GSMA

Making Early Warnings Work for All:
People Centred Design

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Contents

Acronyms and abbreviations

CCW	Co-Creation Workshop
EW4All	Early Warnings for All
EWS	Early Warning System
FGD	Focus Group Discussion
HCD	Human-Centred Design
IFRC	International Federation of Red Cross and Red Crescent Societies
M4H	Mobile for Humanitarian Innovation
MHEWS	Multi-Hazard Early Warning System
MNO	Mobile Network Operator
SARCS	South African Red Cross Society
TRCS	Tanzania Red Cross Society
UNDRR	United Nations Office for Disaster Risk Reduction
WMO	World Meteorological Organization

Executive summary

As climate-related disasters intensify, the need for effective and inclusive early warning systems (EWS) has never been more urgent. The effectiveness of an EWS is not just about the technology or the number of people it reaches, it is about its ability to drive meaningful action at the community level. To ensure EWS are trusted, understood, and acted upon, they must be designed with the lived experiences, preferences and challenges of communities in mind.

Recognising this, the GSMA Mobile for Humanitarian (M4H) programme conducted research in South Africa and Tanzania, in partnership with national Red Cross Societies, as part of the Early Warnings for All (EW4All) initiative. In South Africa, research teams focused on how EWS can be more inclusive and reach marginalised populations like migrants, women and older people. In Tanzania, the objective was to identify community preferences to make EWS more effective.

Through these projects, the M4H team leveraged human-centred design (HCD) approaches to put people at the centre of EWS design. These exercises engaged communities deeply and iteratively, using creative research tools to develop tailored solutions.

The research reinforced that designing people-centred EWS requires more than issuing alerts, it requires multi-faceted solutions that align with the social, cultural and behavioural dynamics that influence whether individuals take action.

Ongoing discussions with EWS stakeholders indicate that similar research is in high demand worldwide, with governments, nonprofits and the private sector working to understand how to help communities prepare for the growing threats of climate change and rapid-onset weather disasters. As global efforts to expand EWS continue under the EW4All initiative, this report illustrates how HCD research can be applied in other contexts to inform EWS design and offers a practical roadmap for applying HCD research methods. It shares insights from South Africa and Tanzania, methodologies for engaging communities, and key principles for designing responsive, user-friendly, and contextually appropriate EWS solutions. Through such approaches, EWS stakeholders can develop EWS that are not only technically sound but also socially meaningful, ensuring they effectively save lives and enhance climate resilience in an increasingly unpredictable world.

Why human-centred design?

Although the objectives were slightly different in each country, the HCD research uncovered insights and lessons that other stakeholders can apply to their EWS strategies:

- **User insights:** HCD can identify user needs, preferences and barriers that may inhibit the effectiveness of an EWS. For example, in Tanzania, a user journey mapping exercise found that literacy levels and access to technology were two of the main factors determining whether an individual engages with an EWS. In South Africa, the biggest factors, identified through HCD research, were socio-economic status, age, location (rural/urban), past disaster experience and degree of community integration. By identifying these factors in their own context, stakeholders can help ensure fewer people are left behind by EWS and improve their propensity to act.
- **System design:** HCD can identify appropriate components of EWS design, like communication channels, icons, terminology, content and timing. For example, in both Tanzania and South Africa, we learned that digital EWS strategies must be paired with community-driven, higher-touch approaches and trusted channels. Whether reaching less connected individuals or leveraging trust in community members, a combination of digital and non-digital communication strategies provides a wider reach and the reinforcement often needed for people to act.
- **Social and cultural factors:** HCD can reveal social and cultural influences on EWS, such as trust, community dynamics, triggers for action and behavioural norms. For example, in Tanzania, individuals often wait for a collective movement before taking preventive action. The research reinforced the role of community leaders in overcoming inertia. In South Africa, communities struggled to identify when the weather was severe enough to act on a warning or if doing so would be an inconvenience. They also felt they did not have the means to take action. In these cases, research showed the importance of clearly identifying thresholds and providing simple and feasible actions.

The human-centred design process

Every HCD exercise is unique, but the Tanzania and South Africa research began with a landscape mapping exercise comprised of desk research and expert interviews. Analytical frameworks were then selected to provide structure for the research and allow the team to approach it methodically.

With a baseline understanding and analytical framework in place, we prepared for field research by developing research questions and selecting diverse communities and target audiences to engage with, including community leaders and everyday citizens, especially marginalised groups and disaster response volunteers.

Over the course of roughly one week in each location, we conducted a series of face-to-face interviews, focus group discussions (FGDs) and co-creation workshops (CCWs). Each modality provided unique insights and sequencing these activities helped us move from the deep, lived experiences of individual community members to shared group perspectives and community-driven ideas that could be applied broadly to the design of EWS.

Human-centred design tools for EWS

The HCD tools we used for the Tanzania and South Africa research changed with each exercise. As details were uncovered and we learned more about users, our questions shifted and we adapted the tools. Some tools worked better with some audiences than others. A few of the tools our team found most useful included:

- **Persona building,** which creates representations of target users, ensuring that the needs, behaviours and challenges of different groups are considered when designing an EWS.
- **Channel, influencer and digital mapping,** which plots communication components, revealing how information flows within a community and which approaches are most effective for EWS alerts.
- **Agree/Disagree cards,** which encourage participants to respond directly to statements, providing insights into their preferences, concerns and perceptions.
- **Tests on weather icons, colours, symbols and terminology,** which ensure that visual and textual elements used in EWS are easily understood and effectively communicate critical information.
- **Crazy Eights prototype building,** which fosters rapid idea generation and iteration by having participants sketch eight components of an EWS solution.
- **Pitch testing,** which presents simplified EWS concepts and gathers feedback through structured questions, enabling researchers to iterate solutions and align them more closely with user needs.

