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Suggested citation: IRDR (2025). Disaster Risk Reduction Products and Processes: Knowledge Sharing for Place- and Context-Specific Actions. Policy Brief [Writing Team: Ruiz-Rivera, N., Garcia Ferrari, M.S., Ismail-Zadeh, A, Yang, S., Garimoi Orach C., Azahari Razak, K., Ngaira J., Lian F.]. Integrated Research on Disaster Risk, International Programme Office, Beijing, China.

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DISASTER RISK REDUCTION PRODUCTS AND PROCESSES: *KNOWLEDGE SHARING FOR PLACE- AND CONTEXT-SPECIFIC ACTIONS*

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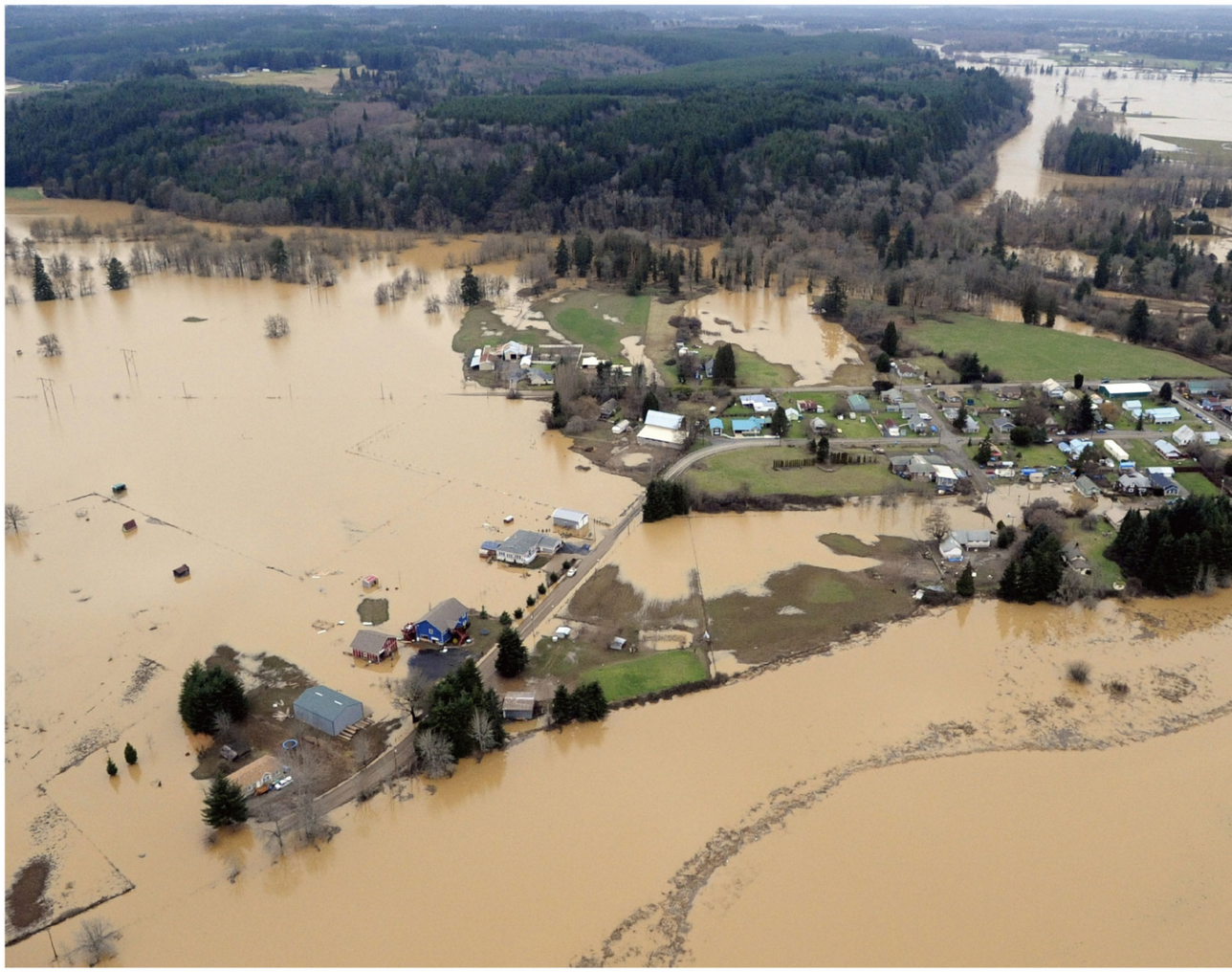


SUMMARY

This policy brief analyzes how scientific evidence can be incorporated into policymaking at local, regional, and national levels through specific disaster risk reduction (DRR) action-oriented products and approaches that draw on context-specific, diverse, and plural knowledge. It sets out policy recommendations that support the development of place-specific products and approaches that enable impactful actions. In addition, it proposes the adoption of local science advisory mechanisms to support the development of DRR products that are locally useful, relevant, and credible. These recommendations are reinforced by a set of approaches for developing science-based DRR products and processes, highlighting good practices that integrate science and diverse forms of knowledge into actions at local and national levels. This brief is intended to guide sub-national and local authorities, as well as research and academic institutions. The policy recommendations acknowledge the need for the proposed local and regional actions to work within a corrective and prospective overall national policy framework for DRR management.

