnings, ensuring that systems are redundant and that as many people as possible receive and trust an alert. Hazard and risk information, as well as warning messages, must be provided in multimedia formats to address varying resources, needs, and abilities, for example, people with no cellular signal, without the Internet, and with hearing impairment.

Structures and approaches implemented at the national and regional levels can be mirrored or complemented at the local level so that top-down and bottom-up DRR and warning mechanisms align. Other measures that can be taken to improve warnings across channels and platforms include:

- Communicating warnings through as many open-source channels, modes, and media as possible, in appropriate languages and styles.

- Using tools such as the CAP where appropriate to aid message consistency and promote inclusivity.
- Ensuring that relevant stakeholders, including communities, receive information and updates on warning messages that are technically accurate yet easy for nonexperts to understand.
- Ensuring redundancy in alerting channels and encouraging year-round awareness raising and conducting of preparedness actions, such as drills.
- Ensuring redundancy of telecommunication and electric power infrastructure.
- Using guidelines and examples from resources such as the Web Content Accessibility Standards to enhance warning inclusivity.

Preparedness and Response Capability: The wider warning context

Connect EWS to preparedness and response infrastructure

A sense of preparedness promoted through awareness campaigns, community training, and evacuation drills helps maintain a constant level of readiness. Critical evaluation of emergency preparedness infrastructure, such as evacuation routes, assistance distribution points, and emergency shelters, from the perspective of minority or excluded groups can enable suitable, sensitive adaptations. To connect EWS to preparedness and response infrastructure, additional design and implementation features can be incorporated, including:

- Working with humanitarian groups and other community organizations to advise on making assistance criteria more inclusive, for example "nonstandard" groups and households that may include single fathers, same-sex parents, and gender-non-conforming individuals, among other communities. Most criteria cater only to heterosexual couples or single mothers.
- Including mechanisms to test whether preparedness activities will be effective in the face of a disaster, including for vulnerable populations (e.g., mock drills).
- Encouraging transboundary and regional real-time information sharing to support national warnings and preparedness.

Annex 1: Entry Points for Addressing Gaps in Inclusion Related to Early Warning Systems

Identification of entry points is based on the Gender Tag and the Social Inclusion Assessment Tool, which the World Bank Group developed to help task teams and their counterparts address gaps in inclusion in policy operations and other projects. Table A.1 articulates logical results chains comprising three elements that identify gaps in inclusion, actions to close these gaps, and indicators for monitoring related progress. The list of gaps, actions, and indicators provided below is not exhaustive but reflects good examples from World Bank operations and international experience in early warning systems (EWS). All entry points are organized around the four critical elements of warnings systems: disaster risk knowledge; observations, monitoring, analysis, and forecasting; warning dissemination and communication; and preparedness and response capabilities. Gaps in inclusion in EWS differ from country to country in their breadth and scope, meaning that all projects' results chains will be country specific.