Mindsets for successful human-centred design research

Regardless of the research topic, HCD works best when teams have a mindset of openness, user participation and iteration. With our EWS research it was important to be flexible and allow the research to evolve and be shaped by participants, to favour visuals and tangible examples over abstract ideas, to encourage human stories to provide a nuanced understanding, to work through a variety of solution ideas and to consider broader behavioural drivers and structures that influence EWS, beyond just weather. By keeping users at the centre, more effective EWS can be designed for all.

Introduction

As disasters become increasingly frequent and severe due to the global climate crisis, critical gaps have emerged in how communities prepare for, respond to and recover from these events. To address these challenges, the Early Warnings for All (EW4All) initiative,[1] launched by the United Nations Secretary-General in 2022, aims to ensure universal access to early warning systems (EWS). The initiative has emphasised that Multi-Hazard Early Warning Systems (MHEWS) should be inclusive and people-centred. Under Pillar 3 (warning communication and dissemination), led by the International Telecommunication Union (ITU), this approach strengthens alert dissemination and feedback channels to deliver actionable information to everyone, particularly marginalised groups.

With mobile networks covering 96% of the world,[2] mobile technology has become a vital tool for disseminating risk communications and emergency alerts. However, to leverage this channel effectively, it is necessary to understand the barriers and opportunities that shape how diverse communities access and act on early warnings.

The GSMA Mobile for Humanitarian (M4H) Innovation programme, together with mobile network operators (MNOs), humanitarian organisations like the International Federation of Red Cross and Red Crescent Societies (IFRC) and government stakeholders, have conducted several research initiatives that use a human-centred design (HCD) approach to improve the design and outcomes of EWS.

HCD is a problem-solving approach focussed on understanding and meeting the needs, behaviours and challenges of the people who will use a product, service or solution. It involves iterative processes of research, ideation, prototyping and testing to ensure the outcomes are practical, accessible and aligned with user expectations. By placing users at the centre, HCD fosters innovative and impactful solutions that are more likely to be adopted and sustained over time.[3]

Using HCD methods, M4H research in South Africa, Enhancing inclusion in mobile-enabled risk communications,[4] explored the unique challenges marginalised groups face in accessing mobile-enabled risk communications. Groups such as women, migrants, people with disabilities, older people and those from lower socio-economic backgrounds often experience digital exclusion, making them vulnerable to missing critical risk communications. The research identified both demographic and environmental barriers to receiving, understanding, trusting and acting on early warning messages delivered on mobile devices, and provided recommendations to make these systems more inclusive and effective.

In Tanzania, where natural hazards like floods, droughts and earthquakes are frequent, M4H conducted similar research to understand user preferences for receiving EWS through mobile channels. This study sought to understand community needs and preferences for receiving early warnings to help a multistakeholder coalition design a more effective EWS strategy.

Both studies demonstrate the importance of a people-centred approach to designing early warning messages and risk communications. While the research revealed common challenges in South Africa and Tanzania, there were nuanced differences that must be understood to ensure EWS are effective in each country. With growing demand for similar research in other countries, this report synthesises key findings from South Africa and Tanzania, while also presenting some of the methodologies that can be used as a starting point for research in other contexts. This includes (i) what an HCD research process looks like, including frameworks to analyse and communicate findings; (ii) useful tools for uncovering insights on EWS; and (iii) mindsets that can guide an HCD process.

1 United Nations "Early Warnings for All" website.
2 GSMA. (2023). The State of Mobile Internet Connectivity 2024.
3 More information on HCD can be found at: https://www.designkit.org/.
4 GSMA. (2024). Enhancing inclusion in mobile-enabled risk communications: Lessons from South Africa.

Lessons from human-centred design research in South Africa and Tanzania

Shared lessons emerged from our twin research initiatives despite the unique contexts. Some are highlighted here to illustrate the types of findings that can emerge from HCD-led studies. Detailed findings from South Africa can be found in the full report.[5] Similar research by the Finnish Red Cross in Tanzania mirrored our takeaways and can be found in their report.[6]

User insights

HCD can uncover important insights into how to create effective EWS, such as user needs, preferences, barriers and opportunities. In our two research contexts, we used HCD tools like persona building and user journey mapping to identify characteristics that may inhibit the effectiveness of EWS.

In Tanzania, literacy levels and limited access to technology emerged as significant barriers. Many participants in rural Morogoro Region struggled to read and understand text-based weather warnings sent to their basic mobile phones. Although smartphones could address literacy challenges through audio, video and visual communication, access to these devices remains limited among less literate populations. This underscored the need for hybrid EWS approaches that integrate digital tools with on-the-ground communication methods.

In South Africa, socio-economic status was a key determinant of effective EWS. Limited financial resources constrained access to technology and the ability to take preventive measures. Age also played a role, with younger people (18–40) more digitally connected than older people. Location further influenced outcomes; rural areas faced infrastructure challenges but benefitted from stronger communal networks, while urban areas prioritised individual property protection due to security concerns.