INTRODUCTION

Now more than ever, disaster risk reduction (DRR) requires evidence-based policies and decision-making processes that are focused on the realities on the ground, and are informed by open, plural and effective use of information gathered across diverse disciplines and communities (UNESCO, 2021; Barcelona Declaration, 2024). Science and policy processes and approaches, however, usually operate under fundamentally different languages, procedures, and knowledge-sharing practices. Problem- and solution-based approaches that are place- and context-specific should help ensure greater engagement and user value among scientists, decision-makers, and communities, including NGOs, cultural religious/spiritual groups, activists, and others who play key roles in DRR management. Such engagements can strengthen support across various policy spheres and contexts, including national and local governments, by fostering knowledge-based, context-specific decisions, enhancing the user value of science and diverse types of knowledge, and integrating civil society knowledge, experiences, concerns, and priorities (UNDRR, 2024).

Scientific curiosity, observations, relevant theories, and methodological tools enable scientists to generate,explore, and derive new knowledge about disaster risks and provide scientific evidence to policymakers. However, decision-making processes and the construction of knowledge and information in DRR require not only convincing evidence but also a range of useful, context-specific, and reality-based options for actions. Well-informed DRR decisions are typically taken in response to multiple urgent issues that span both national and international boundaries (Ismail-Zadeh, 2022). Understanding complex policy questions usually requires evidence across multiple geographical levels (from local to global scales), as well as contextual insights into the perspectives of actors on the ground operating within diverse policy, power, culture, and other spheres of influence. Current practices of evidence synthesis often replicate the silos found in primary (disciplinary) research (e.g., Cutter et al., 2015; Ismail-Zadeh et al., 2017) and in policy spheres, e.g., local government sectors that seldom coordinate across departments. Furthermore, research production and communication are frequently disconnected from local and regional policy processes, leading to knowledge barriers. At the global level, inequalities and language barriers further hinder the consideration of relevant evidence within complex political and power dynamics. A key strategic approach should focus on how policymakers and disaster practitioners, especially at local and subnational government levels, could undertake scientific evidence with society to co-produce action-oriented DRR products that are useful and valuable to society.

While DRR policy increasingly recognizes the fundamental role of science and technology in systemic risk reduction and management, scientific evidence has not always been efficiently integrated from the outset through co-design into actions and tools that address the needs of all citizens, including the vulnerable sectors of the population. In recent years, there has been a shift away from paternalistic, ‘knowledge deficit’ approaches that assume science alone holds the key to effective DRR information for action. Instead of viewing the public as passive recipients of information (Bucchi, 2008), contemporary approaches to public engagement and science communication now emphasize dialogue, co-learning, and the sharing of diverse knowledge systems and approaches among local communities, scientists, and other DRR stakeholders. This shift supports collaboration and, potentially, co-production processes and outcomes among a broad range of actors.

These approaches can lead to integrated, grounded DRR and risk management processes that legitimize and dignify all communities living in hazard-prone regions and those affected by disasters. Such communities are often well placed to observe changes in their environment and can leverage their knowledge to implement strategies and actions to address risks (Smith et al., 2020). Co-design and co-production processes in DRR rely on multifaceted knowledge sharing to build both short- and long-term capacities, either to enable a rapid return to desired territorial functions following a crisis or to support the radical transformations needed to address the root causes of vulnerability and poverty through deliberation, experimentation, and social learning (Pelling, 2011; Aguilar-Barajas et al., 2019; Garcia Ferrari et al. 2021). This engagement and dialogue, if undertaken in humility and ‘listening mode’ enable local knowledge to be valuable for enhancing technical and scientific understanding and informing effecting local DRR action.

Outcome-oriented approaches and products – a practical framework for translating and tailoring DRR science advancements

Disaster Risk Reduction (DRR) Products

DRR products are tools, services, technologies, or informational resources designed to help identify, reduce, or manage the risks associated with disasters. These products support communities, governments, NGOs and civic organizations in preparing for, responding to, and recovering from disasters, ultimately aiming to minimize loss of life, damage to property, and disruption to livelihoods.

DRR products include early warning systems; risk assessment maps showing hazard- and risk-prone areas; disaster preparedness toolkits for schools, households, or local governments; mobile apps that alert users to nearby disasters or provide safety instructions; educational materials and training programs on emergency response; and action plans for risk reduction produced in cooperation with local communities and governments.

DRR products can be classified as physical infrastructure (e.g., building codes, early warning systems, and flood fortifications); technological solution (e.g., mobile apps for emergency communication, satellite imagery for disaster assessment, and data analytics for risk mapping); services (e.g., training programs for disaster response teams, insurance products that cover disaster losses, and community-based risk reduction initiatives); knowledge and information (e.g., educational materials about disaster preparedness, and data on past disasters); and policy and planning (national disaster risk reduction strategies, and local zoning regulations).