Table A.1. Entry points for addressing gaps in EWS

DISASTER RISK KNOWLEDGE		
Gaps	**Actions**	**Indicators**
○ Lack of data disaggregated according to sex, gender, disability status, age, and other characteristics relevant to vulnerable groups ○ Lack of central standardized repositories for disaggregated demographic data and for storage and management of event, data, and risk information. ○ Lack of integration of inclusion considerations into disaster risk assessments. ○ Limited data sharing and lack of interoperability between disaster-related information systems and social protection databases ○ Insufficient use of community-based participatory risk reduction approaches, including co-production of disaster risk knowledge ○ Lack of understanding of specific needs and capabilities of vulnerable groups related to EWS. ○ Unequal access of persons with disabilities to disaster risk knowledge because accessible formats unavailable	○ Systematically collect disaggregated data on marginalized and vulnerable groups such as women, children, elderly, persons with disabilities, and various minority groups. ○ Identify or establish central standardized repositories for disaggregated demographic data and for storage and management of event, data, and risk information (including geographic information system). ○ Use vulnerability data disaggregated according to type and degree of functional disability, age, gender, and geographic location when assessing population dynamics and vulnerable community sectors. ○ Ensure system interoperability between disaster risk information systems and social protection databases (e.g., by developing, adopting, and implementing a data governance framework with a set of principles, procedures, and responsibilities for data management). ○ Apply community-based participatory risk-reduction approaches, including up-to-date social registries of vulnerable people, with contact information, location, and specific needs and multi-hazard impact-based EWS. ○ Increase share of women as heads of community early warning committees ○ Encourage accessibility of information content supporting disaster risk knowledge via multimedia open-source mechanisms and compliance with WCAG 2.1	○ Disaggregated inclusion data on vulnerable and marginalized groups regularly collected and made publicly available ○ Central repository for disaggregated demographic data established ○ Central standardized repository for storage and management of event, data, and risk information established ○ Disaster risk and epidemiological information, disaggregated according to gender, age, and other characteristics, made available through official platform for investment planning and data sharing between sectors ○ New and existing EWS linked to economic and other vulnerability data ○ Interoperability between disaster information systems and social protection databases established ○ Number of people supported by participatory evaluation of disaster risks and operational early warning and response systems, of which female (%) ○ Number of community-level stakeholders consulted on production of disaster management knowledge and materials informing warning design ○ Share of female heads of community early warning committees ○ Number of digital platforms and apps with disaster risk knowledge content in compliance with WCAG 2.1.

Table A.1. Entry points for addressing gaps in EWS (cont.)

OBSERVATIONS, MONITORING, ANALYSIS, AND FORECASTING		
Gaps	**Actions**	**Indicators**
○ Limited involvement of women and other vulnerable groups in design and implementation of EWS. ○ Limited cooperation between agencies responsible for establishing operational frameworks for implementing multi-hazard impact-based EWS and developing warnings processes and agencies responsible for gender mainstreaming, disability, and other inclusivity types. ○ Institutional capacity constraints undermining government's ability to monitor gender-responsive public spending. ○ Insufficient training of vulnerable groups on early warnings and community mobilization. ○ Lack of robust methodologies and guidelines for assessing and subsequently enhancing inclusivity of EWS.	○ Incorporate participatory planning and implementation into projects designed to include vulnerable populations in disaster risk reduction and warning processes. ○ Increase inclusivity of EWS by strengthening multisector coordination, including through interagency protocols to ensure consistency of warning language and communication responsibilities. ○ Encourage digitization of data for accuracy, record keeping, and cross-sector sharing. ○ Establish procedures for monitoring gender-related public spending on inclusive DRM and EWS by local governments and integrate gender-responsive budgeting into financial management information systems to better monitor gender indicators. ○ Provide capacity development, training, and outreach and awareness campaigns on early warnings and community mobilization tailored to intended audience, (e.g., women, girls, persons with disabilities). ○ Support connections between early warning committee members and government officials to enable the committee members to advocate for their community's needs regarding early warning. ○ Develop robust methodologies and guidelines for assessing and subsequently enhancing inclusivity of EWS.	○ Communities involved in planning, implementation, and evaluation of early warning activities ○ Share of women and persons with disabilities working in project planning and implementation (at different levels) ○ Number of people reached by multi-hazard impact-based EWS, disaggregated by sex ○ Interagency protocols established ensuring consistency of warning language and communication responsibilities ○ Digital platform established for data sharing and early warning ○ Percentage of key performance indicators for gender-responsive budgeting programs that directly address documented gender gaps related to EWS ○ Share of female participators in outreach training and advocacy ○ Number of targeted vulnerable people benefiting from greater accuracy and timeliness of weather forecasts and EWS ○ Greater awareness of warnings and emergency response ○ Share of targeted communities trained in use of early warning and evacuation ○ Methodology and guidelines developed for assessing and subsequently enhancing inclusivity of EWS

Table A.1. Entry points for addressing gaps in EWS (cont.)