Past experience with disasters heightened awareness of risk, but often left survivors with less access to digital tools or disconnected from new communities after displacement. Community relationships also shaped responses, with migrants and relocated individuals often encountering trust issues, stigmatisation and language barriers.

System design

HCD can support EWS design by ensuring that every component, from communication channels to user interfaces, is tailored for the greatest impact. HCD can help identify the most effective channels for disseminating alerts, while refining terminology and iconography to be easily understood by diverse audiences. M4H research showed that digital EWS strategies must be paired with community-driven, higher-touch approaches like face-to-face conversations with community leaders or networked systems for peers to notify each other.

In Tanzania, community leaders, such as government officials and religious figures, play an essential role in disseminating information and fostering trust. These leaders use loudspeakers, mosque announcements and door-to-door communication to ensure messages, including those about the weather, are heard and acted upon. Their involvement lends urgency and credibility to warnings, more so than digital or traditional media. In South Africa, while mobile penetration is high, individuals without direct digital access often rely on family and community networks to receive messages. Both contexts underscore the need for hybrid approaches that combine digital and in-person methods. This dual strategy extends reach, builds trust and drives timely action, particularly among marginalised groups.

5 Ibid.
6 Finish Red Cross. (2024). Why early warnings are not leading to early action?

Social and cultural factors

HCD can uncover social and cultural influences on EWS, such as trust, community dynamics, triggers to action and behavioural norms. For example, we learned that trust in EWS requires the use of familiar and credible sources alongside a range of communication channels. In both South Africa and Tanzania, trust was highest when warnings were attributed to recognised entities, such as meteorological agencies and respected community leaders. Multichannel strategies, including SMS, radio, TV and face-to-face communication, ensured that messages reached diverse audiences while reinforcing their credibility through repetition. Additionally, participants emphasised the importance of branding and consistent messaging to differentiate official warnings from misinformation. This multipronged approach not only enhanced trust, but also motivated timely action, particularly in communities with prior disaster experience.

The research showed that it is important for EWS to provide clear calls to action that are reinforced by communities. In Tanzania, decision-making processes often depend on collective rather than individual actions, and community leaders need to be involved to overcome inertia and inaction. Research also revealed that communities struggle to recognise the tipping point for action, as seen in South Africa where confusion between minor and severe weather risks has hindered timely action. Additionally, individuals frequently lack a sense of self-efficacy, limiting their ability to act even with advance warnings. To address these challenges, actionable guidance must be both specific and reinforced through trusted community networks. Engaging leaders and leveraging communal decision-making processes can bridge this gap, empowering individuals and groups to respond effectively to imminent risks.

HCD methods such as interviews, participatory workshops and usability testing were instrumental in identifying effective EWS design. Direct engagement with users revealed critical needs, preferred communication channels and trust issues affecting their response to emergency alerts. Iterative prototyping and testing enabled system features to be refined, such as user-friendly interfaces, appropriate terminology and optimal timing for alerts. Community engagement also revealed cultural practices and social dynamics that influence the flow of information and response behaviours, ensuring system design is inclusive and contextually relevant.

The human-centred design research process

HCD research can take many forms but adheres to certain core principles: understanding the target audience or user needs, engaging stakeholders meaningfully and with an open mind and iteratively refining solutions. By placing people, in this case EWS communication recipients, at the centre of the design process, HCD ensures that systems are practical, inclusive and address the unique barriers faced by different communities.

In our EWS research, these principles translated into a series of structured yet flexible steps:

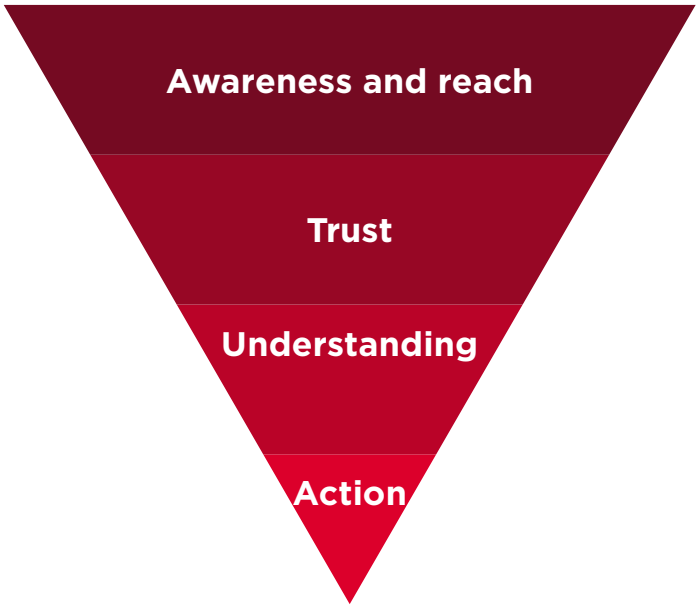
Pre-fieldwork landscape mapping

Before engaging with communities, it was crucial to understand existing information flows and identify key stakeholders. This phase involved calls with stakeholders to map the roles of government agencies, community leaders and other influencers in disseminating warnings. This included consultations with regional leaders of the South African Red Cross Society (SARCS) and the Tanzania Red Cross Society (TRCS), representatives of MNOs and researchers who focus on disaster response. It included a literature review of publications from the South African Weather Service (SAWS) and the National Disaster Management Centre (NDMC) in South Africa, and the Tanzania Meteorological Agency (TMA) in Tanzania. The M4H team also consulted on brief calls with a range of global experts in climate disaster preparedness and response, both researchers and practitioners.