(Source: Izumi et al. (2019) and AI-generated information)

Despite growing awareness of the importance of integrating science into DRR decision making and the value of co-designing DRR solutions, there remain few science-policy frameworks and established processes – such as co-production – that could be tailored for and used in local actions aimed at building resilience. A possible outcome-oriented approach to promoting scientific advice in DRR policymaking would be an incorporation of co-design and co-production into the analysis and implementation of DRR solutions. Drawing on this integrated analysis, DRR products (see Insert) could better address the needs of preventing, monitoring, mitigating, and managing the impacts of disasters (Izumi et al. 2019) if they are developed and used with consideration of the local context. Specific users – including community groups, NGOs, practitioners – can adapt and create these products to achieve more impactful, context-relevant outcomes.

Each of these processes, outcomes and products contributes to a specific type of DRR actions: (1) Understanding and preventing future risk; (2) Reducing current risk; (3) Strengthening response preparedness (readiness); (4) Responding and rehabilitating; and (5) Recovering and reconstructing (Narváez et al., 2009). DRR products can contribute to the goals and activities of each type of the actions by using scientific evidence to design solutions such as risk scenarios, early warning system (EWS), building codes that incorporate mitigation technologies in public works and housing construction, guidelines for improving disaster responses, and territorial planning for recovery. However, these products should be grounded in a realistic understanding of the user's needs, context, capacities, capabilities, and available means. Such a sensitive and inclusive approach can foster capacity building and collaboration among evidence producers and users, thereby strengthening evidence-informed policymaking and improving policy outcomes.

The DRR types of actions respond to different governance logics, and involve a wide range of organizations, actors, and resources, as well as political, cultural, historical, and economic contexts, all of which are necessary to achieve specific goals. For example, while future risk prevention is typically led by planners, health officers, insurers, and public works engineers, response and rehabilitation efforts are often undertaken by community leaders, civic groups, humanitarian organizations, emergency managers, firefighters, and health professionals, among others.

This example highlights the complexity of adapting evidence to DRR practice. Type 1 of DRR actions (understanding and preventing future risk) may include hazard analyses, demographic projections, or advanced engineering designs, which are then translated into products such as hazard maps, building codes, or multi-year budget estimates. in contrast, DRR products focused on response and rehabilitation (type 4) should be developed in conjunction with type 1, as effective co-design requires inputs from field such as trauma medicine, fire engineering, and spatial modelling. These inputs can be translated into products like accessible evacuation maps and procedures, primary school books, or social work guidelines (see Table 1 for additional examples of DRR products and services). Since the users for each type of DRR actions differ, tailored products and approaches are required to achieve the specific objectives of each type of actions. When a range of scientific knowledge and methodologies is applied to design and develop such products, this knowledge and expertise should be communicated to users in ways that are understandable and practical to implement. Therefore, DRR products should become outcome-oriented to enable specific user communities, including practitioners, to effectively achieve DRR goals (Narváez et al., 2009).

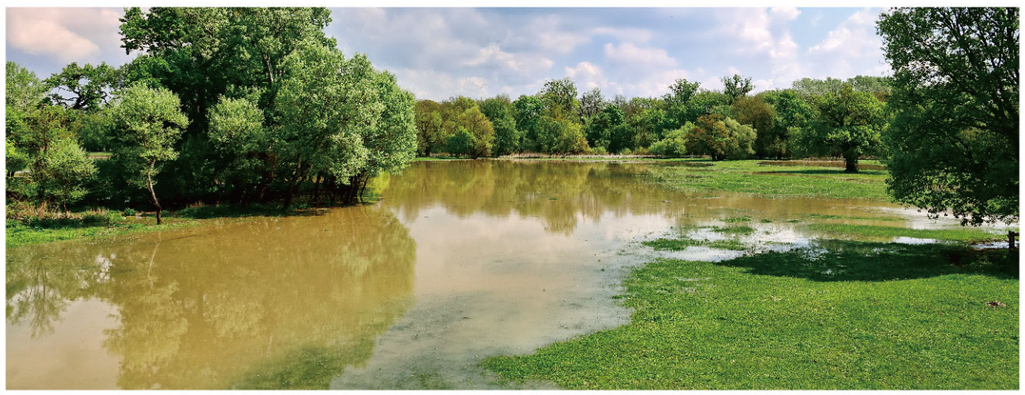


Table 1.
Examples of DRR products and processes that incorporate scientific evidence or methodologies

Inputs	DRR types of actions				
	Understanding and preventing future risk	**Reducing current risk**	**Strengthening response preparedness (readiness)**	**Responding and rehabilitating**	**Recovering and reconstructing**
Hazard and risk mapping	DRR laws / Land use and zoning maps / Hazard micro-zoning / River engineering tools Participatory/ crowdsourced geographic information systems	Geographic Information System (GIS) & remote sensing tools / Building codes	Hazard Information Profiles (HIPs)[1] / Evacuation maps (including participatory cartography) / Local DRR brochures and flyers	Damages and Losses Assessment (DALA) tool[2] / Drones & other UAS	Prospective urban plans (relocation and reconstruction)/ Enhanced hazard and risk maps / Enhanced building codes
Demographic analysis	Prospective urban plans (exposure)	Maps of disaster loss assessments	Civil defense and community level plans	Post-Disaster Needs Assessment (PDNA) tool[6]	Post-disaster urban plans (dynamic vulnerability and exposure)
Behavioral psychology models	Training models for various groups of people / Humanitarian standards[3]	Nudges[4] / Emergency evacuation drills[5]	EWS design of public alerts	Emergency communication (e.g., social media, crowdsourcing)	Models for long-term rehabilitation of and recovering from post-disaster trauma
Architectural innovations	Modern building materials / Indigenous DRR technologies[7]	Building codes / Insurance packages	Resilient building construction plans	Emergency housing plans	Build Back Better (BBB) guidelines
Artificial Intelligence	Epidemiological trends for health managers	Hazard event forecasting / Risk mapping/ EWS for high-speed trains[7]	Evacuation models for local authorities	Rapid damage assessments	Indigenous, sustainable and safer building models