WARNING DISSEMINATION AND COMMUNICATION		
Gaps	**Actions**	**Indicators**
○ Significant share of vulnerable populations without necessary access to disaster information and EWS necessary to make risk-informed decisions and take appropriate protective actions ○ Limited access of persons with disabilities and elderly information and communications technology–related services, including websites, media channels, and social media platforms, because of lack of compliance with internationally recognized accessibility standards WCAG 2.1 ○ Lack of understanding of vulnerable populations communication needs ○ Limited ownership of women and other disadvantaged groups of mobile devices and limited access to the Internet, preventing them from using mobile phone applications designed for early warning dissemination ○ Lack of literacy and digital skills of vulnerable groups, particularly in remote areas, preventing them from understanding and responding to notifications ○ Insufficient training of government professionals on inclusive, accessible communication policies, practices, and techniques	○ Ensure communication of warning messaging over multitude of platforms (digital and non-digital; formal and informal networks) and through a variety of media, using the Common Alerting Protocol to ensure consistency and inclusivity. ○ Establish mandatory technical standards for barrier-free access to all information and communications technology–related services, including websites, media channels, and social media platforms, based on internationally recognized accessibility standards WCAG 2.1. ○ Use technological advances that help translate messages, generate captions, and read text out loud, among other innovations that can increase inclusivity for people with disabilities and elderly. ○ Ensure thorough understanding of communication needs of vulnerable groups through surveys, focus groups, etc., and use this knowledge to inform a warning communication strategy, including by crafting fit-for-audience messages and making effective use of appropriate channels and messengers. ○ Eliminate access barriers to mobile phone applications designed for early warning dissemination. ○ Set up training, advocacy and awareness-raising campaigns targeting specific vulnerable groups with low literacy levels and digital skills. ○ Ensure that scientific information is communicated in simple non-technical language. ○ Provide early warning committees with training to read signs of extreme weather events, ensuring representation from vulnerable groups.	○ National-level Common Alerting Protocol system established and operational ○ Number of users receiving tailor-made forecasts and early warning bulletins with appropriate content, frequency, communication channels, and in local languages ○ Mandatory technical standards for barrier-free access to all information and communications technology–related services, including websites, media channels, and social media platforms, established and operational ○ Share of daily captioning and sign-language interpretation of public TV news programs ○ Share of accessible, usable public documents and websites based on WCAG 2.1 ○ Number of community-level stakeholders consulted for usability of warning notifications ○ Satisfaction of users with EWS ○ Reliable EWS information disseminated in timely manner ○ Share of registered users of mobile phone applications designed for early warning dissemination who are women ○ Number of people who can take action to protect their lives, livelihoods, and property based on early warnings, of which women (%) ○ Percentage improvement in level of understanding of early warning messages ○ Number of government officials trained on inclusive, accessible communication policies, practices, and techniques, of which women (%)

Table A.1. Entry points for addressing gaps in EWS (cont.)