Combining the outcomes of all these discussions and report reviews, we drew a map of the network of stakeholders involved in EWS, including their different and interconnected roles. We also mapped the user journey of a typical community member, highlighting how different communication channels and messages likely reach them and how they might prompt them to act. These activities all contributed to a shared baseline understanding among the project team, and helped pinpoint areas we wanted to confirm, refute and learn about during the field research.

Choosing analytical frameworks

Frameworks can be useful guides in HCD exercises, both for analysis and to logically structure conversations with users. Selecting appropriate frameworks upfront can help to approach complex topics methodically, identify critical blockers to successful EWS strategies and develop clear plans for actionable outcomes. Different frameworks are suited to different contexts, with each offering unique insights depending on the specific needs of the community, the type of hazards and the goals of the research. Our research team used three simple frameworks to provide structure to our approach in South Africa and Tanzania.



- **Reach Model:** In South Africa, a literature review and expert interviews during the landscape mapping phase led the research team to use a simple four-part framework employed by the WMO known as the Reach Model, which breaks down the effectiveness of EWS approaches into four steps: Awareness and reach, Trust, Understanding and Action.[7] By isolating and exploring each of these factors, the research team created a clearer picture of the barriers to EWS, as well as the opportunities. Designing a successful EWS requires considering whether users are aware of information and, if so, whether they trust, understand and are compelled to act on it. This linear and progressive framework helped the team subdivide activities in focus group discussions (FGDs) and develop a clearer set of recommendations for how to employ successful EWS for marginalised communities.

- **Communications Component Model:** In Tanzania, our research objectives were slightly different. Instead of exploring how to reach marginalised groups, we wanted to consider user preferences in EWS communication campaigns. We therefore employed a bespoke framework that broke those campaigns into five components: Channel, Content, Source, Timing and Community Engagement. These categories helped us determine how best to learn about and report findings on the most-effective channels for different audiences, how the content needs to be tailored to resonate with specific audiences, which sources are considered credible, when messages are most likely to reach people and how to best combine digital approaches with on-the-ground, community-driven methods. When co-designing solutions with the target audience, these categories also provided a structure to ideate and design "ideal" EWS campaigns.

- **Disaster Chronology Model:** In both countries, we used a framework that considered early warning communications before, during and after hazardous weather events. This approach allowed for a detailed examination of how communities prepare for, respond to and recover from natural hazards. It also provided insights into users' different information needs at each stage of the disaster cycle, which helps to tailor interventions and resources for the greatest impact.

The three frameworks highlighted here are just a few of the many frameworks that research teams may find useful to employ. Similar research activities have used Jonathan Haidt's Elephant/Rider/Path framework,[8] which considers behaviour change across emotional, rational and environmental components, or COM-B,[9] which breaks behavioural drivers into capabilities, opportunities and motivations, among others. The specific framework is perhaps less important than the structure it provides in guiding the HCD research process, which by nature can feel unstructured or exploratory at times.

7 WMO. (2022). Bulletin: Early Warning and Anticipatory Action. Vol. 71 (1).
8 Verghis, P. (29 July 2016). "Direct the Rider, Motivate the Elephant, Shape the Path". HDI.
9 Pilat, D. and Krastev, S. (n.d.). "The COM-B Model for Behaviour Change". The Decision Lab.

Selecting locations and participants for field research

Drawing on lessons from the landscape mapping, the research team selected locations in each country based on profiles of the population we wanted to learn from. In Tanzania, we focussed on Kilosa District as a rural agricultural area that had experienced flooding from heavy rains multiple times in recent years. In South Africa, we selected three locations that represented diverse lived experiences and certain marginalised groups. In the peri-urban border town of Musina, we encountered a large number of migrants who lacked formal documents to live in South Africa. In Durban, South Africa's third most-populous city, we focussed on women and youth who had recently been impacted by flooding, many of whom were forced to relocate their homes. In the rural Eastern Cape province, we focussed on older populations and people with disabilities. As with any qualitative research exercise, the sample size may be limited, but selecting diverse participants and exploring their experiences in depth can yield robust insights that apply to other locations and groups.

In each location, we conducted sessions with community members, local leaders like village elders, emergency response volunteers and those responsible for disseminating EWS, like media, religious leaders or local government representatives. These diverse perspectives were important, as different stakeholders often held differing opinions on the effectiveness of certain EWS approaches. Bridging the gap between perceived and actual impacts was a critical outcome of participant selection.

Conducting user research

For each location, the team was comprised of two global researchers, one local researcher and a translator, where needed. One to two representatives of local partners like SARCS or TRCS also joined to help recruit participants and facilitate logistics. The teams spent one week in each location and used a combination of the following:

- **Individual interviews:** 60- to 90-minute interviews were conducted in the homes or businesses of local residents or leaders. These semi-structured discussions, typically held at the beginning of each research week, allowed us to capture in-depth personal stories from past EWS experiences, providing a foundational understanding before moving on to group sessions.
- **Focus group discussions:** In each location, we held three to four FGDs with six to eight participants each. These sessions created a space for collective dialogue and capturing diverse perspectives. The size of the groups struck a balance between being inclusive and manageable, with participants able to share personal experiences while also engaging in dynamic discussions. FGDs often generate nuanced insights, such as how community dynamics influence decision-making or the barriers communities face in acting on warnings. Additionally, FGDs encourage peer learning as participants build on each other's ideas, highlighting communal values and behaviours critical to designing effective and inclusive EWS.
- **Co-creation workshops:** In the final days, we shifted from FGDs to CCWs. While similar in structure (120-minute sessions with six to eight participants), CCWs encourage participants to actively engage in brainstorming, prototyping and refining solutions, ensuring that outputs are directly informed by the needs and insights of diverse community members. CCWs are particularly valuable for uncovering innovative ideas, testing potential strategies and aligning solutions with local realities, making them a critical step in developing user-centred and actionable EWS.