[1] https://www.undrr.org/publication/hazard-information-profiles-hips;
[2] https://www.gfdrr.org/en/damage-loss-and-needs-assessment-tools-and-methodology;
[3] https://www.spherestandards.org/;
[4] https://doi.org/10.1007/s10796-020-10062-z;
[5] https://www.cmu.edu/ehs/Fire-Safety/evacuation-drills.html;
[6] https://www.undp.org/publications/post-disaster-needs-assessment;
[7] https://collections.unu.edu/view/UNU:7607

Designing DRR products and processes is often based on an interaction between product developers and users. The design process should embed context-specific information about local needs and priorities, the availability and scale of the scientific evidence, and the experiences and knowledge of the communities involved. This is because the profiles and needs of specific users depend on their socio-economic conditions, geography, and institutional frameworks, and therefore, there are no one-size-fits-all solutions. The process for designing such DRR products is exemplified in Figure 1 and Table 2.

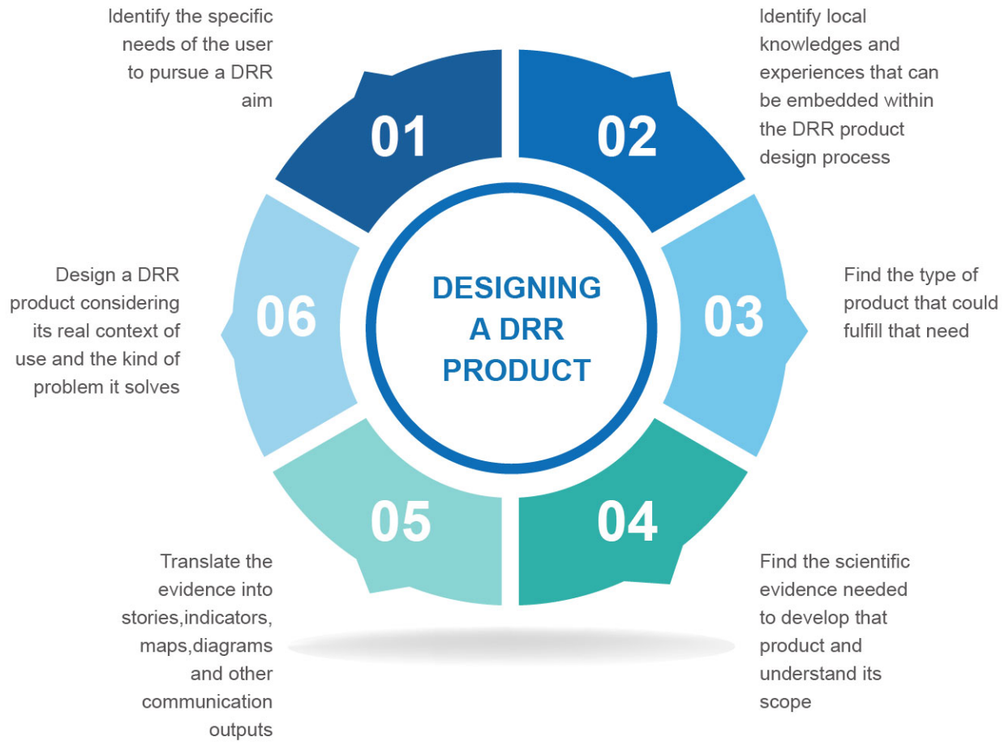


Figure 1. Designing DRR Products and Processes

Table 2.

Questions that facilitate DRR product design

Product	What kind of output is needed by stakeholders or communities? (e.g., cartography, land use plan, urban development guidelines, contingency plan, PDNA input/questionnaire, building code, bylaw).
Process	To which context is a useful DRR solution potentially applicable?
User	Who are the users of this process and potential intervention and solution, and what is the institutional or organizational context in which the user requires it? (e.g., civil protection officers, urban planners, social workers, medical doctors, community leaders, meteorologists or seismologists tailoring technical messages for an EWS…).
Needs	What is the specific need of evidence or scientific results that the user requires? In which format, language, scale or level of technicality do they need scientific input?
Product design itself	Who coordinates the dialogue between the scientist and the user? What kind of skills does this person require to (i) identify the needs, (ii) link science and those needs, and (iii) design the product (e.g., knowledge about legislation, mapmaking, storytelling, etc.)? See Schwendinger et al. (2022).
Implementation and evaluation	What kind of activities do we need to facilitate the use of these products and evaluate their usefulness and acceptance among their users? How can we improve their use?