WARNING DISSEMINATION AND COMMUNICATION		
Gaps	**Actions**	**Indicators**
	○ Distribute test warnings in pilot sites with women and vulnerable groups to ensure that their needs are addressed. ○ Train government officials on enhancing efficacy of warnings and targeting of audiences receiving, understanding, and acting upon warning messages.	○ Number of communication officers trained who participate in intensive communication activities, directly contacting and providing artificial intelligence–related messages and information to women and other vulnerable groups
PREPAREDNESS AND RESPONSE CAPABILITIES		
Gaps	**Actions**	**Indicators**
○ Limited employment of women and persons with disabilities by DRM agencies and other entities ○ Lack of women in DRM-related decision-making positions ○ Insufficient attention to special needs of vulnerable groups in design and implementation of disaster preparedness measures ○ Lack of appropriate infrastructure to accommodate special needs of women, persons with disabilities, and other disadvantaged groups ○ Significant gap in guidelines designed to keep vulnerable groups engaged and able to make informed decisions and act in emergency situations to minimize losses ○ Limited capacity of vulnerable and marginalized groups to prepare effectively for and respond to emergency situations, including because of insufficient training and limited collaboration with local government	○ Develop DRM agencies' capabilities to support employment of marginalized and vulnerable individuals, including women and persons with disabilities. ○ Increase share of women in decision-making positions in relevant bodies. ○ Involve minority and excluded groups in risk identification and management for gender-equitable, inclusive disaster preparedness and plans and provide sense of collective responsibility for mitigating vulnerability and risk. ○ Tailor disaster preparedness measures, including plans and standard operating procedures, to needs of people with different degrees of vulnerability. ○ Involve minority and excluded groups in warning initiatives to support inclusive infrastructure (e.g., safe evacuation routes, accessible shelters). ○ Apply universal design to all fields of EWS and disaster management design as base standard. ○ Conduct drills and other training for vulnerable groups. ○ Create network of disaster management community volunteers and task forces with equal female representation. ○ Support community collaboration with local governments regarding DRM, including female and minority groups.	○ Share of women and persons with disabilities employed by DRM entities, including agencies responsible for establishing operational frameworks for multi-hazard impact-based EWS and warning processes ○ Share of women holding decision-making positions in DRM agencies and committees ○ Share of beneficiaries satisfied with community consultation of early warning activities ○ Share of beneficiaries with marginalizing characteristics who believe they are better prepared to respond to disasters ○ Extent to which evacuation routes, shelters, communication systems, equipment, and devices comply with internationally recognized accessibility standards (e.g., universal design standards) ○ Number of women and other vulnerable groups trained on disaster preparedness measures and impact assessments to complement greater warning capability ○ Number of female facilitators hired and trained to undertake outreach, training, and advocacy activities ○ Number of beneficiaries with marginalizing characteristics trained in early warning and preparedness applying knowledge acquired during disaster response or simulated drills

Note: DRM, disaster risk management; EWS, early warning system.

Annex 2: Other Resources

Guidelines for inclusive messaging and communication:

- Online information and warnings: the Web Content Accessibility Standards contain website design guidance aimed at improving the functionality and usability of online information
- Common Alerting Protocol (CAP) for streamlining and standardizing messaging across multiple platforms
- Guidelines for Implementation of Common Alerting Protocol (CAP)–Enabled Emergency Alerting by the World Meteorological Organization, WMO-No. 1109.

Tools and methodologies to aid inclusivity:

- UCL Warning Research Centre Briefing Notes series
- UCL Centre for Gender and Disaster projects and resources
- GFDRR World Bank (2022) Inclusive Approaches to Disaster Risk Management — A Qualitative Review
- World Meteorological Organization (2018) Multi-hazard Early Warning Systems: A Checklist
- World Bank e-course: Collecting Data on Disability Inclusion
- Disaster risk reduction Dynamics: Hyper-marginalized groups and disaster data
- Disaster risk reduction Dynamics: LGBTQIA+ inclusive policy
- Practical Action Missing Voices Approach
- The "Everybody Ready" campaign in the Philippines: Lahat Handa
- Oxfam Australia's project Down by the River
- Disability inclusion: Disability-inclusive Disaster Risk Reduction Network; International Disability Alliance
- Gender inclusion: Oxfam's Gender and Disaster Risk Reduction training; UNDRR publications and resources

Developing successful policy and action through co-creation, co-production, and co-implementation via:

The 3 I's and the 3 E's form the six core principles that help produce adaptable, effective warnings and match the key four characteristics (accuracy, flexibility, timeliness, transparency), leading to effective action.

- 3 I's: Imagination, Initiative, Integration by the National Preparedness Commission: Enhancing Warnings
- 3 E's: Education, Exchange, Engagement by the National Preparedness Commission: Enhancing Warnings

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