Table 1 outlines a typical research week. While this can be used as a guide, it is important to adapt the agenda based on local project needs.

Table 1:
Sample week agenda

Day 1	Day 2	Day 3	Day 4	Day 5
Community/ village leader interview (60 min) 3 x individual community member interviews (60 min each) Team debrief	FGD with 8 women (120 min) FGD with 8 men (120 min) Team debrief	FGD with 8 individuals aged 18–40 (120 min) FGD with disaster response volunteers (120 min) Team debrief	Morning planning for CCWs CCW with 8 women (120 min) Team debrief	CCW with 8 men (120 men) CCW with 8 partner organisation volunteers (120 min) Team debrief

Tools and research methods for designing early warning systems

When designing an EWS, applying HCD principles helps ensure that solutions are practical, user friendly and aligned with the needs of the communities they serve. The following methods are not prescriptive tools or a rigid blueprint to follow. Instead, they are examples of how the research team applied HCD mindsets, emphasising empathy, co-creation and iteration to gather valuable insights that shaped the EWS design process. By sharing these examples, we aim to inspire others to adapt and tailor HCD methods to their unique contexts when designing or improving EWS.

Persona building

Older women in a rural village near East London, South Africa create a persona called Mrs Nobuhle

What is it? Persona building is a method for creating detailed, fictional representations of key user types based on research and insights. These personas embody the goals, needs, behaviours and challenges of real users, helping designers and stakeholders empathise with their audience. By humanising data into relatable characters, persona building ensures that solutions are tailored to the diverse experiences and expectations of the people they are designed to serve.

How did we use it? We used personas in two ways. First, the M4H team developed a set of personas based on our assumptions about a typical EWS audience. We did this at the beginning of the project, refining the personas as the research progressed and then using them as an analytical tool following our community engagements. Second, we used persona building with participants in FGDs. Together, groups of six to eight community members created a persona of a typical community member like themselves. One participant would draw a simple sketch of this persona, the group would give the persona a name and then participants would debate what this persona's life looks like: their family, their work, their community, access to technology, daily routine, influencers, experiences and so on.

Why did we use it? This exercise not only helps researchers better understand their target audiences and inspires creativity among FGD participants, but it also provides a way for participants to project their sometimes sensitive or traumatic experiences with natural disasters onto hypothetical characters, creating a safer way to share important information. As they become more attached to the stories of the personas they are creating, group members debate and co-create the community's most-shared experiences. In the end, the personas helped the research team identify some of the key factors influencing the effectiveness of EWS communications, namely socio-economic status, age, location, past disaster experience, relationship with other community members, literacy levels and access to technology.

Channel, influencer and digital mapping

Participants in Kilosa, Tanzania map communication channels by how often they have touch points with them

What is it? Channel, influencer and digital mapping is a collaborative exercise designed to uncover the relationships between different communication channels, influential figures and digital technologies within a community. The method visualises how and when people receive information, highlighting key touchpoints and gaps in communication flows. By examining these networks, researchers can better understand how communities engage with various tools and messages during critical moments, such as early warnings for disasters. This process creates a comprehensive picture of the ecosystem that supports, or hinders, effective dissemination of information.

How did we use it? To conduct this mapping, we used a hands-on card-sorting activity. Each card represented a channel (e.g. radio, SMS alerts, social media), an influencer (e.g. religious leader, local official) or a digital tool (e.g. apps, websites). Participants ranked these cards from most to least useful for their community when receiving early warnings. As they worked, we observed the discussions, noting verbal and non-verbal cues, side conversations and debates.

Why did we use it? This mapping exercise was invaluable for understanding not only what communication methods communities rely on, but also why certain channels or influencers are trusted and effective. Beyond producing direct outputs, like ranked lists of preferred communication tools, the process facilitated deeper learning through group interactions and discussions. The group dynamic exposed the reasoning, values and social norms influencing communication. For example, in Tanzania, participants emphasised the role of community leaders in decision-making and peer-to-peer nudges, showing that group consensus was critical for motivating action. Subtle cues, such as who spoke most confidently or what topics sparked debate, provided insights into cultural and social dynamics. These findings are crucial for designing EWS that resonate with local practices.

Women in Kilosa, Tanzania put communication channels in order by their ability to reach them

Agree/Disagree cards

What is it? Agree/Disagree cards are an interactive and dynamic way to gather insights about community perceptions, preferences and experiences with EWS. Participants are presented with statements related to EWS, such as *"Text messages are the best way to warn people about floods"* or *"Local leaders are the most trusted source for weather alerts"*, and respond by holding up cards indicating whether they agree or disagree. This simple yet engaging activity fosters participation, sparks discussions and helps researchers identify points of consensus or contention within a group.