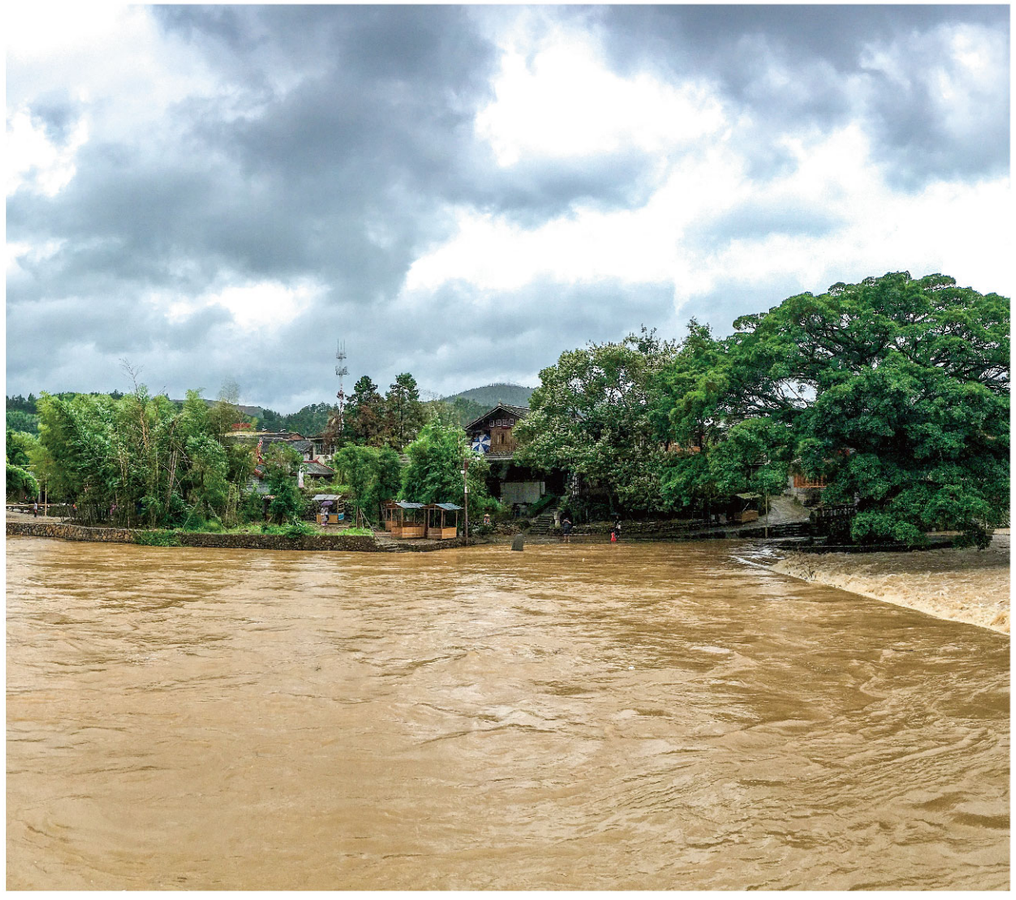
Therefore, the establishment of a local science advisory mechanism and process is essential to ensure actionable and context-specific considerations, and to support the co-production of useful, relevant, and credible scientific evidence by bridging different kinds of knowledge into DRR products at regional, provincial or community levels. This mechanism can be led by professional and practitioner teams – either locally appointed or engaged in the field (e.g., through DRR technical cooperation projects or programs that facilitate collaborations between scientists, academics, DRM officers and communities). These mechanisms would foster collaboration and communication, contribute to the implementation of emerging co-produced actions, and support the use and continuous improvement of sustainable DRR actions.

The local science advisory mechanism could facilitate knowledge brokering to co-produce science with society, translating it into useful, relevant and credible insights (Nishikawa et al., 2022), while embedding local capacities and knowledge into impactful actions.

Therefore, we propose that a broader range of scientific expertise, spanning diverse disciplines, be taken into consideration, particularly those that incorporate practitioner awareness and engagement. This should be accompanied by wider consultation across government departments and civic society organizations, which often operate in isolation due to mandate-specific responsibilities and budget allocations. In addition, such mechanism can support the inclusion of local professionals, academics, communities, and potential users of DRR products in co-design and co-production processes, not only for the use of certain DRR products, but also for the design of local actions through shared responsibility. Improved communication and more inclusive governance are urgently needed, especially in hazard-prone and vulnerable regions. The work of a local science advisory mechanism would be crucial for bridging the gap between science and practice, and for strengthening DRR efforts and investments from a local perspective.

Examples portraying different approaches in the development of science-based DRR products and processes

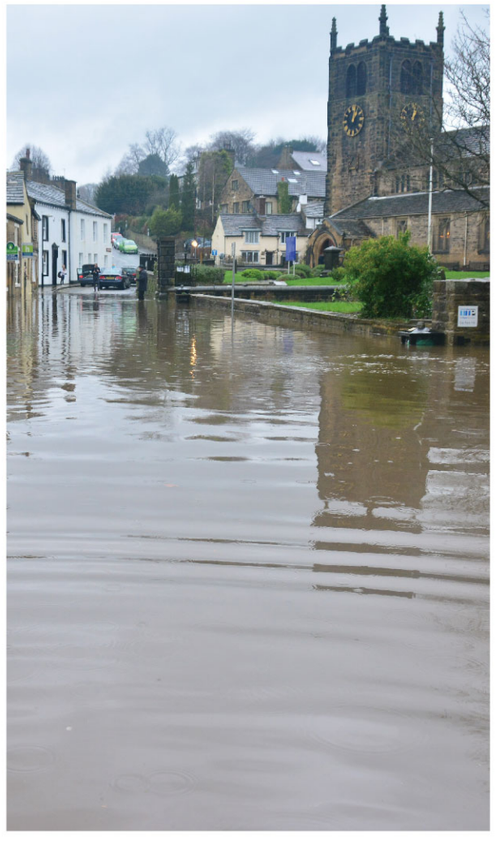
This section presents various examples of co-designed DRR products and processes across different geographical contexts. These multi-stakeholder cases briefly illustrate the participation of diverse actors and the integration of plural perspectives on knowledge and science in the co-production and implementation of DRR actions. The examples also reflect different DRR approaches, including prospective, corrective, and compensatory risk management (UN Sendai Framework, 2025). More examples are available at the IRDR website: https://www.irdrinternational.org/knowledge_pool/publications/130



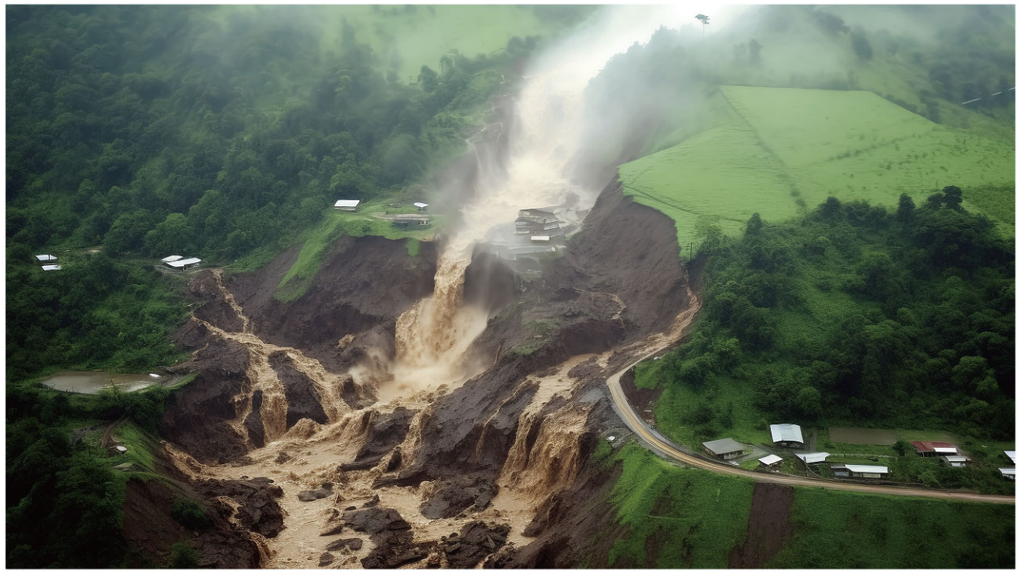
Colombia[1]

Collaborative action-oriented research for implementing climate adaptation plans in peri-urban areas
DRR approach: corrective
Type of DRR action: reducing current risk

Medellín, at the center of the Aburrá Valley (second largest metropolitan area in Colombia, with a population of 3.6 million), experienced increasing urbanization, characterized by informal growth along the rural-urban border, generating vulnerable peri-urban areas that are exposed to disaster risks, which are increasing with climate change. A collaboration among Medellín's Community 8 Housing Board, the Disaster Risk Management Department (DAGRD), Colombia National and Antioquia universities, and Edinburgh and Heriot-Watt universities has evidenced that with support from a multidisciplinary research team and use of information sharing technologies, vulnerable communities can implement bottom-up participatory landslide risk monitoring and climate change adaptation measures. Approximately half of the northeastern edge of Medellín is exposed to risk of landslides, flooding, and torrential rain, affecting 150,000 residents. Based on a dialogue that included geotechnical and social knowledge, community organizations with government institutions have co-designed action-oriented research to develop an integrated risk and climate adaptation plan. Through a co-production process, the developed plan has delivered the implementation of risk mitigation actions, through an inter-institutional articulation strategy connecting government processes with community priorities, as well as disaster risk management with climate change adaptation in several neighborhoods. The strong organizational capacity of this community has facilitated this process, together with ongoing local government-led plans for risk mitigation and climate adaptation. This collaborative process has enabled efficient and timely interventions applying nature-based solutions to DRR mitigation, supported by training and capacity building programs.