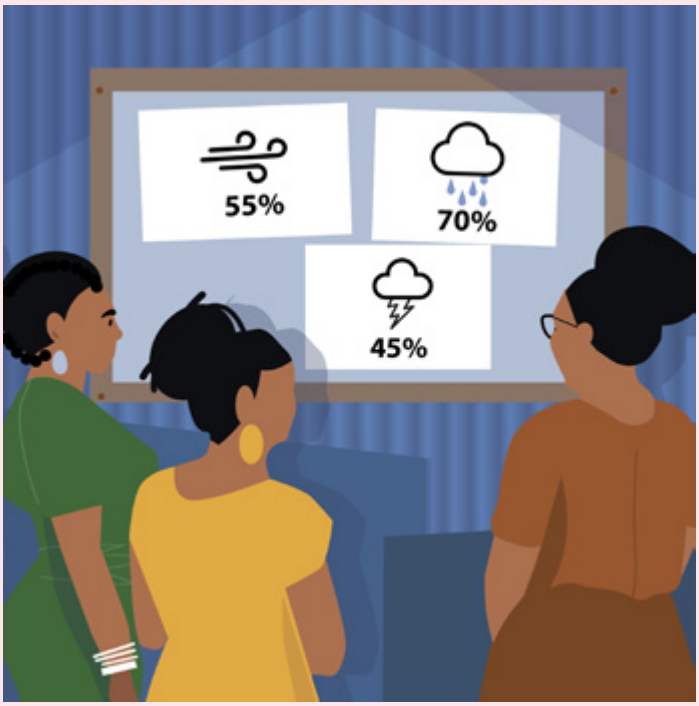
How did we use it? We used printed cards with "Agree" (green with thumbs up icon) on one side and "Disagree" (red with "X" icon) on the other, distributing them to participants seated in a circle or small group. After reading each statement aloud, we observed the group's responses and facilitated open-ended discussions about why individuals held specific opinions. This movement-based activity proved especially effective for topics like weather, which can sometimes feel abstract or dull. We adapted the Agree/Disagree questions as sessions progressed to better understand specific topics of interest.

Why did we use it? Agree/Disagree cards were valuable not just for the direct responses they elicited, but also for the conversations and behaviours they triggered. The group discussions that followed each statement often revealed deeper insights, such as the rationale behind preferences or the social dynamics influencing opinions. For example, when a statement about mobile alerts prompted mixed reactions, side conversations highlighted access barriers for some and the importance of community validation for others. This tool was also an effective icebreaker, helping participants feel comfortable expressing their views. By getting people physically involved, we created a more energetic and collaborative atmosphere that encouraged honest dialogue and allowed us to gather both explicit feedback and subtler, more nuanced lessons critical for designing effective, user-centred EWS.

Women in a rural village near East London, South Africa hold up agree/disagree cards in response to statements about their mobile phone use

Testing icons, colours, symbols and terminology

What is it? Testing icons, symbols, colours and terminology is a hands-on approach to evaluating how communities interpret visual representations and words used in EWS. Participants are shown various weather phrases or designs, such as icons or alert symbols, and asked to share what they think each means. This exercise helps uncover whether the communication approaches are intuitive, culturally relevant and effective in conveying critical information.



Women migrants in Musina interpret weather symbols

How did we do it? We presented participants with a series of weather-related icons printed on flashcards, like those from weather apps, and others newly designed for testing. These included symbols for wind, cyclones, heat, floods and other events. Participants discussed their interpretations of each symbol, and we observed which designs resonated or caused confusion. Unsurprisingly, abstract icons, like those for wind or heat, were often unclear. Many participants suggested they would better understand visuals that depicted the impacts of weather, such as trees falling in a storm or cracked, dry land during a heatwave, rather than the weather itself. Laying the visuals out on a table allowed participants to engage physically and collaboratively in the evaluation process.

We also shared sample SMS message text about different weather events to gauge comprehension, presenting similar data in various ways to test what worked best. For example, for flooding rains, is it best to share how many millimetres are expected to fall, to compare heavy rains to past events, to share the expected impacts (e.g. “Houses may be swept away”) or to communicate it in another way?

Why did we use it? This testing was essential to ensure that EWS visuals and messaging are universally understood and actionable. Misinterpreted icons can delay or prevent appropriate responses, making clear communication critical. Beyond revealing specific design preferences, the exercise highlighted cultural and contextual differences in how weather is perceived. The activity also kept participants engaged through interaction, ensuring richer discussions and insights.

Men in Kilosa, Tanzania interpret sample early warning messages in Swahili

Crazy Eights prototype building

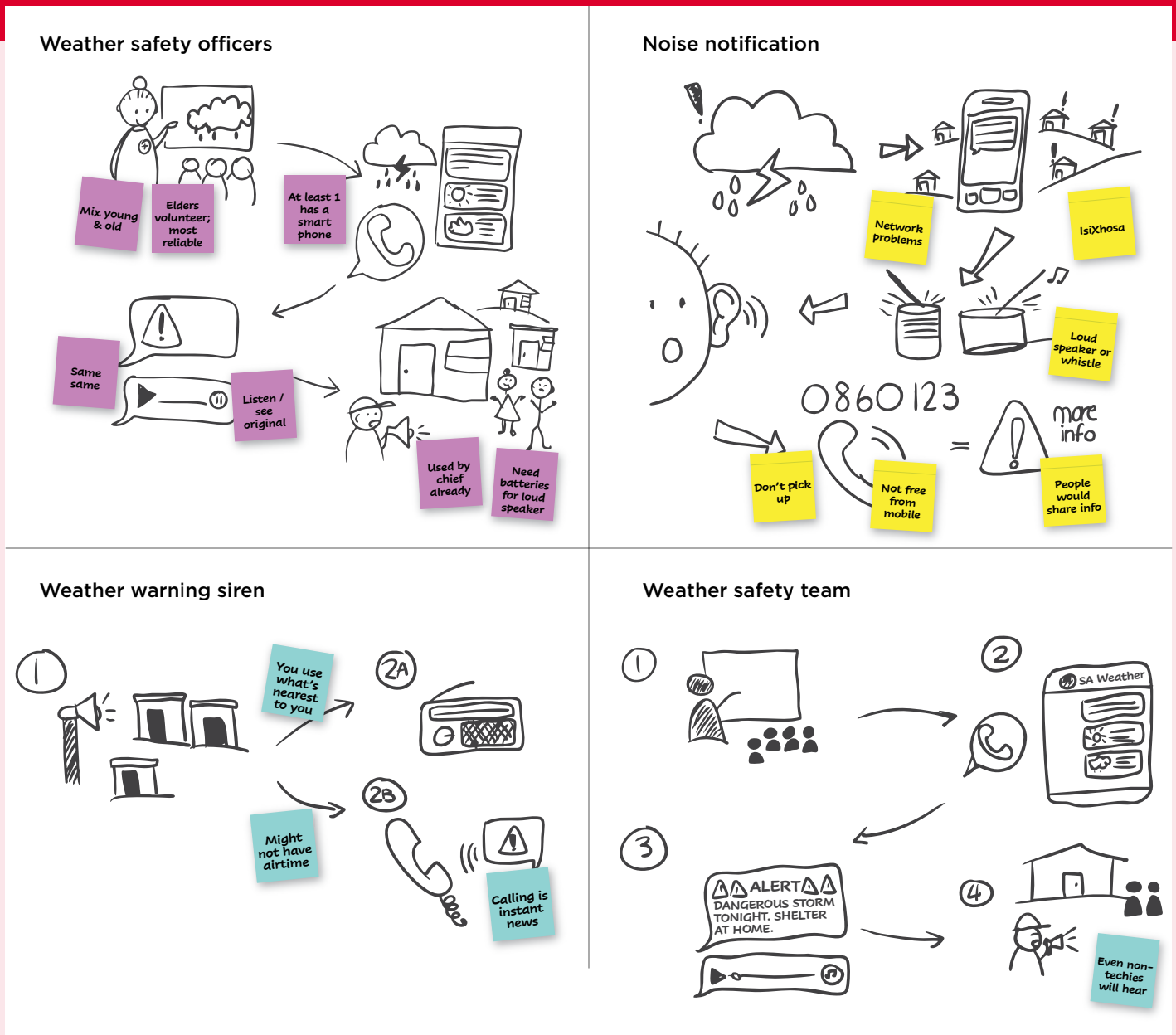
What is it? Crazy Eights is a fast-paced brainstorming tool used to generate a variety of ideas and prototypes in a short time. Participants fold a sheet of paper into eight sections and, within a few minutes, sketch one idea in each section. In this exercise, participants were encouraged to envision how different EWS components, such as warning tiers, colour codes or communication methods, could be designed to meet their community's needs.

How did we do it? Participants were broken into teams of three to four and tasked with sketching or writing out eight different ideas for components of an EWS. Prompts were given by CCW moderators for each of the eight components. For example, (i) share the top-three useful bits of information to be communicated about a flood; (ii) draw a colour-coding warning system to show people this event will be severe; (iii) draw how initial information will spread quickly in the community, and so on. After completing their sketches and notes, participants shared their ideas with the group, allowing for discussion and refinement of their ideas.

Why did we use it? This collaborative activity is particularly valuable for exploring creative solutions and illustrating options for improving EWS functionality. By involving participants in the design process, this tool ensured that the outputs were closely aligned with user needs and contexts. The exercise also allowed groups to engage with EWS design elements in a hands-on and visual way, resulting in tangible prototypes that could be iterated further.

Young people in Durban, South Africa present their ideas back to the group

Pitch testing



Research facilitators pitch a concept for an early warning system in South Africa

What is it? Pitch testing is a straightforward and iterative tool for gathering feedback on early-stage concepts. In this exercise, a simple three- to four-part concept for an EWS is shared with participants in a concise, 60-second explanation. This is followed by structured questions to capture their reactions: *What do you like? What don't you like? What questions do you have? What would you change or improve?* By focusing on simplicity and brevity, pitch testing allows participants to engage quickly and meaningfully, refining ideas as they move towards an ideal solution.

How did we do it? We began by presenting a high-level EWS concept to small groups, outlining components such as alert methods, message content and the timing of delivery. After each pitch, participants shared their thoughts on what resonated, what felt unclear or ineffective and how the concept could be improved. The process was dynamic, with each group's feedback informing adjustments to the concept before testing it with the next group. This iterative approach not only allowed us to refine the idea, but also made participants active contributors in co-creating and improving solutions.