1.https://doi.org/10.5871/jba/009s9.007



Malaysia[2]

EWS technology coupled with local-traditional-indigenous knowledge (LTIK) module.
DRR approach: compensatory
Type of action: response preparedness

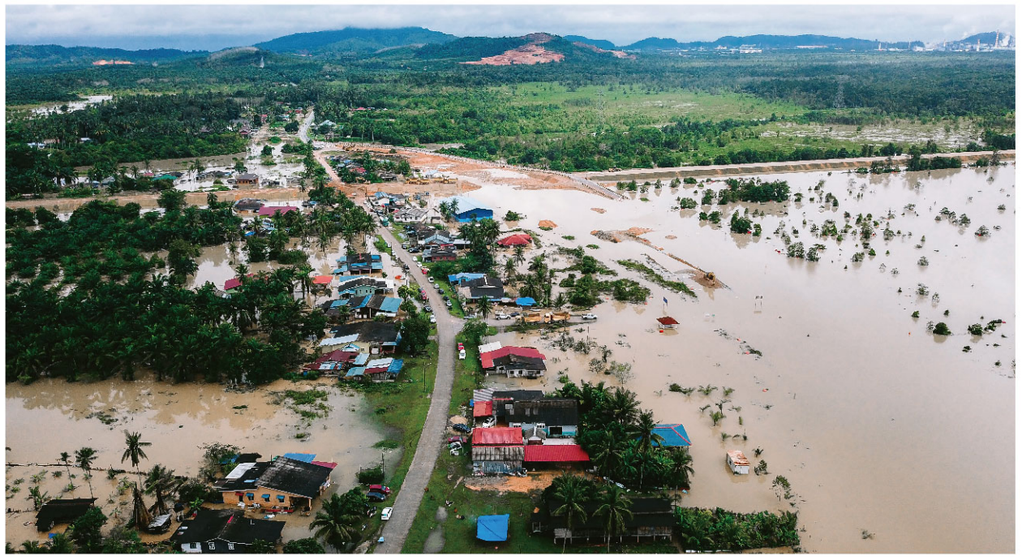
In Malaysia, flood hazards account for the highest number of economic losses, while landslides and debris flow hazards are the leading causes of human casualties. As part of a multi-scale early warning system (EWS), which provides seven-day forecasts as well as short-term alerts (public announcements), a community-based siren system was introduced to empower local communities and enhance the safety of vulnerable rural populations. The Department of Mineral and Geoscience, in collaboration with Universiti Teknologi Malaysia, established a multi-year smart partnership to co-produce a people-centered EWS for debris flow in Jerai Geopark (Yan, Kedah), a region known for tourism and food security. As the country's first community-led program of its kind, this initiative combines state-of-the-art EWS technology with a local-traditional-indigenous knowledge (LTIK) module. To support science-policy-society intervention, the involvement of lawmakers has been key in translating local DRR actions to national level. In this context, the All-Party Parliamentary Group Malaysia - Disaster Risk Management was launched by the Malaysian Parliament to promote an all-of-society and localization approach in addressing climate-induced disaster risk.

2.https://doi.org/10.5194/egusphere-egu24-19871

Mexico[3]

Climatic risk mapping for prospective urban planning and land use regulation
DRR approach: prospective
Type of DRR action: understanding and preventing future risk

Guadalajara, the third largest metropolitan area in Mexico, regularly experiences flooding, which has worsened over the past two decades due to the urbanization of peri-urban forests and the loss of green and permeable areas within the city. In response, the coalition of metropolitan governments commissioned the local Development Planning Institute (IMEPLAN) to update its climatic risk assessment and produce maps to help municipalities regulate land use and improve their zoning criteria. The assessment, developed through a collaboration between IMEPLAN and an interdisciplinary team of the National Autonomous University of Mexico, incorporates state-of-the-art urban climate and social vulnerability models. It generated a series of maps that clearly identified flood prone areas, along with a classification of unoccupied urban areas that should be prioritized for protection due to their ecosystem services (e.g., water infiltration) and risk reduction value (particularly in relation to urban heat island and peri-urban fires). The project also included a strong knowledge transfer component for IMEPLAN practitioners, enabling them to update and manage the GIS tools and effectively communicate these tools to local stakeholders, who would need to adapt to the new mandatory planning criteria. To support social acceptance, a set of simplified maps and a communication strategy were developed.