Why did we use it? Pitch testing proved invaluable for gathering actionable feedback and fostering co-creation. The structured yet conversational nature of the activity encouraged participants to share candid and constructive insights, highlighting both the strengths and weaknesses of each concept. It also revealed key preferences and priorities, such as clarity in messaging or the need for localised content. Importantly, the iterative process allowed the idea to grow and adapt in real time, ensuring it aligned more closely with community needs and expectations.

Mindsets for successful human-centred design research

Developing an HCD toolbox[10] can be a powerful start to a research initiative for EWS design. However, having the right mindset is just as important as tools and methodologies. This section presents the six guiding principles we used to ensure our research put users first.

Let the users guide you through the process

HCD is about putting the user at the centre of the research process. This means not only listening and holding participatory sessions, but remaining flexible. We often found that certain tools, approaches and methods worked better in some contexts than others. For example, those who had recently experienced disasters were better able to map out detailed user journeys of their experiences compared to those who had not experienced extreme weather recently. In these cases, the user journeys were too hypothetical and disconnected from participants' lives, so we pivoted to considering similar, but more relatable communication campaigns like COVID-19 or rolling blackout warnings. HCD is about having a toolbox of approaches and choosing, often on a moment's notice, which ones will help you gather information most effectively.

Make it visual

Visual aids are essential for engaging participants and facilitating deeper understanding of EWS. People respond best when tangible, visual elements like printed cards, sticky notes or sketches are presented in front of them, as these tools make abstract concepts more accessible. For example, when discussing complex topics like seasonal weather cycles or warning tiers, visual aids allow participants to process, reorder and interact with information in a hands-on way. This not only encourages collaboration but also helps uncover insights that might otherwise remain hidden in traditional discussions.

10 Some good starting points for HCD tools include IDEO.org's Design Kit, the GSMA's Human-Centred Design in Humanitarian Settings report, Butterfly Works' Toolbox and Frog's Collective Action Toolkit.

Help the users tell a story

Unlike direct questioning, which can sometimes limit responses, open-ended prompts allow participants to express their emotions, motivations and barriers in their own words. For instance, asking, *"Can you walk us through what happened the last time there was a severe storm?"* invites detailed accounts of decision-making, communication and action. These stories often reveal underlying factors, such as trust in local leaders or challenges in accessing alerts, which might not emerge through traditional questioning. By listening to these narratives, researchers can better understand the lived realities of the target audience and design EWS that address their specific needs and behaviours.

Iterate, iterate, iterate

HCD research changes as we learn. Constantly consider what is working and what is not, as this will help to refine and home in on the most effective ideas. This applies to both the EWS approaches being tested and the research methods. For example, after a few rounds of building personas in focus groups, we found that we were no longer uncovering new ideas. Instead, we decided to switch to an Agree/Disagree card game in which we discussed similar topics but in a new way, leading to deeper insights.

In our CCWs, the baseline EWS concepts that we presented were adapted based on previous sessions. For example, when two groups indicated that they did not think a concept involving volunteers would work in their community, we excluded that idea from future sessions, swapping it out for new concepts developed by participants themselves.

Look beyond weather to social, cultural and behavioural forces

Effective EWS design requires understanding not only how people receive and interpret alerts, but also the broader social, cultural and behavioural forces influencing their actions. Keep in mind: *Who are the trusted influencers shaping decisions? What subtle dynamics drive group behaviour, such as peer pressure or collective decision-making?* Communities often act in nonlinear ways, guided by a web of interconnected relationships, norms and motivations. HCD helps uncover these complexities by exploring how all pieces of the puzzle – weather, communication channels, trust and social structures – interact and fit together. This holistic approach ensures that EWS solutions are grounded in the real-world contexts in which they will function.

Don't miss the subtleties

The value of HCD lies not just in the answers the tools provide but in the learning itself – from observing behaviours, interactions and discussions throughout the process. Insights often emerge organically, such as noticing how participants in the Tanzania FGDs waited to respond and tended to answer collectively, revealing community decision-making dynamics. These subtle observations, captured before formal sessions begin or during side conversations, offer valuable context that structured tools alone might miss. The iterative, immersive nature of HCD allows for a deeper understanding of user environments and social nuances, enriching the design process and resulting in more impactful outcomes.

Conclusion

As climate-related disasters intensify, the need for effective and inclusive EWS becomes more urgent. The effectiveness of an EWS is measured not only by the technology or number of people it reaches, but also by its ability to drive meaningful action at the community level.

Findings from research in South Africa and Tanzania highlight the social, cultural and behavioural dynamics that influence community action. HCD methods have proved valuable in unearthing these user insights. This report has provided a practical roadmap for conducting HCD research on EWS, including methodologies, analytical frameworks and key principles for engaging communities. By using tools such as persona building, journey mapping, usability testing and co-creation workshops, researchers and practitioners can develop more responsive, contextually appropriate and user-friendly EWS solutions.

As global efforts to expand EWS continue under the EW4All initiative, these insights offer valuable guidance on how to ensure no one is left behind. EWS design needs a people-centred approach that goes beyond merely issuing alerts. It needs to also ensure that solutions are tailored to the lived experiences, preferences and challenges of communities so that they are trusted, understood and acted upon. Policymakers, MNOs, humanitarian organisations and disaster response agencies must collaborate to design, test and iterate solutions that truly meet the needs of the people they seek to serve. By prioritising such approaches, they can create EWS that are not just technically sound but socially resonant, ultimately saving lives and strengthening the climate resilience of communities in an increasingly uncertain future.

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