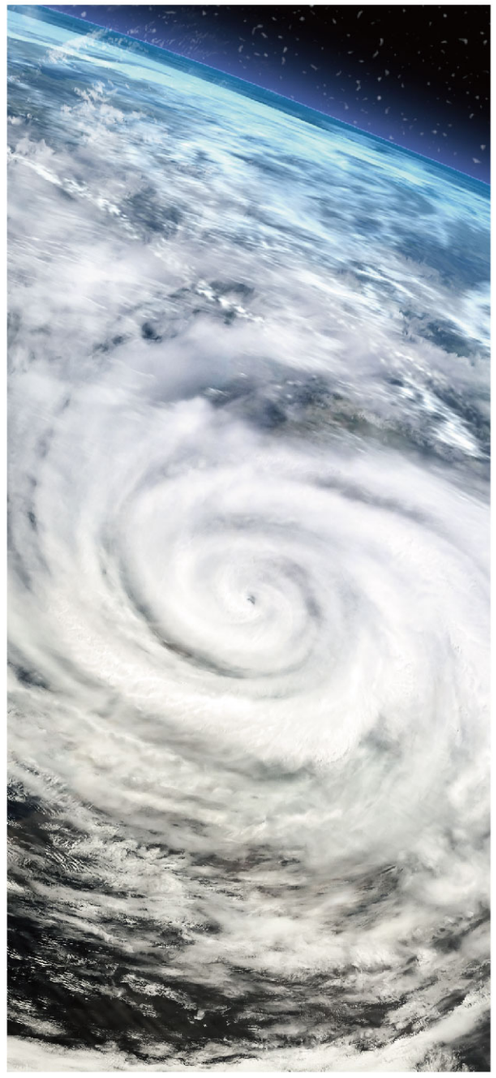


3.https://publicaciones.geografia.unam.mx/index.php/ig/catalog/book/196

Mozambique[4]

Flood and cyclone-resilient techniques labor training and implementation plan in classroom facilities
DRR approach: corrective
Type of DRR action: reducing current risk

The Safer Schools Initiative is a part of Mozambique government's efforts to develop national school safety guidelines and ensure that schools are resilient to large-scale damage by promoting the construction of safer buildings. This initiative was developed by INGD (government institution responsible for coordinating the DRR actions in Mozambique) in collaboration with Eduardo Mondlane University in Maputo, with support from international partners such as the World Bank and UN-Habitat. The resulting multi-hazard resilient infrastructure serves dual purposes: 3500 flood-resistant schools that also function as emergency shelters, constructed using local labor trained in cyclone-resilient building techniques. These structures include elevated foundations (at least 1.5 meters above flood levels), reinforced roofs (capable of withstanding at least 240 km/h winds), and integrated drainage systems that have reduced flood durations by 75% in pilot areas. The initiative ensures long-term impact through annual training of school-based disaster committees in evacuation procedures and shelter operations, thereby maintaining permanent local risk management capacity.



4.https://unhabitat.org/sites/default/files/2023/12/bcr_mozambique_safer_school.pdf

POLICY RECOMMENDATIONS

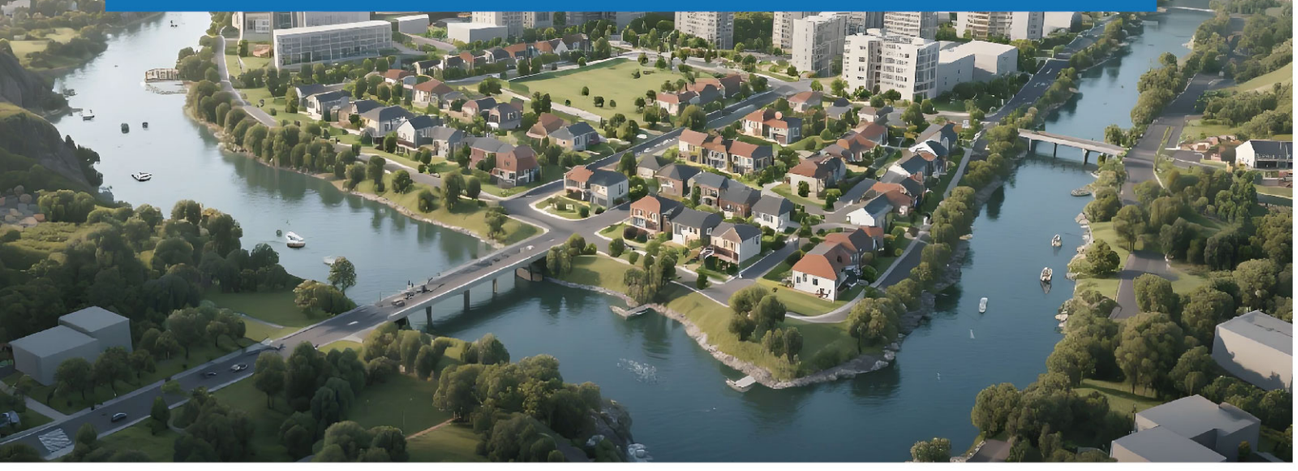
We urge the science academies, funders, and governments across sectors to embrace context-specific, diverse, and plural knowledge as a crucial step toward strengthening evidence-based decision-making processes and accelerating DRR action, particularly at the local level. This effort can be supported by co-produced DRR processes grounded in dialogue, incorporating local knowledge and community-based mechanisms along with available technologies to support evidence synthesis and ensure that scientific research is relevant to policy questions. A way to achieve this is:

Recommendation 1

To encourage place- and context-specific development of DRR processes, products, and approaches that enable impactful risk reduction actions and support collaboration between research, data, and local policymaking communities. It is essential to embed specific users, including local communities and practitioners, in the co-design and co-production of these approaches and products.

Recommendation 2

To promote the adoption of local science advisory mechanisms that help make science useful, relevant, and credible by integrating diverse forms of knowledge into DRR products. By leveraging new technologies, these mechanisms can support the identification, analysis, and dissemination of evidence for policy development and evaluation, bridging technical capabilities with the diverse expertise and needs of real-world users.



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